# 7 Layer 2

## 7.1 NR Layer 2

### 7.1.0 Common test case specific values for Layer 2

For all layer 2 test cases, default values for periodicBSR-Timer, retxBSR-Timer and phr-Config shall be taken according to the table 7.1.0-1 unless test case specific values are given in the test case.

Table 7.1.0-1: MAC-CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.308 [6], clause Table 4.6.3-49 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | infinity |  |  |
| retxBSR-Timer | sf10240 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

### 7.1.1 MAC

#### 7.1.1.0 Default Pre-Test Conditions for all MAC test cases

The following pre-test conditions shall be applied in all MAC test cases until the test case explicitly over writes these conditions

System Simulator:

- The SS configures the test environment in accordance to the execution conditions in Table 7.1.1.0-1.

UE:

- None

Preamble:

- The SS performs the generic procedure in [4] to get UE in state RRC\_CONNECTED in accordance to the execution conditions in Table 7.1.1.0-2 and using the message condition UE TEST LOOP MODE A to return one PDCP SDU per DL PDCP SDU.

Table 7.1.1.0-1: Test environment

|  |  |  |
| --- | --- | --- |
| Execution Condition | Cell configuration | System Information Combination |
| IF pc\_NG\_RAN\_NR | NR Cell 1 | NR: System information Combination NR-1 |
| ELSE IF pc\_EN\_DC | E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NGEN\_DC | NG-RAN E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NE\_DC | NR Cell 1 is PCell,  E-UTRA Cell 1 is PSCell | NR: System information Combination NR-1  E-UTRA: N/A |

Table 7.1.1.0-2: Preamble parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Execution Condition | Multi-PDN / Multi-PDU Sessions Condition | Generic Procedure Parameters | Primary DRB used for Data testing |
| IF pc\_NG\_RAN\_NR | FALSE | Connectivity(*NR*),  Test loop function(*On*)  One DRB | Default DRB of the first PDU session on NR Cell |
| TRUE | Connectivity(*NR*),  Test loop function(*On*)  *N* DRBs (*N* ≥ 2) |  |
| ELSE IF pc\_EN\_DC | FALSE | Connectivity(*EN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*EN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NGEN\_DC | FALSE | Connectivity(*NGEN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*NGEN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NE\_DC | FALSE | Connectivity(*NE-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
|  | TRUE | Connectivity(*NE-DC*),  DC bearer(*N* ≥ 2 MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |  |

Table 7.1.1.0-3: Message conditions

|  |  |
| --- | --- |
| **Execution Condition** | **Message condition exceptions** |
| IF pc\_NG\_RAN\_NR | Message with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_EN\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NGEN\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NE\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.6 according to [4] |

Table 7.1.1.0-4: SDAP Configuration Settings for pc\_NG\_RAN\_NR and pc\_NE\_DC

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value DRB1 | Value DRB2 | Value DRB3 |
| default DRB | true | false | false |
| mappedQoS-FlowsToAdd | QFI 1 in Table 4.8.2.3-1 according to TS38.508-1 | QFI 2 in Table 4.8.2.3-2 according to TS38.508-1 | QFI 3 in Table 4.8.2.3-3 according to TS38.508-1 |

#### 7.1.1.1 Random Access Procedures

##### 7.1.1.1.1 Correct selection of RACH parameters / Random access preamble and PRACH resource explicitly signalled to the UE by RRC / contention free random access procedure

7.1.1.1.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected }

**ensure that** {

**when** { SS sends an RRCReconfiguration message including RACH-ConfigDedicated information element }

**then** { UE sends a prach preamble given in the RACH-ConfigDedicated on the target cell }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell received in RACH-ConfigDedicated on the target cell }

**ensure that** {

**when** { UE does not receive a matching Random Access response in ra-ResponseWindowSize (hence considers RACH attempt as failed) and PREAMBLE\_TRANSMISSION\_COUNTER is less than PREAMBLE\_TRANS\_MAX }

**then** { UE retransmits a PRACH preamble received in RACH-ConfigDedicated on the target cell }

}

7.1.1.1.1.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.2, 5.1.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

…

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

…

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured or indicated by PDCCH (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6], corresponding to the SSB which is quasi-collocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collocated with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see clause 5.1.3).

NOTE: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access procedure for an SCell is performed on uplink carrier where *pusch-Config* is not configured:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

NOTE: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of contention-based Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behaviour is not defined.

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted; or

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on an SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see clause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response reception.

7.1.1.1.1.3 Test description

7.1.1.1.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except the following:

- 2 NR cells (NR Cell 1 and NR Cell 2) are configured.

- Test loop function(*Off*)

7.1.1.1.1.3.2 Test procedure sequence

Table 7.1.1.1.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an *RRCReconfiguration* message to handover NR Cell 1 to target NR Cell 2, including RACH-ConfigDedicated information element  (Note 1, Note 3) | <-- | *RRCReconfiguration* | - | - |
| 2 | Void |  |  |  |  |
| 3 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1 on NR Cell2? | --> | (PRACH Preamble) | 1 | P |
| 4 | Check: Does the UE re-transmits Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1 on NR Cell2? | --> | (PRACH Preamble) | 2 | P |
| 5 | The SS transmits Random Access Response on NR cell 2, with RAPID corresponding to *ra-PreambleIndex* in step 1 | <-- | Random Access Response | - | - |
| 6 | Check: Does the UE transmit an *RRCReconfigurationComplete* message?  (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_PSCell\_HO AND RBConfig\_NoKeyChange.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For FR1,PRACH preamble format 0 as per TS 38.211[24] Table 6.3.3.1-1 is configured (real network deployment). | | | | | |

7.1.1.1.1.3.3 Specific message contents

Table 7.1.1.1.1.3.3-1: *Void*

Table 7.1.1.1.1.3.3-2: *RRCReconfiguration* for EN-DC (step 1, Table 7.1.1.1.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-2A: *RRCReconfiguration* for NR/5GC (step 1, Table 7.1.1.1.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig as per TS 38.508-1[4] Table 4.6.3-132 with conditions DRBn and Recover\_PDCP | n set to the default DRB of the first PDU session | NR |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-3: *CellGroupConfig* for EN-DC (Table 7.1.1.1.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-3A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.1.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-4: *RACH-ConfigDedicated* (Table 7.1.1.1.1.3.3-3 and Table 7.1.1.1.1.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated ::= SEQUENCE { |  |  |  |
| cfra SEQUENCE { |  |  |  |
| occasions SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  | FR1, PRACH Preamble format 0 used |
| } |  |  |  |
| resources CHOICE { |  |  |  |
| ssb SEQUENCE { |  |  |  |
| ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource { | 1 entry |  |  |
| CFRA-SSB-Resource[1] SEQUENCE { |  | entry 1 |  |
| ssb | 0 |  |  |
| ra-PreambleIndex | 52 | Randomly selected |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-5: *RACH-ConfigGeneric* (Table 7.1.1.1.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated ::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 14 |  | FR1 |
|  | 13 |  | FR1 AND HD\_FDD |
|  | 149 |  | FR2 |
| zeroCorrelationZoneConfig | 12 |  | FR1 |
|  | 15 |  | FR2 |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

Table 7.1.1.1.1.3.3-6: *ServingCellConfigCommon* (Table 7.1.1.1.1.3.3-3 and Table 7.1.1.1.1.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.1.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.1.1.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell.. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-9: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 AND SCS30 |
|  | 2 |  | FR1 AND SCS15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-10: ServingCellConfig (Table 7.1.1.1.1.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-11: *BWP-UplinkDedicated* (Table 7.1.1.1.1.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-12: *PUCCH-Config* (Table 7.1.1.1.1.3.3-11)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-13: *SchedulingRequestResourceConfig* (Table 7.1.1.1.1.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-157 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 2 | With SCS = kHz15 results in repetition every 10 ms | SCS15 |
|  | 9 |  | SCS15 AND HD\_FDD |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS30 |
| sl80 | 4 | With SCS = kHz120 results in repetition every 10 ms | SCS120 |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

##### 7.1.1.1.1a Correct selection of RACH parameters / Random access preamble and PRACH resource explicitly signalled to the UE by PDCCH Order / contention free random access procedure

7.1.1.1.1a.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected }

**ensure that** {

**when** { PDCCH control command is received in NR SpCell providing Random Access Preamble }

**then** { UE sends a PRACH preamble given in the PDCCH Order in NR SpCell }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell received in PDCCH control command on NR SpCell }

**ensure that** {

**when** { UE does not receive a matching Random Access response in ra-ResponseWindowSize (hence considers RACH attempt as failed) and PREAMBLE\_TRANSMISSION\_COUNTER is less than PREAMBLE\_TRANS\_MAX }

**then** { UE retransmits a PRACH preamble received in PDCCH control command on NR SpCell }

}

7.1.1.1.1a.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.2, 5.1.4 and TS 38.212 clause 7.3.1.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

…

1> else if the *ra-PreambleIndex* has been explicitly provided by either PDCCH or RRC; and

1> if the *ra-PreambleIndex* is not 0b000000; and

1> if contention-free Random Access Resource associated with SSBs or CSI-RS have not been explicitly provided by RRC:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*.

…

1> if an SSB is selected above and an association between PRACH occasions and SSBs is configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above and an association between PRACH occasions and CSI-RSs is configured:

2> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> else:

2> determine the next available PRACH occasion (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion).

1> perform the Random Access Preamble transmission procedure (see clause 5.1.3).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

...

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers; and

1> if PDCCH transmission is addressed to the C-RNTI; and

...

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a Backoff Indicator subheader:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the Backoff Indicator subheader using Table 7.2-1.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for the SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *preamblePowerRampingStep*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

...

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or:

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTxMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if in this Random Access procedure, the Random Access Preamble was selected by MAC among the contention-based Random Access Preambles:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> delay the subsequent Random Access Preamble transmission by the backoff time.

2> perform the Random Access Resource selection procedure (see subclause 5.1.2).

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

[TS 38.212, 7.3.1.2.1]

If the CRC of the DCI format 1\_0 is scrambled by C-RNTI and the "Frequency domain resource assignment" field are of all ones, the DCI format 1\_0 is for random access procedure initiated by a PDCCH order, with all remaining fields set as follows:

- Random Access Preamble index – 6 bits according to *ra-PreambleIndex* in Subclause 5.1.2 of [8, TS38.321]

- UL/SUL indicator – 1 bit. If the value of the "Random Access Preamble index" is not all zeros and if the UE is configured with SUL in the cell, this field indicates which UL carrier in the cell to transmit the PRACH according to Table 7.3.1.1.1-1; otherwise, this field is reserved

- SS/PBCH index – 6 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission; otherwise, this field is reserved.

- PRACH Mask index – 4 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the RACH occasion associated with the SS/PBCH indicated by "SS/PBCH index" for the PRACH transmission, according to Subclause 5.1.1 of [8, TS38.321]; otherwise, this field is reserved

- Reserved bits – 10 bits

7.1.1.1.1a.3 Test description

7.1.1.1.1a.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*).

7.1.1.1.1a.3.2 Test procedure sequence

Table 7.1.1.1.1a.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0A | SS transmits an RRCReconfiguration message toconfigure specific parameters. Note 1, Note 3 | <-- | RRCReconfiguration | - | - |
| 0B | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 1 | The SS transmits a PDCCH order providing Random Access Preamble ID 37 on NR SpCell. | <-- | (PDCCH Order) | - | - |
| 2 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 1 | P |
| 3 | Check: Does the UE re-transmits Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 2 | P |
| 4 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 2 | P |
| 5 | Check: Does the UE re-transmits Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 2 | P |
| 6 | The SS transmits Random Access Response on NR SpCell, with RAPID corresponding to *ra-PreambleIndex* in step 1 | <-- | Random Access Response | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For FR1, PRACH preamble format 0 as per TS 38.211[24] Table 6.3.3.1-1 is configured in order to provide coverage for PRACH preamble format 0 testing | | | | | |

7.1.1.1.1a.3.3 Specific message contents

Table 7.1.1.1.1a.3.3-1: *RRCReconfiguration* (step 0A, Table7.1.1.1.1a.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
|  |  | TS 38.508-1 [4], 2 |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-2: *CellGroupConfig* (Table 7.1.1.1.1a.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | RNTI-Value |  |  |
| t304 | ms2000 |  |  |
| rach-ConfigDedicated | Not Present |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-3: *ServingCellConfigCommon (*Table 7.1.1.1.1a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-4: *BWP-UplinkCommon (*Table 7.1.1.1.1a.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-5: *RACH-ConfigCommon (*Table 7.1.1.1.1a.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-6: *RACH-ConfigGeneric (*Table 7.1.1.1.1a.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| preambleReceivedTargetPower | -104 |  |  |
| preambleTransMax | n4 |  |  |
| prach-ConfigurationIndex | 14 |  | FR1 |
|  | 13 |  | FR1 AND HD\_FDD |
|  | 149 |  | FR2 |
| zeroCorrelationZoneConfig | 12 |  | FR1 |
|  | 15 |  | FR2 |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

Table 7.1.1.1.1a.3.3-7: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.1a.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  |  |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 AND SCS30 |
|  | 2 |  | FR1 AND SCS15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-8: ServingCellConfig (Table 7.1.1.1.1a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-9: *BWP-UplinkDedicated* (Table 7.1.1.1.1a.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-10: *PUCCH-Config* (Table 7.1.1.1.1a.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-11: *SchedulingRequestResourceConfig* (Table 7.1.1.1.1a.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 2 | With SCS = kHz15 results in repetition every 10 ms | SCS15 |
|  | 9 |  | SCS 15 AND HD\_FDD |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS30 |
| sl80 | 4 | With SCS = kHz120 results in repetition every 10 ms | SCS120 |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

##### 7.1.1.1.2 Random access procedure / Successful / C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the UL MAC PDU Size is less than messageSizeGroupA }

**then** { UE transmits a random access preamble using a preamble in group A of random access preambles }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

**ensure that** {

**when** { SS does not answer with a matching Random Access Response within ra-ResponseWindowSize }

**then** { UE retransmits a PRACH preamble from same group }

}

(3)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

ensure that {

**when** { UE receives while ra-ResponseWindowSizeTimer is running MAC PDU containing multiple RARs but none of the subheaders contains a RAPID corresponding to the UE }

**then** { UE retransmits a PRACH preamble from same group }

}

(4)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

**ensure that** {

**when** { SS sends a Random Access Response including a Backoff Indicator and the Random Access Preamble identifier is different from the value received from the UE }

**then** { UE triggers RA preamble after a random time between 0 and the indicated Backoff parameter from same group }

}

(5)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

**ensure that** {

**when** { UE receives while ra-ResponseWindowSizeTimer is running MAC PDU containing multiple RARs and one of the subheaders contains a RAPID corresponding to the UE and containing Backoff Indicator }

**then** { UE stores Backoff Indicator UE transmits RACH procedure MSG3 }

}

(6)

**with** { UE in RRC\_Connected state after transmission of Msg3 on NR SpCell without dedicated preamble }

**ensure that** {

**when** { The SS does not schedule any PDCCH transmission addressed to UE C-RNTI before Contention resolution timer expiry }

**then** { UE transmits a random access preamble using a preamble in the same group of random access preambles as used for the first transmission of Msg3 }

}

(7)

**with** { UE in RRC\_Connected state after transmission of Msg3 on NR SpCell without dedicated preamble }

**ensure that** {

**when** { UE receive PDCCH transmission addressed to its C-RNTI before Contention resolution timer expiry }

**then** { UE considers RACH procedure as complete }

}

(8)

**with** { UE in RRC CONNECTED state and Random Access Preambles group B is configured }

**ensure that** {

**when** { UE has data available for transmission and the MAC PDU Size carrying this data is greater than ra-Msg3SizeGroupA and TimeAlignmentTimer expires }

**then** {UE transmits a random access preamble using a preamble in group B of random access preambles}

}

(9)

**with** { UE in RRC\_Connected state and having initiated a random access procedure in NR SpCell }

**ensure that** {

**when** { The SS transmits a Timing Advance Command in a Random Access Response message }

**then** {the UE applies the received Timing Advance value in the next transmitted MAC PDU }

}

7.1.1.1.2.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.2, 6.1.3.2, 6.1.5 and 6.2.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

…

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) –*preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> if the association between Random Access Preambles and SSBs is configured:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

2> else:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles within the selected Random Access Preambles group.

2> set the *PREAMBLE\_INDEX* to the selected *ra-PreambleIndex*.

…

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

[TS 38.321, clause 5.1.3]

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if SSB selected is not changed (i.e. same as the previous Random Access Preamble transmission):

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to subclause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX* and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the specified PRACH (0 ≤ s\_id < 14), t\_id is the index of the first slot of the specified PRACH in a system frame (0 ≤ t\_id < 80), f\_id is the index of the specified PRACH in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Msg1 transmission (0 for NUL carrier, and 1 for SUL carrier).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

…

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_B*I.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for the SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *preamblePowerRampingStep*).

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

…

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTxMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers.

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted, the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by a beam failure indication from lower layer and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

…

1> if *ra-ContentionResolutionTimer* expires:

2> discard the *TEMPORARY\_C-RNTI*;

2> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment PREAMBLE\_TRANSMISSION\_COUNTER by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTxMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the PREAMBLE\_BACKOFF;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

[TS 38.321, clause 5.2]

RRC configures the following parameters for the maintenance of UL time alignment:

- *timeAlignmentTimer* (per TAG) which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned.

The MAC entity shall:

1> when a Timing Advance Command MAC CE is received, and if a NTA (as defined in TS 38.211 [8]) has been maintained with the indicated TAG:

2> apply the Timing Advance Command for the indicated TAG;

2> start or restart the *timeAlignmentTimer* associated with the indicated TAG.

…

1> when a *timeAlignmentTimer* expires:

2> if the *timeAlignmentTimer* is associated with the PTAG:

3> flush all HARQ buffers for all Serving Cells;

3> notify RRC to release PUCCH for all Serving Cells, if configured;

3> notify RRC to release SRS for all Serving Cells, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> consider all running *timeAlignmentTimer*s as expired;

3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.

2> else if the *timeAlignmentTimer* isassociated with an STAG, then for all Serving Cells belonging to this TAG*:*

3> flush all HARQ buffers;

3> notify RRC to release PUCCH, if configured;

3> notify RRC to release SRS, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> maintain NTA (defined in TS 38.211 [8]) of this TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell except the Random Access Preamble transmission when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the pTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble transmission on the SpCell.

[TS 38.321, clause 6.1.3.2]

The C-RNTI MAC CE is identified by MAC PDU subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.



Figure 6.1.3.2-1: C-RNTI MAC CE

[TS 38.321, clause 6.1.5]

A MAC PDU consists of one or more MAC subPDUs and optionally padding. Each MAC subPDU consists one of the following:

- a MAC subheader with Backoff Indicator only;

- a MAC subheader with RAPID only (i.e. acknowledgment for SI request);

- a MAC subheader with RAPID and MAC RAR.

A MAC subheader with Backoff Indicator consists of five header fields E/T/R/R/BI as described in Figure 6.1.5-1. A MAC subPDU with Backoff Indicator only is placed at the beginning of the MAC PDU, if included. 'MAC subPDU(s) with RAPID only' and 'MAC subPDU(s) with RAPID and MAC RAR' can be placed anywhere between MAC subPDU with Backoff Indicator only (if any) and padding (if any).

A MAC subheader with RAPID consists of three header fields E/T/RAPID as described in Figure 6.1.5-2.

Padding is placed at the end of the MAC PDU if present. Presence and length of padding is implicit based on TB size, size of MAC subPDU(s).



Figure 6.1.5-1: E/T/R/R/BI MAC subheader



Figure 6.1.5-2: E/T/RAPID MAC subheader



Figure 6.1.5-3: Example of MAC PDU consisting of MAC RARs

[TS 38.321, clause 6.2.3]

The MAC RAR is of fixed size as depicted in Figure 6.2.3-1, and consists of the following fields:

- R: Reserved bit, set to "0";

- Timing Advance Command: The Timing Advance Command field indicates the index value *TA* used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6]. The size of the Timing Advance Command field is 12 bits;

- UL Grant: The Uplink Grant field indicates the resources to be used on the uplink in TS 38.213 [6]. The size of the UL Grant field is 27 bits;

- Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access. The size of the Temporary C-RNTI field is 16 bits.

The MAC RAR is octet aligned.



Figure 6.2.3-1: MAC RAR

7.1.1.1.2.3 Test description

7.1.1.1.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Short\_DCI condition is applied in NR Serving cell configuration.

7.1.1.1.2.3.2 Test procedure sequence

Table 7.1.1.1.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Step 0AA is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 0AA | The SS transmits an updated system information as specified in Table 7.1.1.1.2.3.3-1A. | - | - | - | - |
| 0A | SS transmits an RRCReconfiguration message toconfigure specific parameters. (Note 1) | <-- | RRCReconfiguration | - | - |
| 0B | The UE transmits RRCReconfigurationComplete message. (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 1 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 2 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU of size 56 bits, less then ra-Msg3SizeGroupA (208 bits) on SpCell. (Note 3) | <-- | MAC PDU | - | - |
| 3 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 4 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in CellGroupConfig in RRCReconfiguration (totalNumberOfRA-Preambles, ssb-perRACH-OccasionAndCB-PreamblesPerSSB and numberOfRA-PreamblesGroupA) on SpCell in frame number X meeting condition nSFN mod 8 =1, subframe number 2,6,9 (FDD FR1 except for HD\_FDD), frame number X meeting condition nSFN mod 8 =1, subframe number 4 (HD\_FDD), frame number X meeting condition nSFN mod 2 =1, subframe number 8,9 (FR1 TDD) and frame number X meeting condition nSFN mod 4 =1 and slot number 8, 9, 18, 19, 28, 29, 38, 39 , 48, 49, 58, 59, 68, 69, 78, 79 (FR2 120 kHz)? | --> | PRACH Preamble | 1 | P |
| 5 | Check: Does the UE transmit a preamble on PRACH, in frame number X+8 subframe number 2,6,9 (FDD FR1 except for HD\_FDD), in frame number X+8 subframe number 4 (HD\_FDD), in frame number X or X+2 in subrame number 8,9 (FR1 TDD) and frame number X or X+4 and slot number 8, 9, 18, 19, 28, 29, 38, 39 , 48, 49, 58, 59, 68, 69, 78, 79 (FR2 120 kHz) using the same group A? | --> | PRACH Preamble | 2 | P |
| 6 | The SS transmits a MAC PDU addressed to UE RA-RNTI, containing multiple RARs but none of the MAC sub headers contains a matching RAPID on SpCell. | <-- | Random Access Response | - | - |
| - | EXCEPTION: In parallel with step 7, parallel behaviour defined in table 7.1.1.1.2.3.2-2 is executed. | - | - | - | - |
| 7 | Check: Does the UE re-transmit a preamble on PRACH on SpCell using the same group A? | --> | PRACH Preamble | 3 | P |
| 8 | The SS transmits a Random Access Response with the back off parameter set to value Index field '12' and with the Random Access Preamble identifier different from the value received from the UE in the Random Access Preamble.  The SS sets Timer\_T2 to the Back off value ‘960’ associated with the Index value ‘12’ and starts Timer\_T2. | <-- | Random Access Response(BI, RAPID) | - | - |
| 9 | Check: Does UE send a Random Access Preamble on SpCell while Timer\_T2 is running? | --> | Random Access Preamble | 4 | P |
| 10 | SS sends Random Access Response with an UL Grant of 56-bits, a back off parameter set to value Index field ‘13’ and the Random Access Preamble identifier value set to the same value as received from the UE in the Random Access Preamble. (Note 4) | <-- | Random Access Response(BI, RAPID) | - | - |
| 11 | Check: Does UE sends a msg3 in the grant associated to the Random Access ´Response received in step 10 on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | 5 | P |
| 12 | SS does not schedule any PDCCH transmission for UE C-RNTI.  The SS sets Timer\_T3 to the Back off value ‘1920’ associated with the Index value ‘13’ plus Contention Resolution Timer and starts Timer\_T3. | - | - | - | - |
| 13 | Check: Does the UE transmit preamble on PRACH using a preamble belonging to group A for time equal to Timer\_T3 on SpCell? | --> | PRACH Preamble | 6 | P |
| 14 | The SS transmits Random Access Response with an UL Grant of 56-bits and RAPID corresponding to the transmitted Preamble in step 13, including T-CRNTI. | <-- | Random Access Response | - | - |
| 15 | UE sends a msg3 using the grant associated to the Random Access ´Response received in step 14 on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 16 | SS schedules PDCCH transmission for UE C\_RNTI and allocate uplink grant. | <-- | Contention Resolution | - | - |
| - | EXCEPTION: In parallel with step 17, parallel behaviour defined in table 7.1.1.1.2.3.2-3 is executed. | - | - | - | - |
| 17 | Check: Does the UE transmit a MAC PDU with C-RNTI containing looped back PDCP SDU? | --> | MAC PDU | 7 | P |
| - | EXCEPTION: Step 17AA is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 17AA | The SS transmits an updated system information as specified in Table 7.1.1.1.2.3.3-1A. | - | - | - | - |
| 17A | The SS transmits an RRCReconfiguration message toconfigure specific parameters. (Note 1) | <-- | NR RRC: RRCReconfiguration | - | - |
| 17B | The UE transmits an RRCReconfigurationComplete message. (Note 2) | --> | NR RRC: RRCReconfigurationtComplete | - | - |
| 18 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T4 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 19 | 40 to 50 TTI before Timer\_T4 expires the SS transmits a MAC PDU containing a PDCP SDU of size > ra-Msg3SizeGroupA (208 bits). | <-- | MAC PDU | - | - |
| 20 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 21 | Check: Does the UE transmit preamble on PRACH using a preamble in group B defined in CellGroupConfig in RRCReconfiguration (ssb-perRACH-OccasionAndCB-PreamblesPerSSB, numberOfRA-PreamblesGroupA and numberOfRA-Preambles) on SpCell? | --> | PRACH Preamble | 8 | P |
| 22 | The SS transmits Random Access Response with an UL Grant of 56-bits and RAPID corresponding to the transmitted Preamble in step 21, including T-CRNTI. | <-- | Random Access Response | - | - |
| 23 | UE sends a msg3 using the grant associated to the Random Access ´Response received in step 22 on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 23A | SS schedules PDCCH transmission for UE C\_RNTI and allocate uplink grant. | <-- | Contention Resolution | - | - |
| 24 | Check: Does the UE transmit a MAC PDU with C-RNTI containing looped back PDCP SDU? | --> | MAC PDU | 9 | P |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: MAC PDU size of 56bits is selected to allow UE send status PDU and still stays below the limit of ra-Msg3SizeGrioupA.  Note 4: UL grant of 56bits is to make UE not send any loopback data in uplink with msg3. | | | | | |

Table 7.1.1.1.2.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit msg3 message on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | F |

Table 7.1.1.1.2.3.2-3: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit an PRACH preamble on SpCell? | --> | PRACH Preamble | - | F |

7.1.1.1.2.3.3 Specific message contents

Table 7.1.1.1.2.3.3-1: *MAC-CellGroupConfig* (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| tag-Config SEQUENCE { |  |  |  |
| tag-ToAddModList SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG { | 1 entry |  |  |
| TAG[1] SEQUENCE { |  | entry 1 |  |
| timeAlignmentTimer | ms750 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-1A: *SystemInformationBlockType1* (step 0AA and 17AA, Table 7.1.1.1.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.1.2.3.3-4 |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-2: *RRCReconfiguration* (step 0A and step 17A, Table 7.1.1.1.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
|  |  | TS 38.508-1 [4], 2. |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-3: *CellGroupConfig* (Table 7.1.1.1.2.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | RNTI-Value |  |  |
| t304 | ms2000 |  |  |
| rach-ConfigDedicated | Not Present |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-4: *ServingCellConfigCommon (*Table 7.1.1.1.2.3.3-3, Table 7.1.1.1.2.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-5: *BWP-UplinkCommon (*Table 7.1.1.1.2.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-6: *RACH-ConfigCommon (*Table 7.1.1.1.2.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| totalNumberOfRA-Preambles | 42 |  |  |
| ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| One | n32 |  |  |
| } |  |  |  |
| groupBconfigured SEQUENCE { |  |  |  |
| ra-Msg3SizeGroupA | b208 |  |  |
| messagePowerOffsetGroupB | minusinfinity |  |  |
| numberOfRA-PreamblesGroupA | 28 |  |  |
| } |  |  |  |
| ra-ContentionResolutionTimer | sf48 |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-7: *RACH-ConfigGeneric (*Table 7.1.1.1.2.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 119 | As per Table 6.3.3.2-2: of TS 38.211 [24], this results in PRACH preamble transmission in a radio frame meeting nSFN mod 8=1, subframe number 2, 6, 9 and starting symbol 0 using preamble Format A2. | FR1 FDD |
|  | 120 | As per Table 6.3.3.2-2: of TS 38.211 [24], this results in PRACH preamble transmission in a radio frame meeting nSFN mod 8=1, subframe number 4 and starting symbol 0 using preamble Format A2. | FR1 FDD AND HD\_FDD |
| prach-ConfigurationIndex | 91 | As per Table 6.3.3.2-3: of TS 38.211 [24], this results in PRACH preamble transmission in a radio frame meeting nSFN mod 2=1, subframe number 8, 9 and starting symbol 0 using preamble Format A2. | FR1 TDD |
| prach-ConfigurationIndex | 6 | As per Table 6.3.3.2-4: of TS 38.211 [24] and clause 5.3.2 of TS 38.211 this results in PRACH preamble transmission in radio frame meeting nSFN mod 4 = 1, slot number 8, 9, 18, 19, 28, 29, 38, 39 , 48, 49, 58, 59, 68, 69, 78, 79 and starting symbol 0 using preamble format A1. | FR2 (120 kHz) |
| preambleReceivedTargetPower | dBm-104 |  |  |
| preambleTransMax | n10 |  |  |
| powerRampingStep | dB2 |  |  |
| ra-ResponseWindow | sl8 |  | FR1 FDD and FR2 (120 kHz) |
|  | sl20 |  | FR1 TDD |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

Table 7.1.1.1.2.3.3-8: Void

##### 7.1.1.1.3 Random access procedure / Successful / SI request

7.1.1.1.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Idle State and need for Updated System information }

**ensure that** {

**when** { UE transmitted PRACH preamble and ra-ResponseWindow has expired}

**then** { UE retransmits the PRACH Preamble }

}

(2)

**with** { UE in RRC\_Idle State and transmitted PRACH preamble for System information request }

**ensure that** {

**when** { UE received a RAR message addressed to RA-RNTI and including matching RAPID only }

**then** { UE considers the RACH procedure to be successfully completed and informs the upper layer }

}

(3)

Void

7.1.1.1.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.2, 5.1.3, 5.1.4, and 6.1., 3GPP TS 38.331 clause 5.2.2.2.25. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by either PDCCH or RRC; and

1> if the *ra-PreambleIndex* is not 0b000000; and

1> if contention-free Random Access Resource associated with SSBs or CSI-RSs have not been explicitly provided by RRC:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided by RRC and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided by RRC and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> if the association between Random Access Preambles and SSBs is configured:

3> select a *ra-PreambleIndex* randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

2> else:

3> select a *ra-PreambleIndex* randomly with equal probability from the Random Access Preambles within the selected Random Access Preambles group.

2> set the *PREAMBLE\_INDEX* to the selected *ra-PreambleIndex*.

1> if an SSB is selected above and an association between PRACH occasions and SSBs is configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above and an association between PRACH occasions and CSI-RSs is configured:

2> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> else if Random Access procedure was initiated for beam failure recovery; and

1> if a CSI-RS is selected above and there is no contention-free Random Access Resource associated with the selected CSI-RS:

2> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

1> else:

2> determine the next available PRACH occasion (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

[TS 38.321, clause 5.1.3]

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if SSB selected is not changed (i.e. same as the previous Random Access Preamble transmission):

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to subclause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX* and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the specified PRACH (0 ≤ s\_id < 14), t\_id is the index of the first slot of the specified PRACH in a system frame (0 ≤ t\_id < 80), f\_id is the index of the specified PRACH in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Msg1 transmission (0 for NUL carrier, and 1 for SUL carrier).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for response to beam failure recovery request identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_B*I.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if in this Random Access procedure, the Random Access Preamble was selected by MAC among the contention-based Random Access Preambles:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> delay the subsequent Random Access Preamble transmission by the backoff time.

3> perform the Random Access Resource selection procedure (see subclause 5.1.2).

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

[TS 38.321, clause 6.1.5]

A MAC PDU consists of one or more MAC subPDUs and optionally padding. Each MAC subPDU consists one of the following:

- a MAC subheader with Backoff Indicator only;

- a MAC subheader with RAPID only (i.e. acknowledgment for SI request);

- a MAC subheader with RAPID and MAC RAR.

A MAC subheader with Backoff Indicator consists of five header fields E/T/R/R/BI as described in Figure 6.1.5-1. A MAC subPDU with Backoff Indicator only is placed at the beginning of the MAC PDU, if included. 'MAC subPDU(s) with RAPID only' and 'MAC subPDU(s) with RAPID and MAC RAR' can be placed anywhere between MAC subPDU with Backoff Indicator only (if any) and padding (if any).

A MAC subheader with RAPID consists of three header fields E/T/RAPID as described in Figure 6.1.5-2.

Padding is placed at the end of the MAC PDU if present. Presence and length of padding is implicit based on TB size, size of MAC subPDU(s).



Figure 6.1.5-1: E/T/R/R/BI MAC subheader



Figure 6.1.5-2: E/T/RAPID MAC subheader



Figure 6.1.5-3: Example of MAC PDU consisting of MAC RARs

[38.331, clause 5.2.2.2.2]

UEs in RRC\_IDLE or in RRC\_INACTIVE shall monitor for SI change indication in its own paging occasion every DRX cycle. UEs in RRC\_CONNECTED shall monitor for SI change indication in any paging occasion at least once per modification period if the UE is provided with common search space on the active BWP to monitor paging, as specified in TS 38.213 [13], clause 13.

ETWS or CMAS capable UEs in RRC\_IDLE or in RRC\_INACTIVE shall monitor for indications about PWS notification in its own paging occasion every DRX cycle. ETWS or CMAS capable UEs in RRC\_CONNECTED shall monitor for indication about PWS notification in any paging occasion at least once every *defaultPagingCycle* if the UE is provided with common search space on the active BWP to monitor paging.

For Short Message reception in a paging occasion, the UE monitors the PDCCH monitoring occasion(s) for paging as specified in TS 38.304 [20] and TS 38.213 [13].

If the UE receives a Short Message, the UE shall:

1> if the UE is ETWS capable or CMAS capable, the *etwsAndCmasIndication* bit of Short Message is set, and the UE is provided with *searchSpaceOtherSystemInformation* on the active BWP:

2> immediately re-acquire the *SIB1*;

2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB6*:

3> acquire *SIB6*, as specified in clause 5.2.2.3.2,immediately;

2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB7*:

3> acquire *SIB7*, as specified in clause 5.2.2.3.2,immediately;

2> if the UE is CMAS capable and *si-SchedulingInfo* includes scheduling information for *SIB8*:

3> acquire *SIB8*, as specified in sub-clause 5.2.2.3.2,immediately;

1> if the *systemInfoModification* bit of Short Message is set:

2> apply the SI acquisition procedure as defined in sub-clause 5.2.2.3 from the start of the next modification period.

7.1.1.1.3.3 Test description

7.1.1.1.3.3.1 Pre-test conditions

System Simulator:

- NR Cell 1 and NR Cell 11.

- System information combination NR-3 as defined in TS 38.508-1 [4] clause 4.4.3.1.3 is used in NR Cell 1.

UE:

- None.

Preamble:

- The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.

7.1.1.1.3.3.2 Test procedure sequence

Table 7.1.1.1.3.3.2-1/2 illustrate the downlink power levels and other changing parameters to be applied for the cell at various time instants of the test execution. The exact instants on which these values shall be applied are described in the texts in this clause. Configurations marked "T0" is applied for Preamble. Configurations marked "T1" and "T2" are applied at the points indicated in the Main behaviour description in Table 7.1.1.1.3.3.2-3.

Table 7.1.1.1.3.3.2-1: Time instances of cell power level and parameter changes for FR1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 11 | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/SCS | -90 | Off | The power level is such that SrxlevNRCell1 > 0 |
| Qrxlevmin | dBm | -106 | - |  |
| Qrxlevminoffset | dB | 0 | - |  |
| Pcompensation | dB | 0 | - |  |
|  | Qoffset | dB | 16 | - |  |
| T1 | SS/PBCH  SSS EPRE | dBm/SCS | -90 | -84 | The power level values are assigned to satisfy RNRCell 1 > RNRCell 11 |
|  | Qrxlevmin | dBm | -106 | -106 |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | 16 | - |  |
| T2 | SS/PBCH  SSS EPRE | dBm/SCS | -90 | -84 | The power level values are assigned to satisfy RNRCell 1 < RNRCell 11 |
|  | Qrxlevmin | dBm | -106 | -106 |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | -10 | - |  |
| Note: The downlink signal level uncertainty is specified in TS 38.508-1 [4] clause 6.2.2.1. | | | | | |

Table 7.1.1.1.3.3.2-2: Time instances of cell power level and parameter changes for FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 11 | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/SCS | -91 | Off | The power level is such that SrxlevNRCell1 > 0 |
| Qrxlevmin | dBm | 2\* ROUND((-110+Delta(NRfs))/2) | - |  |
| Qrxlevminoffset | dB | 0 | - |  |
| Pcompensation | dB | 0 | - |  |
|  | Qoffset | dB | 16 | - |  |
| T1 | SS/PBCH  SSS EPRE | dBm/SCS | -91 | -82 | The power level values are assigned to satisfy RNRCell 1 > RNRCell 11 |
|  | Qrxlevmin | dBm | 2\* ROUND((-110+Delta(NRfs))/2) | 2\* ROUND((-110+Delta(NRfs))/2) |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | 16 | - |  |
| T2 | SS/PBCH  SSS EPRE | dBm/SCS | -91 | -82 | The power level values are assigned to satisfy RNRCell 1 < RNRCell 11 |
|  | Qrxlevmin | dBm | 2\* ROUND((-110+Delta(NRfs))/2) | 2\* ROUND((-110+Delta(NRfs))/2) |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | -10 | - |  |
| Note: The downlink signal level uncertainty is specified in TS 38.508-1 [4] section 6.2.2.2. | | | | | |

Table 7.1.1.1.3.3.2-3: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS changes SS/PBCH  EPRE level of NR Cell 11 according to the row "T1" in Table 7.1.1.1.3.3.2-1/2. | - | - | - | - |
| 2 | Wait 60s to ensure UE detects NR Cell 11. | - | *-* | - | - |
| 3 | SS transmits Short Message on PDCCH addressed to P-RNTI using Short Message field in DCI format 1\_0. Bit 1 of Short Message field is set to 1 to indicate the SI modification. | <-- | (Short Message) | - | - |
| 4 | The *valueTag* for SIB3 in the SIB1 message is increased and *si*-*BroadcastStatus* for SIB3 is set to ‘*notBroadcasted’* and SS stops broadcasting SIB3. | <-- |  | - | - |
| 5 | Check: Does the UE transmit a preamble on PRACH using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 6 | Check: Does the UE re-transmit a preamble on PRACH after *ra-ResponseWindow* using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 7 | Check: Does the UE re-transmit a preamble on PRACH after *ra-ResponseWindow* using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 8 | Check: Does the UE re-transmit a preamble on PRACH after *ra-ResponseWindow* using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 9 | The SS transmits a RAR message addressed to UE RA-RNTI including a MAC subPDU with a matching RAPID only. (Note 1) | <-- | Random Access Response | - | - |
| 9A | The SS changes the parameter ‘*Qoffset’* in SIB3 of NR Cell 1 according to the row "T2"inTable 7.1.1.1.3.3.2-1/2 and starts broadcasting SIB3. |  |  |  |  |
| 10 | Check: Does UE send Msg3 containing an *RRCSetupRequest* message in the grant associated to the Random Access Response received in step 9? | --> | *RRCSetupRequest* | 2 | F |
| 11 | Check: Does the test result of generic test procedure in TS 38.508-1 [4] Table 4.9.5.2.2-1 indicate that the UE is camped on NR Cell 11 belonging to a new TA? | - | - | 2 | P |
| Note 1: The UE will indicate the reception of an acknowledgement for SI request to upper layers after UE receives the RAR message including a MAC subPDU with a matching RAPID only, according to TS 38.321 [18] clause 5.1.4. | | | | | |

7.1.1.1.3.3.3 Specific message contents

Table 7.1.1.1.3.3.3-1: *SIB1* on NR Cell 1 (Step 4, Table 7.1.1.1.3.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| si-SchedulingInfo SEQUENCE { |  |  |  |
| schedulingInfoList SEQUENCE { | 2 entries |  |  |
| si-BroadcastStatus[1] | Broadcasting |  |  |
| si-Periodicity[1] | rf32 |  |  |
| sib-MappingInfo[1] SEQUENCE { |  |  |  |
| type | SibType2 |  |  |
| valueTag | 0 |  |  |
| areaScope | Not present |  |  |
| } |  |  |  |
| si-BroadcastStatus[2] | notBroadcasting |  |  |
| si-Periodicity[2] | rf64 |  |  |
| sib-MappingInfo[2] SEQUENCE { |  |  |  |
| type | SibType3 |  |  |
| valueTag | 1 |  |  |
| areaScope | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| si-RequestConfig SEQUENCE { |  |  |  |
| rach-OccasionsSI SEQUENCE { |  |  |  |
| rach-ConfigSI | RACH-ConfigGeneric | TS 38.508-1 [4], Table 4.6.3-130 |  |
| ssb-perRACH-Occasion | one |  |  |
| } |  |  |  |
| si-RequestPeriod | two |  |  |
| si-RequestResources SEQUENCE { | 1 entry |  |  |
| ra-PreambleStartIndex[1] | 52 |  |  |
| ra-AssociationPeriodIndex[1] | 0 |  |  |
| ra-ssb-OccasionMaskIndex[1] | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| si-RequestConfigSUL | Not present |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.3.3.3-2: *SIB3* on NR Cell 1 (Preamble and Step 9A, Table 7.1.1.1.3.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.2-2 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB3 ::= SEQUENCE { |  |  |  |
| intraFreqNeighCellList SEQUENCE { |  |  |  |
| physCellId | The cell identity of NR Cell 11 defined in 38.508-1 [4] clause 4.4.2 |  |  |
| q-OffsetCell | 16 | Preamble |  |
| -10 | Step 9A |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.4 Random access procedure / Successful / Beam Failure / Preamble selected by MAC itself / Non Contention Free RACH procedure

7.1.1.1.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with no failureDetectionResources configured and RACH procedure due to beam failure is triggered }

**ensure that** {

**when** { contention free random access resources for beam failure recovery request associated with SS blocks are not provided by RRC }

**then** { UE selects initiates the non-contention free Random Access Procedure }

}

(2)

**with** { UE in RRC\_CONNECTED state and RACH procedure due to beam failure is triggered }

**ensure** **that** {

**when** { contention free random access resources for beam failure recovery request associated with SS blocks are explicitly provided by RRC }

**then** { UE selects the PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected SS block and initiates the contention free Random Access Procedure }

}

(3)

**with** { UE in RRC\_CONNECTED state and RACH procedure due to beam failure is triggered }

**ensure** **that** {

**when** { contention free random access resources for beam failure recovery request associated with CSI-RS are explicitly provided by RRC }

**then** { UE selects the PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected CSI-RS and initiates the contention free Random Access Procedure }

}

(4)

**with** { UE in RRC\_CONNECTED state with Preamble transmitted for contention free RACH procedure for beam failure }

**ensure** **that** {

**when** { ra-ResponseWindowBFR expires and the PDCCH addressed to the C-RNTI has not been received }

**then** { UE retransmits the PRACH Preamble }

}

(5)

**with** { UE in RRC\_CONNECTED state with Preamble transmitted for contention free RACH procedure for beam failure }

**ensure** **that** {

**when** { before expiry of ra-ResponseWindowBFR the PDCCH addressed to the C-RNTI is received }

**then** { UE considers the RACH procedure to be successfully completed and stops retransmitting PRACH preambles }

}

7.1.1.1.4.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clause 5.1.2, 5.1.3, 5.1.4 and 5.17. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided by RRC and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided by RRC and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> if the association between Random Access Preambles and SSBs is configured:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

2> else:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles within the selected Random Access Preambles group.

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

NOTE: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for response to beam failure recovery request identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

7.1.1.1.4.3 Test description

7.1.1.1.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.1.4.3.2 Test procedure sequence

Table 7.1.1.1.4.3.2-1/1A illustrates the downlink power levels and other changing parameters to be applied for the cells at various time instants of the test execution. Row marked "T0" denotes the initial conditions after preamble, while columns marked "T1"and "T2"are to be applied subsequently. The exact instants on which these values shall be applied are described in the texts in this clause.

Table 7.1.1.1.4.3.2-1: Time instances of cell power level and parameter changes for FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | E-UTRA Cell 1 | NR Cell 1 | NR Cell 1 Beam index #1 | NR Cell 1  Beam index #0 | Remark |
| T0 | Cell-specific RS EPRE | dBm/15kHz | -85 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -88 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | 0 | -57 |
| T1 | Cell-specific RS EPRE | dBm/15kHz | -85 | - | - | - | Beam#1 Switch OFF and Beam#0 Switch ON |
| Reference Power | dBm/SCS | - | -88 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | -57 | 0 |
| T2 | Cell-specific RS EPRE | dBm/15kHz | -85 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -88 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | 0 | -57 |
| NOTE: "Beam index #1" refers to transmission of the SS/PBCH block with SSB index #1 (according to the ssb-PositionsInBurst) and CSI-RS with index #1 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17); "Beam index #0" refers to transmission of the SS/PBCH block with SSB index #0 (according to the ssb-PositionsInBurst) and CSI-RS with index #0 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17). | | | | | | | |

Table 7.1.1.1.4.3.2-1A: Time instances of cell power level and parameter changes for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | E-UTRA Cell 1 | NR Cell 1 | NR Cell 1 Beam index #1 | NR Cell 1  Beam index #0 | Remark |
| T0 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | 0 | -63 |
| T1 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch OFF and Beam#0 Switch ON |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dBm/SCS | - | - | -63 | 0 |
| T2 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dBm/SCS | - | - | 0 | -63 |
| NOTE: "Beam index #1" refers to transmission of the SS/PBCH block with SSB index #1 (according to the ssb-PositionsInBurst) and CSI-RS with index #1 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17); "Beam index #0" refers to transmission of the SS/PBCH block with SSB index #0 (according to the ssb-PositionsInBurst) and CSI-RS with index #0 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17). | | | | | | | |

Table 7.1.1.1.4.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an NR *RRCReconfiguration* message to configure parameters for BFR. Note 1. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | The SS changes NR Cell 1 power level according to the row "T1" in table 7.1.1.1.4.3.2-1/1A. | - | - | - | - |
| 4 | Check: Does the UE transmit a preamble on PRACH for the non-contention free Random Access Procedure on NR Cell 1 Beam index #1? | --> | PRACH Preamble | 1 | P |
| 5 | The SS transmits a MAC PDU addressed to UE RA-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 6 | UE sends a msg3 using the grant associated to the Random Access Response received in Step 5 on NR Cell 1. | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 7 | SS schedules PDCCH transmission for UE C-RNTI. | <-- | Contention Resolution | - | - |
| 8 | The SS transmits an NR *RRCReconfiguration* to establish random access resources for BFR associated with SS blocks explicitly. Note 1. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 9 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 10 | The SS changes NR Cell 1 power level according to the row "T2" in table 7.1.1.1.4.3.2-1/1A. | - | - | - | - |
| 11 | Check: Does the UE transmit preamble on PRACH using a preamble with PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected SS block provided by RRC on NR Cell 1 Beam index #0? | --> | PRACH Preamble | 2 | P |
| 12 | The SS waits for ra-ResponseWindowBFR expire.  NOTE: The SS does not transmit Random Access Response to the UE. | - | - | - | - |
| 13 | Check: Does the UE retransmit a preamble on PRACH with ra-PreambleIndex same as the Step 11? | --> | PRACH Preamble | 4 | P |
| 14 | The SS transmits a MAC PDU addressed to UE C-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 15 | The SS waits for ra-ResponseWindowBFR expire. | - | - | - | - |
| 16 | Check: Does the UE retransmit a preamble on PRACH? | - | - | 5 | F |
| - | EXCEPTION: Steps 17 to 25 describe behaviour that depends on the UE capability. | - | - | - | - |
| 17 | IF pc\_csi\_RS\_CFRA\_ForHO THEN the SS transmits an NR *RRCReconfiguration* message to establish random access resources for BFR associated with CSI-RS explicitly. Note 1. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 18 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 19 | The SS changes NR Cell 1 power level according to the row "T1" in table 7.1.1.1.4.3.2-1/1A. | - | - | - | - |
| 20 | Check: Does the UE transmit preamble on PRACH using a preamble with PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected CSI-RS provided by RRC on NR Cell 1 Beam index #1? | --> | PRACH Preamble | 3 | P |
| 21 | The SS waits for ra-ResponseWindowBFR expire.  NOTE: The SS does not transmit Random Access Response to the UE. | - | - | - | - |
| 22 | Check: Does the UE retransmit a preamble on PRACH with ra-PreambleIndex same as the Step 20? | --> | PRACH Preamble | 4 | P |
| 23 | The SS transmits a MAC PDU addressed to UE C-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 24 | The SS waits for ra-ResponseWindowBFR expire. | - | - | - | - |
| 25 | Check: Does the UE retransmit a preamble on PRACH? | - | - | 5 | F |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration* 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: for EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete*. | | | | | |

7.1.1.1.4.3.3 Specific message contents

Table 7.1.1.1.4.3.3-1: Void

Table 7.1.1.1.4.3.3-2: Void

Table 7.1.1.1.4.3.3-3: *RRCReconfiguration* (Step 1, Step8, Step17 Table 7.1.1.1.4.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration::=SEQUENCE{ |  |  |  |
| criticalExtensions CHOICE{ |  |  |  |
| rrcReconfiguration SEQUENCE{ |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-4: *CellGroupConfig* (Table 7.1.1.1.4.3.3-3: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-5: *ServingCellConfig* (Table 7.1.1.1.4.3.3-4: *CellGroupConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| initialDownlinkBWP | BWP-DownlinkDedicated |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| csi-MeasConfig CHOICE { |  |  | Step 1 |
| setup | CSI-MeasConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated* (Table 7.1.1.1.4.3.3-5: *ServingCellConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-DownlinkDedicated ::= SEQUENCE { |  |  |  |
| pdcch-Config | Not present |  | Step 17 |
| pdcch-Config CHOICE { |  |  | Step 1, Step 8 |
| setup | PDCCH-Config |  |  |
| } |  |  |  |
| pdsch-Config CHOICE { |  |  |  |
| setup | PDSCH-Config |  |  |
| } |  |  |  |
| radioLinkMonitoringConfig CHOICE { |  |  |  |
| setup | RadioLinkMonitoringConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-7: RadioLinkMonitoringConfig(Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-133 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioLinkMonitoringConfig ::= SEQUENCE { |  |  |  |
| failureDetectionResourcesToAddModList SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS { | 2 entries |  |  |
| RadioLinkMonitoringRS[1] SEQUENCE { |  | entry 1 |  |
| radioLinkMonitoringRS-Id | 0 |  |  |
| purpose | rlf |  | Step 1, Step 17 |
|  | both |  | Step 8 |
| detectionResource CHOICE { |  |  |  |
| csi-rs | 0 | NR Cell 1 Beam index #0 |  |
| } |  |  |  |
| } |  |  |  |
| RadioLinkMonitoringRS[2] SEQUENCE { |  | entry 2 |  |
| radioLinkMonitoringRS-Id | 1 |  |  |
| purpose | rlf |  | Step 1, Step 8 |
|  | both |  | Step 17 |
| detectionResource CHOICE { |  |  |  |
| csi-rs | 1 | NR Cell 1 Beam index #1 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| beamFailureInstanceMaxCount | n1 |  |  |
| beamFailureDetectionTimer | pbfd1 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-8: *PDSCH-Config* (Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| tci-StatesToAddModList SEQUENCE(SIZE (1.. maxNrofTCI-States)) OF TCI-State { | 3 entries |  |  |
| TCI-State[1] SEQUENCE { |  | entry 1 |  |
| tci-StateId | 0 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 1 | SSB index #1 |  |
| } |  |  |  |
| qcl-Type | type C |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 1 | SSB index #1 |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| TCI-State[2] SEQUENCE { |  | entry 2 |  |
| tci-StateId | 1 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 0 | SSB index #0 |  |
| } |  |  |  |
| qcl-Type | type C |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 0 | SSB index #0 |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| TCI-State[3] SEQUENCE { |  | entry 3 |  |
| tci-StateId | 2 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| csi-rs | 1 | Csi-Rs index #1 |  |
| } |  |  |  |
| qcl-Type | type A |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| Csi-rs | 1 | Csi-Rs index #1 |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-9: *PDCCH-Config* (Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 2 entries |  |  |
| ControlResourceSet[1] | ControlResourceSetid1 | entry 1 |  |
| ControlResourceSet[2] | ControlResourceSetid2 | entry 2 |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace { | 2 entries |  |  |
| SearchSpace[1] | SearchSpace with condition USS | entry 1 |  |
| SearchSpace[2] | SearchSpaceBFR | entry 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-10: *ControlResourceSetId1* (Table 7.1.1.1.4.3.3-9: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| tci-StatesPDCCH-ToAddList SEQUENCE (SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId { | 1 entry |  | Step 1 |
| TCI-StateId[1] | 2 | entry 1  TCI-State Id 2 |  |
| } |  |  |  |
| tci-StatesPDCCH-ToReleaseList SEQUENCE (SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId { | 1 entry |  | Step 8 |
| TCI-StateId[1] | 2 | entry 1  TCI-State Id 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-11: *ControlResourceSetId2* (Table 7.1.1.1.4.3.3-9: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 2 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-12: *SearchSpaceBFR* (Table 7.1.1.1.4.3.3-9: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-162 | | | |
| Information Element | Value/remark | Comment | Condition |
| SearchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceId | 4 |  |  |
| controlResourceSetId | 2 |  |  |
| searchSpaceType CHOICE { |  |  |  |
| ue-Specific SEQUENCE { |  |  |  |
| dci-Formats | formats0-0-And-1-0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig* (Table 7.1.1.1.4.3.3-5: *ServingCellConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-38 | | | |
| Information Element | Value/remark | Comment | Condition |
| CSI-MeasConfig::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceToAddModList SEQUENCE { | 2 entries |  |  |
| NZP-CSI-RS-Resource[1] | NZP-CSI-RS-ResourceId0 |  |  |
| NZP-CSI-RS-Resource[2] | NZP-CSI-RS-ResourceId1 |  |  |
| } |  |  |  |
| nzp-CSI-RS-ResourceSetToAddModList SEQUENCE { | 1 entry |  |  |
| NZP-CSI-RS-ResourceSet[1] | NZP-CSI-RS-ResourceSetid0 |  |  |
| } |  |  |  |
| csi-IM-ResourceToAddModList | Not present |  |  |
| csi-IM-ResourceSetToAddModList | Not present |  |  |
| csi-SSB-ResourceSetToAddModList | Not present |  |  |
| csi-ReportConfigToAddModList | Not present |  |  |
| reportTriggerSize | Not present |  |  |
| aperiodicTriggerStateList | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-14: *NZP-CSI-RS-ResourceId0* (Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-85 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-Resource ::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceId | 0 |  |  |
| resourceMapping | CSI-RS-ResourceMapping with condition TRS | TS 38.508-1 [4], Table 4.6.3-45 |  |
| qcl-InfoPeriodicCSI-RS | 0 | QCL to SSB #0 |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-15: *NZP-CSI-RS-ResourceId1* (Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-85 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-Resource ::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceId | 1 |  |  |
| resourceMapping | CSI-RS-ResourceMapping with condition TRS | TS 38.508-1 [4], Table 4.6.3-45 |  |
| periodicityAndOffset | CSI-ResourcePeriodicityAndOffset\_Id1 |  |  |
| qcl-InfoPeriodicCSI-RS | 1 | QCL to SSB #1 |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-16: *CSI-ResourcePeriodicityAndOffset\_Id1* (Table 7.1.1.1.4.3.3-15: *NZP-CSI-RS-ResourceId1*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-43 | | | |
| Information Element | Value/remark | Comment | Condition |
| CSI-ResourcePeriodicityAndOffset ::= CHOICE { |  |  |  |
| slots80 | 11 |  | FR1 |
| slots320 | 41 |  | FR2 |
| } |  |  |  |

Table 7.1.1.1.4.3.3-17: *NZP-CSI-RS-ResourceSetid0* (Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-87 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-ResourceSet ::= SEQUENCE { |  |  |  |
| nzp-CSI-ResourceSetId | 0 |  |  |
| nzp-CSI-RS-Resources SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId { | 2 entries |  |  |
| NZP-CSI-RS-ResourceId[1] | 0 | entry 1 |  |
| NZP-CSI-RS-ResourceId[2] | 1 | entry 2 |  |
| } |  |  |  |
| trs-Info | true |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated* (Table 7.1.1.1.4.3.3-5: *ServingCellConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup | PUSCH-Config |  |  |
| } |  |  |  |
| beamFailureRecoveryConfig | BeamFailureRecoveryConfig\_SSB |  | Step8 |
|  | BeamFailureRecoveryConfig\_CSIRS |  | Step17 |
|  | Not Present |  | Step1 |
| } |  |  |  |

Table 7.1.1.1.4.3.3-19: *BeamFailureRecoveryConfig\_SSB* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-6 | | | |
| Information Element | Value/remark | Comment | Condition |
| BeamFailureRecoveryConfig ::= SEQUENCE { |  |  |  |
| rootSequenceIndex-BFR | 0 | See TS 38.508-1 [4] clause 4.4.2, Table 4.4.2-2 |  |
| rach-ConfigBFR | RACH-ConfigGeneric | 38.508-1 [4] Table 4.6.3-130 |  |
| rsrp-ThresholdSSB | 57(-99dBm) |  |  |
| candidateBeamRSList SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR CHOICE{ |  |  |  |
| ssb SEQUENCE { |  |  |  |
| ssb | 1 | NR Cell Beam#1 |  |
| ra-PreambleIndex | 56 | (0..63) |  |
| } |  |  |  |
| } |  |  |  |
| ssb-perRACH-Occasion | one |  |  |
| ra-ssb-OccasionMaskIndex | 0 |  |  |
| recoverySearchSpaceID | 4 |  |  |
| ra-Prioritization | Not Present |  |  |
| beamFailureRecoveryTimer | ms200 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-20: *BeamFailureRecoveryConfig\_CSIRS* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-6 | | | |
| Information Element | Value/remark | Comment | Condition |
| BeamFailureRecoveryConfig ::= SEQUENCE { |  |  |  |
| rootSequenceIndex-BFR | 0 | See TS 38.508-1 [4] clause 4.4.2, Table 4.4.2-2 |  |
| rach-ConfigBFR | RACH-ConfigGeneric | 38.508-1 [4] Table 4.6.3-130 |  |
| rsrp-ThresholdSSB | 57(-99dBm) |  |  |
| candidateBeamRSList SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR CHOICE{ |  |  |  |
| csi-RS SEQUENCE { |  |  |  |
| csi-RS | 0 |  |  |
| ra-OccasionList SEQUENCE (SIZE(1..maxRA-OccasionsPerCSIRS)) OF INTEGER (0..maxRA-Occasions-1) { | 1 entry |  |  |
| INTEGER[1] | 0 | entry 1  NR Cell Beam#0 |  |
| } |  |  |  |
| ra-PreambleIndex | 59 |  |  |
| } |  |  |  |
| } |  |  |  |
| ssb-perRACH-Occasion | Not Present |  |  |
| ra-ssb-OccasionMaskIndex | Not Present |  |  |
| recoverySearchSpaceID | 4 |  |  |
| ra-Prioritization | Not Present |  |  |
| beamFailureRecoveryTimer | ms200 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-21: *PUCCH-Config* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| pucch-Config::= SEQUENCE { |  |  |  |
| pucch-PowerControl SEQUENCE { |  |  |  |
| pathlossReferenceRSs SEQUENCE (SIZE (1..maxNrofPUCCH-PathlossReferenceRSs)) OF PUCCH-PathlossReferenceRS { | 1 entry |  |  |
| PUCCH-PathlossReferenceRS[1] SEQUENCE { |  | entry 1 |  |
| referenceSignal CHOICE { |  |  |  |
| ssb-Index | 1 |  | Step1, Step17 |
|  | 0 |  | Step8 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-22: *PUSCH-Config* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| pusch-Config::= SEQUENCE { |  |  |  |
| pusch-PowerControl SEQUENCE { |  |  |  |
| pathlossReferenceRSToAddModList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS { | 1 entry |  |  |
| PUSCH-PathlossReferenceRS[1] SEQUENCE { |  | entry 1 |  |
| referenceSignal CHOICE{ |  |  |  |
| ssb-Index | 1 |  | Step1, Step17 |
|  | 0 |  | Step8 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.5 Random access procedure / Successful / Supplementary Uplink

7.1.1.1.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with supplementary uplink configured and RACH procedure is triggered }

**ensure** **that** {

**when** { RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL* }

**then** { UE performs the Random Access Procedure on the Supplementary Uplink carrier }

}

7.1.1.1.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in TS 38.321: clause 5.1.1 and clause 5.16. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.1]

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

NOTE 1: If a new Random Access procedure is triggered while another is already ongoing in the MAC entity, it is up to UE implementation whether to continue with the ongoing procedure or start with the new procedure (e.g. for SI request).

RRC configures the following parameters for the Random Access procedure:

- *prach-ConfigurationIndex*: the available set of PRACH occasions for the transmission of the Random Access Preamble;

- *preambleReceivedTargetPower*: initial Random Access Preamble power;

- *rsrp-ThresholdSSB*: an RSRP threshold for the selection of the SSB. If the Random Access procedure is initiated for beam failure recovery, *rsrp-ThresholdSSB* used for the selection of the SSB within *candidateBeamRSList* refers to *rsrp-ThresholdSSB* in *BeamFailureRecoveryConfig* IE;

- *rsrp-ThresholdCSI-RS*: an RSRP threshold for the selection of CSI-RS. If the Random Access procedure is initiated for beam failure recovery, *rsrp-ThresholdCSI-RS* is equal to *rsrp-ThresholdSSB* in *BeamFailureRecoveryConfig* IE;

- *rsrp-ThresholdSSB-SUL*: an RSRP threshold for the selection between the NUL carrier and the SUL carrier;

- *candidateBeamRSList*: a list of reference signals (CSI*-RS* and/or SSB) identifying the candidate beams for recovery and the associated Random Access parameters;

- *recoverySearchSpaceId*: the search space identity for monitoring the response of the beam failure recovery request;

- *powerRampingStep*: the power-ramping factor;

- *powerRampingStepHighPriority*: the power-ramping factor in case of prioritized Random Access procedure;

- *scalingFactorBI*: a scaling factor for prioritized Random Access procedure;

- *ra-PreambleIndex*: Random Access Preamble;

- *ra-ssb-OccasionMaskIndex*: defines PRACH occasion(s) associated with an SSB in which the MAC entity may transmit a Random Access Preamble (see clause 7.4);

- *ra-OccasionList*: defines PRACH occasion(s) associated with a CSI-RS in which the MAC entity may transmit a Random Access Preamble;

- *ra-PreambleStartIndex*: the starting index of Random Access Preamble(s) for on-demand SI request;

- *preambleTransMax*: the maximum number of Random Access Preamble transmission;

- *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*: defines the number of SSBs mapped to each PRACH occasion and the number of contention-based Random Access Preambles mapped to each SSB;

- if *groupBconfigured* is configured, then Random Access Preambles group B is configured.

- Amongst the contention-based Random Access Preambles associated with an SSB (as defined in TS 38.213 [6]), the first *numberOfRA-PreamblesGroupA* Random Access Preambles belong to Random Access Preambles group A. The remaining Random Access Preambles associated with the SSB belong to Random Access Preambles group B (if configured).

NOTE 2: If Random Access Preambles group B is supported by the cell Random Access Preambles group B is included for each SSB.

- if Random Access Preambles group B is configured:

- *ra-Msg3SizeGroupA*: the threshold to determine the groups of Random Access Preambles;

- *msg3-DeltaPreamble*: ∆*PREAMBLE\_Msg3* in TS 38.213 [6];

- *messagePowerOffsetGroupB*: the power offset for preamble selection;

- *numberOfRA-PreamblesGroupA*: defines the number of Random Access Preambles in Random Access Preamble group A for each SSB.

- the set of Random Access Preambles and/or PRACH occasions for SI request, if any;

- the set of Random Access Preambles and/or PRACH occasions for beam failure recovery request, if any;

- the set of Random Access Preambles and/or PRACH occasions for reconfiguration with sync, if any;

- *ra-ResponseWindow*: the time window to monitor RA response(s) (SpCell only);

- *ra-ContentionResolutionTimer*: the Contention Resolution Timer (SpCell only).

In addition, the following information for related Serving Cell is assumed to be available for UEs:

- if Random Access Preambles group B is configured:

- if the Serving Cell for the Random Access procedure is configured with supplementary uplink as specified in TS 38.331 [5], and SUL carrier is selected for performing Random Access Procedure:

- PCMAX,f,c of the SUL carrier as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16].

- else:

- PCMAX,f,c of the NUL carrier as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16].

The following UE variables are used for the Random Access procedure:

- *PREAMBLE\_INDEX*;

- *PREAMBLE\_TRANSMISSION\_COUNTER*;

- *PREAMBLE\_POWER\_RAMPING\_COUNTER*;

- *PREAMBLE\_POWER\_RAMPING\_STEP*;

- *PREAMBLE\_RECEIVED\_TARGET\_POWER*;

- *PREAMBLE\_BACKOFF*;

- *PCMAX*;

- *SCALING\_FACTOR\_BI*;

- *TEMPORARY\_C-RNTI*.

When the Random Access procedure is initiated on a Serving Cell, the MAC entity shall:

1> flush the Msg3 buffer;

1> set the *PREAMBLE\_TRANSMISSION\_COUNTER* to 1;

1> set the *PREAMBLE\_POWER\_RAMPING\_COUNTER* to 1;

1> set the *PREAMBLE\_BACKOFF* to 0 ms;

1> if the carrier to use for the Random Access procedure is explicitly signalled:

2> select the signalled carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the signalled carrier.

1> else if the carrier to use for the Random Access procedure is not explicitly signalled; and

1> if the Serving Cell for the Random Access procedure is configured with supplementary uplink as specified in TS 38.331 [5]; and

1> if the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL*:

2> select the SUL carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the SUL carrier.

1> else:

2> select the NUL carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the NUL carrier.

1> perform the BWP operation as specified in clause 5.15;

1> set *PREAMBLE\_POWER\_RAMPING\_STEP* to

*powerRampingStep*;1> set *SCALING\_FACTOR\_BI* to 1;

1> if the Random Access procedure was initiated for beam failure recovery (as specified in clause 5.17); and

1> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier:

2> start the *beamFailureRecoveryTimer*, if configured;

2> apply the parameters *powerRampingStep*, *preambleReceivedTargetPower*, and *preambleTransMax* configured in the *beamFailureRecoveryConfig*;

2> if *powerRampingStepHighPriority* is configured in the *beamFailureRecoveryConfig*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

2> else:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *powerRampingStep*.

2> if *scalingFactorBI* is configured in the *beamFailureRecoveryConfig*:

3> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

1> else if the Random Access procedure was initiated for handover; and

1> if *rach-ConfigDedicated* is configured for the selected carrier:

2> if *powerRampingStepHighPriority* is configured in the *rach-ConfigDedicated*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

2> if *scalingFactorBI* is configured in the *rach-ConfigDedicated*:

3> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

1> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.16]

The Supplementary UL (SUL) carrier can be configured as a complement to the normal UL (NUL) carrier. Switching between the NUL carrier and the SUL carrier means that the UL transmissions move from one carrier to the other carrier, which is done by:

- an indication in DCI;

- the Random Access procedure as specified in clause 5.1.1.

If the MAC entity receives a UL grant indicating an SUL switch while a Random Access procedure is ongoing, the MAC entity shall ignore the UL grant.

The Serving Cell configured with *supplementaryUplink* belongs to a single TAG.

7.1.1.1.5.3 Test description

7.1.1.1.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that supplementary uplink (SUL) carrier is configured on NR Cell 33.

7.1.1.1.5.3.2 Test procedure sequence

Table 7.1.1.1.5.3.2-1 illustrates the downlink power levels to be applied for the NR cells at various time instants of the test execution. Row marked "T0" denotes the initial conditions, while row marked "T1" are to be applied subsequently. The exact instants on which these values shall be applied are described in the texts in this clause.

Table 7.1.1.1.5.3.2-1: Time instances of cell power level changes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1  (NUL) | NR Cell 33 (SUL) | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/SCS | -75 | N/A | NR Cell1 Power level is higher than *rsrp-ThresholdSSB-SUL.* |
| T1 | SS/PBCH  SSS EPRE | dBm/SCS | -85 | N/A | NR Cell1 Power level is lower than *rsrp-ThresholdSSB-SUL.* |

Table 7.1.1.1.5.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant |  | - | - | - |
| 2 | The SS transmits a MAC PDU containing a PDCP SDU on NR Cell 1. | <-- | MAC PDU | - | - |
| 3 | The SS changes NR Cell 1’s power level according to the row "T1" in table 7.1.1.1.5.3.2-1. (Note 1) | - | - | - | - |
| 4 | Void. | - | - | - | - |
| 5 | Check: Does the UE initiate the random access procedure on SUL carrier on NR Cell 33? | --> | PRACH Preamble | 1 | P |
| 6 | The SS transmits Random Access Response with an UL Grant of 56-bits on NR Cell 1 and RAPID corresponding to the transmitted preamble in step 5. (Note 2) | <-- | Random Access Response | - | - |
| 7 | Check: Does the UE send a msg3 using the grant associated to the Random Access Response received in Step 6 on SUL carrier on NR Cell 33? | --> | Msg3 (C-RNTI MAC CE) | 1 | P |
| 8 | The SS schedules PDCCH transmission on NR Cell 1 for UE C-RNTI with uplink grant’s UL/SUL indicator set to 1. | <-- | Contention Resolution | - | - |
| 9 | Check: Does the UE transmit a MAC PDU with C-RNTI containing looped back PDCP SDU on SUL carrier on NR Cell 33? | --> | MAC PDU | 1 | P |
| Note 1: Reduce the NR Cell 1 SS/PBCH EPRE level to ensure that RSRP of the downlink pathloss reference is lower than rsrp-ThresholdSSB-SUL, while UE is still able to receive msg2 and msg4 correctly.  Note 2: UL grant of 56 bits is to make UE not send any loopback data in uplink with msg3, according to TS 38.321 [18] clause 5.4.3.1. | | | | | |

7.1.1.1.5.3.3 Specific message contents

Table 7.1.1.1.5.3.3-1: SIB1 of NR Cell 1 (preamble and all steps, Table 7.1.1.1.5.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommonSIB |  |  |
| } |  |  |  |

Table 7.1.1.1.5.3.3-2: ServingCellConfigCommonSIB (Table 7.1.1.1.5.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-169 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommonSIB ::= SEQUENCE { |  |  |  |
| supplementaryUplink SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.5.3.3-3: BWP-UplinkCommon (Table 7.1.1.1.5.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.5.3.3-4: RACH-ConfigCommon(Table 7.1.1.1.5.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rsrp-ThresholdSSB-SUL | 76 | IE value 76 means -80dBm | SUL |
| } |  |  |  |

Table 7.1.1.1.5.3.3-5: DCI Format 0-1(Step 8 of Table 7.1.1.1.5.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.3.6.1.1.2-1 | | | |
| Information Element | Value/remark | Comment | Condition |
| UL/SUL indicator | 1 |  | UE configured with SUL in the cell |

##### 7.1.1.1.6 Random access procedure / Successful/ Temporary C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC Idle state has UL CCCH PDU to send and Random Access Preambles group B is configured }

**ensure that** {

**when** { the UL CCCH MAC PDU Size is less than messageSizeGroupA }

**then** { UE transmits a random access preamble using a preamble in group A of random access preambles }

}

(2)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSG3 }

**ensure that** {

**when** { The SS schedules any PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry with MAC PDU does not contain a matching UE Contention Resolution Identity MAC CE }

**then** {UE re transmits a random access preamble using a preamble in the same group of random access preambles as used for the first transmission of Msg3 }

}

(3)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSG3 }

**ensure that** {

**when** { The SS does not schedule any PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry }

**then** {UE re transmits a random access preamble using a preamble in the same group of random access preambles as used for the first transmission of Msg3 }

}

(4)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSG3 }

**ensure that** {

**when** { The SS schedules a PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry }

**then** {UE assumes RACH procedure as complete }

}

7.1.1.1.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clauses 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.2, 6.1.3.2, 6.1.5 and 6.2.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided in *rach-ConfigDedicated* and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

> select a Random Access Preamble3 randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

> else:

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

11> ifthe Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured or indicated by PDCCH (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the ra-ssb-OccasionMaskIndex if configured, corresponding to the SSB in candidateBeamRSList which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the SSB which is quasi-colocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-colocated with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> else if Random Access procedure was initiated for beam failure recovery; and

1> if a CSI-RS is selected above and there is no contention-free Random Access Resource associated with the selected CSI-RS:

2> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

1> else:

2> determine the next available PRACH occasion (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

NOTE: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

[TS 38.321, clause 5.1.3]

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to subclause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX* and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the PRACH occasion (0 ≤ s\_id < 14), t\_id is the index of the first slot of the PRACH occasion in a system frame (0 ≤ t\_id < 80), f\_id is the index of the PRACH occasion in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_B*I.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

NOTE: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of contention-based Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behavior is not defined.

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted; or

> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received1:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response reception.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted, the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNT:I

> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

5> else:

6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Random Access procedure successfully completed.

4> else:

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

1> if *ra-ContentionResolutionTimer* expires:

2> discard the *TEMPORARY\_C-RNTI*;

2> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

3> perform the Random Access Resource selection procedure (see subclause 5.1.2).

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

[TS 38.321, clause 5.2]

RRC configures the following parameters for the maintenance of UL time alignment:

- *timeAlignmentTimer* (per TAG) which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned.

The MAC entity shall:

1> when a Timing Advance Command MAC CE is received, and if an NTA (as defined in TS 38.211 [8]) has been maintained with the indicated TAG:

2> apply the Timing Advance Command for the indicated TAG;

2> start or restart the *timeAlignmentTimer* associated with the indicated TAG.

1> when a Timing Advance Command is received in a Random Access Response message for a Serving Cell belonging to a TAG:

2> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble:

3> apply the Timing Advance Command for this TAG;

3> start or restart the *timeAlignmentTimer* associated with this TAG.

2> else if the *timeAlignmentTimer* associated with this TAG is not running:

3> apply the Timing Advance Command for this TAG;

3> start the *timeAlignmentTimer* associated with this TAG;

3> when the Contention Resolution is considered not successful as described in subclause 5.1.5; or

3> when the Contention Resolution is considered successful for SI request as described in subclause 5.1.5, after transmitting HARQ feedback for MAC PDU including UE Contention Resolution Identity MAC CE:

4> stop *timeAlignmentTimer* associated with this TAG.

2> else:

3> ignore the received Timing Advance Command.

1> when a *timeAlignmentTimer* expires:

2> if the *timeAlignmentTimer* is associated with the PTAG:

3> flush all HARQ buffers for all Serving Cells;

3> notify RRC to release PUCCH for all Serving Cells, if configured;

3> notify RRC to release SRS for all Serving Cells, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> consider all running *timeAlignmentTimer*s as expired;

3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.

2> else if the *timeAlignmentTimer* is associated with an STAG, then for all Serving Cells belonging to this TAG:

3> flush all HARQ buffers;

3> notify RRC to release PUCCH, if configured;

3> notify RRC to release SRS, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> maintain NTA (defined in TS 38.211 [8]) of this TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell except the Random Access Preamble transmission when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the PTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble transmission on the SpCell.

[TS 38.321, clause 6.1.3.2]

The C-RNTI MAC CE is identified by MAC PDU subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.



Figure 6.1.3.2-1: C-RNTI MAC CE

[TS 38.321, clause 6.1.5]

A MAC PDU consists of one or more MAC subPDUs and optionally padding. Each MAC subPDU consists one of the following:

- a MAC subheader with Backoff Indicator only;

- a MAC subheader with RAPID only (i.e. acknowledgment for SI request);

- a MAC subheader with RAPID and MAC RAR.

A MAC subheader with Backoff Indicator consists of five header fields E/T/R/R/BI as described in Figure 6.1.5-1. A MAC subPDU with Backoff Indicator only is placed at the beginning of the MAC PDU, if included. 'MAC subPDU(s) with RAPID only' and 'MAC subPDU(s) with RAPID and MAC RAR' can be placed anywhere between MAC subPDU with Backoff Indicator only (if any) and padding (if any).

A MAC subheader with RAPID consists of three header fields E/T/RAPID as described in Figure 6.1.5-2.

Padding is placed at the end of the MAC PDU if present. Presence and length of padding is implicit based on TB size, size of MAC subPDU(s).



Figure 6.1.5-1: E/T/R/R/BI MAC subheader



Figure 6.1.5-2: E/T/RAPID MAC subheader



Figure 6.1.5-3: Example of MAC PDU consisting of MAC RARs

[TS 38.321, clause 6.2.3]

The MAC RAR is of fixed size as depicted in Figure 6.2.3-1, and consists of the following fields:

- R: Reserved bit, set to "0";

- Timing Advance Command: The Timing Advance Command field indicates the index value *TA* used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6]. The size of the Timing Advance Command field is 12 bits;

- UL Grant: The Uplink Grant field indicates the resources to be used on the uplink in TS 38.213 [6]. The size of the UL Grant field is 27 bits;

- Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access. The size of the Temporary C-RNTI field is 16 bits.

The MAC RAR is octet aligned.



Figure 6.2.3-1: MAC RAR

7.1.1.1.6.3 Test description

7.1.1.1.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*).7.1.1.1.6.3.2 Test procedure sequence

Table 7.1.1.1.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in *servingCellConfigCommon* in *SIB1* (totalNumberOfRA-Preambles, ssb-perRACH-OccasionAndCB-PreamblesPerSSB and numberOfRA-PreamblesGroupA)? | --> | PRACH Preamble | 1 | P |
| 3 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 2, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - | - |
| 4 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. (Note 1) | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 5 | Before the contention resolution timer expires, the SS does not schedule any PDCCH. |  |  |  |  |
| 6 | Check: Does the UE re-transmit a preamble on PRACH using a preamble in the same group A? | --> | PRACH Preamble | 3 | P |
| 7 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 6, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - | - |
| 8 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. (Note 1) | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 9 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* message, but not including a matching ‘UE Contention Resolution Identity’ MAC control element. | <-- | MAC PDU  (*RRCSetup*) | - | - |
| - | EXCEPTION: In parallel with step 10, the parallel behaviour in table 7.1.1.1.6.3.2-2 is running. | - | - | - | - |
| 10 | Check: Does the UE re-transmit a preamble on PRACH using a preamble in the same group A? | --> | PRACH Preamble | 2 | P |
| 11 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 10, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - |  |
| 12 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. (Note 1) | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 13 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 14 | Check: Does UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message? | --> | MAC PDU (*RRCSetupComplete)* | 4 | P |
| Note 1: Size of *RRCSetupRequest* message is 45 bits, octet aligned = 48 bits. With 16 bits of MAC Header the minimum size of MAC PDU carrying *RRCSetupRequest* is 64 bits. | | | | | |

Table 7.1.1.1.6.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: UE transmits a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message? | --> | MAC PDU (*RRCSetupComplete)* | 2 | F |

7.1.1.1.6.3.3 Specific message contents

Table 7.1.1.1.6.3.3-1: *SIB1 (*Preamble, Table 7.1.1.1.6.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.6.3.3-2: *BWP-UplinkCommon (*Table 7.1.1.1.6.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.6.3.3-3: *RACH-ConfigCommon (*Table 7.1.1.1.6.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| totalNumberOfRA-Preambles | 42 |  |  |
| ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| One | n32 |  |  |
| } |  |  |  |
| groupBconfigured SEQUENCE { |  |  |  |
| ra-Msg3SizeGroupA | b208 |  |  |
| messagePowerOffsetGroupB | minusinfinity |  |  |
| numberOfRA-PreamblesGroupA | 28 |  |  |
| } |  |  |  |
| ra-ContentionResolutionTimer | sf48 |  |  |
| } |  |  |  |

##### 7.1.1.1.7 Random access procedure / 2-step RACH / RA\_TYPE selection

7.1.1.1.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected and NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above msgA-RSRP-Threshold }

**then** { UE SET RA\_TYPE to 2-step AND sends a MSGA on the NR SpCell }

}

(2)

**with** { UE in RRC\_Connected NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources }

**then** { UE SET RA\_TYPE to 2-step AND sends a MSGA on the NR SpCell }

}

7.1.1.1.7.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.1, 5.1.2a and 5.1.3a. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.1]

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

7.1.1.1.7.3 Test description

7.1.1.1.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.1.7.3.2 Test procedure sequence

Table 7.1.1.1.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 0A | SS transmits an RRCReconfiguration message toconfigure both 2-Step and 4-Step RA type Random Access Resources. (Note 1) | <-- | RRCReconfiguration | - | - |
| 0B | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 1 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 2 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU.(Note 3) | <-- | MAC PDU | - | - |
| 3 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 4 | Check: Does the UE transmit a MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA? | --> | MAC PDU (including C-RNTI MAC CE) | 1 | P |
| 5 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance  Command MAC Control Element) | - | - |
| 6 | SS transmits an RRCReconfiguration message toconfigure only 2-Step RA type Random Access Resources. (Note 1) | <-- | RRCReconfiguration | - | - |
| 7 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 8 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 9 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU.(Note 3) | <-- | MAC PDU | - | - |
| 10 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 11 | Check: Does the UE MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA | --> | MAC PDU (including C-RNTI MAC CE) | 2 | P |
| 12 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance  Command MAC Control Element) | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: PDCP SDU is 56 bit. | | | | | |

7.1.1.1.7.3.3 Specific message contents

Table 7.1.1.1.7.3.3-1: *RRCReconfiguration* for EN-DC (steps 0A and 6, Table 7.1.1.1.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-1A: *RRCReconfiguration* for NR/5GC (steps 0A and 6, Table 7.1.1.1.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-2: *CellGroupConfig* for EN-DC (Table 7.1.1.1.7.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| rach-ConfigDedicated | Not present |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-2A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.7.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| rach-ConfigDedicated | Not present |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-3: *ServingCellConfigCommon* (Table 7.1.1.1.7.3.3-2 and Table 7.1.1.1.7.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-4: *BWP-UplinkCommon (*Table 7.1.1.1.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  | Step 0A |
| Not present |  | Step 6 |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-5: *RACH-ConfigCommon (*Table 7.1.1.1.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-6: *MsgA-ConfigCommon* (Table 7.1.1.1.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommonL-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-7: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 SCS 30 |
| ms5 |  | FR1 SCS 15 |
| ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 SCS 30 |
| 3 |  | FR1 SCS 15 |
| 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 SCS 30 |
|  | 10 |  | FR1 SCS 15 |
| 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 SCS 30 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 SCS 30 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 SCS 30 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-8: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 57 | -100 dBm |  |

Table 7.1.1.1.7.3.3-9: *MsgA-PUSCH-Config* (Table 7.1.1.1.7.3.3-4)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B | | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-PUSCH-Config-r16 ::= SEQUENCE { |  |  |  |
| msgA-PUSCH-ResourceGroupA-r16 SEQUENCE { |  |  |  |
|  |  |  |  |
| msgA-PUSCH-TimeDomainOffset-r16 | 5 |  |  |
|  | 10 |  | FR1 SCS 30 |
| startSymbolAndLengthMsgA-PO-r16 | 27 |  |  |
| nrofPRBs-PerMsgA-PO-r16 | 4 |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.8 Correct selection of RACH parameters / 2-step RACH/MSGA and PRACH resource explicitly signalled to the UE by RRC / contention free random access procedure

7.1.1.1.8.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected }

**ensure that** {

**when** { SS sends an RRCReconfiguration message including RACH-ConfigDedicated information element and the contention-free Random Access Resources for 2-step RA type have been explicitly provided in rach-ConfigDedicated }

**then** { UE SET RA\_TYPE to 2-step AND sends a MSGA on the NR PSCell }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell received in RACH-ConfigDedicated on the target cell }

**ensure that** {

**when** { UE does not receive a matching MSGB in msgB-ResponseWindow and PREAMBLE\_TRANSMISSION\_COUNTER is less than msgA-TransMax + 1 }

**then** { UE retransmits a MSGA in RACH-ConfigDedicated on the target cell }

}

7.1.1.1.8.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.1, 5.1.2a, 5.1.3a and 5.1.4a. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.1]

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

1> if C-RNTI MAC CE was included in the MSGA:

2> monitor the PDCCH of the SpCell for Random Access Response identified by the C-RNTI while the *msgB-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in MSGA:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Random Access Response reception successful;

4> stop the *msgB-ResponseWindow*;

4> consider this Random Access procedure successfully completed.

3> else if the *timeAlignmentTimer* associated with the PTAG is running:

4> if the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

5> consider this Random Access Response reception successful;

5> stop the *msgB-ResponseWindow*;

5> consider this Random Access procedure successfully completed.

3> else:

4> if a downlink assignment has been received on the PDCCH for the C-RNTI and the received TB is successfully decoded:

5> if the MAC PDU contains the Absolute Timing Advance Command MAC CE:

6> process the received Timing Advance Command (see clause 5.2);

6> consider this Random Access Response reception successful;

6> stop the *msgB-ResponseWindow*;

6> consider this Random Access procedure successfully completed and finish the disassembly and demultiplexing of the MAC PDU.

2> if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the MSGB-RNTI and the received TB is successfully decoded:

3> if the MSGB contains a MAC subPDU with Backoff Indicator:

4> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

3> else:

4> set the *PREAMBLE\_BACKOFF* to 0 ms.

3> if the MSGB contains a fallbackRAR MAC subPDU; and

3> if the Random Access Preamble identifier in the MAC subPDU matches the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3a):

4> consider this Random Access Response reception successful;

4> apply the following actions for the SpCell:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

6> consider the Random Access procedure successfully completed;

6> process the received UL grant value and indicate it to the lower layers.

5> else:

6> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

6> if the Msg3 buffer is empty:

7> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

6> process the received UL grant value and indicate it to the lower layers and proceed with Msg3 transmission.

NOTE: If within a 2-step RA type procedure, an uplink grant provided in the fallback RAR has a different size than the MSGA payload, the UE behaviour is not defined.

3> else if the MSGB contains a successRAR MAC subPDU; and

3> if the CCCH SDU was included in the MSGA and the UE Contention Resolution Identity in the MAC subPDU matches the CCCH SDU:

4> stop *msgB-ResponseWindow*;

4> if this Random Access procedure was initiated for SI request:

5> indicate the reception of an acknowledgement for SI request to upper layers.

4> else:

5> set the C-RNTI to the value received in the *successRAR*;

5> apply the following actions for the SpCell:

6> process the received Timing Advance Command (see clause 5.2);

6> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*).

4> deliver the *TPC*, *PUCCH resource Indicator*, *ChannelAccess-CPext* (if indicated), and *HARQ feedback Timing Indicator* received in successRAR to lower layers.

4> consider this Random Access Response reception successful;

4> consider this Random Access procedure successfully completed;

4> finish the disassembly and demultiplexing of the MAC PDU.

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers;

3> if this Random Access procedure was triggered for SI request:

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

4> set the *RA\_TYPE* to *4-stepRA*;

4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

3> else:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time.

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

7.1.1.1.8.3 Test description

7.1.1.1.8.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*).

7.1.1.1.8.3.2 Test procedure sequence

Table 7.1.1.1.8.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | SS transmits an RRCReconfiguration message with reconfiguration with sync and contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated*. (Note 1) | <-- | RRCReconfiguration | - | - |
| - | Exception: Steps 2 to 3 are run *msgA-TransMax* times | - | - | - | - |
| 2 | Check: Does the UE transmit a MSGA including C-RNTI MAC CE message using the Random Access Resources for 2-step RA type explicitly provided? | --> | MAC PDU (including C-RNTI MAC CE) | 1,2 | P |
| 3 | SS does not schedulePDCCH transmission for UE C\_RNTI until *msgB-ResponseWindow* expires. | - | - | - | - |
| 4 | Check: Does the UE transmit a MSGA including C-RNTI MAC CEmessage using the Random Access Resources for 2-step RA type explicitly provided? | --> | MAC PDU (including C-RNTI MAC CE) | 2 | P |
| 5 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance  Command MAC Control Element) | - | - |
| 6 | UE transmits an RRCReconfigurationComplete message.(Note 2) | --> | RRCReconfigurationComplete | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete and sent in E-UTRA cell. RRCConnectionReconfigurationComplete could be transmitted during Step2 and Step5. | | | | | |

7.1.1.1.8.3.3 Specific message contents

Table 7.1.1.1.8.3.3-1: *RRCReconfiguration* for EN-DC (steps 1, Table 7.1.1.1.8.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-1A: *RRCReconfiguration* for NR/5GC (step 1, Table 7.1.1.1.8.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig as per TS 38.508-1[4] Table 4.6.3-132 with conditions DRBn and Recover\_PDCP | n set to the default DRB of the first PDU session | NR |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-2: *CellGroupConfig* for EN-DC (Table 7.1.1.1.8.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-2A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.8.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-3: *RACH-ConfigDedicated* (Table 7.1.1.1.8.3.3-2 and Table 7.1.1.1.8.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated ::= SEQUENCE { |  |  |  |
| cfra-TwoStep-r16 SEQUENCE { |  |  |  |
| occasionsTwoStepRA-r16 SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA |  |  |
| ssb-PerRACH-OccasionTwoStepRA-r16 | one |  |  |
| } |  |  |  |
| msgA-CFRA-PUSCH-r16 SEQUENCE { |  |  |  |
| msgA-PUSCH-TimeDomainOffset-r16 | 5 |  |  |
|  | 10 |  | FR1 SCS 30 |
| startSymbolAndLengthMsgA-PO-r16 | 27 | S=0, L=14 |  |
| msgA-TransMax-r16 | n10 |  |  |
| resourcesTwoStep-r16 SEQUENCE { |  |  |  |
| ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource { |  |  |  |
| ssb | 0 |  |  |
| ra-PreambleIndex | 52 | Randomly selected |  |
| msgA-PUSCH-Resource-Index-r16 | Not present |  |  |
| } |  |  |  |
| ra-ssb-OccasionMaskIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-4: *RACH-ConfigGeneric* (Table 7.1.1.1.8.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 14 |  | FR1 |
|  | 149 |  | FR2 |
| zeroCorrelationZoneConfig | 12 |  | FR1 |
|  | 15 |  | FR2 |
| } |  |  |  |

Table 7.1.1.1.8.3.3-5: *RACH-ConfigGenericTwoStepRA* (Table 7.1.1.1.8.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| *RACH-ConfigGenericTwoStepRA* ::= SEQUENCE { |  |  |  |
| msgA-PRACH-ConfigurationIndex-r16 | Not present |  |  |
|  | 13 |  | FR1 AND HD\_FDD |
| msgA-RO-FDM-r16 | Not present |  |  |
| msgA-RO-FrequencyStart-r16 | Not present |  |  |
| msgA-ZeroCorrelationZoneConfig-r16 | Not present |  |  |
| msgA-PreamblePowerRampingStep-r16 | Not present |  |  |
| msgA-PreambleReceivedTargetPower-r16 | Not present |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

Table 7.1.1.1.8.3.3-6: *ServingCellConfigCommon* (Table 7.1.1.1.8.3.3-2 and Table 7.1.1.1.8.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.1.8.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.1.8.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| Ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-9: *MsgA-ConfigCommon* (Table 7.1.1.1.8.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommon-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-10: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.8.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 SCS 30 |
| ms5 |  | FR1 SCS 15 |
| ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 SCS 30 |
|  | 10 |  | FR1 SCS 15 |
| 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 SCS 30 or FR1 SCS 15 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 SCS 30 or FR1 SCS 15 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-11: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.8.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 57 | -100 dBm |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-12: *Void*

##### 7.1.1.1.9 Random access procedure / Successful / 2-step RACH/C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.9.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state after NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the UL MAC PDU Size is less than ra-MsgA-SizeGroupA }

**then** { UE transmits a MSGA using a preamble in group A of random access preambles }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell }

**ensure that** {

**when** { SS does not answer with a matching MSGB within msgB-ResponseWindow }

**then** { UE retransmits a MSGA using a preamble from same group }

}

(3)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell }

**ensure that** {

**when** { SS sends a MSGB including a Backoff Indicator and the Random Access Preamble identifier is different from the value received from UE }

**then** { UE performs the Random Access Resource selection procedure for 2-step RA type Random Access after a random time between 0 and the indicated Backoff parameter from same group }

}

(4)

**with** { UE in RRC\_Connected state after NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the UL MAC PDU Size is greater than messageSizeGroupA }

**then** { UE transmits a MSGA using a preamble in group B of random access preambles }

}

(5)

**with** { UE in RRC\_Connected state and having initiated a 2-step RA type Random Access procedure in NR SpCell }

**ensure that** {

**when** { SS transmits a Timing Advance Command in a MSGB message }

**then** { UE applies the received Timing Advance value in the next transmitted MAC PDU }

}

7.1.1.1.9.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38,321, clause 5.1.2a, 5.1.3a, 5.1.4a, 5.1.5 and 5.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

1> if LBT failure indication is received from lower layers for the transmission of this MSGA Random Access Preamble:

2> instruct the physical layer to cancel the transmission of the MSGA payload on the associated PUSCH resource;

2> if *lbt-FailureRecoveryConfig* is configured:

3> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

2> else:

3> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

3> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider this Random Access procedure unsuccessfully completed.

3> if the Random Access procedure is not completed:

4> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

5> set the *RA\_TYPE* to *4-stepRA*;

5> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

5> if the Msg3 buffer is empty:

6> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

5> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

5> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

5> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

NOTE: The MSGA transmission includes the transmission of the PRACH Preamble as well as the contents of the MSGA buffer in the PUSCH resource corresponding to the selected PRACH occasion and *PREAMBLE\_INDEX* (see TS 38.213 [6])

The MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

MSGB-RNTI = 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id + 14 × 80 × 8 × 2

where s\_id is the index of the first OFDM symbol of the PRACH occasion (0 ≤ s\_id < 14), t\_id is the index of the first slot of the PRACH occasion in a system frame (0 ≤ t\_id < 80), where the subcarrier spacing to determine t\_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f\_id is the index of the PRACH occasion in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier). The RA-RNTI is calculated as specified in clause 5.1.3.

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

1> if C-RNTI MAC CE was included in the MSGA:

2> monitor the PDCCH of the SpCell for Random Access Response identified by the C-RNTI while the *msgB-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in MSGA:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Random Access Response reception successful;

4> stop the *msgB-ResponseWindow*;

4> consider this Random Access procedure successfully completed.

3> else if the *timeAlignmentTimer* associated with the PTAG is running:

4> if the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

5> consider this Random Access Response reception successful;

5> stop the *msgB-ResponseWindow*;

5> consider this Random Access procedure successfully completed.

3> else:

4> if a downlink assignment has been received on the PDCCH for the C-RNTI and the received TB is successfully decoded:

5> if the MAC PDU contains the Absolute Timing Advance Command MAC CE:

6> process the received Timing Advance Command (see clause 5.2);

6> consider this Random Access Response reception successful;

6> stop the *msgB-ResponseWindow*;

6> consider this Random Access procedure successfully completed and finish the disassembly and demultiplexing of the MAC PDU.

2> if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the MSGB-RNTI and the received TB is successfully decoded:

3> if the MSGB contains a MAC subPDU with Backoff Indicator:

4> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

3> else:

4> set the *PREAMBLE\_BACKOFF* to 0 ms.

3> if the MSGB contains a fallbackRAR MAC subPDU; and

3> if the Random Access Preamble identifier in the MAC subPDU matches the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3a):

4> consider this Random Access Response reception successful;

4> apply the following actions for the SpCell:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

6> consider the Random Access procedure successfully completed;

6> process the received UL grant value and indicate it to the lower layers.

5> else:

6> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

6> if the Msg3 buffer is empty:

7> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

6> process the received UL grant value and indicate it to the lower layers and proceed with Msg3 transmission.

NOTE: If within a 2-step RA type procedure, an uplink grant provided in the fallback RAR has a different size than the MSGA payload, the UE behaviour is not defined.

3> else if the MSGB contains a successRAR MAC subPDU; and

3> if the CCCH SDU was included in the MSGA and the UE Contention Resolution Identity in the MAC subPDU matches the CCCH SDU:

4> stop *msgB-ResponseWindow*;

4> if this Random Access procedure was initiated for SI request:

5> indicate the reception of an acknowledgement for SI request to upper layers.

4> else:

5> set the C-RNTI to the value received in the *successRAR*;

5> apply the following actions for the SpCell:

6> process the received Timing Advance Command (see clause 5.2);

6> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*).

4> deliver the *TPC*, *PUCCH resource Indicator*, *ChannelAccess-CPext* (if indicated), and *HARQ feedback Timing Indicator* received in successRAR to lower layers.

4> consider this Random Access Response reception successful;

4> consider this Random Access procedure successfully completed;

4> finish the disassembly and demultiplexing of the MAC PDU.

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers;

3> if this Random Access procedure was triggered for SI request:

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

4> set the *RA\_TYPE* to *4-stepRA*;

4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

3> else:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time.

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

5> else:

6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Random Access procedure successfully completed.

4> else:

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

1> if *ra-ContentionResolutionTimer* expires:

2> discard the *TEMPORARY\_C-RNTI*;

2> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if the *RA\_TYPE* is set to *4-stepRA*:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure (see clause 5.1.2);

4> else:

5> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

3> else (i.e. the *RA\_TYPE* is set to *2-stepRA*):

4> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

5> set the *RA\_TYPE* to *4-stepRA*;

5> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

5> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

5> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

5> perform the Random Access Resource selection as specified in clause 5.1.2.

4> else:

5> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

5> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

6> perform the Random Access Resource selection procedure for 2-step RA type as specified in clause 5.1.2a.

5> else:

6> perform the Random Access Resource selection for 2-step RA type procedure (see clause 5.1.2a) after the backoff time.

[TS 38.321, clause 5.2]

RRC configures the following parameters for the maintenance of UL time alignment:

- *timeAlignmentTimer* (per TAG) which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned.

The MAC entity shall:

1> when a Timing Advance Command MAC CE is received, and if an NTA (as defined in TS 38.211 [8]) has been maintained with the indicated TAG:

2> apply the Timing Advance Command for the indicated TAG;

2> start or restart the *timeAlignmentTimer* associated with the indicated TAG.

1> when a Timing Advance Command is received in a Random Access Response message for a Serving Cell belonging to a TAG or in a MSGB for an SpCell:

2> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble:

3> apply the Timing Advance Command for this TAG;

3> start or restart the *timeAlignmentTimer* associated with this TAG.

2> else if the *timeAlignmentTimer* associated with this TAG is not running:

3> apply the Timing Advance Command for this TAG;

3> start the *timeAlignmentTimer* associated with this TAG;

3> when the Contention Resolution is considered not successful as described in clause 5.1.5; or

3> when the Contention Resolution is considered successful for SI request as described in clause 5.1.5, after transmitting HARQ feedback for MAC PDU including UE Contention Resolution Identity MAC CE:

4> stop *timeAlignmentTimer* associated with this TAG.

2> else:

3> ignore the received Timing Advance Command.

1> when an Absolute Timing Advance Command is received in response to a MSGA transmission including C-RNTI MAC CE as specified in clause 5.1.4a:

2> apply the Timing Advance Command for PTAG;

2> start or restart the *timeAlignmentTimer* associated with PTAG.

1> when a *timeAlignmentTimer* expires:

2> if the *timeAlignmentTimer* is associated with the PTAG:

3> flush all HARQ buffers for all Serving Cells;

3> notify RRC to release PUCCH for all Serving Cells, if configured;

3> notify RRC to release SRS for all Serving Cells, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> consider all running *timeAlignmentTimer*s as expired;

3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.

2> else if the *timeAlignmentTimer* is associated with an STAG, then for all Serving Cells belonging to this TAG:

3> flush all HARQ buffers;

3> notify RRC to release PUCCH, if configured;

3> notify RRC to release SRS, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> maintain NTA (defined in TS 38.211 [8]) of this TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell except the Random Access Preamble and MSGA transmission when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the PTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble and MSGA transmission on the SpCell.

7.1.1.1.9.3 Test description

7.1.1.1.9.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.1.9.3.2 Test procedure sequence

Table 7.1.1.1.9.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Step 1 is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 1 | The SS transmits an updated system information as specified in Table 7.1.1.1.9.3.3-2. | - | - | - | - |
| 2 | SS transmits an RRCReconfiguration message toconfigure 2-Step and RA type Random Access Resources. (Note 1) | <-- | RRCReconfiguration | - | - |
| 3 | The UE transmits RRCReconfigurationComplete message. (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 4 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC CE) | - | - |
| 5 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU of size 56 bits, less than *ra-MsgA-SizeGroupA* (208 bits) on SpCell. (Note 3) | <-- | MAC PDU | - | - |
| 6 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 7 | Check: Does the UE transmit MSGA using preamble on PRACH in group A? | --> | MAC PDU (including C-RNTI MAC CE) | 1 | P |
| 8 | Check: Does the UE re-transmit MSGA using a preamble on PRACH in the same group A after expiry of *msgB-ResponseWindow*? | --> | MAC PDU (including C-RNTI MAC CE) | 2 | P |
| 9 | The SS transmits a MSGB with the Backoff parameter set to value Index field '12' and with the RAPID different from the value received from the UE.  The SS sets Timer\_T2 to the Backoff value ‘960’ associated with the Index value ‘12’ and starts Timer\_T2. | <-- | MAC PDU(BI, RAPID) | - | - |
| 10 | Check: Does UE transmit MSGA using preamble on PRACH in group A while Timer\_T2 is running? | --> | MAC PDU (including C-RNTI MAC CE) | 3 | P |
| 11 | The SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance Command MAC CE) | - | - |
| 12 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T3 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC CE) | - | - |
| 13 | 40 to 50 TTI before Timer\_T3 expires the SS transmits a MAC PDU containing a PDCP SDU of size 256 bits, more than *ra-MsgA-SizeGroupA* (208 bits) on SpCell. (Note 4) | <-- | MAC PDU | - | - |
| 14 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 15 | Check: Does the UE transmit MSGA using preamble on PRACH in group B? | --> | MAC PDU (including C-RNTI MAC CE) | 4 | P |
| 16 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Timing Advance Command MAC CE. | <-- | MAC PDU(Timing Advance  Command MAC CE) | - | - |
| 17 | The SS is configured to allocate normal uplink grant. | - | - | - | - |
| 18 | SS transmits a MAC PDU containing a PDCP SDU | <-- | MAC PDU | - | - |
| 19 | Check: Does the UE transmit a MAC PDU looped back PDCP SDU using the new Timing Advance value? | --> | MAC PDU | 5 | P |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: MAC PDU size of 56bits is selected to allow UE send status PDU and stays below the limit of ra-MsgA-SizeGroupA.  Note 4: MAC PDU size of 256bits is selected to allow UE send status PDU and stays above the limit of ra-MsgA-SizeGroupA. | | | | | |

7.1.1.1.9.3.3 Specific message contents

Table 7.1.1.1.9.3.3-1: *MAC-CellGroupConfig* (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| tag-Config SEQUENCE { |  |  |  |
| tag-ToAddModList SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG { | 1 entry |  |  |
| TAG[1] SEQUENCE { |  | entry 1 |  |
| timeAlignmentTimer | ms750 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-2: *SIB1* (steps 1 and 12, Table 7.1.1.1.9.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-3: *ServingCellConfigCommon* (Table 7.1.1.1.9.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-4: *BWP-UplinkCommon* (Table 7.1.1.1.9.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon-r16 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-5: *MsgA-ConfigCommon-r16* (Table 7.1.1.1.9.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommon-r16 :: = SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA-r16 |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config-r16 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-6: *RACH-ConfigCommonTwoStepRA-r16* (Table 7.1.1.1.9.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA-r16 |  |  |
| msgA-TotalNumberOfRA-Preambles-r16 | 16 |  |  |
| msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB-r16 CHOICE { |  |  |  |
| two | n4 |  |  |
| } |  |  |  |
| groupB-ConfiguredTwoStepRA-r16 | GroupB-ConfiguredTwoStepRA-r16 |  |  |
| msgA-PRACH-RootSequenceIndex-r16 CHOICE { |  |  |  |
| l839 | 100 |  |  |
| } |  |  |  |
| msgA-TransMax-r16 | n4 |  |  |
| msgA-RSRP-ThresholdSSB-r16 | 56 |  |  |
| msgA-RestrictedSetConfig-r16 | unrestrictedSet |  |  |
| ra-PrioritizationForAccessIdentityTwoStep-r16 SEQUENCE { |  |  |  |
| ra-Prioritization-r16 | RA-Prioritization | TS 38.508-1 [4], Table 4.6.3-131 |  |
| ra-PrioritizationForAI-r16 | ‘00’B |  |  |
| } |  |  |  |
| ra-ContentionResolutionTimer-r16 | sf32 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-7: *RACH-ConfigGenericTwoStepRA-r16* (Table 7.1.1.1.9.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGenericTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-PRACH-ConfigurationIndex-r16 | 0 |  |  |
| msgA-RO-FDM-r16 | one |  |  |
| msgA-RO-FrequencyStart-r16 | 0 |  |  |
| msgA-ZeroCorrelationZoneConfig-r16 | 0 |  |  |
| msgA-PreamblePowerRampingStep-r16 | dB2 |  |  |
| msgA-PreambleReceivedTargetPower-r16 | -200 |  |  |
| msgB-ResponseWindow-r16 | sl80 |  |  |
| preambleTransMax-r16 | n4 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-8: *GroupB-ConfiguredTwoStepRA-r16* (Table 7.1.1.1.9.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| GroupB-ConfiguredTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| ra-MsgA-SizeGroupA | b208 |  |  |
| messagePowerOffsetGroupB | minusinfinity |  |  |
| numberOfRA-PreamblesGroupA | 8 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-9: *MsgA-PUSCH-Config-r16* (Table 7.1.1.1.9.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-PUSCH-Config-r16 ::= SEQUENCE { |  |  |  |
| msgA-PUSCH-ResourceGroupA-r16 | MsgA-PUSCH-Resource-r16 |  |  |
| msgA-PUSCH-ResourceGroupB-r16 | MsgA-PUSCH-Resource-r16 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-10: *MsgA-PUSCH-Resource-r16* (Table 7.1.1.1.9.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6] ,clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-PUSCH-Resource-r16 ::= SEQUENCE { |  |  |  |
| msgA-MCS-r16 | 0 |  |  |
| nrofSlotsMsgA-PUSCH-r16 | 1 |  |  |
| nrofMsgA-PO-PerSlot-r16 | one |  |  |
| msgA-PUSCH-TimeDomainOffset-r16 | 1 |  |  |
| guardBandMsgA-PUSCH-r16 | 0 |  |  |
| frequencyStartMsgA-PUSCH-r16 | 0 |  |  |
| nrofPRBs-PerMsgA-PO-r16 | 24 |  |  |
| nrofMsgA-PO-FDM-r16 | one |  |  |
| msgA-DMRS-Config-r16 | MsgA-DMRS-Config-r16 |  |  |
| nrofDMRS-Sequences-r16 | 1 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-11: *MsgA-DMRS-Config-r16* (Table 7.1.1.1.9.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-DMRS-Config-r16 ::= SEQUENCE { |  |  |  |
| msgA-DMRS-AdditionalPosition-r16 | pos0 |  |  |
| msgA-MaxLength-r16 | len2 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-12: *RRCReconfiguration* (steps 2 and 13, Table 7.1.1.1.9.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-13: *CellGroupConfig* (Table 7.1.1.1.9.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.1.9.3.3-3 |  |
| newUE-Identity | RNTI-Value |  |  |
| t304 | ms2000 |  |  |
| rach-ConfigDedicated | Not present |  |  |
| } |  |  |  |

##### 7.1.1.1.9a Random access procedure / 2-step RACH / Successful / RRC\_IDLE

7.1.1.1.9a.1 Test Purpose (TP)

(1)

**with** { UE in RRC Idle state and 2-step RA type Random Access resources is configured }

**ensure that** {

**when** { UE has UL CCCH PDU to send }

**then** { UE transmits a MSGA }

}

(2)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSGA }

**ensure that** {

**when** { SS does not answer with a MSGB containing a matching successRAR within msgB-ResponseWindow }

**then** { UE retransmits a MSGA }

}

(3)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSGA }

**ensure that** {

**when** { SS answers with a MSGB containing a matching successRAR within msgB-ResponseWindow }

**then** { UE assumes RACH procedure as complete }

}

7.1.1.1.9a.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.1, 5.1.2a, 5.1.3a and 5.1.4a. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.1]

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

…

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

…

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

*…*

3> else if the MSGB contains a successRAR MAC subPDU; and

3> if the CCCH SDU was included in the MSGA and the UE Contention Resolution Identity in the MAC subPDU matches the CCCH SDU:

4> stop *msgB-ResponseWindow*;

4> if this Random Access procedure was initiated for SI request:

5> indicate the reception of an acknowledgement for SI request to upper layers.

4> else:

5> set the C-RNTI to the value received in the *successRAR*;

5> apply the following actions for the SpCell:

6> process the received Timing Advance Command (see clause 5.2);

6> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*).

4> deliver the *TPC*, *PUCCH resource Indicator*, *ChannelAccess-CPext* (if indicated), and *HARQ feedback Timing Indicator* received in successRAR to lower layers.

4> consider this Random Access Response reception successful;

4> consider this Random Access procedure successfully completed;

4> finish the disassembly and demultiplexing of the MAC PDU.

…

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

7.1.1.1.9a.3 Test description

7.1.1.1.9a.3.1 Pre-test conditions

System Simulator:

- The SS configures the test environment in accordance to the execution conditions in Table 7.1.1.0-1.

UE:

- None

Preamble:

- The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.

7.1.1.1.9a.3.2 Test procedure sequence

Table 7.1.1.1.9a.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmit MSGA? | --> | MAC PDU (*RRCSetupRequest*) | 1 | P |
| 3 | Check: Does the UE re-transmit MSGA after expiry of *msgB-ResponseWindow*? | --> | MAC PDU (*RRCSetupRequest*) | 2 | P |
| 4 | The SS transmits a MSGB including a successRAR MAC subPDU containing matching Contention Resolution Identity . | <-- | MAC PDU(successRAR, *RRCSetup*) | - | - |
| 5 | Check: Does UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message? | --> | MAC PDU (*RRCSetupComplete)* | 3 | P |

7.1.1.1.9a.3.3 Specific message contents

Table 7.1.1.1.9a.3.3-1: *SIB1 (*Preamble, Table 7.1.1.1.9a.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9a.3.3-2: *BWP-UplinkCommon (*Table 7.1.1.1.9a.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9a.3.3-3: *MsgA-ConfigCommon* (Table 7.1.1.1.9a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommonL-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.9a.3.3-4: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.9a.3.3-3)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA-r16 |  |  |
| } |  |  |  |

Table 7.1.1.1.9a.3.3-5: *RACH-ConfigGenericTwoStepRA-r16* (Table 7.1.1.1.9a.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGenericTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgB-ResponseWindow-r16 | sl40 |  |  |
| } |  |  |  |

##### 7.1.1.1.10 Random access procedure / 2-step RACH/not complete/ RA\_TYPE to 4-stepRA

7.1.1.1.10.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell }

**ensure that** {

**when** { UE does not receive a matching MSGB in msgB-ResponseWindow and PREAMBLE\_TRANSMISSION\_COUNTER is equal to msgA-TransMax+1 }

**then** { UE triggers 4-step RACH procedure on NR SpCell }

}

7.1.1.1.10.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.1.1, and 5.1.4a.

[TS 38.321, clause5.1.1]

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

…

1> if the Random Access procedure is initiated by PDCCH order and if the *ra-PreambleIndex* explicitly provided by PDCCH is not 0b000000; or

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]) and the Random Access Resources for SI request have been explicitly provided by RRC; or

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

…

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers;

3> if this Random Access procedure was triggered for SI request:

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

4> set the *RA\_TYPE* to *4-stepRA*;

4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

3> else:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time.

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

7.1.1.1.10.3 Test description

7.1.1.1.10.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.1.10.3.2 Test procedure sequence

Table 7.1.1.1.10.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | SS transmits an RRCReconfiguration message toconfigure both 2-Step and 4-Step RA type Random Access Resources. Note 1 | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 3 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 4 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU | <-- | MAC PDU | - | - |
| 5 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| - | Exception: Step 6 will be repeated preambleTransMax times and SS does not response the MSGA in STEP 6, to make PREAMBLE\_TRANSMISSION\_COUNTER = msgA-TransMax+1. | - | - | - | - |
| 6 | The UE transmits MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA | --> | MAC PDU (including C-RNTI MAC CE) | - | - |
| 7 | Check: Does the UE transmit preamble on PRACH? | --> | PRACH Preamble | 1 | P |
| 8 | The SS transmits Random Access Response and RAPID corresponding to the transmitted Preamble in step 7. | <-- | Random Access Response | - | - |
| 9 | UE sends a msg3 using the grant associated to the Random Access Response received in step 8 | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 10 | SS schedules PDCCH transmission for UE C\_RNTI and allocate uplink grant. | <-- | Contention Resolution | - | - |
| 11 | The UE transmits a MAC PDU with C-RNTI containing looped back PDCP SDU | --> | MAC PDU | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.1.10.3.3 Specific message contents

Table 7.1.1.1.10.3.3-1: *RRCReconfiguration* for EN-DC (step 1, Table 7.1.1.1.10.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-1A: *RRCReconfiguration* for NR/5GC (step 1, Table 7.1.1.1.10.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-2: *CellGroupConfig* for EN-DC (Table 7.1.1.1.10.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-2A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.10.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-3: *RACH-ConfigDedicated* (Table 7.1.1.1.10.3.3-2 and Table 7.1.1.1.10.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 with condition 2-step RA | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated ::= SEQUENCE { |  |  |  |
| cfra-TwoStep-r16 SEQUENCE { |  |  |  |
| occasionsTwoStepRA-r16 SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-4: *Void*

Table 7.1.1.1.10.3.3-5: *RACH-ConfigGenericTwoStepRA* (Table 7.1.1.1.10.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGenericTwoStepRA ::= SEQUENCE { |  |  |  |
| msgA-PRACH-ConfigurationIndex-r16 | Not present |  |  |
| msgA-RO-FDM-r16 | Not present |  |  |
| msgA-RO-FrequencyStart-r16 | Not present |  |  |
| msgA-ZeroCorrelationZoneConfig-r16 | Not present |  |  |
| msgA-PreamblePowerRampingStep-r16 | Not present |  |  |
| msgA-PreambleReceivedTargetPower-r16 | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-6: *ServingCellConfigCommon* (Table 7.1.1.1.10.3.3-2 and Table 7.1.1.1.10.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.1.10.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.1.10.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-9: *MsgA-ConfigCommon* (Table 7.1.1.1.10.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommon-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-10: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.10.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 SCS 30 |
| ms5 |  | FR1 SCS 15 |
| ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 SCS 30 |
|  | 10 |  | FR1 SCS 15 |
| 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 SCS 30 or FR1 SCS 15 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 SCS 30 or FR1 SCS 15 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-11: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.10.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 57 | -100 dBm |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-12:Void

##### 7.1.1.1.10a Random access procedure / 2-step RACH/ Fallback for CBRA

7.1.1.1.10a.1 Test Purpose (TP)

(1)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSGA }

**ensure that** {

**when** { SS answers with a matching MSGB including fallbackRAR within msgB-ResponseWindow }

**then** { UE transmits a MSG3 using the UL grant scheduled in the fallbackRAR }

}

(2)

**with** { UE received a MSGB including fallbackRAR within msgB-ResponseWindow, and transmitted a MSG3 using the UL grant scheduled in the fallbackRAR }

**ensure that** {

**when** { The SS does not schedule any PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry }

**then** { UE retransmits a MSGA }

}

(3)

**with** { UE received a MSGB including fallbackRAR within msgB-ResponseWindow, and transmitted a MSG3 using the UL grant scheduled in the fallbackRAR }

**ensure that** {

**when** { The SS schedules a PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry }

**then** { UE assumes RACH procedure as complete }

}

7.1.1.1.10a.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.4a and 5.1.5, and TS38.300, clause 9.2.6. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

1> if C-RNTI MAC CE was included in the MSGA:

2> monitor the PDCCH of the SpCell for Random Access Response identified by the C-RNTI while the *msgB-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

…

2> if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the MSGB-RNTI and the received TB is successfully decoded:

3> if the MSGB contains a MAC subPDU with Backoff Indicator:

4> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

3> else:

4> set the *PREAMBLE\_BACKOFF* to 0 ms.

3> if the MSGB contains a fallbackRAR MAC subPDU; and

3> if the Random Access Preamble identifier in the MAC subPDU matches the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3a):

4> consider this Random Access Response reception successful;

4> apply the following actions for the SpCell:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

6> consider the Random Access procedure successfully completed;

6> process the received UL grant value and indicate it to the lower layers.

5> else:

6> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

6> if the Msg3 buffer is empty:

7> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

6> process the received UL grant value and indicate it to the lower layers and proceed with Msg3 transmission.

…

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted the MAC entity shall:

1> if Msg3 is transmitted on a non-terrestrial network:

2> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission plus the UE estimate of UE-gNB RTT.

1> else if the Msg3 transmission (i.e. initial transmission or HARQ retransmission) is scheduled with Type A PUSCH repetition:

2> start or restart the *ra-ContentionResolutionTimer* in the first symbol after the end of all repetitions of the Msg3 transmission.

…

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

…

2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

5> else:

6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Random Access procedure successfully completed.

4> else:

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

1> if *ra-ContentionResolutionTimer* expires:

2> if Msg3 is transmitted on a non-terrestrial network and *ra-ContentionResolutionTimer* expires prior to the first symbol after the end of a Msg3 retransmission plus the UE estimate of UE-gNB RTT:

3> do not consider the Contention Resolution unsuccessful.

2> else:

3> discard the *TEMPORARY\_C-RNTI*;

3> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if the *RA\_TYPE* is set to *4-stepRA*:

…

3> else (i.e. the *RA\_TYPE* is set to *2-stepRA*):

4> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

5> set the *RA\_TYPE* to *4-stepRA*;

5> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

5> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

5> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

5> perform the Random Access Resource selection as specified in clause 5.1.2.

4> else:

5> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

5> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

6> perform the Random Access Resource selection procedure for 2-step RA type as specified in clause 5.1.2a.

5> else:

6> perform the Random Access Resource selection for 2-step RA type procedure (see clause 5.1.2a) after the backoff time.

[TS 38.321, clause 6.2.3.a]

The fallbackRAR is of fixed size as depicted in Figure 6.2.3a-1, and consists of the following fields:

- R: Reserved bit, set to 0;

- Timing Advance Command: The Timing Advance Command field indicates the index value *TA* used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6]. The size of the Timing Advance Command field is 12 bits;

- UL Grant: The Uplink Grant field indicates the resources to be used on the uplink in TS 38.213 [6]. The size of the UL Grant field is 27 bits;

- Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access. The size of the Temporary C-RNTI field is 16 bits.

The fallbackRAR is octet aligned.



Figure 6.2.3a-1: fallbackRAR

…

[TS 38.300, clause 9.2.6]

…

The MSGA of the 2-step RA type includes a preamble on PRACH and a payload on PUSCH. After MSGA transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble and PUSCH resource are configured for MSGA transmission and upon receiving the network response, the UE ends the random access procedure as shown in Figure 9.2.6-1(d). For CBRA, if contention resolution is successful upon receiving the network response, the UE ends the random access procedure as shown in Figure 9.2.6-1(b); while if fallback indication is received in MSGB, the UE performs MSG3 transmission using the UL grant scheduled in the fallback indication and monitors contention resolution as shown in Figure 9.2.6-2. If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSGA transmission.

…



Figure 9.2.6-2: Fallback for CBRA with 2-step RA type

…

7.1.1.1.10a.3 Test description

7.1.1.1.10a.3.1 Pre-test conditions

System Simulator:

- The SS configures the test environment in accordance to the execution conditions in Table 7.1.1.0-1.

UE:

- None

Preamble:

- The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.

7.1.1.1.10a.3.2 Test procedure sequence

Table 7.1.1.1.10a.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | The UE transmit MSGA. | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 3 | The SS transmits a MSGB DL MAC PDU containing a fallbackRAR. | <-- | MAC PDU(fallbackRAR) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including RRCSetupRequest message using the grant associated to fallbackRAR MAC subPDU received in step 3? | --> | MAC PDU (*RRCSetupRequest*)` | 1 | P |
| 5 | Before the contention resolution timer expires, the SS does not schedule any PDCCH. | - | - | - | - |
| 6 | Check: Does the UE transmit MSGA? | --> | MAC PDU (*RRCSetupRequest*) | 2 | P |
| 7 | The SS transmits a MSGB DL MAC PDU containing a fallbackRAR. | <-- | MAC PDU(fallbackRAR) | - | - |
| 8 | Check: Does the UE transmit a MAC PDU including RRCSetupRequest message using the grant associated to fallbackRAR MAC subPDU received in step 7? | --> | MAC PDU (*RRCSetupRequest*)` | 1 | P |
| 9 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (UE Contention Resolution Identity MAC CE, *RRCSetup*) | - | - |
| 10 | Check: Does UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message? | --> | MAC PDU (*RRCSetupComplete)* | 3 | P |

7.1.1.1.10a.3.3 Specific message contents

Table 7.1.1.1.10a.3.3-1: *SIB1 (*Preamble, Table 7.1.1.1.10a.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10a.3.3-2: *BWP-UplinkCommon (*Table 7.1.1.1.10a.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10a.3.3-3: *RACH-ConfigCommon (*Table 7.1.1.1.10a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10a.3.3-4: *MsgA-ConfigCommon* (Table 7.1.1.1.10a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommonL-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.10a.3.3-5: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.10a.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 57 | -100 dBm |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA-r16 |  |  |
| } |  |  |  |

Table 7.1.1.1.10a.3.3-5A: *RACH-ConfigGenericTwoStepRA-r16* (Table 7.1.1.1.9a.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGenericTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgB-ResponseWindow-r16 | sl40 |  |  |
| } |  |  |  |

Table 7.1.1.1.10a.3.3-6: *MsgA-PUSCH-Config* (Table 7.1.1.1.10a.3.3-5)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B |

##### 7.1.1.1.11 Random access procedure / Successful/ Slice specific RACH configuration

7.1.1.1.11.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_IDLE state and starts Random Access procedure}

**ensure that** {

**when** { SS configures NSAG indicator and associated set of preambles in FeatureCombinationPreambles in SIB1}

**then** { UE transmits a random access preamble using the slice specific random access resource}

}

7.1.1.1.11.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clauses 5.1.1a, 5.1.1c, 5.1.1d, 5.1.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1a]

The MAC entity shall:

1. if *RA\_TYPE* is set to *2-stepRA*:

…

1> else (i.e. *RA\_TYPE* is set to *4-stepRA*):

2> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *powerRampingStep*;

2> set *SCALING\_FACTOR\_BI* to 1;

2> set *preambleTransMax* to *preambleTransMax* included in the *RACH-ConfigGeneric*;

…

2> else if *ra-PrioritizationForSlicing* for a NSAG identity is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with this NSAG identity:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicing* for this NSAG identity:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicing* for this NSAG identity:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForAccessIdentity* is configured for the selected carrier; and

[TS 38.321, clause 5.1.1c]

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if RedCap indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a Random Access procedure for which RedCap indication is not applicable.

1> if SDT indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure which is not triggered for SDT.

1> if NSAG indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure unless it is triggered for the corresponding NSAG indication.

1> if MSG3 repetition indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure if MSG3 repetition is not applicable.

1> if a set of Random Access resources is not configured with any of the RedCap or SDT or NSAG(s) or MSG3 repetition indications:

2> consider the set of Random Access resources to not associated with any feature indication.

[TS 38.321, clause 5.1.1d]

The MAC entity shall:

1> among the available sets of Random Access resources for this Random Access procedure (as specified in clause 5.1.1c), identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].

1> if a single set of Random Access resources is identified:

2> select this set of Random Access resources.

1> else if more than one set of Random Access resources is identified:

2> repeat the procedure taking as an input the identified sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

1> else (i.e. no set of Random Access resources is identified):

2> repeat the procedure taking as an input the previous identified available sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

[TS 38.321, clause 5.1.2]

If the selected *RA\_TYPE* is set to *4-stepRA*, the MAC entity shall:

…

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if the *RA\_TYPE* is switched from *2-stepRA* to *4-stepRA*:

3> if a Random Access Preambles group was selected during the current Random Access procedure:

4> select the same group of Random Access Preambles as was selected for the 2-step RA type.

3> else:

4> if Random Access Preambles group B is configured; and

4> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

2> else if Msg3 buffer is empty:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC subheader(s) and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

7.1.1.1.11.3 Test description

7.1.1.1.11.3.1 Pre-test conditions

The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.. The NSAG identifier transmitted in SIB1 is same as the NSAG identifier provided to the UE in Registration Accept message.

7.1.1.1.11.3.2 Test procedure sequence

Table 7.1.1.1.11.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmits a preamble on PRACH using a preamble in the FeatureCombinationPreambles configured for NSAG? | --> | PRACH Preamble | 1 | P |
| 3 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 2, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - |  |
| 4 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 5 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 6 | The UE transmits a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message. | --> | MAC PDU (*RRCSetupComplete)* | - | - |

7.1.1.1.11.3.3 Specific message contents

Table 7.1.1.1.11.3.3-1: SIB 1 (preamble and all steps, Table 7.1.1.1.11.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Table 7.1.1.1.11.3.3-2 |  |
| } |  |  |  |

Table 7.1.1.1.11.3.3-2: ServingCellConfigCommon (7.1.1.1.11.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon | Table 7.1.1.1.11.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.11.3.3-3: BWP-UplinkCommon(Table 7.1.1.1.11.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| AdditionalRACH-ConfigList-r17 SEQUENCE { |  |  |  |
| AdditionalRACH-Config-r17 SEQUENCE { |  |  |  |
| rach-ConfigCommon-r17 | RACH-ConfigCommon | Table 7.1.1.1.11.3.3-4 |  |
| ) |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.11.3.3-4: RACH-ConfigCommon *(*Table 7.1.1.1.11.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| featureCombinationPreamblesList-r17 SEQUENCE { |  |  |  |
| FeatureCombinationPreambles-r17 | FeatureCombinationPreambles | Table 7.1.1.1.11.3.3-5 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.11.3.3-5: FeatureCombinationPreambles(Table 7.1.1.1.11.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-56E | | | |
| Information Element | Value/remark | Comment | Condition |
| FeatureCombinationPreambles-r17 ::= SEQUENCE { |  |  |  |
| featureCombination-r17 ::= SEQUENCE { |  |  |  |
| nsag-r17::= SEQUENCE { |  |  |  |
| nsag-r17[0] | ‘0000 0001’B |  |  |
| } |  |  |  |
| } |  |  |  |
| startPreambleForThisPartition-r17 | 8 | Randomly selected |  |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 12 |  |  |
| ssb-SharedRO-MaskIndex-r17 | Not present |  |  |
| groupBconfigured-r17 | Not present |  |  |
| separateMsgA-PUSCH-Config-r17 | Not present |  |  |
| msgA-RSRP-Threshold-r17 | Not present |  |  |
| rsrp-ThresholdSSB-r17 | Not present |  |  |
| deltaPreamble-r17 | Not present |  |  |
| } |  |  |  |

##### 7.1.1.1.12 Random access procedure / Successful/ ra-PrioritizationForSlicing

7.1.1.1.12.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_IDLE state and starts Random Access procedure}

**ensure that** {

**when** { SS configures both ra-PrioritizationForSlicing for a NSAG identity and ra-PrioritizationForAccessIdentity in SIB1 and set enableRA-PrioritizationForSlicing to TRUE}

**then** { UE uses powerRampingStepHighPriority and scalingFactorBI configured in the ra-PrioritizationForSlicing for Random Access procedure }

}

(2)

**with** { UE in NR RRC\_IDLE state after transmission of a PRACH preamble on NR SpCell and SS configured scalingFactorBI in ra-PrioritizationForSlicing for a NSAG identity in SIB1 }

**ensure that** {

**when** { SS sends a Random Access Response including a Backoff Indicator with the Random Access Preamble identifier different from the value received from the UE}

**then** { UE triggers RA preamble after a random time between 0 and the indicated Backoff parameter multiplied with scalingFactorBI configured in the ra-PrioritizationForSlicing }

}

7.1.1.1.12.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clauses 5.1.1a, 5.1.1c, 5.1.1d, 5.1.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1a]

The MAC entity shall:

1. if *RA\_TYPE* is set to *2-stepRA*:

…

1> else (i.e. *RA\_TYPE* is set to *4-stepRA*):

2> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *powerRampingStep*;

2> set *SCALING\_FACTOR\_BI* to 1;

2> set *preambleTransMax* to *preambleTransMax* included in the *RACH-ConfigGeneric*;

…

2> if the MAC entity is provided by upper layers with both this NSAG identity and Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *enableRA-PrioritizationForSlicing* is set to *true*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicing* for this NSAG identity:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicing* for this NSAG identity:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

3> else if *enableRA-PrioritizationForSlicing* is set to *false*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentity*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentity*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForSlicing* for a NSAG identity is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with this NSAG identity:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicing* for this NSAG identity:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicing* for this NSAG identity:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForAccessIdentity* is configured for the selected carrier; and

[TS 38.321, clause 5.1.1c]

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if RedCap indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a Random Access procedure for which RedCap indication is not applicable.

1> if SDT indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure which is not triggered for SDT.

1> if NSAG indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure unless it is triggered for the corresponding NSAG indication.

1> if MSG3 repetition indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure if MSG3 repetition is not applicable.

1> if a set of Random Access resources is not configured with any of the RedCap or SDT or NSAG(s) or MSG3 repetition indications:

2> consider the set of Random Access resources to not associated with any feature indication.

[TS 38.321, clause 5.1.1d]

The MAC entity shall:

1> among the available sets of Random Access resources for this Random Access procedure (as specified in clause 5.1.1c), identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].

1> if a single set of Random Access resources is identified:

2> select this set of Random Access resources.

1> else if more than one set of Random Access resources is identified:

2> repeat the procedure taking as an input the identified sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

1> else (i.e. no set of Random Access resources is identified):

2> repeat the procedure taking as an input the previous identified available sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

[TS 38.321, clause 5.1.2]

If the selected *RA\_TYPE* is set to *4-stepRA*, the MAC entity shall:

…

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if the *RA\_TYPE* is switched from *2-stepRA* to *4-stepRA*:

3> if a Random Access Preambles group was selected during the current Random Access procedure:

4> select the same group of Random Access Preambles as was selected for the 2-step RA type.

3> else:

4> if Random Access Preambles group B is configured; and

4> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

2> else if Msg3 buffer is empty:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC subheader(s) and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

7.1.1.1.12.3 Test description

7.1.1.1.12.3.1 Pre-test conditions

The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.. The NSAG identifier transmitted in SIB1 is same as the NSAG identifier provided to the UE in Registration Accept message. The UE is assigned the MPS indicator bit of the 5GS network feature support IE to "Access identity 1 valid", in the REGISTRATION ACCEPT message.

7.1.1.1.12.3.2 Test procedure sequence

Table 7.1.1.1.12.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmits a preamble on PRACH using a preamble in the FeatureCombinationPreambles configured for NSAG? | --> | PRACH Preamble | 1 | P |
| 3 | The SS transmits Random Access Response with RAPID not corresponding to the transmitted Preamble in step 2, including TC-RNTI and including Back off Indicator subheader. | <-- | Random Access Response | - |  |
| 4 | Check: Does the UE transmits a preamble on PRACH using a preamble in the FeatureCombinationPreambles configured for NSAG? Note 1 | --> | PRACH Preamble | 2 | P |
| 5 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 4, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - |  |
| 6 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 7 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 8 | The UE transmits a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message. | --> | MAC PDU (*RRCSetupComplete)* | - | - |
| Note 1: The Step 4 occurs after random time between 0 and the step 3 Backoff indicator multiplied with scalingFactorBI configured in the ra-PrioritizationForSlicing for NSAG. | | | | | |

7.1.1.1.12.3.3 Specific message contents

Table 7.1.1.1.12.3.3-1: SIB 1 (preamble and all steps, Table 7.1.1.1.12.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Table 7.1.1.1.12.3.3-2 |  |
| } |  |  |  |

Table 7.1.1.1.12.3.3-2: ServingCellConfigCommon (7.1.1.1.12.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon | Table 7.1.1.1.12.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.12.3.3-3: BWP-UplinkCommon(Table 7.1.1.1.12.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| enableRA-PrioritizationForSlicing | true |  |  |
| AdditionalRACH-ConfigList-r17 SEQUENCE { |  |  |  |
| AdditionalRACH-Config-r17 SEQUENCE { |  |  |  |
| rach-ConfigCommon-r17 | RACH-ConfigCommon | Table 7.1.1.1.12.3.3-4 |  |
| ) |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.12.3.3-4: RACH-ConfigCommon *(*Table 7.1.1.1.12.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| ra-PrioritizationForAccessIdentity-r16 SEQUENCE { |  |  |  |
| ra-Prioritization-r16 | RA-Prioritization With condition AI\_RACH |  |  |
| ra-PrioritizationForAI-r16 | '10'B |  |  |
| } |  |  |  |
| ra-PrioritizationForSlicing-r17 | *RA-PrioritizationForSlicing* | Table 7.1.1.1.12.3.3-6 |  |
| featureCombinationPreamblesList-r17 SEQUENCE { |  |  |  |
| FeatureCombinationPreambles-r17 | FeatureCombinationPreambles | Table 7.1.1.1.12.3.3-5 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.12.3.3-5: FeatureCombinationPreambles(Table 7.1.1.1.12.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-56E | | | |
| Information Element | Value/remark | Comment | Condition |
| FeatureCombinationPreambles-r17 ::= SEQUENCE { |  |  |  |
| featureCombination-r17 ::= SEQUENCE { |  |  |  |
| nsag-r17::= SEQUENCE { |  |  |  |
| nsag-r17[0] | ‘0000 0001’B |  |  |
| } |  |  |  |
| } |  |  |  |
| startPreambleForThisPartition-r17 | 8 | Randomly selected |  |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 12 |  |  |
| ssb-SharedRO-MaskIndex-r17 | Not present |  |  |
| groupBconfigured-r17 | Not present |  |  |
| separateMsgA-PUSCH-Config-r17 | Not present |  |  |
| msgA-RSRP-Threshold-r17 | Not present |  |  |
| rsrp-ThresholdSSB-r17 | Not present |  |  |
| deltaPreamble-r17 | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.12.3.3-6: *RA-PrioritizationForSlicing* (Table 7.1.1.1.12.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| RA-PrioritizationForSlicing-r17::= SEQUENCE { |  |  |  |
| ra-PrioritizationSliceInfoList-r17 SEQUENCE (SIZE (1..maxSliceInfo-r17)) OF RA-PrioritizationSliceInfo-r17 { | 1 entry |  |  |
| RA-PrioritizationSliceInfo-r17[1] SEQUENCE{ |  | entry 1 |  |
| nsagIDList-r17 SEQUENCE (SIZE (1..maxSliceInfo-r17)) OF NSAG-ID-r17 { | 1 entry |  |  |
| NSAG-ID-r17 | ‘0000 0001’B |  |  |
| } |  |  |  |
| ra-Prioritization-r17 | RA-Prioritization with condition Slice\_RACH |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.12.3.3-7: *RA-Prioritization*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| RA-Prioritization::= SEQUENCE { |  |  |  |
| powerRampingStepHighPriority | dB0 |  | AI\_RACH |
|  | dB2 |  | Slice\_RACH |
| scalingFactorBI | zero |  | AI\_RACH |
|  | dot25 |  | Slice\_RACH |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| AI\_RACH | Access Identity specific RACH configuration |
| Slice\_RACH | Slice specific RACH configuration |

##### 7.1.1.1.13 Random access procedure / Successful / Slice specific RACH configuration / 2-step RACH

7.1.1.1.13.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_IDLE state and starts Random Access procedure}

**ensure that** {

**when** { SS configures NSAG indicator and associated set of preambles in FeatureCombinationPreambles in RACH-ConfigCommonTwoStepRA in SIB1}

**then** { UE transmits a random access preamble using the slice specific random access resource}

}

7.1.1.1.13.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clauses 5.1.1a, 5.1.1c, 5.1.1d, 5.1.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1a]

The MAC entity shall:

1> if *RA\_TYPE* is set to *2-stepRA*:

2> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *msgA-PreamblePowerRampingStep*;

2> set *SCALING\_FACTOR\_BI* to 1;

2> apply *preambleTransMax* included in the *RACH-ConfigGenericTwoStepRA*;

2> if the Random Access procedure was initiated for reconfiguration with sync or for SCG activation; and

2> if *cfra-TwoStep* is configured for the selected carrier:

3> if *msgA-TransMax* is configured in the *cfra-TwoStep*:

4> apply *msgA-TransMax* configured in the *cfra-TwoStep*.

2> else if *msgA-TransMax* is included in the *RACH-ConfigCommonTwoStepRA*:

3> apply *msgA-TransMax* included in the *RACH-ConfigCommonTwoStepRA*.

2> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17); and

2> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier; and

2> if *ra-PrioritizationTwoStep* is configured in the *beamFailureRecoveryConfig*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-PrioritizationTwoStep* in *beamFailureRecoveryConfig*;

3> if *scalingFactorBI* is configured in the *ra-PrioritizationTwoStep* in *beamFailureRecoveryConfig*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if the Random Access procedure was initiated for reconfiguration with sync or for SCG activation; and

2> if *rach-ConfigDedicated* is configured for the selected carrier; and

2> if *ra-PrioritizationTwoStep* is configured in the *rach-ConfigDedicated*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-PrioritizationTwoStep* in *rach-ConfigDedicated*;

3> if *scalingFactorBI* is configured in *ra-PrioritizationTwoStep* in the *rach-ConfigDedicated*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if both *ra-PrioritizationForSlicingTwoStep* for a NSAG identity and *ra-PrioritizationForAccessIdentityTwoStep* are configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with both this NSAG identity and Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *enableRA-PrioritizationForSlicing* is set to *true*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

3> else if *enableRA-PrioritizationForSlicing* is set to *false*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForSlicingTwoStep* for a NSAG identity is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with this NSAG identity:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

[TS 38.321, clause 5.1.1c]

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if RedCap indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a Random Access procedure for which RedCap indication is not applicable.

1> if SDT indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure which is not triggered for SDT.

1> if NSAG indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure unless it is triggered for the corresponding NSAG indication.

1> if MSG3 repetition indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure if MSG3 repetition is not applicable.

1> if a set of Random Access resources is not configured with any of the RedCap or SDT or NSAG(s) or MSG3 repetition indications:

2> consider the set of Random Access resources to not associated with any feature indication.

[TS 38.321, clause 5.1.1d]

The MAC entity shall:

1> among the available sets of Random Access resources for this Random Access procedure (as specified in clause 5.1.1c), identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].

1> if a single set of Random Access resources is identified:

2> select this set of Random Access resources.

1> else if more than one set of Random Access resources is identified:

2> repeat the procedure taking as an input the identified sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

1> else (i.e. no set of Random Access resources is identified):

2> repeat the procedure taking as an input the previous identified available sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured, or *ra-ssb-OccasionMaskIndex* if configured, or *ssb-SharedRO-MaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-Resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE 1: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

NOTE 2: If a RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode is configured with a BWP indicated by *initialDownlinkBWP-RedCap* which is not associated with any SSB, SS-RSRP measurement is performed based on the SSB associated with the BWP indicated by *initialDownlinkBWP*.

7.1.1.1.13.3 Test description

7.1.1.1.13.3.1 Pre-test conditions

The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1. The NSAG identifier transmitted in SIB1 is same as the NSAG identifier provided to the UE in Registration Accept message.

7.1.1.1.13.3.2 Test procedure sequence

Table 7.1.1.1.13.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmits a preamble on PRACH using a preamble in the FeatureCombinationPreambles configured for NSAG? | --> | PRACH Preamble | 1 | P |
| 3 | Check: Does the UE transmit MSGA using the PRACH Preamble in step 2 associated PUSCH resource containing a *RRCSetupRequest* message. | --> | MAC PDU (*RRCSetupRequest*) | 1 | P |
| 4 | The SS schedules PDCCH transmission addressed to MSGB-RNTI corresponding to preamble in Step 2 to transmit a valid MAC PDU containing MAC subPDU for successRAR (with matching UE Contention Resolution Identity) *and MAC subPDU for RRCSetup* message. | <-- | MAC PDU  (successRAR *, RRCSetup*) | - | - |
| 5 | The UE transmits a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message. | --> | MAC PDU (*RRCSetupComplete)* | - | - |

7.1.1.1.13.3.3 Specific message contents

Table 7.1.1.1.13.3.3-1: SIB 1 (preamble and all steps, Table 7.1.1.1.13.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Table 7.1.1.1.13.3.3-2 |  |
| } |  |  |  |

Table 7.1.1.1.13.3.3-2: ServingCellConfigCommon (7.1.1.1.13.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon | Table 7.1.1.1.13.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.13.3.3-3: BWP-UplinkCommon(Table 7.1.1.1.13.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| AdditionalRACH-ConfigList-r17 SEQUENCE { |  |  |  |
| AdditionalRACH-Config-r17 SEQUENCE { |  |  |  |
| msgA-ConfigCommon-r17 | MsgA-ConfigCommon-r16 | Table 7.1.1.1.13.3.3-4 |  |
| ) |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.13.3.3-4: MsgA-ConfigCommon-r16 (Table 7.1.1.1.13.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommon-r16 :: = SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA-r16 | Table 7.1.1.1.13.3.3-5 |  |
| } |  |  |  |

Table 7.1.1.1.13.3.3-5: RACH-ConfigCommonTwoStepRA-r16 (Table 7.1.1.1.13.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| featureCombinationPreamblesList-r17 SEQUENCE { |  |  |  |
| FeatureCombinationPreambles-r17 | FeatureCombinationPreambles | Table 7.1.1.1.13.3.3-6 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.13.3.3-6: FeatureCombinationPreambles(Table 7.1.1.1.13.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| FeatureCombinationPreambles-r17 ::= SEQUENCE { |  |  |  |
| featureCombination-r17 ::= SEQUENCE { |  |  |  |
| nsag-r17::= SEQUENCE { |  |  |  |
| nsag-r17[0] | ‘0000 0001’B |  |  |
| } |  |  |  |
| } |  |  |  |
| startPreambleForThisPartition-r17 | 8 | Randomly selected |  |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 12 |  |  |
| ssb-SharedRO-MaskIndex-r17 | Not present |  |  |
| groupBconfigured-r17 | Not present |  |  |
| separateMsgA-PUSCH-Config-r17 | *MsgA-PUSCH-Config* | 38.508-1 table 4.6.3-81B |  |
| msgA-RSRP-Threshold-r17 | 57 | -100 dBm |  |
| rsrp-ThresholdSSB-r17 | RSRP-Range | 38.508-1 table 4.6.3-152 |  |
| deltaPreamble-r17 | Not present |  |  |
| } |  |  |  |

##### 7.1.1.1.14 Random access procedure / Successful/ ra-PrioritizationForSlicingTwoStep / 2-step RACH

7.1.1.1.14.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_IDLE state and starts Random Access procedure}

**ensure that** {

**when** { SS configures both ra-PrioritizationForSlicingTwoStep for a NSAG identity and ra-PrioritizationForAccessIdentityTwoStep in SIB1 and set enableRA-PrioritizationForSlicing to TRUE}

**then** { UE uses powerRampingStepHighPriority and scalingFactorBI configured in the ra-PrioritizationForSlicing for Random Access procedure}

}

(2)

**with** { UE in NR RRC\_IDLE state after transmission of a MSGA on NR SpCell and SS configured scalingFactorBI in ra-PrioritizationForSlicingTwoStep for a NSAG identity in SIB1 }

**ensure that** {

**when** { SS sends a MSGB including a Backoff Indicator with the Random Access Preamble identifier different from the value received from the UE}

**then** { UE performs the Random Access Resource selection procedure for 2-step RA type Random Access after a random time between 0 and the indicated Backoff parameter multiplied with scalingFactorBI configured in the ra-PrioritizationForSlicing }

}

7.1.1.1.14.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clauses 5.1.1a, 5.1.1c, 5.1.1d, 5.1.2a. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1a]

The MAC entity shall:

1> if *RA\_TYPE* is set to *2-stepRA*:

2> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *msgA-PreamblePowerRampingStep*;

2> set *SCALING\_FACTOR\_BI* to 1;

2> apply *preambleTransMax* included in the *RACH-ConfigGenericTwoStepRA*;

2> if the Random Access procedure was initiated for reconfiguration with sync or for SCG activation; and

2> if *cfra-TwoStep* is configured for the selected carrier:

3> if *msgA-TransMax* is configured in the *cfra-TwoStep*:

4> apply *msgA-TransMax* configured in the *cfra-TwoStep*.

2> else if *msgA-TransMax* is included in the *RACH-ConfigCommonTwoStepRA*:

3> apply *msgA-TransMax* included in the *RACH-ConfigCommonTwoStepRA*.

2> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17); and

2> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier; and

2> if *ra-PrioritizationTwoStep* is configured in the *beamFailureRecoveryConfig*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-PrioritizationTwoStep* in *beamFailureRecoveryConfig*;

3> if *scalingFactorBI* is configured in the *ra-PrioritizationTwoStep* in *beamFailureRecoveryConfig*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if the Random Access procedure was initiated for reconfiguration with sync or for SCG activation; and

2> if *rach-ConfigDedicated* is configured for the selected carrier; and

2> if *ra-PrioritizationTwoStep* is configured in the *rach-ConfigDedicated*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-PrioritizationTwoStep* in *rach-ConfigDedicated*;

3> if *scalingFactorBI* is configured in *ra-PrioritizationTwoStep* in the *rach-ConfigDedicated*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if both *ra-PrioritizationForSlicingTwoStep* for a NSAG identity and *ra-PrioritizationForAccessIdentityTwoStep* are configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with both this NSAG identity and Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *enableRA-PrioritizationForSlicing* is set to *true*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

3> else if *enableRA-PrioritizationForSlicing* is set to *false*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForSlicingTwoStep* for a NSAG identity is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with this NSAG identity:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicingTwoStep* for this NSAG identity:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

[TS 38.321, clause 5.1.1c]

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if RedCap indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a Random Access procedure for which RedCap indication is not applicable.

1> if SDT indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure which is not triggered for SDT.

1> if NSAG indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure unless it is triggered for the corresponding NSAG indication.

1> if MSG3 repetition indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for the Random Access procedure if MSG3 repetition is not applicable.

1> if a set of Random Access resources is not configured with any of the RedCap or SDT or NSAG(s) or MSG3 repetition indications:

2> consider the set of Random Access resources to not associated with any feature indication.

[TS 38.321, clause 5.1.1d]

The MAC entity shall:

1> among the available sets of Random Access resources for this Random Access procedure (as specified in clause 5.1.1c), identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].

1> if a single set of Random Access resources is identified:

2> select this set of Random Access resources.

1> else if more than one set of Random Access resources is identified:

2> repeat the procedure taking as an input the identified sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

1> else (i.e. no set of Random Access resources is identified):

2> repeat the procedure taking as an input the previous identified available sets of Random Access resources and the feature applicable to the current Random Access procedure with the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure, except the features considered already.

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured, or *ra-ssb-OccasionMaskIndex* if configured, or *ssb-SharedRO-MaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-Resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE 1: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

NOTE 2: If a RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode is configured with a BWP indicated by *initialDownlinkBWP-RedCap* which is not associated with any SSB, SS-RSRP measurement is performed based on the SSB associated with the BWP indicated by *initialDownlinkBWP*.

7.1.1.1.14.3 Test description

7.1.1.1.14.3.1 Pre-test conditions

The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1. The NSAG identifier transmitted in SIB1 is same as the NSAG identifier provided to the UE in Registration Accept message. The UE is assigned the MPS indicator bit of the 5GS network feature support IE to "Access identity 1 valid", in the REGISTRATION ACCEPT message.

7.1.1.1.14.3.2 Test procedure sequence

Table 7.1.1.1.14.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmits a preamble on PRACH using a preamble in the FeatureCombinationPreambles configured for NSAG? | --> | PRACH Preamble | 1 | P |
| 3 | Check: Does the UE transmit MSGA using the PRACH Preamble in step 2 associated PUSCH resource containing a *RRCSetupRequest* message. | --> | MAC PDU (*RRCSetupRequest*) | 1 | P |
| 4 | The SS schedules PDCCH transmission addressed to MSGB-RNTI corresponding to preamble in Step 2 to transmit a valid MAC PDU containing MAC subPDU for successRAR(without matching UE Contention Resolution Identity)and including Back off Indicator subheader.. | <-- | MAC PDU  (successRAR *,Back off Indicator* ) | - | - |
| 5 | Check: Does the UE transmits a preamble on PRACH using a preamble in the FeatureCombinationPreambles configured for NSAG? Note 1 | --> | PRACH Preamble | 2 | P |
| 6 | Check: Does the UE transmit MSGA using the PRACH Preamble in step 5 associated PUSCH resource containing a *RRCSetupRequest* message. | --> | MAC PDU (*RRCSetupRequest*) | 2 | P |
| 7 | The SS schedules PDCCH transmission addressed to MSGB-RNTI corresponding to preamble in Step 2 to transmit a valid MAC PDU containing MAC subPDU for successRAR (with matching UE Contention Resolution Identity) *and MAC subPDU for RRCSetup* message. | <-- | MAC PDU  (successRAR *, RRCSetup*) | - | - |
| 8 | The UE transmits a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message. | --> | MAC PDU (*RRCSetupComplete)* | - | - |
| Note 1: The Step 5 occurs after random time between 0 and the step 4 Backoff indicator multiplied with scalingFactorBI configured in the ra-PrioritizationForSlicing for NSAG. | | | | | |

7.1.1.1.14.3.3 Specific message contents

Table 7.1.1.1.14.3.3-1: SIB 1 (preamble and all steps, Table 7.1.1.1.14.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Table 7.1.1.1.14.3.3-2 |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-2: ServingCellConfigCommon (7.1.1.1.14.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon | Table 7.1.1.1.14.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-3: BWP-UplinkCommon(Table 7.1.1.1.14.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| enableRA-PrioritizationForSlicing | true |  |  |
| AdditionalRACH-ConfigList-r17 SEQUENCE { |  |  |  |
| AdditionalRACH-Config-r17 SEQUENCE { |  |  |  |
| msgA-ConfigCommon-r17 | MsgA-ConfigCommon-r16 | Table 7.1.1.1.14.3.3-4 |  |
| ) |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-4: MsgA-ConfigCommon-r16 (Table 7.1.1.1.14.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommon-r16 :: = SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA-r16 | Table 7.1.1.1.14.3.3-5 |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-5: RACH-ConfigCommonTwoStepRA-r16 (Table 7.1.1.1.14.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| ra-PrioritizationForAccessIdentityTwoStep-r16 SEQUENCE { |  |  |  |
| ra-Prioritization-r16 | RA-Prioritization With condition AI\_RACH |  |  |
| ra-PrioritizationForAI-r16 | '10'B |  |  |
| } |  |  |  |
| ra-PrioritizationForSlicingTwoStep-r17 | *RA-PrioritizationForSlicing* |  |  |
| featureCombinationPreamblesList-r17 SEQUENCE { |  |  |  |
| FeatureCombinationPreambles-r17 | FeatureCombinationPreambles |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-6: FeatureCombinationPreambles(Table 7.1.1.1.14.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| FeatureCombinationPreambles-r17 ::= SEQUENCE { |  |  |  |
| featureCombination-r17 ::= SEQUENCE { |  |  |  |
| nsag-r17::= SEQUENCE { |  |  |  |
| nsag-r17[0] | ‘0000 0001’B |  |  |
| } |  |  |  |
| } |  |  |  |
| startPreambleForThisPartition-r17 | 8 | Randomly selected |  |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 12 |  |  |
| ssb-SharedRO-MaskIndex-r17 | Not present |  |  |
| groupBconfigured-r17 | Not present |  |  |
| separateMsgA-PUSCH-Config-r17 | *MsgA-PUSCH-Config* | 38.508-1 table 4.6.3-81B |  |
| msgA-RSRP-Threshold-r17 | 57 | -100 dBm |  |
| rsrp-ThresholdSSB-r17 | RSRP-Range | 38.508-1 table 4.6.3-152 |  |
| deltaPreamble-r17 | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-7: *RA-PrioritizationForSlicing* (Table 7.1.1.1.14.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| RA-PrioritizationForSlicing-r17::= SEQUENCE { |  |  |  |
| ra-PrioritizationSliceInfoList-r17 SEQUENCE (SIZE (1..maxSliceInfo-r17)) OF RA-PrioritizationSliceInfo-r17 { | 1 entry |  |  |
| RA-PrioritizationSliceInfo-r17[1] SEQUENCE{ |  | entry 1 |  |
| nsagIDList-r17 SEQUENCE (SIZE (1..maxSliceInfo-r17)) OF NSAG-ID-r17 { | 1 entry |  |  |
| NSAG-ID-r17 | ‘0000 0001’B |  |  |
| } |  |  |  |
| ra-Prioritization-r17 | RA-Prioritization with condition Slice\_RACH |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.14.3.3-8: *RA-Prioritization*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| RA-Prioritization::= SEQUENCE { |  |  |  |
| powerRampingStepHighPriority | dB0 |  | AI\_RACH |
|  | dB2 |  | Slice\_RACH |
| scalingFactorBI | zero |  | AI\_RACH |
|  | dot25 |  | Slice\_RACH |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| AI\_RACH | Access Identity specific RACH configuration |
| Slice\_RACH | Slice specific RACH configuration |

##### 7.1.1.1.15 Random access procedure / RedCap UE / SI request

7.1.1.1.15.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Idle State and initialUplinkBWP-RedCap and si-RequestConfigRedCap is configured in SIB1 of Serving Cell}

**ensure that** {

**when** { one System information,which *si-BroadcastStatus* is set to *notBroadcasting,* is updated }

**then** { UE transmitted PRACH preamble for System information request using the PRACH preamble(s) and PRACH resource(s) in si-RequestConfigRedcap and retransmitted PRACH preamble when ra-ResponseWindow has expired }

}

(2)

**with** { UE in RRC\_Idle State and transmitted PRACH preamble for System information request }

**ensure that** {

**when** { UE received a RAR message addressed to RA-RNTI and including matching RAPID only }

**then** { UE considers the RACH procedure to be successfully completed and informs the upper layer }

}

7.1.1.1.15.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.1 and 5.1.2, TS38.331, clauses 5.2.2.3.3 and 6.3.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1]

- *ra-PreambleStartIndex*: the starting index of Random Access Preamble(s) for on-demand SI request;

[TS 38.321, clause 5.1.2]

If the selected *RA\_TYPE* is set to *4-stepRA*, the MAC entity shall:

…

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

[TS 38.331, clause 5.2.2.3.3]

The UE shall, while SDT procedure is not ongoing:

…

1> else if the UE is a RedCap UE and if *initialUplinkBWP-RedCap* is configured in *UplinkConfigCommonSIB* and if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfigRedCap* and criteria to select normal uplink as defined in TS 38.321[3], clause 5.1.1 is met:

2> trigger the lower layer to initiate the Random Access procedure on normal uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfigRedcap* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;

2> if acknowledgement for SI request is received from lower layers:

3> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;

1> else:

2> if the UE is not a RedCap UE and if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfig* and criteria to select normal uplink as defined in TS 38.321[3], clause 5.1.1 is met; or

2> if the UE is a RedCap UE and if *initialUplinkBWP-RedCap* is not configured in *UplinkConfigCommonSIB* and if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfig* and criteria to select normal uplink as defined in TS 38.321[3], clause 5.1.1 is met:

3> trigger the lower layer to initiate the Random Access procedure on normal uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfig* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;

3> if acknowledgement for SI request is received from lower layers:

4> acquire the requested SI message(s) as defined in clause 5.2.2.3.2, immediately;

[TS 38.331, clause 6.3.2]

***si-RequestConfigRedCap***

Configuration of Msg1 resources for *initialUplinkBWP-RedCap*that the RedCap UE uses for requesting SI-messages for which *si-BroadcastStatus* is set to *notBroadcasting*.

7.1.1.1.15.3 Test description

7.1.1.1.15.3.1 Pre-test conditions

System Simulator:

- NR Cell 1 and NR Cell 11.

- System information combination NR-3 as defined in TS 38.508-1 [4] clause 4.4.3.1.3 is used in NR Cell 1.

UE:

- None.

Preamble:

- The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.

7.1.1.1.15.3.2 Test procedure sequence

Same test procedure sequence as in clause 7.1.1.1.3.3.3 with the following differences:

Table 7.1.1.1.15.3.2-3 is the same as Table 7.1.1.1.3.3.2-3 with the exception that the preamble is indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfigRedCap* in *SIB1* in Table 7.1.1.1.15.3.3-1 in step 5/6/7/8.

7.1.1.1.15.3.3 Specific message contents

Table 7.1.1.1.15.3.3-1: *SIB1* on NR Cell 1 (Step 4, Table 7.1.1.1.15.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| si-SchedulingInfo SEQUENCE { |  |  |  |
| schedulingInfoList SEQUENCE { | 2 entries |  |  |
| si-BroadcastStatus[1] | Broadcasting |  |  |
| si-Periodicity[1] | rf32 |  |  |
| sib-MappingInfo[1] SEQUENCE { |  |  |  |
| type | SibType2 |  |  |
| valueTag | 0 |  |  |
| areaScope | Not present |  |  |
| } |  |  |  |
| si-BroadcastStatus[2] | notBroadcasting |  |  |
| si-Periodicity[2] | rf64 |  |  |
| sib-MappingInfo[2] SEQUENCE { |  |  |  |
| type | SibType3 |  |  |
| valueTag | 1 |  |  |
| areaScope | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| si-RequestConfig SEQUENCE { |  |  |  |
| rach-OccasionsSI SEQUENCE { |  |  |  |
| rach-ConfigSI | RACH-ConfigGeneric | TS 38.508-1 [4], Table 4.6.3-130 |  |
| ssb-perRACH-Occasion | one |  |  |
| } |  |  |  |
| si-RequestPeriod | two |  |  |
| si-RequestResources SEQUENCE { | 1 entry |  |  |
| ra-PreambleStartIndex[1] | 52 |  |  |
| ra-AssociationPeriodIndex[1] | 0 |  |  |
| ra-ssb-OccasionMaskIndex[1] | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| si-RequestConfigSUL | Not present |  |  |
| } |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommonSIB | Table 7.1.1.1.15.3.3-2 |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| si-SchedulingInfo-v1740 SEQUENCE { |  |  |  |
| si-RequestConfigRedCap-r17 SEQUENCE { |  |  |  |
| rach-OccasionsSI SEQUENCE { |  |  |  |
| rach-ConfigSI | RACH-ConfigGeneric | TS 38.508-1 [4], Table 4.6.3-130 |  |
| ssb-perRACH-Occasion | one |  |  |
| } |  |  |  |
| si-RequestPeriod | two |  |  |
| si-RequestResources SEQUENCE { | 1 entry |  |  |
| ra-PreambleStartIndex[1] | 53 | Different from the ra-PreambleStartIndex in si-RequestConfig |  |
| ra-AssociationPeriodIndex[1] | 0 |  |  |
| ra-ssb-OccasionMaskIndex[1] | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| nonCriticalExtension | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.15.3.3-2: *ServingCellConfigCommonSIB* (Table 7.1.1.1.15.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-169 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommonSIB ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon-v1700 ::= SEQUENCE { |  |  |  |
| initialUplinkBWP-RedCap-r17 | BWP-UplinkCommon | Table 7.1.1.1.15.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.15.3.3-3: *BWP-UplinkCommon* (Table 7.1.1.1.15.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| pucch-ConfigCommon CHOICE { |  |  |  |
| setup | PUCCH-ConfigCommon | Table 7.1.1.1.15.3.3-4 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.15.3.3-4: *PUCCH-ConfigCommon* (Table 7.1.1.1.15.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-113 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-ConfigCommon ::= SEQUENCE { |  |  |  |
| pucch-ResourceCommon | Not present |  |  |
| pucch-ResourceCommonRedCap-r17 | 0 |  |  |
| } |  |  |  |

Table 7.1.1.1.15.3.3-5: *SIB3* on NR Cell 1 (Preamble and Step 9A, Table 7.1.1.1.15.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.2-2 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB3 ::= SEQUENCE { |  |  |  |
| intraFreqNeighCellList SEQUENCE { |  |  |  |
| physCellId | The cell identity of NR Cell 11 defined in 38.508-1 [4] clause 4.4.2 |  |  |
| q-OffsetCell | 16 | Preamble |  |
| -10 | Step 9A |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.16 Random access procedure / RedCap UE identification / Msg3-based / CCCH1

7.1.1.1.16.1 Test Purpose (TP)

(1)

**with** { UE supporting RedCap and in NR RRC\_Inactive state }

**ensure that** {

**when** { UE starts Random Access procedure }

**then** { the UE uses the RedCap specific LCID in Msg3}

}

7.1.1.1.16.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clause 6.2.1 and TS38.331,clause 5.3.13.3. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 6.2.1]

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 0 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]), except for a RedCap UE |
| 1–32 | Identity of the logical channel of DCCH and DTCH |
| 33 | Extended logical channel ID field (two-octet eLCID field) |
| 34 | Extended logical channel ID field (one-octet eLCID field) |
| 35 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]) for a RedCap UE |
| 36 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]) for a RedCap UE |
| 37–42 | Reserved |
| 43 | Truncated Enhanced BFR (one octet Ci) |
| 44 | Timing Advance Report |
| 45 | Truncated Sidelink BSR |
| 46 | Sidelink BSR |
| 47 | Reserved |
| 48 | LBT failure (four octets) |
| 49 | LBT failure (one octet) |
| 50 | BFR (one octet Ci) |
| 51 | Truncated BFR (one octet Ci) |
| 52 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]), except for a RedCap UE |
| 53 | Recommended bit rate query |
| 54 | Multiple Entry PHR (four octets Ci) |
| 55 | Configured Grant Confirmation |
| 56 | Multiple Entry PHR (one octet Ci) |
| 57 | Single Entry PHR |
| 58 | C-RNTI |
| 59 | Short Truncated BSR |
| 60 | Long Truncated BSR |
| 61 | Short BSR |
| 62 | Long BSR |
| 63 | Padding |

[TS 38.331, clause 5.3.13.3]

The UE shall set the contents of *RRCResumeRequest* or *RRCResumeRequest1* message as follows:

1> if field *useFullResumeID* is signalled in *SIB1*:

2> select *RRCResumeRequest1* as the message to use;

2> set the *resumeIdentity* to the stored *fullI-RNTI* value;

7.1.1.1.16.3 Test description

7.1.1.1.16.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None

Preamble:

- The UE is in 2N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) and Test loop function(*Off*) according to TS 38.508-1 [4].

7.1.1.1.16.3.2 Test procedure sequence

Table 7.1.1.1.16.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS changes the SIB1 of NR Cell 1 to set the *useFullResumeID* to True. | - | - | - | - |
| 2 | The SS transmits a Short message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 3 | Wait for 2.1\* modification period second for the UE to receive new system information.  (Note 1) | - | - | - | - |
| 4 | The SS transmits a *Paging* message including a matched identity (correct *fullI-RNTI*). | <-- | NR RRC: *Paging* | - | - |
| 5 | Check: Does the UE transmit an *RRCResumeRequest1* message by setting LCID to 36? | --> | NR RRC: *RRCResumeRequest1* | 1 | P |
| 6 | The SS transmits an *RRCResume* message. | <-- | NR RRC: *RRCResume* | - | - |
| 7 | The UE transmits an *RRCResumeComplete* message. | --> | NR RRC: *RRCResumeComplete* | - | - |
| Note 1: The modification period, expressed in number of radio frames = modificationPeriodCoeff \* defaultPagingCycle. | | | | | |

7.1.1.1.16.3.3 Specific message contents

Table 7.1.1.1.16.3.3-1: SIB1 (step 1, Table 7.1.1.1.16.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| useFullResumeID | true |  |  |
| } |  |  |  |

Table 7.1.1.1.16.3.3-2: Paging (step 4, Table 7.1.1.1.16.3.2-1)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-9 with condition NR\_RRC\_RESUME |

##### 7.1.1.1.17 Random access procedure / RedCap UE identification

7.1.1.1.17.1 Test Purpose (TP)

(1)

**with** { UE supporting RedCap and in NR RRC\_IDLE state }

**ensure that** {

**when** { UE starts Random Access procedure }

**then** { the UE uses the RedCap specific random access resource in Msg1}

}

(2)

**with** { UE supporting RedCap and in NR RRC\_IDLE state }

**ensure that** {

**when** { UE starts Random Access procedure }

**then** { the UE uses the RedCap specific LCID in Msg3 }

}

7.1.1.1.17.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.1, 5.1.1b, 5.1.1c ,5.1.1d and 6.2.1, TS38.300, clauses 16.13.3. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1]

…

When a Random Access procedure is initiated, UE selects a set of Random Access resources as specified in clause 5.1.1b and initialises the following parameters for the Random Access procedure according to the values configured by RRC for the selected set of Random Access resources:

…

*- featurePriorities*: priorities for features, such as REDCAP, Slice group(s), etc. (see clause 5.1.1d);

…

- *startPreambleForThisPartition*: the first preamble associated with the set of Random Access Resources applicable to the Random Access procedure;

…

- *numberOfPreamblesForThisPartition*: the number of consequtive preambles associated with the set of Random Access Resources applicable to the Random Access procedure;

…

When the Random Access procedure is initiated on a Serving Cell, the MAC entity shall:

…

1> perform the BWP operation as specified in clause 5.15;

1> select the set of Random Access resources applicable to the current Random Access procedure according to clause 5.1.1b;

…

[TS 38.321, clause 5.1.1b]

The MAC entity shall:

…

1> if contention-free Random Access Resources have not been provided for this Random Access procedure and one or more of the features including REDCAP and/or a specific slice group(s) and/or SDT and/or MSG3 repetition is applicable for this Random Access procedure:

Editor's Note: FFS if some clarification is needed on how feature applicability is known (e.g. from RRC etc)

2> if none of the sets of Random Access resources are available for the current Random Access procedure (as specified in clause 5.1.1c):

3> select the set of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if there are one or more set(s) of Random Access resources available (as specified in clause 5.1.1c) and one of these set(s) of Random Access resources can be used for indicating all features triggering this Random Access procedure:

3> select the available set of Random Access resources for this Random Access procedure.

…

[TS 38.321, clause 5.1.1c]

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if REDCAP indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a RACH procedure for which REDCAP indication is not applicable.

…

[TS 38.321, clause 5.1.1d]

The MAC entity shall:

1> among the available sets of Random Access resources, identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].

1> if a single set of Random Access resources is identified:

2> select this set of Random Access resources.

…

[TS 38.300, clause 16.13.3]

A RedCap UE can be identified by the network during Random Access procedure via MSG3/MSGA from a RedCap specific LCID(s) and optionally via MSG1/MSGA (PRACH occasion or PRACH preamble). For RedCap UE identification via MSG1/MSGA, RedCap specific Random Access configuration may be configured by the network. For MSG3/MSGA, a RedCap UE is identified by the dedicated LCID(s) indicated for CCCH identification (CCCH or CCCH1) regardless whether RedCap specific Random Access configuration is configured by the network.

[TS 38.321, clause 6.2.1]

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 0 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]), except for a RedCap UE |
| 1–32 | Identity of the logical channel of DCCH and DTCH |
| 33 | Extended logical channel ID field (two-octet eLCID field) |
| 34 | Extended logical channel ID field (one-octet eLCID field) |
| 35 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]) for a RedCap UE |
| 36 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]) for a RedCap UE |
| 37–42 | Reserved |
| 43 | Truncated Enhanced BFR (one octet Ci) |
| 44 | Timing Advance Report |
| 45 | Truncated Sidelink BSR |
| 46 | Sidelink BSR |
| 47 | Reserved |
| 48 | LBT failure (four octets) |
| 49 | LBT failure (one octet) |
| 50 | BFR (one octet Ci) |
| 51 | Truncated BFR (one octet Ci) |
| 52 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]), except for a RedCap UE |
| 53 | Recommended bit rate query |
| 54 | Multiple Entry PHR (four octets Ci) |
| 55 | Configured Grant Confirmation |
| 56 | Multiple Entry PHR (one octet Ci) |
| 57 | Single Entry PHR |
| 58 | C-RNTI |
| 59 | Short Truncated BSR |
| 60 | Long Truncated BSR |
| 61 | Short BSR |
| 62 | Long BSR |
| 63 | Padding |

7.1.1.1.17.3 Test description

7.1.1.1.17.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None

Preamble:

- The UE is in 1N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) and Test loop function(*Off*) according to TS 38.508-1 [4].

7.1.1.1.17.3.2 Test procedure sequence

Table 7.1.1.1.17.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS changes the SIB1 of NR Cell 1 to configure the specific PRACH resource for RedCap in initialUplinkBWP. | - | - | - | - |
| 2 | The SS transmits a Short message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 3 | Wait for 2.1\* modification period second for the UE to receive new system information.  (Note 1) | - | - | - | - |
| 4 | The SS transmits a Paging message including a matched identity. | <-- | NR RRC: Paging | - | - |
| 5 | Check: Does the UE transmit Preamble on PRACH with *ra-PreambleIndex* range from 8 to 11 on NR Cell 1? | --> | PRACH Preamble | 1 | P |
| 6 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 5. | <-- | Random Access Response | - |  |
| 7 | Check: Does the UE transmit a MAC PDU containing an *RRCSetupRequest* message by setting LCID to 35? | --> | MAC PDU (*RRCSetupRequest*) | 2 | P |
| 8 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 9 | UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message | --> | MAC PDU (*RRCSetupComplete)* | - | - |
| 10 | The test steps 5 to 8 of generic test procedure in TS 38.508-1 [4] Table 4.5.4.2-3 are performed on NR Cell 1. | - | - | - | - |
| 11 | The SS transmits *RRCRelease.* | <-- | NR RRC: RRCRelease | - |  |
| 12 | The SS changes the SIB1 of NR Cell 1 to configure the specific PRACH resource for RedCap in initialUplinkBWP-RedCap. | - | - | - | - |
| 13 | The SS transmits a Short message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 14 | Wait for 2.1\* modification period second for the UE to receive new system information.  (Note 1) | - | - | - | - |
| 15 | The SS transmits a Paging message including a matched identity. | <-- | NR RRC: Paging | - | - |
| 16 | Check: Does the UE transmit Preamble on PRACH with *ra-PreambleIndex* range from 12 to 15 on NR Cell 1? | --> | PRACH Preamble | 1 | P |
| 17 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 16. | <-- | Random Access Response | - |  |
| 18 | Check: Does the UE transmit a MAC PDU containing an *RRCSetupRequest* message by setting LCID to 35? | --> | MAC PDU (*RRCSetupRequest*) | 2 | P |
| 19 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 20 | UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message | --> | MAC PDU (*RRCSetupComplete)* | - | - |
| Note 1: The modification period, expressed in number of radio frames = modificationPeriodCoeff \* defaultPagingCycle. | | | | | |

7.1.1.1.17.3.3 Specific message contents

Table 7.1.1.1.17.3.3-1: *SIB1* (step 1 and step12, Table 7.1.1.1.17.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommonSIB | Table 7.1.1.1.17.3.3-2 |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| featurePriorities-r17 SEQUENCE { |  |  |  |
| redCapPriority-r17 | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-2: *ServingCellConfigCommonSIB* (Table 7.1.1.1.17.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-169 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommonSIB ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon | UplinkConfigCommonSIB | Table 7.1.1.1.17.3.3-3 | Step1 |
| uplinkConfigCommon | UplinkConfigCommonSIB | TS 38.508-1 [4] Table 4.6.3-202 | Step 12 |
| uplinkConfigCommon-v1700 | Not present |  | Step 1 |
| uplinkConfigCommon-v1700 SEQUENCE { |  |  | Step12 |
| initialUplinkBWP-RedCap-r17 | BWP-UplinkCommon-RedCap | Table 7.1.1.1.17.3.3-4A |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-3: *UplinkConfigCommonSIB* (Table 7.1.1.1.17.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-202 | | | |
| Information Element | Value/remark | Comment | Condition |
| UplinkConfigCommonSIB ::= SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon | Table 7.1.1.1.17.3.3-4 |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-4: *BWP-UplinkCommon* (Table 7.1.1.1.17.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon | Table 7.1.1.1.17.3.3-5 | Step 1 |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-4A: *BWP-UplinkCommon-RedCap* (Table 7.1.1.1.17.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon | Table 7.1.1.1.17.3.3-5 | Step 12 |
| } |  |  |  |
| pucch-ConfigCommon CHOICE { |  |  |  |
| setup | PUCCH-ConfigCommon-RedCap | Table 7.1.1.1.17.3.3-6 | Step 12 |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-5: *RACH-ConfigCommon* (Table 7.1.1.1.17.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| featureCombinationPreamblesList-r17 SEQUENCE (SIZE(1..maxFeatureCombPreamblesPerRACHResource-r17)) OF FeatureCombinationPreambles-r17 { | 1 entry |  |  |
| FeatureCombinationPreambles-r17[1] SEQUENCE { |  | entry 1 |  |
| featureCombination-r17 SEQUENCE { |  |  |  |
| redCap-r17 | True |  |  |
| } |  |  |  |
| startPreambleForThisPartition-r17 | 8 |  | Step 1 |
|  | 12 |  | Step 12 |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-6: *PUCCH-ConfigCommon-RedCap* (Table 7.1.1.1.17.3.3-4A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-113 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-ConfigCommon ::= SEQUENCE { |  |  |  |
| pucch-ResourceCommon | Not present |  |  |
| pucch-ResourceCommonRedCap-r17 | 0 |  |  |
| } |  |  |  |

##### 7.1.1.1.18 Random access procedure / Msg3 repetition indication / Random access resources selection

7.1.1.1.18.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_IDLE state and supporting MSG3 repetition }

**ensure that** {

**when** { UE is configured with both sets of Random Access resources with and without MSG3 repetition indication AND the RSRP of the downlink pathloss reference is less than the configured threshold }

**then** { UE requests MSG3 repetition via separate RACH resources and performs MSG3 repetition for MSG3 initial transmission and retransmission as per network indication }

}

(2)

**with** { UE in RRC\_IDLE state and supporting MSG3 repetition }

**ensure that** {

**when** { UE is configured with both sets of Random Access resources with and without MSG3 repetition indication AND the RSRP of the downlink pathloss reference is higher than the configured threshold }

**then** { UE does not request MSG3 repetition }

}

(3)

**with** { UE in RRC\_IDLE state and supporting MSG3 repetition }

**ensure that** {

**when** { UE is only configured with Random Access resources with MSG3 repetition indication }

**then** { UE requests MSG3 repetition via separate RACH resources and performs MSG3 repetition for MSG3 initial transmission and retransmission as per network indication }

}

7.1.1.1.18.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.213 clause 8.1, 8.3, TS 38.214 clause 6.1.2.1, TS 38.300, clause 19, and TS 38.321 clause 5.1.1b. Unless otherwise stated these are Rel-17 requirements.

[TS 38.213 clause 8.1]

For a random access procedure associated with a feature combination indicated by *FeatureCombinationPreambles*, a UE is provided a number of SS/PBCH block indexes associated with one PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* or *msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB* when provided and a number of contention based preambles per SS/PBCH block index per valid PRACH occasion by *startPreambleForThisPartition* and *numberOfPreamblesPerSSB-ForThisPartition*. The PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle for a UE provided with a PRACH mask index by *ssb-SharedRO-MaskIndex* according to [11, TS 38.321].

[TS 38.213 clause 8.3]

A UE can be provided in *BWP-UplinkCommon* a set of numbers of repetitions for a PUSCH transmission with PUSCH repetition Type A that is scheduled by a RAR UL grant or by a DCI format 0\_0 with CRC scrambled by a TC-RNTI. If the UE requests repetitions for the PUSCH transmission [11, TS 38.321], the UE transmits the PUSCH over slots, where is indicated by the 2 MSBs of the MCS field in the RAR UL grant or in the DCI format 0\_0 from a set of four values provided by *numberOfMsg3-RepetitionsList* or from {1, 2, 3, 4} if *numberOfMsg3-RepetitionsList* is not provided. The UE determines an MCS for the PUSCH transmission by the 2 LSBs of the MCS field in the RAR UL grant or by the 3 LSBs of the MCS field in the DCI format 0\_0, and determines a redundancy version and RBs for each repetition as described in [6, TS 38.214]. For unpaired spectrum operation, the UE determines the slots as the first slots starting from slot where a repetition of the PUSCH transmission does not include a symbol indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or indicated as a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

[TS 38.214 clause 6.1.2.1]

For PUSCH repetition type A, when transmitting PUSCH scheduled by RAR UL grant, the 2 MSBs of the MCS information field of the RAR UL grant provide a codepoint to determine the number of repetitions *K* according to Table 6.1.2.1-1A, based on whether or not the higher layer parameter *numberOfMsg3-RepetitionsList* is configured. The number of slots used for TBS determination N is equal to 1.

For PUSCH repetition type A, when transmitting PUSCH scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI, the 2 MSBs of the MCS information field of the DCI format 0\_0 with CRC scrambled by TC-RNTI provide a codepoint to determine the number of repetitions *K* according to Table 6.1.2.1-1A, based on whether or not the higher layer parameter *numberOfMsg3-RepetitionsList* is configured. The number of slots used for TBS determination N is equal to 1.

Table 6.1.2.1-1A: Number of repetition *K* as a function of 2 MSBs of MCS information field

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *numberOfMsg3-RepetitionsList is configured* | |  | *numberOfMsg3-RepetitionsList is not configured* | |
| *Codepoint* | *K* |  | Codepoint | *K* |
| 00 | First value of *numberOfMsg3-RepetitionsList* |  | 00 | 1 |
| 01 | Second value of *numberOfMsg3-RepetitionsList* |  | 01 | 2 |
| 10 | Third value of *numberOfMsg3-RepetitionsList* |  | 10 | 3 |
| 11 | Fourth value of *numberOfMsg3-RepetitionsList* |  | 11 | 4 |

…

For a PUSCH transmission scheduled by DCI format 0\_1, or 0\_2, or 0\_0 with CRC scrambled by TC-RNTI, the redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, …-1, is determined according to table 6.1.2.1-2.

For a PUSCH transmission of a PUSCH repetition Type A scheduled by RAR UL grant, the redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, …-1, is determined according to the first row of Table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or TB processing over multiple slots) or *n*th actual repetition (repetition Type B) | | | |
| *((n-(n mod N))/N)* mod 4 = 0 | *((n-(n mod N))/N)* mod 4 = 1 | *((n-(n mod N))/N)* mod 4 = 2 | *((n-(n mod N))/N)* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

[TS 38.300, clause 19]

To improve NR uplink coverage for both FR1 and FR2, the following enhancements on PUSCH, PUCCH and MSG3 PUSCH are supported:

- …

- Aggregation of multiple slots with TB repetition for MSG3 transmission is supported on both NUL and SUL, applicable to CBRA with 4-step RA type. If configured, the UE requests MSG3 repetition via separate RACH resources when the RSRP of DL path-loss reference is lower than a configured threshold. BWP configured with RACH resources solely for MSG3 repetition is also supported without the need to consider the RSRP of DL path-loss reference by the UE.

[TS 38.321, clause 5.1.1b]

The MAC entity shall:

1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with MSG3 repetition indication and set(s) of Random Access resources without MSG3 repetition indication and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg3*; or

1> if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with MSG3 repetition indication;

2> assume MSG3 repetition is applicable for the current Random Access procedure.

1> else:

2> assume MSG3 repetition is not applicable for the current Random Access procedure.

NOTE 1: Void.

1> if contention-free Random Access Resources have not been provided for this Random Access procedure and one or more of the features including RedCap and/or a specific NSAG(s) and/or SDT and/or MSG3 repetition is applicable for this Random Access procedure:

NOTE 2: The applicability of SDT is determined by MAC entity according to clause 5.27. The applicability of specific slice group(s) is determined by upper layers when the Random Access procedure is initiated by the upper layers. The applicability of RedCap is also determined by upper layers when Random Access procedure is initiated and it is applicable to the Random Access procedures initiated by PDCCH orders and any Random Access procedure initiated by the MAC entity.

2> if none of the sets of Random Access resources are available for any feature applicable to the current Random Access procedure (as specified in clause 5.1.1c):

3> select the set(s) of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if there is one set of Random Access resources available which can be used for indicating all features triggering this Random Access procedure:

3> select this set of Random Access resources for this Random Access procedure.

2> else (i.e. there are one or more sets of Random Access resources available that are configured with indication(s) for a subset of all features triggering this Random Access procedure):

3> select a set of Random Access resources from the available set(s) of Random Access resources based on the priority order indicated by upper layers as specified in clause 5.1.1d for this Random Access Procedure.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure and RedCap is applicable for the current Random Access procedure and there is one set of Random Access resources available that is only configured with RedCap indication:

2> select this set of Random Access resources for this Random Access procedure.

1> else:

2> select the set of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for the current Random Access procedure.

7.1.1.1.18.3 Test description

7.1.1.1.18.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

- System information combination NR-1 as defined in TS 38.508-1 [4] clause 4.4.3.1 is used in NR Cell 1.

UE:

- None

Preamble:

- The UE is in 1N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) and Test loop function(*Off*) according to TS 38.508-1 [4].

7.1.1.1.18.3.2 Test procedure sequence

Table 7.1.1.1.18.3.2-1/2 illustrate the downlink power levels and other changing parameters to be applied for the cell at various time instants of the test execution. The exact instants on which these values shall be applied are described in the texts in this clause. Configurations marked "T0" is applied for Preamble. Configurations marked "T1" are applied at the points indicated in the Main behaviour description in Table 7.1.1.1.18.3.2-3.

Table 7.1.1.1.18.3.2-1: Time instances of cell power level and parameter changes for FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/  SCS | -77 | The power level is such that RSRP of PL-RS >*rsrp-ThresholdMsg3* |
| T1 | SS/PBCH  SSS EPRE | dBm/  SCS | -93 | The power level is such that RSRP of PL-RS < *rsrp-ThresholdMsg3* |
| Note: The downlink signal level uncertainty is specified in TS 38.508-1 [4] clause 6.2.2.1. | | | | |

Table 7.1.1.1.18.3.2-2: Time instances of cell power level and parameter changes for FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/  SCS | -71 | The power level is such that RSRP of PL-RS > *rsrp-ThresholdMsg3* |
| T1 | SS/PBCH  SSS EPRE | dBm/  SCS | -99 | The power level is such that RSRP of PL-RS < *rsrp-ThresholdMsg3* |
| Note: The downlink signal level uncertainty is specified in TS 38.508-1 [4] clause 6.2.2.1. | | | | |

Table 7.1.1.1.18.3.2-3: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 0A | The SS changes NR Cell 1 power level according to the row "T1  " in Table 7.1.1.1.18.3.2-1/2 | - | - | - | - |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | NR RRC*: Paging* | - | - |
| 2 | Check: Does the UE transmit a PRACH preamble belonging to the random access resource set for Msg3 repetition? | --> | PRACH preamble | 1 | P |
| 3 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 2 and MCS = “0000”. | <-- | Random Access Response | - | - |
| 4 | Check: Does the UE transmit a MAC PDU containing an *RRCSetupRequest* message and repeat transmitting this MAC PDU in every slot which is suitable for UL transmission in the next consecutive N-1 slots with same resource allocation but different redundancy version?  NOTE 1: N is the repetition number indicated by the 1st entry of *numberOfMsg3-RepetitionsList*.  NOTE 2: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions. | --> | MAC PDU (*RRCSetupRequest*) | 1 | P |
| 5 | The SS transmits a DCI format 0\_0 addressed to TC-RNTI with MCS = “01000” and rvID = 2 to indicate Msg.3 retransmission. | <-- | DCI format 0\_0 (TC-RNTI) | - | - |
| 6 | Check: Does the UE retransmit the MAC PDU containing *RRCSetupRequest* message and repeat transmitting this MAC PDU in every slot which is suitable for UL transmission in the next consecutive N-1 slots with same resource allocation but different redundancy version?  NOTE 1: N is the repetition number indicated by the 2nd entry of *numberOfMsg3-RepetitionsList*.  NOTE 2: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, second row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions. | --> | MAC PDU (*RRCSetupRequest*) | 1 | P |
| 7-12 | Steps 3 to 8 of generic test procedure in TS 38.508-1 [4] Table 4.5.4.2-3 are performed on NR Cell 1. | - | - | - | - |
| 13 | The SS transmits an *RRCRelease* message*.* | <-- | NR RRC*: RRCRelease* | - | - |
| 14 | The SS changes NR Cell 1 power level according to the row "T0" in Table 7.1.1.1.18.3.2-1/2 | - | - | - | - |
| 15 | Wait 10s. | - | - | - | - |
| 16 | The SS transmits a Paging message including a matched UE identity. | <-- | NR RRC*: Paging* | - | - |
| 17 | Check: Does the UE transmit a PRACH preamble belonging to the random access resource set not for Msg3 repetition? | --> | PRACH preamble | 2 | P |
| 18 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 17 and MCS = “0000”. | <-- | Random Access Response | - | - |
| 19 | Check: Does the UE transmit a MAC PDU containing an *RRCSetupRequest* message and not repeat transmitting this MAC PDU in following slots which are suitable for UL transmission? | --> | MAC PDU (*RRCSetupRequest*) | 2 | P |
| 20-25 | Steps 3 to 8 of generic test procedure in TS 38.508-1 [4] Table 4.5.4.2-3 are performed on NR Cell 1. | - | - | - | - |
| 26 | The SS transmits an *RRCRelease* message*.* | <-- | NR RRC*: RRCRelease* | - | - |
| 27 | The SS changes the SIB1 of NR Cell 1 to release the random access resource set not for Msg3 repetition. | - | - | - | - |
| 28 | The SS transmits a Short Message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 29 | Wait for 2.1\* modification period seconds for the UE to receive new system information.  NOTE: The modification period, expressed in number of radio frames = modificationPeriodCoeff \* defaultPagingCycle. | - | - | - | - |
| 30 | The SS transmits a Paging message including a matched UE identity. | <-- | NR RRC*: Paging* | - | - |
| 31 | Check: Does the UE transmit a PRACH preamble belonging to the random access resource set for Msg3 repetition? | --> | PRACH preamble | 3 | P |
| 32 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 31 and MCS = “0000”. | <-- | Random Access Response | - | - |
| 33 | Check: Does the UE transmit a MAC PDU containing an *RRCSetupRequest* message and not repeat transmitting this MAC PDU in following slots which is suitable for UL transmission? | --> | MAC PDU (*RRCSetupRequest*) | 3 | P |
| 34 | The SS transmits a DCI format 0\_0 addressed to TC-RNTI with MCS = “01000” and rvID = 2 to indicate Msg3 retransmission. | <-- | DCI format 0\_0 (TC-RNTI) | - | - |
| 35 | Check: Does the UE retransmit the MAC PDU containing *RRCSetupRequest* message and repeat transmitting this MAC PDU in every slot which is suitable for UL transmission in the next consecutive 1 slot with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, second row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions. | --> | MAC PDU (*RRCSetupRequest*) | 3 | P |
| 36-41 | Steps 3 to 8 of generic test procedure in TS 38.508-1 [4] Table 4.5.4.2-3 are performed on NR Cell 1. | - | - | - | - |
| 42 | The SS transmits an *RRCRelease* message*.* | <-- | NR RRC*: RRCRelease* | - | - |

7.1.1.1.18.3.3 Specific message contents

Table 7.1.1.1.18.3.3-1: *SIB1* (Cell 1, Preamble and Step 27, Table 7.1.1.1.18.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { | |  |  |  |
| servingCellConfigCommon SEQUENCE { | |  |  |  |
| uplinkConfigCommon SEQUENCE { | |  |  |  |
| initialUplinkBWP | | BWP-UplinkCommon | Table 7.1.1.1.18.3.3-2 |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.18.3.3-2: *BWP-UplinkCommon* (Table 7.1.1.1.18.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon-2Group | Table 7.1.1.1.18.3.3-3 | Preamble |
|  | RACH-ConfigCommon-1Group | Table 7.1.1.1.18.3.3-4 | Step 27 |
| } |  |  |  |
| rsrp-ThresholdMsg3-r17 | 71 | Actual value = 71-156 = -85 dBm/SCS | Preamble |
|  | Not present |  | Step 27 |
| numberOfMsg3-RepetitionsList-r17 | Not present |  | Step 27 |
| numberOfMsg3-RepetitionsList-r17 SEQUENCE (SIZE (4)) OF NumberOfMsg3-Repetitions-r17 { | 4 entries |  | Preamble |
| NumberOfMsg3-Repetitions-r17[1] | n4 | Entry 1 |  |
| NumberOfMsg3-Repetitions-r17[2] | n3 | Entry 2 |  |
| NumberOfMsg3-Repetitions-r17[3] | n2 | Entry 3 |  |
| NumberOfMsg3-Repetitions-r17[4] | n1 | Entry 4 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.18.3.3-3: *RACH-ConfigCommon-2Group* (Table 7.1.1.1.18.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| featureCombinationPreambles-r17 SEQUENCE (SIZE(1..maxFeatureCombPreamblesPerRACHResource-r17)) OF FeatureCombinationPreambles-r17 { | 2 entries |  |  |
| FeatureCombinationPreambles-r17[1] | FeatureCombinationPreamble-NoMsg3Repetition | Entry 1  Table 7.1.1.1.18.3.3-5 |  |
| FeatureCombinationPreambles-r17[2] | FeatureCombinationPreamble-Msg3Repetition | Entry 2  Table 7.1.1.1.18.3.3-6 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.18.3.3-4: *RACH-ConfigCommon-1Group* (Table 7.1.1.1.18.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| featureCombinationPreambles-r17 SEQUENCE (SIZE(1..maxFeatureCombPreamblesPerRACHResource-r17)) OF FeatureCombinationPreambles-r17 { | 1 entry |  |  |
| FeatureCombinationPreambles-r17[1] | FeatureCombinationPreamble-Msg3Repetition | Entry 1  Table 7.1.1.1.18.3.3-6 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.18.3.3-5: *FeatureCombinationPreambles*-*NoMsg3Repetition* (Table 7.1.1.1.18.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-56E | | | |
| Information Element | Value/remark | Comment | Condition |
| FeatureCombinationPreambles-r17 ::= SEQUENCE { |  |  |  |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 4 | RAP index 0,1,2,3 belong to this group | FR1 |
|  | 2 | RAP index 0,1 belong to this group | FR2 |
| msgA-RSRP-Threshold-r17 | Not present |  |  |
| rsrp-ThresholdSSB-r17 | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.18.3.3-6: *FeatureCombinationPreambles*-*Msg3Repetition* (Table 7.1.1.1.18.3.3-3 and Table 7.1.1.1.18.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-56E | | | |
| Information Element | Value/remark | Comment | Condition |
| FeatureCombinationPreambles-r17 ::= SEQUENCE { |  |  |  |
| featureCombination-r17 | FeatureCombination-r17 with condition MSG3\_REP |  |  |
| startPreambleForThisPartition-r17 | 4 |  | FR1 |
|  | 2 |  | FR2 |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 4 | RAP index 4,5,6,7 belong to this group | FR1 |
|  | 2 | RAP index 2,3 belong to this group | FR2 |
| msgA-RSRP-Threshold-r17 | Not present |  |  |
| rsrp-ThresholdSSB-r17 | Not present |  |  |
| } |  |  |  |

##### 7.1.1.1.19 Random access procedure / Successful / Beam Failure / Unified TCI

7.1.1.1.19.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with TCI-State\_r17 configured and periodic SRS resource configured, and RACH procedure due to beam failure is triggered }

**ensure that** {

**when** { UE initiates the Random Access Procedure, and receives the first PDCCH in the search space provided by recoverySearchSpaceID}

**then** { UE starts to transmit SRS that associates with the indicated unified TCI state }

}

7.1.1.1.19.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.213 clause 6, TS 38.321, clause 5.1.2, 5.1.3, 5.1.4 and 5.17. Unless otherwise stated these are Rel-17 requirements.

[TS 38.213, clause 6]

For the PCell or the PSCell, a UE can be provided a CORESET through a link to a search space set provided by *recoverySearchSpaceId,* as described in clause 10.1, for monitoring PDCCH in the CORESET. If the UE is provided *recoverySearchSpaceId*, the UE does not expect to be provided another search space set for monitoring PDCCH in the CORESET associated with the search space set provided by *recoverySearchSpaceId*.

For the PCell or the PSCell, the UE can be provided, by *PRACH-ResourceDedicatedBFR*, a configuration for PRACH transmission as described in clause 8.1. For PRACH transmission in slot and according to antenna port quasi co-location parameters associated with periodic CSI-RS resource configuration or with SS/PBCH block associated with index provided by higher layers [11, TS 38.321], the UE monitors PDCCH in a search space set provided by *recoverySearchSpaceId* for detection of a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI starting from slot , where is the SCS configuration for the PRACH transmission and is a number of slots provided by *kmac* [12, TS 38.331] or if *kmac* is not provided, within a window configured by *BeamFailureRecoveryConfig*. For PDCCH monitoring in a search space set provided by *recoverySearchSpaceId* and for corresponding PDSCH receptions, the UE assumes the same antenna port quasi-collocation parameters as the ones associated with index until the UE receives by higher layers an activation for a TCI state or any of the parameters *tci-StatesPDCCH-ToAddList* and/or *tci-StatesPDCCH-ToReleaseList*. After the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI in the search space set provided by *recoverySearchSpaceId*, the UE continues to monitor PDCCH candidates in the search space set provided by *recoverySearchSpaceId* until the UE receives a MAC CE activation command for a TCI state or *tci-StatesPDCCH-ToAddList* and/or *tci-StatesPDCCH-ToReleaseList.*

For the PCell or the PSCell, after 28 symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* for which the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI and until the UE receives an activation command for *PUCCH-SpatialRelationInfo* [11, TS 38.321] or is provided *PUCCH-SpatialRelationInfo* for PUCCH resource(s), the UE transmits a PUCCH on a same cell as the PRACH transmission using

- a same spatial filter as for the last PRACH transmission

- a power determined as described in clause 7.2.1 with , , and

For the PCell or the PSCell and for sets and , after 28 symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* where a UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI, the UE assumes same antenna port quasi-collocation parameters as the ones associated with index for PDCCH monitoring in a CORESET with index 0.

If a UE is provided *dl-OrJointTCI-StateList* or *ul-TCI-StateList* indicating a unified TCI state for the PCell or the PSCell [6, TS 38.214], after 28 symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* where the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI, the UE

- if *SSB-MTC-AdditionalPCI* is not provided, monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS resource in a CSI-RS resource set with same indicated TCI state as for the PDCCH and PDSCH, using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any

- transmits PUSCH, PUCCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUSCH and the PUCCH, using a same spatial domain filter as for the last PRACH transmission using the following parameters for determination of a corresponding power as described in clauses 7.1.1, 7.2.1, and 7.3.1

- the RS index for obtaining the downlink pathloss estimate

- the values of , , and the PUSCH power control adjustment state provided by *p0AlphaSetforPUSCH* associated with the smallest value of *ul-powercontrolId* for the PCell or the PSCell

- the value of and the PUCCH power control adjustment state provided by *p0AlphaSetforPUCCH* associated with the smallest value of *ul-powercontrolId* for the PCell or the PSCell

- the values of , , and the SRS power control adjustment state provided by *p0AlphaSetforSRS* associated with the smallest value of *ul-powercontrolId* for the PCell or the PSCell

For the remaining of this clause, if a PDCCH reception includes two PDCCH candidates from two linked search space sets based on *searchSpaceLinkingId*, as described in clause 10.1, the last symbol of the PDCCH reception is the last symbol of the PDCCH candidate that ends later. The PDCCH reception includes the two PDCCH candidates also when the UE is not required to monitor one of the two PDCCH candidates as described in clauses 10 (except clause 10.4), 11.1, 11.1.1 and 17.2.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided by RRC and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided by RRC and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if the *RA\_TYPE* is switched from *2-stepRA* to *4-stepRA*:

3> if a Random Access Preambles group was selected during the current Random Access procedure:

4> select the same group of Random Access Preambles as was selected for the 2-step RA type.

3> else:

4> if Random Access Preambles group B is configured; and

4> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

2> else if Msg3 buffer is empty:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC subheader(s) and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, or *ssb-SharedRO-MaskIndex* if configured, or indicated by PDCCH (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the SSB which is quasi-colocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-colocated with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers regardless the FR2 UL gap, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see clause 5.1.3).

NOTE 1: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

NOTE 2: Void.

NOTE 3: If a RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode is configured with a BWP indicated by *initialDownlinkBWP-RedCap* which is not associated with any SSB, SS-RSRP measurement is performed based on the SSB associated with the BWP indicated by *initialDownlinkBWP*. If a RedCap UE in RRC\_INACTIVE mode is configured with SDT and with a BWP indicated by *initialDownlinkBWP-RedCap* which is associated with NCD-SSB, SS-RSRP measurement can also be performed based on this NCD-SSB during SDT.

NOTE 4: If a RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode is configured with a BWP indicated by *initialDownlinkBWP-RedCap* which is not associated with any SSB for RACH, it is up to the UE implementation to perform a new RSRP measurements before Msg1/MsgA retransmission.

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> if the contention-free Random Access Preamble for beam failure recovery request was transmitted on a non-terrestrial network:

3> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the PDCCH occasion as specified in TS 38.213 [6].

2> else:

3> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission.

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> if the Random Access Preamble was transmitted on a non-terrestrial network:

3> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the PDCCH occasion as specified in TS 38.213 [6].

2> else:

3> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission.

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access procedure for an SCell is performed on uplink carrier where *pusch-Config* is not configured:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

7> if there is at least one Serving Cell of this MAC entity configured with two BFD-RS sets:

8> indicate to the Multiplexing and assembly entity to include an Enhanced BFR MAC CE or a Truncated Enhanced BFR MAC CE in the subsequent uplink transmission.

7> else:

8> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

6> else if the Random Access procedure was initiated for beam failure recovery of both BFD-RS sets of SpCell:

7> indicate to the Multiplexing and assembly entity to include an Enhanced BFR MAC CE or a Truncated Enhanced BFR MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

NOTE: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of contention-based Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behavior is not defined.

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted; or

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on an SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see clause 5.1.2).

3> else if the Random Access procedure for an SCell is performed on uplink carrier where *pusch-Config* is not configured:

4> delay the subsequent Random Access transmission until the Random Access Procedure is triggered by a PDCCH order with the same *ra-PreambleIndex*, *ra-ssb-OccasionMaskIndex*, and UL/SUL indicator TS 38.212 [9].

3> else:

4> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response reception.

[TS 38.214, clause 6.2.1]

The UE may be configured with one or more Sounding Reference Signal (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet* or *SRS-PosResourceSet*. For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS resource set is configured with the higher layer parameter *SRS-PosResourceSet,* a UE may be configured with *K* ≥1 SRS resources (higher layer parameter *SRS-PosResource*), where the maximum value of K is 16. The SRS resource set applicability is configured by the higher layer parameter *usage* in *SRS-ResourceSet.* When the higher layer parameter *usage* is set to 'beamManagement'*,* only one SRS resource in each of multiple SRS resource sets may be transmitted at a given time instant, but the SRS resources in different SRS resource sets with the same time domain behaviour in the same BWP may be transmitted simultaneously.

During non-active periods of cell DRX, the UE configured with cell DRX is not expected to transmit the periodic SRS, or semi-persistent SRS for channel acquisition. SRS for positioning is not impacted by cell DRX operation.

For the SRS resource set(s) configured *in srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* set to '*antennaSwitching*' or '*beamManagement*', the UE expects the same SRS resource set(s) with the same *usage* being configured in *srs-ResourceSetToAddModList.*

When the UE is configured *dl-OrJointTCI-StateList* or *ul-TCI-StateList,* the UE can assume that SRS resource(s) in any SRS resource set, except SRS resource set for positioning and an SRS resource set configured with *followUnifiedTCI-StateSRS*, can be configured with *TCI-State* or *TCI-UL-State* or updated as described in clause 6.1.3.59 or 6.1.3.60 of [10, TS 38.321]. The reference RS in the *TCI-State* can be a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*. The reference RS in the *TCI-UL-State*(s) can be a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*, an SRS resource with the higher layer parameter *usage* set to 'beamManagement', or SS/PBCH block associated with the same or different PCI from the PCI of the serving cell.

If an SRS resource set, except an SRS resource set for positioning, is configured with *followUnifiedTCI-StateSRS*, the UE shall transmit the target SRS resource(s) within the SRS resource set according to the spatial relation, if applicable, with a reference to the RS used for determining UL TX spatial filter. The RS is determined based on an RS configured with *qcl-Type* set to 'typeD' in *QCL-Info* of the indicated *TCI-State* or an RS in the indicated *TCI-UL-State*. The reference RS in the indicated *TCI-State* can be a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info.* The reference RS in the indicated *TCI-UL-State* can be a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info,* an SRS resource with the higher layer parameter *usage* set to 'beamManagement', or SS/PBCH block associated with the same or different PCI from the PCI of the serving cell.

When the UE is configured *dl-OrJointTCI-StateList* or *TCI-UL-State* and is having two indicated TCI-States or TCI-UL-States, and if the UE is configured with [[*followUnifiedTCI-StateSRS]]* to*,* a periodic, semi-persistent or aperiodic SRS resource set with higher layer parameter *usage* in *SRS-ResourceSet* set to ‘*codebook*’, ‘*nonCodebook*’ or ‘*antennaSwitching*’ or to an aperiodic SRS resource set with higher layer parameter *usage* in *SRS-ResourceSet* set to ‘*beamManagement*’

- The UE may be configured by higher layer parameter *applyIndicatedTCIState* to the SRS resource set to indicate whether the UE shall apply the first or the second indicated *TCI-State* or *TCI-UL-State* to the SRS resource set.

- When a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, the first and second indicated *TCI-States* or *TCI-UL-States* correspond to the indicated *TCI-States* or *TCI-UL-States* specific to *coresetPoolIndex* value 0 and value 1, respectively.

- When a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, and the aperiodic SRS resource set which is not configured with higher layer parameter *applyIndicatedTCIState* and the aperiodic SRS resource set is triggered by PDCCH on a CORESET associated with a *coresetPoolIndex* value, the UE shall apply the indicated *TCI-State* or *TCI-UL-State* specific to the *coresetPoolIndex* value to the aperiodic SRS resource set.

- When two SRS resource sets with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' or ‘nonCodebook’ are configured, the UE does not expectthat the first indicated *TCI-State* or *TCI-UL-State* is applied to the second SRS resource set and that the second indicated *TCI-State* or *TCI-UL-State* is applied to the first SRS resource set.

For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set(s).

7.1.1.1.19.3 Test description

7.1.1.1.19.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.1.19.3.2 Test procedure sequence

Table 7.1.1.1.19.3.2-1 illustrates the downlink power levels and other changing parameters to be applied for the cells at various time instants of the test execution. Row marked "T0" denotes the initial conditions after preamble, while columns marked "T1" is to be applied subsequently. The exact instants on which these values shall be applied are described in the texts in this clause.

Table 7.1.1.1.19.3.2-1: Time instances of cell power level and parameter changes for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | E-UTRA Cell 1 | NR Cell 1 | NR Cell 1 Beam index #1 | NR Cell 1  Beam index #0 | Remark |
| T0 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE | dB | - | - | 0 | -63 |
| T1 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch OFF and Beam#0 Switch ON |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE | dBm/SCS | - | - | -63 | 0 |
| NOTE: "Beam index #1" refers to transmission of the SS/PBCH block with SSB index #1 (according to the ssb-PositionsInBurst) and CSI-RS with index #1 (according to the CSI-MeasConfig being signalled to the UE at step 1/8); "Beam index #0" refers to transmission of the SS/PBCH block with SSB index #0 (according to the ssb-PositionsInBurst) and CSI-RS with index #0 (according to the CSI-MeasConfig being signalled to the UE at step 1/8). | | | | | | | |

Table 7.1.1.1.19.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an NR *RRCReconfiguration* message to establish random access resources for BFR associated with SS blocks explicitly. Note 1. | <-- | NR RRC: RRCReconfiguration | - | - |
| 2 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: RRCReconfigurationComplete | - | - |
| 3 | The SS changes NR Cell 1 power level according to the row "T1" in table 7.1.1.1.19.3.2-1/1A. | - | - | - | - |
| 4 | UE transmit preamble on PRACH using a preamble with PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected SS block provided by RRC on NR Cell 1 Beam index #0. | --> | PRACH Preamble | - | - |
| 5 | The SS transmits a MAC PDU addressed to UE C-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 6 | UE receives the first PDCCH transmission on the search space indicated by recoverySearchSpaceId of the SpCell identified by the C-RNTI before ra-ResponseWindow expire. | - | - | - | - |
| 7 | Check: Does UE start to transmit SRS that associates with the indicated unified TCI state? | - | - | 1 | P |
| 8 | The SS waits for ra-ResponseWindowBFR expire. | - | - | - | - |
| 9 | UE not retransmit a preamble on PRACH. | - | - | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration* 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: for EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete*. | | | | | |

7.1.1.1.19.3.3 Specific message contents

Table 7.1.1.1.19.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.1.19.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration::=SEQUENCE{ |  |  |  |
| criticalExtensions CHOICE{ |  |  |  |
| rrcReconfiguration SEQUENCE{ |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-2: *CellGroupConfig* (Table 7.1.1.1.19.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-3: *ServingCellConfig* (Table 7.1.1.1.19.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| initialDownlinkBWP | BWP-DownlinkDedicated |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-4: *BWP-DownlinkDedicated* (Table 7.1.1.1.19.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-DownlinkDedicated ::= SEQUENCE { |  |  |  |
| pdcch-Config CHOICE { |  |  | Step 1 |
| setup | PDCCH-Config |  |  |
| } |  |  |  |
| pdsch-Config CHOICE { |  |  |  |
| setup | PDSCH-Config |  |  |
| } |  |  |  |
| radioLinkMonitoringConfig CHOICE { |  |  |  |
| setup | RadioLinkMonitoringConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-5: RadioLinkMonitoringConfig(Table 7.1.1.1.19.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-133 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioLinkMonitoringConfig ::= SEQUENCE { |  |  |  |
| failureDetectionResourcesToAddModList SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS { | 1 entry |  |  |
| RadioLinkMonitoringRS[1] SEQUENCE { |  |  |  |
| radioLinkMonitoringRS-Id | 0 |  |  |
| purpose | both |  |  |
| detectionResource CHOICE { |  |  |  |
| csi-rs | 0 | NR Cell 1 Beam index #0 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| beamFailureInstanceMaxCount | n1 |  |  |
| beamFailureDetectionTimer | pbfd1 |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-6: *PDSCH-Config* (Table 7.1.1.1.19.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| unifiedTCI-StateRef-r17 | ServingCellAndBWP-Id-r17 |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-7: ServingCellAndBWP-Id-r17 (Table 7.1.1.1.19.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellAndBWP-Id-r17 ::= SEQUENCE { |  |  |  |
| servingcell-r17 | Cell ID |  |  |
| bwp-r17 | BWP ID |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-8: *PDCCH-Config* (Table 7.1.1.1.19.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 2 entries |  |  |
| ControlResourceSet[1] | ControlResourceSetid1 | entry 1 |  |
| ControlResourceSet[2] | ControlResourceSetid2 | entry 2 |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace { | 2 entries |  |  |
| SearchSpace[1] | SearchSpace with condition USS | entry 1 |  |
| SearchSpace[2] | SearchSpaceBFR | entry 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-9: *ControlResourceSetId1* (Table 7.1.1.1.19.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| tci-StatesPDCCH-ToReleaseList SEQUENCE (SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId { | 1 entry |  | Step 1 |
| TCI-StateId[1] | 2 | entry 1  TCI-State Id 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-10: *ControlResourceSetId2* (Table 7.1.1.1.19.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 2 |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-11: *SearchSpaceBFR* (Table 7.1.1.1.19.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-162 | | | |
| Information Element | Value/remark | Comment | Condition |
| SearchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceId | 4 |  |  |
| controlResourceSetId | 2 |  |  |
| searchSpaceType CHOICE { |  |  |  |
| ue-Specific SEQUENCE { |  |  |  |
| dci-Formats | formats0-0-And-1-0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-12: *BWP-UplinkDedicated* (Table 7.1.1.1.19.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup | PUSCH-Config |  |  |
| } |  |  |  |
| srs-Config CHOICE { |  |  |  |
| setup | SRS-Config |  |  |
| } |  |  |  |
| beamFailureRecoveryConfig | BeamFailureRecoveryConfig\_SSB |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-13: *SRS-Config* (Table 7.1.1.1.19.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-182 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SRS-Config ::= SEQUENCE { |  |  |  |
| srs-ResourceSetToAddModList SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet{ |  |  |  |
| SRS-ResourceSet[1] SEQUENCE { |  | entry 1 |  |
| followUnifiedTCI-StateSRS-r17 | enabled |  |  |
| } |  |  |  |
| } |  |  |  |
| srs-ResourceToReleaseList | Not present |  |  |
| srs-ResourceToAddModList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-Resource { | 1 entry |  |  |
| SRS-Resource[1] SEQUENCE { |  | entry 1 |  |
| resourceType CHOICE { |  |  |  |
| periodic SEQUENCE { |  |  |  |
| periodicityAndOffset-p | SRS-PeriodicityAndOffset |  |  |
| } |  |  |  |
| } |  |  |  |
| sequenceId | 0 |  |  |
| spatialRelationInfo SEQUENCE { | SRS-SpatialRelationInfo |  |  |
| servingCellId | Not present |  |  |
| referenceSignal CHOICE { |  |  |  |
| ssb-Index | 0 | SSB index #0 |  |
| } |  |  |  |
| } |  |  |  |
| srs-TCI-State-r17 CHOICE { |  |  |  |
| srs-UL-TCI-State | INTEGER (0..63) |  |  |
| } |  |  |  |
| } |  |  |  |
| tpc-Accumulation | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-14: *SRS-PeriodicityAndOffset* (Table 7.1.1.1.19.3.3-13)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| SRS-PeriodicityAndOffset ::= SEQUENCE { |  |  |  |
| slots320 | 41 |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-15: *BeamFailureRecoveryConfig\_SSB* (Table 7.1.1.1.19.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-6 | | | |
| Information Element | Value/remark | Comment | Condition |
| BeamFailureRecoveryConfig ::= SEQUENCE { |  |  |  |
| rootSequenceIndex-BFR | 0 | See TS 38.508-1 [4] clause 4.4.2, Table 4.4.2-2 |  |
| rach-ConfigBFR | RACH-ConfigGeneric | 38.508-1 [4] Table 4.6.3-130 |  |
| rsrp-ThresholdSSB | 57(-99dBm) |  |  |
| candidateBeamRSList SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR CHOICE{ |  |  |  |
| ssb SEQUENCE { |  |  |  |
| ssb | 0 | NR Cell Beam#0 |  |
| ra-PreambleIndex | 56 | (0..63) |  |
| } |  |  |  |
| } |  |  |  |
| ssb-perRACH-Occasion | one |  |  |
| ra-ssb-OccasionMaskIndex | 0 |  |  |
| recoverySearchSpaceID | 4 |  |  |
| ra-Prioritization | Not Present |  |  |
| beamFailureRecoveryTimer | ms200 |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-16: *PUCCH-Config* (Table 7.1.1.1.19.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| pucch-Config::= SEQUENCE { |  |  |  |
| pucch-PowerControl SEQUENCE { |  |  |  |
| pathlossReferenceRSs SEQUENCE (SIZE (1..maxNrofPUCCH-PathlossReferenceRSs)) OF PUCCH-PathlossReferenceRS { | 1 entry |  |  |
| PUCCH-PathlossReferenceRS[1] SEQUENCE { |  | entry 1 |  |
| referenceSignal CHOICE { |  |  |  |
| ssb-Index | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.19.3.3-17: *PUSCH-Config* (Table 7.1.1.1.19.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| pusch-Config::= SEQUENCE { |  |  |  |
| pusch-PowerControl SEQUENCE { |  |  |  |
| pathlossReferenceRSToAddModList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS { | 1 entry |  |  |
| PUSCH-PathlossReferenceRS[1] SEQUENCE { |  | entry 1 |  |
| referenceSignal CHOICE{ |  |  |  |
| ssb-Index | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

#### 7.1.1.2 Downlink Data Transfer

##### 7.1.1.2.1 Correct Handling of DL MAC PDU / Assignment / HARQ process

7.1.1.2.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives downlink assignment on the PDCCH for the UE’s C-RNTI and receives data in the associated Slot and UE performs HARQ operation }

**then** { UE sends a HARQ feedback on the HARQ process }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS transmits downlink assignment on the PDCCH with a C-RNTI unknown by the UE and data is available in the associated Slot }

**then** { UE does not send any HARQ feedback on the HARQ process }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { the UE receives a MAC PDU addressed to its C-RNTI and decode fails in the associated Slot }

**then** { the UE transmits a NACK for the corresponding HARQ process }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { the UE receives a MAC PDU retransmission addressed to its C-RNTI, and results in successful decode in the associated Slot}

**then** { the UE transmits an ACK for the corresponding HARQ process and forward to higher layer }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU containing multiple MAC sub PDUs each containing a MAC SDU that is larger than 256 bytes (16 bits L field used) with padding MAC sub PDU at the end }

**then** { UE successfully decodes the MAC PDU and forward to higher layer }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU containing multiple MAC sub PDUs each containing a MAC SDU that is smaller than 256 bytes (8 bits L field used) with padding MAC sub PDU at the end }

**then** { UE successfully decodes the MAC PDU and forward to higher layer }

}

(7)

**with** { UE in RRC\_CONNECTED state }

ensure that {

**when** { UE receives a MAC PDU containing MAC sub PDU containing a MAC SDU and no padding MAC sub PDU}

**then** { UE successfully decodes the MAC PDU and forward to higher layer }

}

(8)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU containing MAC sub PDU containing a MAC SDU that is smaller than 256 bytes (8 bits L field used) plus MAC sub PDU containing a MAC SDU that is greater than 256 bytes (16 bits L field used)and no padding }

**then** { UE successfully decodes the MAC PDU and forwards the AMD PDUs to higher layer }

}

(9)

**with** { UE in RRC\_CONNECTED state and configured with a specific *TDD-UL-DL-ConfigCommon* including configuration of *pattern2*}

**ensure that** {

**when** { UE receives downlink assignment on the PDCCH associated with *pattern2* for the UE’s C-RNTI and receives data in the associated Slot and UE performs HARQ operation }

**then** { UE sends a HARQ feedback on the HARQ process }

}

7.1.1.2.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.3.1, 5.3.2.1, 5.3.2.2 and 6.1.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity’s C-RNTI, or Temporary C‑RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity’s C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity’s CS-RNTI or a configured downlink assignment:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity’s CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the timeAlignmentTimer associated with the PTAG is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in subclause 5.8.1;

4> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> indicate the presence of a configured downlink assignment for this Serving Cell and deliver the stored HARQ information to the HARQ entity.

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (numberOfSlotsPerFrame × semiPersistSchedIntervalDL))] modulo nrofHARQ-Processes

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or more (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode;

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

[TS 38.321, clause 6.1.2]

A MAC PDU consists of one or more MAC subPDUs. Each MAC subPDU consists of one of the following:

- A MAC subheader only (including padding);

- A MAC subheader and a MAC SDU;

- A MAC subheader and a MAC CE;

- A MAC subheader and padding.

The MAC SDUs are of variable sizes.

Each MAC subheader corresponds to either a MAC SDU, a MAC CE, or padding.

A MAC subheader except for fixed sized MAC CE and padding consists of the four header fields R/F/LCID/L. A MAC subheader for fixed sized MAC CE and padding consists of the two header fields R/LCID.



Figure 6.1.2-1: R/F/LCID/L MAC subheader with 8-bit L field



Figure 6.1.2-2: R/F/LCID/L MAC subheader with 16-bit L field



Figure 6.1.2-3: R/LCID MAC subheader

MAC CEs are placed together. DL MAC subPDU(s) with MAC CE(s) is placed before any MAC subPDU with MAC SDU and MAC subPDU with padding as depicted in Figure 6.1.2-4. UL MAC subPDU(s) with MAC CE(s) is placed after all the MAC subPDU(s) with MAC SDU and before the MAC subPDU with padding in the MAC PDU as depicted in Figure 6.1.2-5. The size of padding can be zero.



Figure 6.1.2-4: Example of a DL MAC PDU



Figure 6.1.2-5: Example of a UL MAC PDU

A maximum of one MAC PDU can be transmitted per TB per MAC entity.

7.1.1.2.1.3 Test description

7.1.1.2.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and parameters as in Table 7.1.1.2.1.3.1-1.

Table 7.1.1.2.1.3.1-1: MAC Parameters

|  |  |
| --- | --- |
| nrofHARQ-ProcessesForPDSCH | n16 |

7.1.1.2.1.3.2 Test procedure sequence

Table 7.1.1.2.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE | <-- | (PDCCH (C-RNTI)) | - | - |
| 2 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 1 | P |
| 4 | SS transmits a downlink assignment to including a C-RNTI different from the assigned to the UE | <-- | (PDCCH (unknown C-RNTI)) | - | - |
| 5 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE send any HARQ ACK/NACK on PUCCH? | --> | HARQ ACK/NACK | 2 | F |
| - | EXCEPTION: Steps 7 to 10 are run repeated using test parameter values as given for each iteration in table 7.1.1.2.1.3.2.-2. | - | - | - | - |
| 7 | The SS indicates a new transmission on PDCCH and transmits a MAC PDU including a RLC PDU with poll bit not set, with content set so that UE could not successfully decode the data from its soft buffer. (Note 1) | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | 3 | P |
| - | EXCEPTION: Step 9 shall be repeated till HARQ ACK is received at step 10 or until HARQ retransmission count = 4 is reached for MAC PDU at step 9 (Note 2). | - | - | - | - |
| 9 | The SS indicates a retransmission on PDCCH and transmits the same MAC PDU like step 7 (Note 1). | <-- | MAC PDU | - | - |
| - | EXCEPTION: Up to [3] HARQ NACK from the UE should be allowed at step 10 (Note 2). | - | - | - | - |
| 10 | Check: Does the UE send a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 11 | The SS transmits a MAC PDU containing three MAC sub PDUs each containing a MAC SDU(RLC PDU) that is of 260 bytes (16 bits L field used) and a padding MAC sub PDU at the end. The third RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of all the AMD PDUs in step 11? | --> | MAC PDU (RLC STATUS PDU ) | 5 | P |
| 13 | The SS transmits a MAC PDU containing three MAC sub PDUs each containing a MAC SDU(RLC PDU) that is of 128 bytes (8 bits L field used) and a padding MAC sub PDU at the end. The third RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 14 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of all the AMD PDUs in step 13? | --> | MAC PDU (RLC STATUS PDU ) | 6 | P |
| 15 | The SS transmits a MAC PDU containing one MAC sub PDU containing a MAC SDU(RLC PDU) that is of [128] bytes (8 bits L field used) and no padding MAC sub PDU at the end. The RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 16 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 15? | --> | MAC PDU (RLC STATUS PDU ) | 7 | P |
| 17 | The SS transmits a MAC PDU containing one MAC sub PDU containing a MAC SDU(RLC PDU) that is of [128] bytes (8 bits L field used), one MAC sub PDU containing a MAC SDU(RLC PDU) that is of [260] bytes (16 bits L field used) and no padding MAC sub PDU at the end. The second RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 18 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of all the AMD PDUs in step 17? | --> | MAC PDU (RLC STATUS PDU ) | 8 | P |
| - | EXCEPTION : Steps 19a0 to 19a5 are executed for operation on NR TDD band only | - | *-* | - | - |
| 19a0 | The SS transmits an updated system information as specified in Table 7.1.1.3.1.3.3-14. (Note 5) | - | *-* | - | - |
| 19a1 | The SS transmits NR RRCReconfiguration message including *TDD-UL-DL-ConfigCommon* with *pattern1 and pattern2* specified in Table 7.1.1.2.1.3.3-5 (Note 3) | <-- | *RRCReconfiguration* | - | - |
| 19a2 | The UE transmits a NR *RRCReconfigurationComplete* message.  (Note 4) | --> | *RRCReconfigurationComplete* | - | - |
| 19a3 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE indicating downlink reception in a symbol in a slot part of pattern2. | <-- | (PDCCH (C-RNTI)) | - | - |
| 19a4 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 19a5 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 9 | P |
| Note 1: SS should transmit this PDU so as to ensure at least one NACK.  Note 2: The value 4 for the maximum number of HARQ retransmissions has been chosen based on an assumption that, given the radio conditions used in this test case, a UE soft combiner implementation should have sufficient retransmissions to be able to successfully decode the data in its soft buffer.  Note 3: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 4: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 5: if pc\_NG\_RAN\_NR only | | | | | |

Table 7.1.1.2.1.3.2-2: Test Parameters

|  |  |
| --- | --- |
| Iteration | DL HARQ process (X) |
| K=1 to 16 | X=K-1 |

7.1.1.2.1.3.3 Specific message contents

Table 7.1.1.2.1.3.3-1: *Void*

Table 7.1.1.2.1.3.3-2: *RRCReconfiguration* (step19a1, Table 7.1.1.2.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-131 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-3: *CellGroupConfig* (Table 7.1.1.2.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-4, 7.1.1.2.1.3.3-13: *ServingCellConfigCommon (*Table 7.1.1.2.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-5: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.2.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 |
|  | 2 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 |
|  | 2 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms2 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 4 |  | FR1 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 0 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 0 |  | FR1 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 0 |  | FR1 |
|  | 2 |  | FR2 |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-6: *BWP-UplinkCommon (*Table 7.1.1.2.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-7: *RACH-ConfigCommon (*Table 7.1.1.2.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-8: *RACH-ConfigGeneric (*Table 7.1.1.2.1.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-configurationIndex | 156 |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-9: ServingCellConfig (Table 7.1.1.2.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-10: *BWP-UplinkDedicated* (Table 7.1.1.2.1.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-11: *PUCCH-Config* (Table 7.1.1.2.1.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig[1] | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-12: *SchedulingRequestResourceConfig* (Table 7.1.1.2.1.3.3-11)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 5 | With SCS = kHz15 results in repetition every 10 ms | SCS\_15kHz |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS\_30kHz |
| sl80 | 5 | With SCS = kHz120 results in repetition every 10 ms | SCS\_120kHz |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-13: *SystemInformationBlockType1* (step 19a0, Table 7.1.1.2.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.2.1.3.3-5 |  |
| } |  |  |  |

##### 7.1.1.2.2 Correct Handling of DL HARQ process PDSCH Aggregation

7.1.1.2.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and pdsch-AggregationFactor > 1 }

**ensure that** {

**when** { UE receives downlink assignment on the PDCCH for the UE’s C-RNTI and receives data in the associated slot and successive pdsch-AggregationFactor – 1 HARQ retransmissions within a bundle and UE performs HARQ operation }

**then** { UE sends a HARQ feedback on the HARQ process }

}

7.1.1.2.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.3.1, 5.3.2.1 and 5.3.2.2, TS 38.214, clause 5.1.2.1.

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, or Temporary C‑RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity's C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's CS-RNTI or a configured downlink assignment:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the timeAlignmentTimer associated with the PTAG is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in subclause 5.8.1;

4> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> indicate the presence of a configured downlink assignment for this Serving Cell and deliver the stored HARQ information to the HARQ entity.

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (*numberOfSlotsPerFrame* × *periodicity*))] modulo *nrofHARQ-Processes*

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Position* = 3 | | | | | | |

When the UE is configured with *aggregationF*actorDL > 1, the same symbol allocation is applied across the *aggregationFactorDL* consecutive slots. The UE may expect that the TB is repeated within each symbol allocation among each of the *aggregationFactorDL* consecutive slots and the PDSCH is limited to a single transmission layer. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 5.1.2.1-2.

Table 5.1.2.1-2: Applied redundancy version when *aggregationFactorDL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PDSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration as defined in Subclause 11.1 of [6, TS 38.213] determines symbol of a slot allocated for PDSCH as uplink symbols, the transmission on that slot is omitted for multi-slot PDSCH transmission.

The UE is not expected to receive a PDSCH with mapping type A in a slot, if the PDCCH scheduling the PDSCH was received in the same slot and was not contained within the first three symbols of the slot.

The UE is not expected to receive a PDSCH with mapping type B in a slot, if the first symbol of the PDCCH scheduling the PDSCH was received in a later symbol than the first symbol indicated in the PDSCH time domain resource allocation.

7.1.1.2.2.3 Test description

7.1.1.2.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and parameters as in Table 7.1.1.2.2.3.1-1.

Table 7.1.1.2.2.3.1-1: Void

7.1.1.2.2.3.2 Test procedure sequence

Table 7.1.1.2.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits in the indicated downlink assignment an NR RRCReconfiguration. (Note 1) | <-- | - | - | - |
| 2 | UE transmits NR RRCReconfigurationComplete message to the SS. (Note 2) | --> | - | - | - |
| 3 | The SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, the rv\_idx is 0. | <-- | - | - | - |
| 4 | The SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set, The CRC is calculated in such a way, it will result in CRC error on UE side. | <-- | MAC PDU | - | - |
| 5 | In the following 3 consecutive slots, the SS transmits on the same downlink assignment the same MAC PDU as in step 4, The CRC is calculated in such a way, it will result in CRC error on UE side. (Note3) | <-- | MAC PDU | - | - |
| 5A | Void | - | - | - | - |
| 6 | Check: Does the UE transmit a HARQ NACK on slot n3+k1? (Note 4) | --> | HARQ NACK | 1 | P |
| 7 | The SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, the rv\_idx is 0. | <-- | - | - | - |
| 8 | The SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set, The CRC is calculated in such a way, it will result in CRC pass on UE side. | <-- | MAC PDU | - | - |
| 9 | In the following 3 consecutive slots, the SS transmits on the same downlink assignment the same MAC PDU as in step 8, The CRC is calculated in such a way, it will result in CRC pass on UE side. (Note3) | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK on slot n3+k1? (Note 4) | --> | HARQ ACK | 1 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For *aggregationF*actorDL=4, the PDSCH will repeat in following 4-1=3 slots with same resource allocation but different redundancy version, if the slot can be used for downlink transmission.  Note 4: n0 is the index of slot when 1st transmission of MAC PDU in step 4/8 happens, n1, n2, n3 are indices of slots when 2nd, 3rd, 4th transmission of MAC PDU in step 5/9 may happen, k1 is obtained from "PDSCH-to-HARQ\_feedback timing indicator" of downlink assignment in step 3/7. | | | | | |

7.1.1.2.2.3.3 Specific message contents

Table 7.1.1.2.2.3.3-1: RRCReconfiguration(step 1, Table 7.1.1.2.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs ::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.2.3.3-2: cellGroupConfig (Table 7.1.1.2.2.3.3-1: RRCReconfiguration)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  |  |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig SEQUENCE { |  |  |  |
| initialDownlinkBWP SEQUENCE { |  |  |  |
| pdsch-Config SEQUENCE { |  |  |  |
| pdsch-AggregationFactor | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.2.3.3-3: Physical layer parameters for DCI format 1\_1 (Steps 3, 7, Table 7.1.1.2.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.3.6.1.2.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| PDSCH-to-HARQ\_feedback timing indicator | Corresponding to K1=5 slots as per dl-DataToUL-ACK in Table 4.6.3-112 TS 38.508-1 [4]. | “011”B |  |

##### 7.1.1.2.3 Correct HARQ process handling / CCCH

7.1.1.2.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to RA-RNTI }

**then** { UE does not transmit the HARQ feedback for the corresponding HARQ process }

}

(2)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to T-CRNTI without UE Contention Resolution Identity corresponding the transmitted RRCSetupRequest message }

**then** { UE does not transmit the HARQ feedback for the corresponding HARQ process }

}

(3)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to T-CRNTI and cannot decode properly }

**then** { UE does not transmit the HARQ feedback for the corresponding HARQ process }

}

(4)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to T-CRNTI with UE Contention Resolution Identity corresponding the transmitted RRCSetupRequest message }

**then** { UE transmits the HARQ ACK for the corresponding HARQ process }

}

7.1.1.2.3.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.3.2.1 and 5.3.2.2.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

NOTE: If the MAC entity receives a retransmission with a TB size different from the last TB size signalled for this TB, the UE behavior is left up to UE implementation.

7.1.1.2.3.3 Test description

7.1.1.2.3.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None

Preamble:

- The UE is in 1N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) according to TS 38.508-1 [4].

7.1.1.2.3.3.2 Test procedure sequence

Table 7.1.1.2.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a Paging message including a matched identity. | <-- | - | - | - |
| 2 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 3 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. The CRC is calculated in such a way, it will result in CRC error on UE side. | <-- | Random Access Response | - | - |
| 4 | Check: does the UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 1 | F |
| 5 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 6 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. The CRC is calculated in such a way, it will result in CRC pass on UE side. | <-- | Random Access Response | - | - |
| 7 | Check: does the UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 1 | F |
| 8 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU | - | - |
| 9 | The SS transmits a valid MAC PDU containing *RRCSetup*, and including ‘UE Contention Resolution Identity’ MAC control element with not matching ‘Contention Resolution Identity’. | <-- | MAC PDU | - | - |
| 10 | Check: does the UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 2 | F |
| 11 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 12 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. | <-- | Random Access Response | - | - |
| 13 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU | - | - |
| 14 | The SS transmits a valid MAC PDU containing *RRCSetup*, and including ‘UE Contention Resolution Identity’ MAC control element with matching ‘Contention Resolution Identity’. The CRC is calculated in such a way that it will result in CRC error on UE side. | <-- | MAC PDU | - | - |
| 15 | Check: Does UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 3 | F |
| 16 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 17 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. | <-- | Random Access Response | - | - |
| 18 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU | - | - |
| 19 | The SS transmits a valid MAC PDU containing *RRCSetup*, and including ‘UE Contention Resolution Identity’ MAC control element with matching ‘Contention Resolution Identity’. The CRC is calculated in such a way that it will result in CRC pass on UE side. | <-- | MAC PDU | - | - |
| 20 | Check: does the UE transmit a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 21 | The UE transmits a MAC PDU containing an *RRCSetupComplete* message including SERVICE REQUEST message indicating acceptance of *RRCSetup* message | --> | MAC PDU | - | - |
| 22-25 | Steps 5 to 8 of the generic radio bearer establishment procedure (TS 38.508 table 4.5.4.2-3) are executed to successfully complete the service request procedure. | - | - | - | - |

7.1.1.2.3.3.3 Specific message contents

None.

##### 7.1.1.2.4 Correct HARQ process handling / BCCH

7.1.1.2.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU addressed to SI-RNTI on the broadcast HARQ process }

**then** { UE does not transmit the HARQ feedback for the broadcast HARQ process }

}

7.1.1.2.4.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.3.2.1 and 5.3.2.2.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

NOTE: If the MAC entity receives a retransmission with a TB size different from the last TB size signalled for this TB, the UE behaviour is left up to UE implementation.

7.1.1.2.4.3 Test description

7.1.1.2.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Short\_DCI condition is applied in NR Serving cell configuration.

7.1.1.2.4.3.2 Test procedure sequence

Table 7.1.1.2.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a Short message on PDCCH using P-RNTI indicating a systemInfoModification. (Note 1) | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 2 | At the start of the modification period, the SS transmits an updated system information with SI-RNTI addressed in L1/L2 header. CRC is calculated in such a way, it will result in CRC fail on UE side. Dedicated HARQ process for broadcast is used. (Note 5) | <-- | - | - | - |
| 3 | Check: Does the UE transmit a HARQ ACK/NACK? (Note 2 and 3) | --> | HARQ ACK/NACK | 1 | F |
| 4 | After 400ms of step 2, the SS transmits an updated system information contents same as in step 2 with SI-RNTI addressed in L1/L2 header. CRC is calculated in such a way, it will result in CRC pass on UE side. Dedicated HARQ process for broadcast is used. | <-- | - | - | - |
| 5 | Check: Does the UE transmit a HARQ ACK/NACK? (Note 2 and 4) | -> | HARQ ACK/NACK | 1 | F |
| 6 | After 100 ms of Step 4, SS is configured to not allocate UL Grants on Scheduling Request. | - | - | - | - |
| 7 | The SS transmits MAC PDU containing an RLC PDU. | <-- | MAC PDU | - | - |
| 8 | The UE transmits a HARQ ACK. | --> | HARQ ACK | - | - |
| 9 | Check: Does the UE transmit PRACH Preamble, using PRACH resources as in new SI? | --> | PRACH Preamble | 1 | P |
| 10 | The SS transmits Random Access Response | <-- | Random Access Response | - | - |
| 11 | The UE transmits a MAC PDU with C-RNTI containing loop backed RLC PDU. | --> | MAC PDU | - | - |
| 12 | SS sends PDCCH transmission for UE C-RNTI to complete contention resolution. | <-- | - | - | - |
| Note 1: The Short Message was transmitted in controlResourceSetZero as Configured in SIB1, need to guarantee that the UE will receive at least one Paging in the Modification Period preceding the SysInfo change, SS should send the Paging message in every eligible PO in this Modification Period.  Note 2: When requested to check HARQ feedback for the dedicated broadcast HARQ process, the SS shall assume the same PUCCH reception requirement as specified in TS 38.213 section 9 for a normal HARQ process.  Note 3: For duration of 400ms, the SS shall check HARQ ACK/NACK for all broadcast SIBs. This duration is sufficient to ensure that SS transmits few times SIBs with CRC corruption.  Note 4: For duration of 100 ms, The SS shall check for HARQ ACK/NACK for all broadcast SIBs. This duration is sufficient to ensure that SS transmits few times SIBs after CRC corruption is removed.  Note 5: The modification period boundaries are defined by SFN values for which SFN mod m = 0, where m is the number of radio frames comprising the modification period. Value of m is caluclated based on the parameters specified in TS 38.508-1 [4] i.e m = (*modificationPeriodCoeff=4)* \* (*defaultPagingCycle=128* | | | | | |

7.1.1.2.4.3.3 Specific message contents

Table 7.1.1.2.4.3.3-1: *SystemInformationBlockType1* (steps 2 and 4 of table 7.1.1.2.4.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| rach-ConfigCommon SEQUENCE { |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | 20 |  | FDD |
| l139 | 2 |  | TDD |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.2.5 Correct HARQ process handling / DL grant prioritization

7.1.1.2.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with two PUCCH-config each corresponds to a PHY priority}

**ensure that** {

**when** { UE receives DL MAC PDU’s with DL grant indicating different priorities }

**then** { UE transmit the HARQ feedback using correct PUCCH resource as per priority}

}

7.1.1.2.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.213 clause 9, 9.2.4. Unless otherwise stated these are Rel-16 requirements.

[TS 38.213, clause 9]

A PUSCH or a PUCCH transmission, including repetitions if any, can be of priority index 0 or of priority index 1. For a configured grant PUSCH transmission, a UE determines a priority index from *phy-PriorityIndex*, if provided. For a PUCCH transmission with HARQ-ACK information corresponding to a SPS PDSCH reception or a SPS PDSCH release, a UE determines a priority index from *harq-CodebookID*, if provided. For a PUCCH transmission with SR, a UE determines the corresponding priority as described in Clause 9.2.4. For a PUSCH transmission with semi-persistent CSI report, a UE determines a priority index from a priority indicator field, if provided, in a DCI format that activates the semi-persistent CSI report. If a priority index is not provided to a UE for a PUSCH or a PUCCH transmission, the priority index is 0.

[TS 38.213, clause 9.1]

If a UE is provided *pdsch-HARQ-ACK-CodebookList*, the UE can be indicated by *pdsch-HARQ-ACK-CodebookList* to generate one or two HARQ-ACK codebooks. If the UE is indicated to generate one HARQ-ACK codebook, the HARQ-ACK codebook is associated with a PUCCH of priority index 0. If a UE is provided *pdsch-HARQ-ACK-CodebookList*, the UE multiplexes in a same HARQ-ACK codebook only HARQ-ACK information associated with a same priority index. If the UE is indicated to generate two HARQ-ACK codebooks

- a first HARQ-ACK codebook is associated with a PUCCH of priority index 0 and a second HARQ-ACK codebook is associated with a PUCCH of priority index 1

[TS 38.213, clause 9.2.4]

A UE can be configured by *SchedulingRequestResourceConfig* a set of configurations for SR in a PUCCH transmission using either PUCCH format 0 or PUCCH format 1. A UE can be configured by *schedulingRequestID-BFR-SCell* a configuration for LRR in a PUCCH transmission using either PUCCH format 0 or PUCCH format 1. The UE can be provided, by *phy-PriorityIndex* in *SchedulingRequestResourceConfig*, a priority index 0 or a priority index 1 for the SR. If the UE is not provided a priority index for SR, the priority index is 0.

7.1.1.2.5.3 Test description

7.1.1.2.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and parameters as in Table 7.1.1.2.5.3.1-1.

Table 7.1.1.2.5.3.1-1: MAC Parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Comment** |
| priorityIndicatorDCI-1-1-r16 | enabled |  |
| pdsch-HARQ-ACK-CodebookList-r16 | dynamic, semiStatic | 2 entries |

7.1.1.2.5.3.2 Test procedure sequence

Table 7.1.1.2.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE with priority indicator =0 | <-- | (PDCCH (C-RNTI) priority Ind =0)  (PDCCH (C-RNTI)) | - | - |
| 2 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit an HARQ ACK on PUCCH associated with priority indicator 0? | --> | HARQ ACK | 1 | P |
| 4 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE with priority indicator =1 | <-- | (PDCCH (C-RNTI) priority Ind =1)  (PDCCH (C-RNTI)) | - | - |
| 5 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit an HARQ ACK on PUCCH associated with priority indicator 1? | --> | HARQ ACK | 1 | P |

7.1.1.2.5.3.3 Specific message contents

None

##### 7.1.1.2.6 Correct Handling of DL MAC PDU / Assignment / HARQ process

7.1.1.2.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and supporting dynamic PUCCH repetition indication. UE is configured with a set of PUCCH resources and resource-specific PUCCH repetition numbers }

**ensure that** {

**when** { UE receives a DCI scheduling PDSCH reception }

**then** { UE transmits HARQ feedback on PUCCH with the repetition number associated with the PUCCH resource indicated by DCI scheduling PDSCH }

}

7.1.1.2.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.213 clause 9.2.6, TS 38.321, clauses 5.3.1, 5.3.2.1, 5.3.2.2 and 6.1.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.213 clause 9.2.6]

A UE can be indicated to transmit a PUCCH over slots using a PUCCH resource, where

- if the PUCCH resource is indicated by a DCI format and includes *pucch-RepetitionNrofSlots*, is provided by *pucch-RepetitionNrofSlots*

- otherwise, is provided by *nrofSlots*

…

For ,

- the UE repeats the PUCCH transmission with the UCI over slots

- a repetition of the PUCCH transmission in each of the slots has a same number of consecutive symbols, as provided by *nrofSymbols*

- a repetition of the PUCCH transmission in each of the slots has a same first symbol, as provided by *startingSymbolIndex* if *subslotLengthForPUCCH* is not provided; otherwise mod(*startingSymbolIndex*, *subslotLengthForPUCCH*)

- the UE is configured by *interslotFrequencyHopping* whether or not to perform frequency hopping for repetitions of the PUCCH transmission in different slots

- if the UE is configured to perform frequency hopping for repetitions of a PUCCH transmission across slots and the UE is not provided *PUCCH-DMRS-Bundling* = 'enabled'

- the UE performs frequency hopping per slot

- the UE transmits the PUCCH starting from a first PRB, provided by *startingPRB*, in slots with even number and starting from a second PRB, provided by *secondHopPRB*, in slots with odd number. The slot indicated to the UE for the first repetition of the PUCCH transmission has number 0 and each subsequent slot until the UE transmits the PUCCH in slots is counted regardless of whether or not the UE transmits the PUCCH in the slot

- the UE does not expect to be configured to perform frequency hopping for a repetition of the PUCCH transmission within a slot

…

- if the UE is not configured to perform frequency hopping for repetitions of a PUCCH transmission across slots and the UE is configured to perform frequency hopping for a repetition of the PUCCH transmission within a slot, the frequency hopping pattern between the first PRB and the second PRB is same within each slot

If the UE determines that, for a repetition of a PUCCH transmission in a slot, the number of symbols available for the PUCCH transmission is smaller than the value provided by *nrofSymbols* for the corresponding PUCCH format, the UE does not transmit the PUCCH repetition in the slot.

A SS/PBCH block symbol is a symbol of an SS/PBCH block with candidate SS/PBCH block index corresponding to the SS/PBCH block index indicated to a UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon* or by *NonCellDefiningSSB* if provided or, if the UE is not provided *dl-OrJointTCI-StateList*, by *ssb-PositionsInBurst* in *SSB-MTCAdditionalPCI* associated to physical cell ID with active TCI states for PDCCH or PDSCH, or for a set of symbols of a slot corresponding to SS/PBCH blocks configured for L1 beam measurement/reporting.

For unpaired spectrum, the UE determines the slots for a PUCCH transmission starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting and having

- an UL symbol, as described in clause 11.1, or flexible symbol that is not SS/PBCH block symbol provided by *startingSymbolIndex* as a first symbol, and

- consecutive UL symbols, as described in clause 11.1, or flexible symbols that are not SS/PBCH block symbols, starting from the first symbol, equal to or larger than a number of symbols provided by *nrofsymbols*

For paired spectrum or supplementary uplink band, the UE determines the slots for a PUCCH transmission as the consecutive slots starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting.

…

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, CS-RNTI, G-RNTI or G-CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, or Temporary C‑RNTI, or G-RNTI configured for multicast MTCH:

…

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

…

[TS 38.321, clause 5.3.2.2]

…

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

…

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

7.1.1.2.6.3 Test description

7.1.1.2.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.2.6.3.2 Test procedure sequence

Table 7.1.1.2.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits an *RRCReconfiguration* message to configure 2 PUCCH resources associated with resource specific repetition factors. | <-- | NR RRC: RRCReconfiguration | - | - |
| 2 | UE transmits an *RRCReconfigurationComplete* message. | --> | NR RRC: RRCReconfigurationComplete | - | - |
| 3 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, which indicates UE to use PUCCH resource #0 for HARQ feedback. | <-- | DCI format 1\_1(UE C-RNTI, PUCCH resource indicator = “000”) | - | - |
| 4 | SS transmits in the indicated downlink assignment a MAC PDU including an RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit HARQ ACK N0 times using PUCCH resource #0?  NOTE: Value of N0 is given by the pucch-RepetitionNrofSlots-r17 associated to PUCCH resource #0. | --> | HARQ ACK/NACK | 1 | P |
| 6 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, which indicates UE to use PUCCH resource #1 for HARQ feedback. | <-- | DCI format 1\_1(UE C-RNTI, PUCCH resource indicator = “001”) | - | - |
| 7 | SS transmits in the indicated downlink assignment a MAC PDU including an RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit HARQ ACK N1 times using PUCCH resource #1?  NOTE: Value of N1 is given by the pucch-RepetitionNrofSlots-r17 associated to PUCCH resource #1. | --> | HARQ ACK/NACK | 1 | P |
| 9 | SS transmits an *RRCReconfiguration* message to release resource specific repetition factors and configure PUCCH format specific repetition factor. | <-- | NR RRC: RRCReconfiguration | - | - |
| 10 | UE transmits an *RRCReconfigurationComplete* message. | --> | NR RRC: RRCReconfigurationComplete | - | - |
| 11 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, which indicates UE to use PUCCH resource #0 for HARQ feedback. | <-- | DCI format 1\_1(UE C-RNTI, PUCCH resource indicator = “000”) | - | - |
| 12 | SS transmits in the indicated downlink assignment a MAC PDU including an RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 13 | Check: Does the UE transmit HARQ ACK N times using PUCCH resource #0?  NOTE: Value of N is given by the nrofSlots associated to the format of PUCCH resource #0. | --> | HARQ ACK/NACK | 1 | P |

7.1.1.2.6.3.3 Specific message contents

Table 7.1.1.2.6.3.3-1: *RRCReconfiguration* (Step 1 & 9, Table 7.1.1.2.6.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition NR | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | Not present |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig | Table 7.1.1.2.6.3.3-2 |  |
| dedicatedNAS-MessageList | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.6.3.3-2: *CellGroupConfig* (Table 7.1.1.2.6.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4] Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.6.3.3-3: *ServingCellConfig* (Table 7.1.1.2.6.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4] Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { | BWP-UplinkDedicated |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config-1 | Table 7.1.1.2.6.3.3-4 | Step 1 |
|  | PUCCH-Config-2 | Table 7.1.1.2.6.3.3-5 | Step 9 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.6.3.3-4: *PUCCH-Config* (Table 7.1.1.2.6.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| resourceToAddModList SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-Resource { | 16 entries |  |  |
| PUCCH-Resource[1] SEQUENCE { |  | entry 1  resource #0 |  |
| intraSlotFrequencyHopping | Not present |  |  |
| } |  |  |  |
| PUCCH-Resource[2] SEQUENCE { |  | entry 2  resource #1 |  |
| intraSlotFrequencyHopping | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceToAddModListExt-r16 SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-ResourceExt-v1610 { | 16 entries |  |  |
| PUCCH-ResourceExt-v1610[1] SEQUENCE { |  | entry 1  resource #0 |  |
| interlaceAllocation-r16 | Not present |  |  |
| format-v1610 | Not present |  |  |
| format-v1700 | Not present |  |  |
| pucch-RepetitionNrofSlots-r17 | n2 |  |  |
| } |  |  |  |
| PUCCH-ResourceExt-v1610[2] SEQUENCE { |  | entry 2  resource #1 |  |
| interlaceAllocation-r16 | Not present |  |  |
| format-v1610 | Not present |  |  |
| format-v1700 | Not present |  |  |
| pucch-RepetitionNrofSlots-r17 | n4 |  |  |
| } |  |  |  |
| PUCCH-ResourceExt-v1610[k, k=3..16] SEQUENCE { |  | entry k  resource #k+1 |  |
| interlaceAllocation-r16 | Not present |  |  |
| format-v1610 | Not present |  |  |
| format-v1700 | Not present |  |  |
| pucch-RepetitionNrofSlots-r17 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.6.3.3-5: *PUCCH-Config* (Table 7.1.1.2.6.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| resourceToAddModListExt-r16 SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-ResourceExt-v1610 { | 16 entries |  |  |
| PUCCH-ResourceExt-v1610[k, k=1..16] SEQUENCE { |  | entry k  resource #k+1 |  |
| interlaceAllocation-r16 | Not present |  |  |
| format-v1610 | Not present |  |  |
| format-v1700 | Not present |  |  |
| pucch-RepetitionNrofSlots-r17 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| format0-r17 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| interslotFrequencyHopping | Not present |  |  |
| additionalDMRS | Not present |  |  |
| maxCodeRate | Not present |  |  |
| nrofSlots | n8 |  |  |
| pi2BPSK | Not present |  |  |
| simultaneousHARQ-ACK-CSI | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.6.3.3-6: Physical layer parameters for DCI format 1\_1 (step 3, 6 & 11, Table 7.1.1.2.6.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] Table 4.3.6.1.2.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| PUCCH resource indicator | *PUCCH-ResourceId[1]* = 0 in pucch-ResourceSetID[1] | “000” | Step 3, Step 11 |
|  | *PUCCH-ResourceId[2]* = 1 in pucch-ResourceSetID[1] | “001” | Step 6 |

##### 7.1.1.2.7 Correct HARQ process handling / Unified TCI Activation

7.1.1.2.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with TCI-State\_r17 configured and 2 unified TCI states are activated by MAC-CE }

**ensure that** {

**when** { UE receives PDSCH scheduling by DCI\_1\_1 carring the 1st activated unified TCI state}

**then** { UE sends a HARQ feedback on the HARQ process }

}

(2)

**with** { UE in RRC\_CONNECTED state with TCI-State\_r17 configured and 2 unified TCI states are activated by MAC-CE }

**ensure that** {

**when** { UE receives DCI\_1\_1 carring the 2nd activated unified TCI state without DL assignment }

**then** { UE sends a HARQ feedback on the HARQ process }

}

7.1.1.2.7.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clause 5.1.5, TS 38.321, clauses 5.3.1, 5.3.2.1, 5.3.2.2 and 6.1.3.47. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214 clause 5.1.5]

The UE can be configured with a list of up to *M* *TCI-State* configurations within the higher layer parameter *PDSCH-Config* to decode PDSCH according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M depends on the UE capability *maxNumberConfiguredTCIstatesPerCC*. Each *TCI-State* contains parameters for configuring a quasi co-location relationship between one or two downlink reference signals and the DM-RS ports of the PDSCH, the DM-RS port of PDCCH or the CSI-RS port(s) of a CSI-RS resource. The quasi co-location relationship is configured by the higher layer parameter *qcl-Type1* for the first DL RS, and *qcl-Type2* for the second DL RS(if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter *qcl-Type* in *QCL-Info* and may take one of the following values:

- 'typeA': {Doppler shift, Doppler spread, average delay, delay spread}

- 'typeB': {Doppler shift, Doppler spread}

- 'typeC': {Doppler shift, average delay}

- 'typeD': {Spatial Rx parameter}

The UE can be configured with a list of up to *128* *TCI-State* configurations, within the higher layer parameter *dl-OrJointTCI-StateList* in *PDSCH-Config* for providing a reference signal for the quasi co-location for DM-RS of PDSCH and DM-RS of PDCCH in a BWP/CC, for CSI-RS, and to provide a reference, if applicable, for determining UL TX spatial filter for dynamic-grant and configured-grant based PUSCH and PUCCH resource in a BWP/CC, and SRS.

If the *TCI-State* or *TCI-UL-State* configurations are absent in a BWP of the CC, the UE can apply the *TCI-State* or *TCI-UL-State* configurations from a reference BWP of a reference CC. The UE is not expected to be configured with *tci-StatesToAddModList*, *SpatialRelationInfo* or *PUCCH-SpatialRelationInfo*, except *SpatialRelationInfoPos* in a CC in a band, if the UE is configured with *dl-OrJointTCI-StateList* or *ul-TCI-StateList* in any CC in the same band. The UE can assume that when the UE is configured with *tci-StatesToAddModList* in any CC in the CC list configured by *simultaneousTCI-UpdateList1-r16, simultaneousTCI-UpdateList2-r16,* *simultaneousSpatial-UpdatedList1-r16, or simultaneousSpatial-UpdatedList2-r16,* the UE is not configured with *dl-OrJointTCI-StateList* or *ul-TCI-StateList* in any CC within the same band in the CC list.

The UE receives an activation command, as described in clause 6.1.3.xx of [10, TS 38.321], 6.1.3.47 of [10, TS 38.321] or 6.1.4.xx of [10, TS 38.321], used to map up to 8 TCI states and/or pairs of TCI states, with one TCI state for DL channels/signals and/or one TCI state for UL channels/signals to the codepoints of the DCI field *'Transmission Configuration Indication'* for one or for a set of CCs/DL BWPs, [and/] or up to 8 sets of TCI states, where each set is comprised of up to two TCI state(s) for DL and UL signals/channels, or up to two TCI state(s) for DL channels/signals and up to two TCI state(s) for UL channels/signals to the codepoints of the DCI field *'Transmission Configuration Indication'* for one or for a set of CCs/DL BWPs, and if applicable, for one or for a set of CCs/UL BWPs. When a set of TCI state IDs are activated for a set of CCs/DL BWPs and if applicable, for a set of CCs/UL BWPs, where the applicable list of CCs is determined by the indicated CC in the activation command, the same set of TCI state IDs are applied for all DL and/or UL BWPs in the indicated CCs. If the activation command maps *TCI-State(s)* and/or *TCI-UL-State(s)* to only one TCI codepoint, the UE shall apply the indicated *TCI-State(s)* and/or *TCI-UL-State(s)* to one or to a set of CCs /DL BWPs, and if applicable, to one or to a set of CCs /UL BWPs once the indicated mapping for the one single TCI codepoint is applied as described in [11, TS 38.133].

When the *bwp-id* or *cell* for QCL-TypeA/D source RS in a QCL-Info of the TCI state is not configured, the UE assumes that QCL-TypeA/D source RS is configured in the CC/DL BWP where TCI state applies.

When *tci-PresentInDCI* is set as 'enabled' or *tci-PresentDCI-1-2* is configured for the CORESET, a UE configured with *dl-OrJointTCI-StateList* with activated *TCI-State* or *ul-TCI-StateList* with activated *TCI-UL-State* receives DCI format 1\_1/1\_2/1\_3 providing indicated *TCI-State(s)* and/or *TCI-UL-State(s)* for a CC or all CCs in the same CC list configured by *simultaneousU-TCI-UpdateList1-r17, simultaneousU-TCI-UpdateList2-r17, simultaneousU-TCI-UpdateList3-r17, simultaneousU-TCI-UpdateList4-r17*. The DCI format 1\_1/1\_2 can be with or without, if applicable, DL assignment. If the DCI format 1\_1/1\_2/ is without DL assignment, the UE can assume the following:

- CS-RNTI is used to scramble the CRC for the DCI

- The values of the following DCI fields are set as follows:

- RV = all '1's

- MCS = all '1's

- NDI = 0

- Set to all '0's for FDRA Type 0, or all '1's for FDRA Type 1, or all '0's for dynamicSwitch (same as in Table 10.2-4 of [6, TS 38.213]).

After a UE receives an initial higher layer configuration of *dl-OrJointTCI-StateList* with more than one *TCI-State* and before application of an indicated TCI state from the configured TCI states:

- The UE assumes that DM-RS of PDSCH and DM-RS of PDCCH and the CSI-RS applying the indicated TCI state are quasi co-located with the SS/PBCH block the UE identified during the initial access procedure

After a UE receives an initial higher layer configuration of *dl-OrJointTCI-StateList* with more than one *TCI-State* or *ul-TCI-StateList* with more than one *TCI-UL-State* and before application of an indicated TCI state from the configured TCI states:

- The UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant and configured-grant based PUSCH and PUCCH, and for SRS applying the indicated TCI state, is the same as that for a PUSCH transmission scheduled by a RAR UL grant during the initial access procedure

After a UE receives a higher layer configuration of *dl-OrJointTCI-StateList* with more than one *TCI-State* as part of a Reconfiguration with sync procedure as described in [12, TS 38.331]and before applying an indicated TCI state from the configured TCI states:

- The UE assumes that DM-RS of PDSCH and DM-RS of PDCCH, and the CSI-RS applying the indicated TCI state are quasi co-located with the SS/PBCH block or the CSI-RS resource the UE identified during the random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331].

After a UE receives a higher layer configuration of *dl-OrJointTCI-StateList* with more than one *TCI-State* or more than one *TCI-UL-State* as part of a Reconfiguration with sync procedure as described in [12, TS 38.331] and before applying an indicated TCI state from the configured TCI states:

- The UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant and configured-grant based PUSCH and PUCCH, and for SRS applying the indicated TCI state, is the same as that for a PUSCH transmission scheduled by a RAR UL grant during random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331].

If a UE receives a higher layer configuration of *dl-OrJointTCI-StateList* with a single TCI-State, that can be used as an indicated TCI state, the UE obtains the QCL assumptions from the configured TCI state for DM-RS of PDSCH and DM-RS of PDCCH, and the CSI -RS applying the indicated TCI state.

If a UE receives a higher layer configuration of *dl-OrJointTCI-StateList* with a single TCI-State or *ul-TCI-StateList* with a single *TCI-UL-State*, that can be used as an indicated TCI state, the UE determines an UL TX spatial filter, if applicable, from the configured TCI state for dynamic-grant and configured-grant based PUSCH and PUCCH, and SRS applying the indicated TCI state.

When a UE configured with *dl-OrJointTCI-StateList* would transmit a PUCCH with positive HARQ-ACK or a PUSCH with positive HARQ-ACK corresponding to the DCI carrying the TCI State indication and without DL assignment, or corresponding to the PDSCH scheduled by the DCI carrying the TCI State indication, and if the indicated TCI State(s) is/are different from the previously indicated one(s), the indicatedTCI-State(s) and/or *TCI-UL-State*(s)should be applied starting from the first slot that is at least symbols after the last symbol of the PUCCH or the PUSCH. The first slot and the symbols are both determined on the active BWP with the smallest SCS among the BWP(s) from the CCs applying the indicated *TCI-State*(s) or *TCI-UL-State*(s) that are active at the end of the PUCCH or the PUSCH carrying the positive HARQ-ACK.

If a UE is configured with *pdsch-TimeDomainAllocationListForMultiPDSCH* in which one or more rows contain multiple *SLIV*s for PDSCH on a DL BWP of a serving cell, and the UE is receiving a DCI carrying the *TCI-State* indication and without DL assignment, the UE does not expect that the number of indicated *SLIV*s in the row of the *pdsch-TimeDomainAllocationListForMultiPDSCH* by the DCI is more than one.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see clause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

NOTE: It is up to UE implementation to allocate the received TB for MCCH or broadcast MTCH to one HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if the HARQ process is associated with a transmission indicated with a MCCH-RNTI for MBS broadcast, and this is the first received transmission for the TB according to the MCCH schedule indicated by RRC; or

1> if the HARQ process is associated with a transmission indicated with a G-RNTI for MBS broadcast, and this is the first received transmission for the TB according to the MTCH schedule indicated by RRC or according to the scheduling indicated by DCI as specified in TS 38.214 [7]; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see clause 5.1.5); or

1> if the HARQ process is associated with a transmission indicated with a MSGB-RNTI and the Random Access procedure is not yet successfully completed (see clause 5.1.4a); or

1> if the HARQ process is equal to the broadcast process; or

1> if the HARQ process is associated with a transmission indicated with a MCCH-RNTI or a G-RNTI for MBS broadcast; or

1> if the HARQ process is associated with a transmission indicated with a G-RNTI or a G-CS-RNTI or a configured downlink assignment for MBS multicast and HARQ feedback is disabled for this G-RNTI or G-CS-RNTI, as specified in clause 18 of TS 38.213 [6]; or

1> if the HARQ process is associated with a transmission indicated with a G-RNTI or a G-CS-RNTI or a configured downlink assignment for MBS multicast and NACK only HARQ feedback is configured for this G-RNTI or G-CS-RNTI and the data for this TB is successfully decoded and the transmission is not the first transmission of PDSCH where the configured downlink assignment was (re-)initialised; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired and if the *cg-SDT-TimeAlignmentTimer*, if configured, is not running; or

1> if the HARQ process is configured with disabled HARQ feedback:

2> if *harq-FeedbackEnablingforSPSactive* is configured with value *true* and the transmission is the first transmission on the configured downlink assignment after activation of the configured downlink assignment:

3> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

2> else:

3> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

NOTE: If the MAC entity receives a retransmission with a TB size different from the last TB size signalled for this TB, the UE behavior is left up to UE implementation.

[TS 38.321, clause 6.1.3.47]

The Unified TCI States Activation/Deactivation MAC CE is identified by a MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size consisting of following fields:

- Serving Cell ID: This field indicates the identity of the Serving Cell for which the MAC CE applies. The length of the field is 5 bits. If the indicated Serving Cell is configured as part of a *simultaneousU-TCI-UpdateList1*, *simultaneousU-TCI-UpdateList2*, *simultaneousU-TCI-UpdateList3* or *simultaneousU-TCI-UpdateList4* as specified in TS 38.331 [5], this MAC CE applies to all theServing Cells in the set *simultaneousU-TCI-UpdateList1*, *simultaneousU-TCI-UpdateList2*, *simultaneousU-TCI-UpdateList3* or *simultaneousU-TCI-UpdateList4*, respectively;

- DL BWP ID: This field indicates a DL BWP for which the MAC CE applies as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9]. The length of the BWP ID field is 2 bits;

- UL BWP ID: This field indicates a UL BWP for which the MAC CE applies as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9]. If value of *unifiedTCI-StateType* in the Serving Cell indicated by Serving Cell IDis *joint*, this field is considered as the reserved bits. The length of the BWP ID field is 2 bits;

- Pi: This field indicates whether each TCI codepoint has multiple TCI states or single TCI state. If Pi field is set to 1, it indicates that ith TCI codepoint includes the DL TCI state and the UL TCI state. If Pi field is set to 0, it indicates that ith TCI codepoint includes only the DL/joint TCI state or the UL TCI state. The codepoint to which a TCI state is mapped is determined by its ordinal position among all the TCI state ID fields;

- D/U: This field indicate whether the TCI state ID in the same octet is for joint/downlink or uplink TCI state. If this field is set to 1, the TCI state ID in the same octet is for joint/downlink. If this field is set to 0, the TCI state ID in the same octet is for uplink;

- TCI state ID: This field indicates the TCI state identified by *TCI-StateId* as specified in TS 38.331 [5]. If D/U is set to 1, 7-bits length TCI state ID i.e. *TCI-StateId* as specified in TS 38.331 [5] is used. If D/U is set to 0, the most significant bit of TCI state ID is considered as the reserved bit and remainder 6 bits indicate the *TCI-UL-State-Id* as specified in TS 38.331 [5]. The maximum number of activated TCI states is 16;

- R: Reserved bit, set to 0.



Figure 6.1.3.47-1: Unified TCI state activation/deactivation MAC CE

7.1.1.2.7.3 Test description

7.1.1.2.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.2.7.3.2 Test procedure sequence

Table 7.1.1.2.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits an *RRCReconfiguration* message to configure 2 unified TCI states activated by MAC-CE. (Note 1) | <-- | NR RRC: RRCReconfiguration | - | - |
| 2 | UE transmits an *RRCReconfigurationComplete* message. (Note 2) | --> | NR RRC: RRCReconfigurationComplete | - | - |
| 3 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, which carries the 1st activated unified TCI state. | <-- | DCI format 1\_1(UE C-RNTI, Transmission configuration indication = “000”) | - | - |
| 4 | SS transmits in the indicated downlink assignment a MAC PDU including an RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 1 | P |
| 6 | SS transmits a DCI\_1\_1 addressed to the C-RNTI assigned to the UE without DL assignment, which carries the 2nd activated unified TCI state. | <-- | DCI format 1\_1(UE C-RNTI, Transmission configuration indication = “001”) | - | - |
| 7 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.2.7.3.3 Specific message contents

Table 7.1.1.2.7.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.2.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration::=SEQUENCE{ |  |  |  |
| criticalExtensions CHOICE{ |  |  |  |
| rrcReconfiguration SEQUENCE{ |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING | EN-DC |
| nonCriticalExtension c |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-2: *CellGroupConfig* (Table 7.1.1.2.7.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| simultaneousU-TCI-UpdateList1-r17 SEQUENCE{ |  |  |  |
| ServCellIndex[1] | ServCellIndex of NR SpCell | Cell ID |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-3: *ServingCellConfig* (Table 7.1.1.2.7.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| initialDownlinkBWP | BWP-DownlinkDedicated |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| MIMOParam-r17 SEQUENCE { |  |  |  |
| unifiedTCI-StateType-r17 | separate |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-4: *BWP-DownlinkDedicated* (Table 7.1.1.2.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-DownlinkDedicated ::= SEQUENCE { |  |  |  |
| pdcch-Config CHOICE { |  |  |  |
| setup | PDCCH-Config |  |  |
| } |  |  |  |
| pdsch-Config CHOICE { |  |  |  |
| setup | PDSCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-5: *PDSCH-Config* (Table 7.1.1.2.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| unifiedTCI-StateRef-r17 | ServingCellAndBWP-Id-r17 |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-6: ServingCellAndBWP-Id-r17 (Table 7.1.1.2.7.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellAndBWP-Id-r17 ::= SEQUENCE { |  |  |  |
| servingcell-r17 | Cell ID |  |  |
| bwp-r17 | BWP ID |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-7: *PDCCH-Config* (Table 7.1.1.2.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 1 entry |  |  |
| ControlResourceSet[1] | ControlResourceSetid1 | entry 1 |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace { | 1 entry |  |  |
| SearchSpace[1] | SearchSpace with condition USS | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-8: *ControlResourceSetId1* (Table 7.1.1.2.7.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| tci-PresentInDCI | enabled |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.7.3.3-9: Physical layer parameters for DCI format 1\_1(Steps 3 and 6, Table 7.1.1.2.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.3.6.1.2.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| Transmission configuration indication | 0 | “000” | Step 3 |
|  | 1 | “001” | Step 6 |

#### 7.1.1.3 Uplink Data Transfer

##### 7.1.1.3.1 Correct Handling of UL MAC PDU / Assignment / HARQ process

7.1.1.3.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives for a Slot an uplink grant with valid C-RNTI }

**then** { UE transmits data and associated HARQ information to the HARQ entity for this Slot }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS transmits for a Slot an uplink grant with not allocated C-RNTI }

**then** { UE does not transmit data and associated HARQ information to the HARQ entity for this Slot }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives an UL Grant with toggled NDI and has data available for transmission }

**then** { UE transmits a new MAC PDU }

}

(4)

**with** { UE in RRC\_CONNECTED state and having transmitted a MAC PDU on a HARQ process }

**ensure that** {

**when** { UE receives an uplink grant on PDCCH for the next Slot corresponding to the HARQ process with old NDI not toggled}

**then** { UE performs an adaptive retransmission of the MAC PDU with redundancy version as received on PDCCH }

}

(5)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives an uplink grant on PDCCH for the next Slot corresponding to the HARQ process with toggled NDI, and data is not available for transmission }

**then** { UE transmits any MAC Padding PDU }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has a MAC SDU to be transmitted that is smaller or equal to 256 bytes }

**then** { UE sets F field to 0 and includes 8 bit L field in the MAC sub PDU}

}

(7)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has a MAC SDU to be transmitted that is larger than 256 bytes }

**then** { UE sets F field to 1 and includes 16 bit L field in the MAC sub PDU }

}

(8)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE has to insert padding in a MAC PDU }

**then** { UE inserts the last MAC sub PDU as a padding sub PDU }

}

(9)

**with** { UE in  RRC\_CONNECTED state and configured with a specific *TDD-UL-DL-ConfigCommon* including configuration of *pattern2*}

**ensure that** {

**when** { UE receives for a Slot an uplink grant associated with *pattern2* with valid C-RNTI }

**then** { UE transmits data and associated HARQ information to the HARQ entity for this Slot }

}

7.1.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.1, 5.4.2.1, 5.4.2.2 and 6.1.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity’s C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity’s C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity’s CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this serving cell on the PDCCH for the MAC entity’s CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> stop the *ConfiguredGrantTimer* for the corresponding HARQ process, if running;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured grant confirmation;

4> store the uplink grant for this serving cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this serving cell to start in the associated PUSCH duration and to recur according to rules in subclause 5.8.2;

4> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> stop the *ConfiguredGrantTimer* for the corresponding HARQ process, if running;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

1> if the *ConfiguredGrantTimer* for the corresponding HARQ process is not running:

2> consider the NDI bit for the corresponding HARQ process to have been toggled;

2> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

NOTE 1: For the same serving cell, an uplink grant addressed to C-RNTI shall override a configured uplink grant in case of overlap in time domain.

For configured uplink grants, the HARQ Process ID associated with this symbol is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *numberOfConfGrant-Processes*

where CURRENT\_symbol=(SFN \* *numberOfSlotsPerFrame* \* *numberOfSymbolsPerSlot* + slot number in the frame \* *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 2: CURRENT\_symbol refers to the symbol index of the first transmission of a repetition bundle that takes place.[TS 36.322, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*),which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response, HARQ process identifier 0 is used.

When repetition is configured with *repK* >1, the parameter *repK* provides the number of repetitions of a TB within a bundle. Repetition operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and triggered without waiting for feedback from previous transmissions according to *repK*.

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process(es) associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else:

4> obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a new transmission.

4> if the uplink grant is addressed to CS-RNTI or the uplink grant is a configured uplink grant:

5> start or restart the *ConfiguredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

2> else:

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI or the uplink grant is a configured uplink grant:

5> start or restart the *ConfiguredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on either PDCCH, Random Access Response, or RRC. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH.

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

1> if the MAC PDU was obtained from the Msg3 buffer; or

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer:

2> instruct the physical layer to generate a transmission according to the stored uplink grant.

[TS 38.321, clause 6.1.2]

A MAC PDU consists of one or more MAC subPDUs. Each MAC subPDU consists of one of the following:

- A MAC subheader only (including padding);

- A MAC subheader and a MAC SDU;

- A MAC subheader and a MAC CE;

- A MAC subheader and padding.

The MAC SDUs are of variable sizes.

Each MAC subheader corresponds to either a MAC SDU, a MAC CE, or padding.

A MAC subheader except for fixed sized MAC CE and padding consists of the four header fields R/F/LCID/L. A MAC subheader for fixed sized MAC CE and padding consists of the two header fields R/LCID.



Figure 6.1.2-1: R/F/LCID/L MAC subheader with 8-bit L field



Figure 6.1.2-2: R/F/LCID/L MAC subheader with 16-bit L field



Figure 6.1.2-3: R/LCID MAC subheader

MAC CEs are placed together. DL MAC subPDU(s) with MAC CE(s) is placed before any MAC subPDU with MAC SDU and MAC subPDU with padding as depicted in Figure 6.1.2-4. UL MAC subPDU(s) with MAC CE(s) is placed after all the MAC subPDU(s) with MAC SDU and before the MAC subPDU with padding in the MAC PDU as depicted in Figure 6.1.2-5. The size of padding can be zero.



Figure 6.1.2-4: Example of a DL MAC PDU



Figure 6.1.2-5: Example of a UL MAC PDU

A maximum of one MAC PDU can be transmitted per TB per MAC entity.

7.1.1.3.1.3 Test description

7.1.1.3.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.3.1.3.2 Test procedure sequence

Table 7.1.1.3.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | SS transmits a MAC PDU including a RLC SDU | <-- | MAC PDU | - | - |
| - | EXCEPTION: Step 3 runs in parallel with behaviour in table 7.1.1.3.1.3.2-2 | - | - | - | - |
| 3 | For 100 ms SS transmits an UL Grant every 10 ms , allowing the UE to return the RLC SDU as received in step 2, on PDCCH, but with the C-RNTI different from the C-RNTI assigned to the UE. | <-- | (UL Grant (unknown C-RNTI)) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 3? | --> | MAC PDU | 2 | F |
| 5 | SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 2, on PDCCH with the C-RNTI assigned to the UE. | <-- | (UL Grant (C-RNTI)) | - | - |
| 6 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 6? | --> | MAC PDU | 1 | P |
| 6A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 6. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| 7 | The SS Transmits a valid MAC PDU containing RLC PDU | <-- | MAC PDU | - | - |
| 8 | The SS allocates an UL Grant for one HARQ process X, sufficient for one RLC SDU to be looped back in a Slot, and NDI indicates new transmission redundancy version to be used as 0 | <-- | Uplink Grant | - | - |
| 9 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process X? | --> | MAC PDU | 3 | P |
| 10 | The SS transmits an UL grant corresponding to slot for HARQ process X, with NDI not toggled and redundancy version to be used as 1 | <-- | Uplink Grant | - | - |
| 11 | Check: Does the UE retransmit the MAC PDU in for HARQ process X, using redundancy version1? | --> | MAC PDU | 4 | P |
| 11A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 11. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| 12 | The SS transmits an UL grant corresponding to SLOT for HARQ process X, with NDI toggled and redundancy version to be used as 0 | <-- | Uplink Grant | - | - |
| 13 | Check: Does the UE retransmit the MAC PDU containing padding for HARQ process X, using redundancy version 0? | --> | MAC PDU | 5 | P |
| 14 | SS transmits a MAC PDU including a RLC PDU of size 128 bytes | <-- | MAC PDU | - | - |
| 15 | The SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 14 and padding. | <-- | (UL Grant (C-RNTI)) | - | - |
| 16 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 14 with F field set to 0 and includes 8 bit L field in the MAC sub PDU and includes a padding sub PDU at end? | --> | MAC PDU | 6,8 | P |
| 16A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 16. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| 17 | SS transmits a MAC PDU including a RLC PDU of size 512 bytes | <-- | MAC PDU | - | - |
| 18 | The SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 17 and padding. | <-- | (UL Grant (C-RNTI)) | - | - |
| 19 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 17 with F field set to 1 and includes 16 bit L field in the MAC sub PDU and includes a padding sub PDU at end? | --> | MAC PDU | 7,8 | P |
| 19A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 19. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| - | EXCEPTION : Steps 20a0 to 20a6 are executed for operation on NR TDD band only | - | *-* | - | - |
| 20a0 | The SS transmits an updated system information as specified in Table 7.1.1.3.1.3.3-14. |  |  |  |  |
| 20a1 | The SS transmits a NR RRCReconfiguration message including *TDD-UL-DL-ConfigCommon* with *pattern1 and pattern 2* specified in Table 7.1.1.3.1.3.3-5 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 20a2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 20a3 | SS transmits a MAC PDU including a RLC SDU | <-- | MAC PDU | - | - |
| 20a4 | SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 20a3, on PDCCH with the C-RNTI assigned to the UE. | <-- | (UL Grant (C-RNTI)) | - | - |
| 20a5 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 20a4? | --> | MAC PDU | 9 | P |
| 20a6 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 20a5. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

Table 7.1.1.3.1.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | UE transmits a Scheduling Request. | --> | (SR) | - | - |

7.1.1.3.1.3.3 Specific message contents

Table 7.1.1.3.1.3.3-1: *Void*

Table 7.1.1.3.1.3.3-2: *Void*

Table 7.1.1.3.1.3.3-3: *RRCReconfiguration* (step20a1, Table 7.1.1.3.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-4: *CellGroupConfig* (Table 7.1.1.3.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-5: *ServingCellConfigCommon (*Table 7.1.1.3.1.3.3-4, Table 7.1.1.3.1.3.3-14)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-6: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.3.1.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 |
|  | 2 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 |
|  | 2 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms2 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 4 |  | FR1 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 0 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 0 |  | FR1 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 0 |  | FR1 |
|  | 2 |  | FR2 |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.3.1.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.3.1.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-9: *RACH-ConfigGeneric (*Table 7.1.1.3.1.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-configurationIndex | 156 |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-10: *ServingCellConfig* (Table 7.1.1.3.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-11: *BWP-UplinkDedicated* (Table 7.1.1.3.1.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-12: *PUCCH-Config* (Table 7.1.1.3.1.3.3-11)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig[1] | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-13: *SchedulingRequestResourceConfig* (Table 7.1.1.3.1.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 5 | With SCS = kHz15 results in repetition every 10 ms | SCS\_15kHz |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS\_30kHz |
| sl80 | 4 | With SCS = kHz120 results in repetition every 10 ms | SCS\_120kHz |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-14: *SystemInformationBlockType1* (step 20a0, Table 7.1.1.3.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.3.1.3.3-5 |  |
| } |  |  |  |

##### 7.1.1.3.2 Logical channel prioritization handling

7.1.1.3.2.1 Test Purpose (TP)

(1)

**with** {UE in RRC\_CONNECTED state}

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR }

}

7.1.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.4.3.1.1, 5.4.3.1.2, 5.4.3.1.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.3.1.1]

The Logical Channel Prioritization procedure is applied whenever a new transmission is performed.

RRC controls the scheduling of uplink data by signalling for each logical channel per MAC entity:

- *priority* where an increasing priority value indicates a lower priority level;

- *prioritisedBitRate* which sets the Prioritized Bit Rate (PBR);

- *bucketSizeDuration* which sets the Bucket Size Duration (BSD).

RRC additionally controls the LCP procedure by configuring mapping restrictions for each logical channel:

- *allowedSCS-List* which sets the allowed Subcarrier Spacing(s) for transmission;

- *maxPUSCH-Duration* which sets the maximum PUSCH duration allowed for transmission;

- *configuredGrantType1Allowed* which sets whether a Configured Grant Type 1 can be used for transmission;

- *allowedServingCells* which sets the allowed cell(s) for transmission.

The following UE variable is used for the Logical channel prioritization procedure:

- *Bj* which is maintained for each logical channel j.

The MAC entity shall initialize Bj of the logical channel to zero when the logical channel is established.

For each logical channel j, the MAC entity shall:

1> increment *Bj* by the product PBR × T before every instance of the LCP procedure, where T is the time elapsed since *Bj* was last updated;

1> if the value of *Bj* is greater than the bucket size (i.e. PBR × BSD):

2> set *Bj* to the bucket size.

NOTE: The exact moment(s) when the UE updates *Bj* between LCP procedures is up to UE implementation, as long as *Bj* is up to date at the time when a grant is processed by LCP.

[TS 38.321, clause 5.4.3.1.2]

The MAC entity shall, when a new transmission is performed:

1> select the logical channels for each UL grant that satisfy all the following conditions:

2> the set of allowed Subcarrier Spacing index values in *allowedSCS-List*, if configured, includes the Subcarrier Spacing index associated to the UL grant; and

2> *maxPUSCH-Duration*, if configured, is larger than or equal to the PUSCH transmission duration associated to the UL grant; and

2> *configuredGrantType1Allowed*, if configured, is set to TRUE in case the UL grant is a Configured Grant Type 1; and

2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant.

NOTE: The Subcarrier Spacing index, PUSCH transmission duration and Cell information are included in Uplink transmission information received from lower layers for the corresponding scheduled uplink transmission.

[TS 38.321, clause 5.4.3.1.3]

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in subclause 5.4.3.1.2 for the UL grant with Bj > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to "infinity", the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement Bj by the total size of MAC SDUs served to logical channel j above;

NOTE: The value of Bj can be negative.

2> if any resources remain, all the logical channels selected in subclause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of Bj) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given an UL grant size that is equal to or larger than 8 bytes while having data available for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:

- the MAC entity is configured with *skipUplinkTxDynamic* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

- the MAC PDU includes zero MAC SDUs; and

- the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- MAC CE for C-RNTI or data from UL-CCCH;

- MAC CE for SPS confirmation;

- MAC CE for BSR, with exception of BSR included for padding;

- MAC CE for single entry PHR or multiple entry PHR;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for BSR included for padding.

7.1.1.3.2.3 Test description

7.1.1.3.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 UM SN terminated SCG bearers configured according to Table 7.1.1.3.2.3.1-1.

Table 7.1.1.3.2.3.1-1: Priority, PBR and Bucket Delay settings

|  |  |  |  |
| --- | --- | --- | --- |
| DRB | priority | prioritizedBitRate (kbytes/s) | bucketSizeDuration (ms) |
| DRB1 | 6 | 8 | 100 |
| DRB2 | 7 | 16 | 100 |
| DRB3 | 8 | 32 | 100 |

Table 7.1.1.3.2.3.1-2: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| Discard\_Timer | ms1500 |

7.1.1.3.2.3.2 Test procedure sequence

Table 7.1.1.3.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 3 are run 4 times using the parameters specified for each run in table 7.1.1.3.2.3.2-3. | - | - | - | - |
| 1 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| 1A | Start WatchDog\_Timer set to 5 seconds | - | - | - | - |
| - | EXCEPTION: In parallel to the event described in step 2 the events specified in Table 7.1.1.3.2.3.2-2 shall take place. | - | - | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 150 ms after Step 1 (Note1), for a duration of T2, the SS transmits an UL grant of D octets every T1. | <-- | (UL grants) | - | - |
| 3 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 is D1 octets +/- 10%  - total number of octets received for DRB2 is D2 octets +/- 10%  - total number of octets received for DRB3 is D3 octets +/- 10% ? | - | - | 1 | P |
| 4 | Wait for WatchDog\_Timer expiry(Note2) | - | - | - | - |
| Note 1: This wait time will ensure that a) all octets have been completely received by the UE on all 3 DRBs before the first UL grant is received and b) the Bjs for each logical channel have reached their maximum value i.e. the bucket size of the corresponding logical channel before the first UL grant is received.  Note 2: Several PDUs on DRB3 after second run and on DRB2 after third run and on DRB1 after fourth run would be awaiting on PDCP Tx Buffer. Timer 5 seconds ensures the PDCP Data PDUs are discarded after expiry of Discard\_timer(1500ms). | | | | | |

Table 7.1.1.3.2.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit the RLC SDUs back to the SS? | --> | - | 1 | P |

Table 7.1.1.3.2.3.2-3: Test parameter values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | First run | Second run | Third run | Fourth run |
| N1 (SDUs) | 13 | 13 | 7 | 104 |
| N2 (SDUs) | 25 | 25 | 50 | 25 |
| N3 (SDUs) | 50 | 50 | 50 | 50 |
| D (octets) | 1153 | 576 | 1153 | 1153 |
| T1 (ms) | 20 | 20 | 20 | 10 |
| T2 (ms) | 500 | 700 | 500 | 500 |
| D1 (octets) | 4160 | 4160 | 2240 | 33350 (Note 1) |
| D2 (octets) | 8000 | 8000 | 10435 (Note 1) | 8000 |
| D3 (octets) | 16000 | 7790 (Note 1) | 16000 | 16000 |
| Note 1: Calculated using the following equation for the case of the least header size: (D1 + D2 + D3) = (D - 6) \* T2 / T1 | | | | |

NOTE: The Test parameter values above and the test procedure assume that the UE has a loopback buffer of at least 57280 octets.

7.1.1.3.2.3.3 Specific message contents

Table 7.1.1.3.2.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

##### 7.1.1.3.2b Logical channel prioritization handling with Mapping restrictions

7.1.1.3.2b.1 Test Purpose (TP)

(1)

**with** {UE in RRC\_CONNECTED state with allowedSCS-List configured }

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR and respecting allowedSCS-List }

}

(2)

**with** {UE in RRC\_CONNECTED state with maxPUSCH-Duration configured }

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR and respecting maxPUSCH-Duration }

}

(3)

**with** { UE in RRC\_CONNECTED state with configuredGrantType1Allowed configured and supporting Type 1 PUSCH transmissions with configured grant }

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR and respecting configuredGrantType1Allowed }

}

7.1.1.3.2b.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.4.3.1.1, 5.4.3.1.2, 5.4.3.1.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.3.1.1]

The Logical Channel Prioritization (LCP) procedure is applied whenever a new transmission is performed.

RRC controls the scheduling of uplink data by signalling for each logical channel per MAC entity:

- *priority* where an increasing priority value indicates a lower priority level;

- *prioritisedBitRate* which sets the Prioritized Bit Rate (PBR);

- *bucketSizeDuration* which sets the Bucket Size Duration (BSD).

RRC additionally controls the LCP procedure by configuring mapping restrictions for each logical channel:

- *allowedSCS-List* which sets the allowed Subcarrier Spacing(s) for transmission;

- *maxPUSCH-Duration* which sets the maximum PUSCH duration allowed for transmission;

- *configuredGrantType1Allowed* which sets whether a configured grant Type 1 can be used for transmission;

- *allowedServingCells* which sets the allowed cell(s) for transmission.

The following UE variable is used for the Logical channel prioritization procedure:

- *Bj* which is maintained for each logical channel *j*.

The MAC entity shall initialize *Bj* of the logical channel to zero when the logical channel is established.

For each logical channel *j*, the MAC entity shall:

1> increment *Bj* by the product PBR × T before every instance of the LCP procedure, where T is the time elapsed since *Bj* was last incremented;

1> if the value of *Bj* is greater than the bucket size (i.e. PBR × BSD):

2> set *Bj* to the bucket size.

NOTE: The exact moment(s) when the UE updates *Bj* between LCP procedures is up to UE implementation, as long as *Bj* is up to date at the time when a grant is processed by LCP.

[TS 38.321, clause 5.4.3.1.2]

The MAC entity shall, when a new transmission is performed:

1> select the logical channels for each UL grant that satisfy all the following conditions:

2> the set of allowed Subcarrier Spacing index values in *allowedSCS-List*, if configured, includes the Subcarrier Spacing index associated to the UL grant; and

2> *maxPUSCH-Duration*, if configured, is larger than or equal to the PUSCH transmission duration associated to the UL grant; and

2> *configuredGrantType1Allowed*, if configured, is set to *true* in case the UL grant is a Configured Grant Type 1; and

2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant. Does not apply to logical channels associated with a DRB configured with PDCP duplication within the same MAC entity (i.e. CA duplication) for which PDCP duplication is deactivated.

NOTE: The Subcarrier Spacing index, PUSCH transmission duration and Cell information are included in Uplink transmission information received from lower layers for the corresponding scheduled uplink transmission.

[TS 38.321, clause 5.4.3.1.3]

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in subclause 5.4.3.1.2 for the UL grant with *Bj* > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to *infinity*, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement *Bj* by the total size of MAC SDUs served to logical channel *j* above;

2> if any resources remain, all the logical channels selected in subclause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of *Bj*) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

NOTE: The value of *Bj* can be negative.

If the MAC entity is requested to simultaneously transmit multiple MAC PDUs, or if the MAC entity receives the multiple UL grants within one or more coinciding PDCCH occasions (i.e. on different Serving Cells), it is up to UE implementation in which order the grants are processed.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given a UL grant size that is equal to or larger than 8 bytes while having data available and allowed (according to subclause 5.4.3.1) for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:

- the MAC entity is configured with *skipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

- there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

- the MAC PDU includes zero MAC SDUs; and

- the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding.

7.1.1.3.2b.3 Test description

7.1.1.3.2b.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 UM NR DRBs configured according to Table 7.1.1.3.2b.3.1-1.

Table 7.1.1.3.2b.3.1-1: Priority, PBR, Bucket Delay allowed-SCSList settings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRB | priority | prioritizedBitRate (kbytes/s) | bucketSizeDuration (ms) | allowed-SCSList | |
| FR1 | FR2 |
| DRB1 | 6 | 8 | 100 | {15KHz, 30KHz} | {60KHz, 120KHz} |
| DRB2 | 7 | 16 | 100 | {60KHz} | {60KHz} |
| DRB3 | 8 | 32 | 100 | {15KHz, 30KHz,60KHz} | {120KHz} |

Table 7.1.1.3.2b.3.1-2: allowed-SCSList and maxPUSCH-Duration settings

|  |  |  |
| --- | --- | --- |
| DRB | allowed-SCSList | maxPUSCH-Duration |
| DRB1 | Not Present | ms0p02 |
| DRB2 | Not Present | ms0p5 |
| DRB3 | Not Present | ms0p5 |

Table 7.1.1.3.2b.3.1-2a: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation { | 2 entry |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 |  |
| k2 | n4 |  | FR1 |
|  | n8 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 52 | Start symbol(S)=10, Length(L)=4 | FR1 |
| startSymbolAndLength | 42 | Start symbol(S)=0, Length(L)=4 | FR2 |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 |  |
| k2 | n4 |  | FR1 |
|  | n8 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.2b.3.1-3: maxPUSCH-Duration and configuredGrantType1Allowed settings

|  |  |  |
| --- | --- | --- |
| DRB | maxPUSCH-Duration | configuredGrantType1Allowed |
| DRB1 | Not Present | true |
| DRB2 | Not Present | false |
| DRB3 | Not Present | true |

Table 7.1.1.3.2b.3.1-4: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| Discard\_Timer | ms1500 |

7.1.1.3.2b.3.2 Test procedure sequence

Table 7.1.1.3.2b.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 3 are run using the parameters specified for first run in table 7.1.1.3.2b.3.2-3. | - | - | - | - |
| 1 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| - | EXCEPTION: In parallel to the event described in step 2 the events specified in Table 7.1.1.3.2b.3.2-2 shall take place. | - | - | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 150 ms after Step 1 (Note 1), for a duration of T2, the SS transmits an UL grant of D octets every T1. | <-- | (UL grants) | - | - |
| 3 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 is D1 octets +/- 10%  - total number of octets received for DRB2 is 0  - total number of octets received for DRB3 is  D3 octets +/- 10% otherwise? | - | - | 1 | P |
| 4 | SS transmits NR *RRCReconfiguration* message to configure allowed-SCSList and maxPUSCH-Duration as per Table 7.1.1.3.2b.3.1-2. (Note 2) | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| - | EXCEPTION: In parallel to the event described in step 5 the events specified in Table 7.1.1.3.2b.3.2-2a shall take place on DRB2 | - | - | - | - |
| 5 | The UE transmits NR *RRCReconfigurationComplete* message. (Note 3) | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| - | EXCEPTION: Steps 6 to 8 are run using the parameters specified for second run in table 7.1.1.3.2b.3.1-2. | - | - | - | - |
| 6 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| - | EXCEPTION: In parallel to the event described in step 7 the events specified in Table 7.1.1.3.2b.3.2-2 shall take place. | - | - | - | - |
| 7 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 150 ms after Step 6 (Note 1), for a duration of T2, the SS transmits an UL grant of D octets every T1. | <-- | (UL grants) | - | - |
| 8 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 are 0  - total number of octets received for DRB2 are D2 octets +/- 10%  - total number of octets received for DRB3 are D3 octets +/- 10%? | - | - | 2 | P |
| - | EXCEPTION: Steps 9 to 14 describe behaviour that depends on the UE capability. | - | - | - | - |
| 9 | IF pc\_configuredUL\_GrantType1 the SS transmits NR *RRCReconfiguration* message to configure UL configured grant type 1for a duration of T2 and an UL configured grant type1 of D octets every T1. It also configuresmaxPUSCH-Duration and configuredGrantType1Allowed as per Table 7.1.1.3.2b.3.1-3 (Note 2) | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| - | EXCEPTION: In parallel to the event described in step 10 the events specified in Table 7.1.1.3.2b.3.2-2a shall take place on DRB1 | - | - | - | - |
| 10 | The UE transmits NR *RRCReconfigurationComplete* message. (Note 3) | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| - | EXCEPTION: Steps 11 to 13 are run using the parameters specified for third run in table 7.1.1.3.2b.3.1-3. | - | - | - | - |
| 11 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| - | EXCEPTION: In parallel to the event described in step 12 the events specified in Table 7.1.1.3.2b.3.2-2 shall take place. | - | - | - | - |
| 12 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 are D1 octets +/- 10%  - total number of octets received for DRB2 are 0  - total number of octets received for DRB3 are D3 octets +/- 10%? | - | - | 3 | P |
| 13 | The SS sends one Uplink Grant to send loop back PDU on DRB 2. | <-- | (UL grants) | - | - |
| 14 | The UE transmits the RLC SDU back to the SS. | --> | - | - | - |
| Note 1: This wait time will ensure that a) all octets have been completely received by the UE on all 3 DRBs before the first UL grant is received and b) the Bjs for each logical channel have reached their maximum value i.e. the bucket size of the corresponding logical channel before the first UL grant is received.  Note 2: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 3: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete* | | | | | |

Table 7.1.1.3.2b.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U – S | Message |  |  |
| 1 | Check: Does the UE transmit the RLC SDUs back to the SS? | --> | - | 1,2,3 | P |

Table 7.1.1.3.2b.3.2-2a: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U – S | Message |  |  |
| 1 | The UE may transmit the RLC SDU back to the SS within one second. | --> | - | - | - |

Table 7.1.1.3.2b.3.2-3: Test parameter values

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | First run | Second run | Third run |
| N1 (SDUs) | 13 | 1 | 13 |
| N2 (SDUs) | 1 | 25 | 1 |
| N3 (SDUs) | 50 | 50 | 50 |
| D (octets) | 1153 | 576 | 1153 |
| T1 (ms) | 20 | 20 | 40 |
| T2 (ms) | 360 | 860 | 720 |
| D1 (octets) | 4160 | 0 | 4160 |
| D2 (octets) | 0 | 8000 | 0 |
| D3 (octets) | 16000 | 16000 | 16000 |
| Note 1: Calculated using the following equation for the case of the least header size:(D1 + D2 + D3) = (D - 6) \* T2 / T1. | | | |

7.1.1.3.2b.3.3 Specific message contents

Table 7.1.1.3.2b.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.3-20 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

Table 7.1.1.3.2b.3.3-2: *RRCReconfiguration* (step 9, Table 7.1.1.3.2b.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | Not present |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension := SEQUENCE {} | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.2b.3.3-3: *CellGroupConfig* (Table 7.1.1.3.2b.3.3-2: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList | Not present |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig SEQUENCE { |  |  |  |
| cs-RNTI CHOICE { |  |  |  |
| setup SEQUENCE{ |  |  |  |
| RNTI-Value | ‘FFE0’H |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| reconfigurationWithSync | Not present |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 9 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1[4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym40x14 | 40ms | 15kHz |
| periodicity | Sym80x14 | 40ms | 30kHz |
| periodicity | Sym160x14 | 40ms | 60kHz |
| periodicity | Sym320x14 | 40ms | 120kHz |
| rrc-ConfiguredUplinkGrant SEQUENCE{ |  |  |  |
| timeDomainOffset | 9 |  |  |
| timeDomainAllocation | 0 | Reference TS 38.508-1 [4], Table 4.6.3-122 |  |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB = 23 PRB,  RBstart = 0,  NBWPsize is the size [PRBs] of the active carrier bandwidth part and ontained in TS.38.508-1 [4] clause 4.3.1.1. |  |
| antennaPort | 0 |  |  |
| precodingAndNumberOfLayers | 0 |  |  |
| srs-ResourceIndicator | Not present |  |  |
| mcsAndTBS | 16 |  |  |
| pathlossReferenceIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.3 Correct handling of MAC control information / Scheduling requests

7.1.1.3.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE has UL data available for transmission and UE has no UL-SCH resources available and SR\_COUNTER is less than sr-TransMax }

**then** { the UE transmits a SR on every available PUCCH until resources are granted }

}

(2)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE receives an UL grant for a new transmission }

**then** { UE cancels all pending SR(s) }

}

(3)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE has UL data available for transmission and UE has no UL-SCH resources available and SR\_COUNTER becomes equal to sr-TransMax }

**then** { the UE transmits a PRACH Preamble to initiate a Random Access procedure }

}

(4)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured and logicalChannelSR-DelayTimer is configured }

**ensure that** {

**when** { UE has UL data available for transmission on LCH for which logicalChannelSR-DelayTimer is configured and UE has no UL-SCH resources available and SR\_COUNTER is less than sr-TransMax }

**then** { the UE delays transmission of SR until logicalChannelSR-DelayTimer expires }

}

(5)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE has UL data available for transmission on LCH for which logicalChannelSR-DelayTimer is not configured and UE has no UL-SCH resources available and SR\_COUNTER is less than sr-TransMax }

**then** { the UE transmits a SR on every available PUCCH until resources are granted }

}

7.1.1.3.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.4 and 5.4.5. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.4]

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

The MAC entity may be configured with zero, one, or more SR configurations. An SR configuration consists of a set of PUCCH resources for SR across different BWPs and cells. For a logical channel, at most one PUCCH resource for SR is configured per BWP.

Each SR configuration corresponds to one or more logical channels. Each logical channel may be mapped to zero or one SR configuration, which is configured by RRC. The SR configuration of the LCH that triggered the BSR (subclause 5.4.5) (if such a configuration exists) is considered as corresponding SR configuration for the triggered SR. For BSR triggered by *retxBSR-Timer* expiry, the corresponding SR configuration for the triggered SR is that of the highest priority LCH (if such a configuration exists) that has data available for transmission at the time the BSR is triggered.

RRC configures the following parameters for the scheduling request procedure:

- *sr-ProhibitTimer* (per SR configuration);

- *sr-TransMax* (per SR configuration);

- *sr-ConfigIndex*.

The following UE variables are used for the scheduling request procedure:

- *SR\_COUNTER* (per SR configuration).

If an SR is triggered and there are no other SRs pending corresponding to the same SR configuration, the MAC entity shall set the *SR\_COUNTER* of the corresponding SR configuration to 0.

When an SR is triggered, it shall be considered as pending until it is cancelled. All pending SR(s) shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when a MAC PDU is assembled and this PDU includes a BSR which contains buffer status up to (and including) the last event that triggered a BSR (see subclause 5.4.5), or when the UL grant(s) can accommodate all pending data available for transmission.

Only PUCCH resources on a BWP which is active at the time of SR transmission occasion are considered valid.

As long as at least one SR is pending, the MAC entity shall for each pending SR:

1> if the MAC entity has no valid PUCCH resource configured for the pending SR:

2> initiate a Random Access procedure (see subclause 5.1) on the SpCell and cancel the pending SR.

1> else, for the SR configuration corresponding to the pending SR:

2> when the MAC entity has an SR transmission occasion on the valid PUCCH resource for SR configured; and

2> if *sr-ProhibitTimer* is not running at the time of the SR transmission occasion; and

2> if the PUCCH resource for the SR transmission occasion does not overlap with a measurement gap; and

2> if the PUCCH resource for the SR transmission occasion does not overlap with a UL-SCH resource:

3> if *SR\_COUNTER* < *sr-TransMax*:

4> increment *SR\_COUNTER* by 1;

4> instruct the physical layer to signal the SR on one valid PUCCH resource for SR;

4> start the *sr-ProhibitTimer*.

3> else:

4> notify RRC to release PUCCH for all serving cells;

4> notify RRC to release SRS for all serving cells;

4> clear any configured downlink assignments and uplink grants;

4> initiate a Random Access procedure (see subclause 5.1) on the SpCell and cancel all pending SRs.

NOTE: The selection of which valid PUCCH resource for SR to signal SR on when the MAC entity has more than one overlapping valid PUCCH resource for the SR transmission occasion is left to UE implementation.

[TS 38.321, clause 5.4.5]

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

…

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

7.1.1.3.3.3 Test description

7.1.1.3.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 2 AM DRBs configured according to Table 7.1.1.3.3.3.1-1 and Table 7.1.1.3.3.3.1-2 and with MAC-CellGroupConfig configured according to Table 7.1.1.3.3.3.1-3 and Short\_DCI condition is applied in NR Serving cell configuration.

Table 7.1.1.3.3.3.1-1: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |
| logicalChannelSR-DelayTimerApplied | False | True |
| logicalChannelSR-DelayTimer | Not Present | sf512 |

Table 7.1.1.3.3.3.1-2: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

Table 7.1.1.3.3.3.1-3: MAC-CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.308 [6], clause Table 4.6.3-49 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | infinity |  |  |
| retxBSR-Timer | sf2560 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

7.1.1.3.3.3.2 Test procedure sequence

Table 7.1.1.3.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a MAC PDU containing A MAC Sub PDU containing a RLC SDU on LCH 5 | <-- | MAC PDU (containing 1 MAC sub PDU) | - | - |
| 2 | Check: Does the UE transmit Scheduling Requests for logicalChannelSR-DelayTimer (sf512) from step 1? | --> | (SR) | 4 | F |
| 3 | Check: Does the UE transmit [x] Scheduling Requests separately on [x] consecutively available PUCCHs after logicalChannelSR-DelayTimer expiry? (Note 1) | --> | (SR) | 1,4 | P |
| 4 | The SS transmits an UL grant to allocate UL-SCH resources that are enough to transmit looped back PDU | <-- | (UL Grant) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on LCH5? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 6 | The SS transmits a MAC PDU containing A MAC Sub PDU containing a RLC SDU on LCH 4 | <-- | MAC PDU (containing 1 MAC sub PDU) | - | - |
| 7 | Check: Does the UE transmit Scheduling Requests separately on [x] consecutively available PUCCHs? (Note 1) | --> | (SR) | 1,5 | P |
| 8 | The SS transmits an UL grant to allocate UL-SCH resources that are enough to transmit looped back PDU | <-- | (UL Grant ) | - | - |
| 9 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on LCH4? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 10 | Check: For 1 second, does the UE transmit a Scheduling Request? | --> | (SR) | 1,2 | F |
| 11 | The SS transmits a MAC PDU containing a Timing Advance Command MAC Control Element, but does not send any subsequent alignments. | <-- | MAC PDU (Timing Advance Command) | - | - |
| 12 | The SS transmits a MAC PDU containing a MAC SDU on LCH 4 | <-- | MAC PDU (MAC SDU) | - | - |
| - | EXCEPTION: Step 13 is repeated less than sr-TransMax times | - | - | - | - |
| 13 | The UE may transmit Scheduling Requests before time alignment timer expires. The SS shall not respond to the Scheduling Requests in this step. (Note 2) | --> | (SR) | - | - |
| 14 | Check: does the UE transmit a preamble on PRACH? | --> | (PRACH Preamble) | 3 | P |
| 15 | The SS transmits a Random Access Response including an UL grant to enable UE to transmit C-RNTI MAC Control Element and the MAC SDU as received in step 14. | <-- | Random Access Response | - | - |
| 16 | The UE transmit a MAC PDU including a C-RNTI MAC Control Element and a MAC SDU. (Note 3) | --> | MAC PDU (MAC Sub PDU containing C-RNTI control element, MAC sub PDU containing MAC SDU) | - | - |
| 17 | The SS sends PDCCH transmission for UE C-RNTI | <-- | - | - | - |
| Note 1: The UE repeats the scheduling requests on every available PUCCH as long as SR\_COUNTER < dsr-TransMax and there is UL data available for transmission and there are no resources available to transmit it. At the reception of first Scheduling Request from the UE, SS will be scheduled to transmit a grant after 100ms. Hence SS will receive 10 Scheduling Requests.  Note 2: In step 8, SR repetition of [63] times (*sr-TransMax* (64)) will take at least [63\*10 = 630] ms which is smaller than TA timer [infinity].  Note 3: The UE transmission of the MAC PDU ensures that the random access procedure was successful. | | | | | |

7.1.1.3.3.3.3 Specific message contents

Table 7.1.1.3.3.3.3-1: SchedulingRequestConfig (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestConfig ::= SEQUENCE { schedulingRequestToAddModList (SIZE(1..maxNrofSR-ConfigPerCellGroup)) OF SSchedulingRequestToAddMod { | 1 entry |  |  |
| SchedulingRequestToAddMod[1] SEQUENCE { |  | entry 1 |  |
| sr-TransMax | n64 | MAX Value |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.4 Correct handling of MAC control information / Buffer status / UL data arrive in the UE Tx buffer / Regular BSR

7.1.1.3.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UL data arrives in the UE transmission buffer and the data belongs to a logical channel with higher priority than those for which data is already available for transmission and the new logical channel and the existing logical channels belongs to the different LCG }

**then** { UE Reports a Long Buffer Status Reporting (BSR) }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UL data arrives in the UE transmission buffer and there is no data available for transmission for any of the logical channels which belong to a LCG }

**then** { UE Reports a Short Buffer Status Reporting (BSR) }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UL data arrives in the UE transmission buffer and the data belongs to a logical channel with higher priority than those for which data is already available for transmission and the new logical channel and existing logical channels belong to the same LCG }

**then** { UE Reports a Short Buffer Status Reporting (BSR) }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { retxBSR-Timer expires and only one LCG has data available for transmission }

**then** { UE triggers a regular BSR and Reports a Short Buffer Status Reporting (BSR) }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { a Regular BSR has been triggered and UE has pending data for transmission and UE has only resources to send either BSR report or data }

**then** { UE transmits the BSR report }

}

(6)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE determines that a BSR has been triggered since the last transmission of a BSR and UE has no UL resources allocated for new transmission for this TTI }

**then** { UE transmits a scheduling request }

}

(7)

Void.

(8)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { a Regular BSR has been triggered and UE has pending data on several logical channels for transmission and UE has UL resources to send all pending data including BSR }

**then** { UE transmits the UL data and reports buffer status reporting (BSR) that indicates there is no more data in the buffer }

}

7.1.1.3.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.5, 6.1.3.1, 6.2.1 and TS 38.323 clause 5.6. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.3.1.3]

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding.

[TS 38.321, clause 5.4.5]

The Buffer Status reporting (BSR) procedure is used to provide the serving gNB with information about UL data volume in the MAC entity.

RRC configures the following parameters to control the BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *logicalChannelSR-Delay*;

- *logicalChannelSR-DelayTimer*;

- *logicalChannelGroup*.

Each logical channel may be allocated to an LCG using the *logicalChannelGroup*. The maximum number of LCGs is eight.

The MAC entity determines the amount of UL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4].

A BSR shall be triggered if any of the following events occur:

- the MAC entity has new UL data available for a logical channel which belongs to an LCG; and either

- the new UL data belongs to a logical channel with higher priority than the priority of any logical channel containing available UL data which belong to any LCG; or

- none of the logical channels which belong to an LCG contains any available UL data.

in which case the BSR is referred below to as 'Regular BSR';

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC CE plus its subheader, in which case the BSR is referred below to as 'Padding BSR';

- *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains UL data, in which case the BSR is referred below to as 'Regular BSR';

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as 'Periodic BSR'.

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic BSR, the MAC entity shall:

1> if more than one LCG has data available for transmission when the BSR is to be transmitted:

2> report Long BSR for all LCGs which have data available for transmission.

1> else:

2> report Short BSR.

For Padding BSR:

1> if the number of padding bits is equal to or larger than the size of the Short BSR plus its subheader but smaller than the size of the Long BSR plus its subheader:

2> if more than one LCG has data available for transmission when the BSR is to be transmitted:

3> if the number of padding bits is equal to the size of the Short BSR plus its subheader:

4> report Short Truncated BSR of the LCG with the highest priority logical channel with data available for transmission.

3> else:

4> report Long Truncated BSR of the LCG(s) with the logical channels having data available for transmission following a decreasing order of priority, and in case of equal priority, in increasing order of LCGID.

2> else:

3> report Short BSR;

1> else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader:

2> report Long BSR for all LCGs which have data available for transmission.

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

A MAC PDU shall contain at most one BSR MAC CE, even when multiple events have triggered a BSR by the time. The Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of a grant for transmission of new data on any UL-SCH.

All triggered BSRs may be cancelled when the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the BSR MAC control element plus its subheader. All triggered BSRs shall be cancelled when a BSR is included in a MAC PDU for transmission.

The MAC entity shall transmit at most one BSR in one MAC PDU. Padding BSR shall not be included when the MAC PDU contains a Regular or Periodic BSR.

[TS 38.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC CEs consist of either:

- Short BSR format (fixed size); or

- Long BSR format (variable size); or

- Short Truncated BSR format (fixed size); or

- Long Truncated BSR format (variable size).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in Table 6.2.1-2.

The fields in the BSR MAC CE are defined as follows:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose buffer status is being reported. The length of the field is 3 bits;

- LCGi: For the Long BSR format, this field indicates the presence of the Buffer Size field for the logical channel group i. The LCGi field set to "1" indicates that the Buffer Size field for the logical channel group i is reported. The LCGi field set to "0" indicates that the Buffer Size field for the logical channel group i is not reported. For the Long Truncated BSR format, this field indicates whether logical channel group i has data available. The LCGi field set to "1" indicates that logical channel group i has data available. The LCGi field set to "0" indicates that logical channel group i does not have data available;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4] across all logical channels of a logical channel group after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field for the Short BSR format and the Short Truncated BSR format is 5 bits. The length of this field for the Long BSR format and the Long Truncated BSR format is 8 bits. The values for the 5-bit and 8-bit Buffer Size fields are shown in Tables 6.1.3.1-1 and 6.1.3.1-2, respectively. For the Long BSR format and the Long Truncated BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Long Truncated BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the Long Truncated BSR format can be zero.



Figure 6.1.3.1-1: Short BSR and Short Truncated BSR MAC CE



Figure 6.1.3.1-2: Long BSR and Long Truncated BSR MAC CE

Table 6.1.3.1-1: Buffer size levels (in bytes) for 5-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 8 | ≤ 102 | 16 | ≤ 1446 | 24 | ≤ 20516 |
| 1 | ≤ 10 | 9 | ≤ 142 | 17 | ≤ 2014 | 25 | ≤ 28581 |
| 2 | ≤ 14 | 10 | ≤ 198 | 18 | ≤ 2806 | 26 | ≤ 39818 |
| 3 | ≤ 20 | 11 | ≤ 276 | 19 | ≤ 3909 | 27 | ≤ 55474 |
| 4 | ≤ 28 | 12 | ≤ 384 | 20 | ≤ 5446 | 28 | ≤ 77284 |
| 5 | ≤ 38 | 13 | ≤ 535 | 21 | ≤ 7587 | 29 | ≤ 107669 |
| 6 | ≤ 53 | 14 | ≤ 745 | 22 | ≤ 10570 | 30 | ≤ 150000 |
| 7 | ≤ 74 | 15 | ≤ 1038 | 23 | ≤ 14726 | 31 | > 150000 |

Table 6.1.3.1-2: Buffer size levels (in bytes) for 8-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 64 | ≤ 560 | 128 | ≤ 31342 | 192 | ≤ 1754595 |
| 1 | ≤ 10 | 65 | ≤ 597 | 129 | ≤ 33376 | 193 | ≤ 1868488 |
| 2 | ≤ 11 | 66 | ≤ 635 | 130 | ≤ 35543 | 194 | ≤ 1989774 |
| 3 | ≤ 12 | 67 | ≤ 677 | 131 | ≤ 37850 | 195 | ≤ 2118933 |
| 4 | ≤ 13 | 68 | ≤ 720 | 132 | ≤ 40307 | 196 | ≤ 2256475 |
| 5 | ≤ 14 | 69 | ≤ 767 | 133 | ≤ 42923 | 197 | ≤ 2402946 |
| 6 | ≤ 15 | 70 | ≤ 817 | 134 | ≤ 45709 | 198 | ≤ 2558924 |
| 7 | ≤ 16 | 71 | ≤ 870 | 135 | ≤ 48676 | 199 | ≤ 2725027 |
| 8 | ≤ 17 | 72 | ≤ 926 | 136 | ≤ 51836 | 200 | ≤ 2901912 |
| 9 | ≤ 18 | 73 | ≤ 987 | 137 | ≤ 55200 | 201 | ≤ 3090279 |
| 10 | ≤ 19 | 74 | ≤ 1051 | 138 | ≤ 58784 | 202 | ≤ 3290873 |
| 11 | ≤ 20 | 75 | ≤ 1119 | 139 | ≤ 62599 | 203 | ≤ 3504487 |
| 12 | ≤ 22 | 76 | ≤ 1191 | 140 | ≤ 66663 | 204 | ≤ 3731968 |
| 13 | ≤ 23 | 77 | ≤ 1269 | 141 | ≤ 70990 | 205 | ≤ 3974215 |
| 14 | ≤ 25 | 78 | ≤ 1351 | 142 | ≤ 75598 | 206 | ≤ 4232186 |
| 15 | ≤ 26 | 79 | ≤ 1439 | 143 | ≤ 80505 | 207 | ≤ 4506902 |
| 16 | ≤ 28 | 80 | ≤ 1532 | 144 | ≤ 85730 | 208 | ≤ 4799451 |
| 17 | ≤ 30 | 81 | ≤ 1631 | 145 | ≤ 91295 | 209 | ≤ 5110989 |
| 18 | ≤ 32 | 82 | ≤ 1737 | 146 | ≤ 97221 | 210 | ≤ 5442750 |
| 19 | ≤ 34 | 83 | ≤ 1850 | 147 | ≤ 103532 | 211 | ≤ 5796046 |
| 20 | ≤ 36 | 84 | ≤ 1970 | 148 | ≤ 110252 | 212 | ≤ 6172275 |
| 21 | ≤ 38 | 85 | ≤ 2098 | 149 | ≤ 117409 | 213 | ≤ 6572925 |
| 22 | ≤ 40 | 86 | ≤ 2234 | 150 | ≤ 125030 | 214 | ≤ 6999582 |
| 23 | ≤ 43 | 87 | ≤ 2379 | 151 | ≤ 133146 | 215 | ≤ 7453933 |
| 24 | ≤ 46 | 88 | ≤ 2533 | 152 | ≤ 141789 | 216 | ≤ 7937777 |
| 25 | ≤ 49 | 89 | ≤ 2698 | 153 | ≤ 150992 | 217 | ≤ 8453028 |
| 26 | ≤ 52 | 90 | ≤ 2873 | 154 | ≤ 160793 | 218 | ≤ 9001725 |
| 27 | ≤ 55 | 91 | ≤ 3059 | 155 | ≤ 171231 | 219 | ≤ 9586039 |
| 28 | ≤ 59 | 92 | ≤ 3258 | 156 | ≤ 182345 | 220 | ≤ 10208280 |
| 29 | ≤ 62 | 93 | ≤ 3469 | 157 | ≤ 194182 | 221 | ≤ 10870913 |
| 30 | ≤ 66 | 94 | ≤ 3694 | 158 | ≤ 206786 | 222 | ≤ 11576557 |
| 31 | ≤ 71 | 95 | ≤ 3934 | 159 | ≤ 220209 | 223 | ≤ 12328006 |
| 32 | ≤ 75 | 96 | ≤ 4189 | 160 | ≤ 234503 | 224 | ≤ 13128233 |
| 33 | ≤ 80 | 97 | ≤ 4461 | 161 | ≤ 249725 | 225 | ≤ 13980403 |
| 34 | ≤ 85 | 98 | ≤ 4751 | 162 | ≤ 265935 | 226 | ≤ 14887889 |
| 35 | ≤ 91 | 99 | ≤ 5059 | 163 | ≤ 283197 | 227 | ≤ 15854280 |
| 36 | ≤ 97 | 100 | ≤ 5387 | 164 | ≤ 301579 | 228 | ≤ 16883401 |
| 37 | ≤ 103 | 101 | ≤ 5737 | 165 | ≤ 321155 | 229 | ≤ 17979324 |
| 38 | ≤ 110 | 102 | ≤ 6109 | 166 | ≤ 342002 | 230 | ≤ 19146385 |
| 39 | ≤ 117 | 103 | ≤ 6506 | 167 | ≤ 364202 | 231 | ≤ 20389201 |
| 40 | ≤ 124 | 104 | ≤ 6928 | 168 | ≤ 387842 | 232 | ≤ 21712690 |
| 41 | ≤ 132 | 105 | ≤ 7378 | 169 | ≤ 413018 | 233 | ≤ 23122088 |
| 42 | ≤ 141 | 106 | ≤ 7857 | 170 | ≤ 439827 | 234 | ≤ 24622972 |
| 43 | ≤ 150 | 107 | ≤ 8367 | 171 | ≤ 468377 | 235 | ≤ 26221280 |
| 44 | ≤ 160 | 108 | ≤ 8910 | 172 | ≤ 498780 | 236 | ≤ 27923336 |
| 45 | ≤ 170 | 109 | ≤ 9488 | 173 | ≤ 531156 | 237 | ≤ 29735875 |
| 46 | ≤ 181 | 110 | ≤ 10104 | 174 | ≤ 565634 | 238 | ≤ 31666069 |
| 47 | ≤ 193 | 111 | ≤ 10760 | 175 | ≤ 602350 | 239 | ≤ 33721553 |
| 48 | ≤ 205 | 112 | ≤ 11458 | 176 | ≤ 641449 | 240 | ≤ 35910462 |
| 49 | ≤ 218 | 113 | ≤ 12202 | 177 | ≤ 683087 | 241 | ≤ 38241455 |
| 50 | ≤ 233 | 114 | ≤ 12994 | 178 | ≤ 727427 | 242 | ≤ 40723756 |
| 51 | ≤ 248 | 115 | ≤ 13838 | 179 | ≤ 774645 | 243 | ≤ 43367187 |
| 52 | ≤ 264 | 116 | ≤ 14736 | 180 | ≤ 824928 | 244 | ≤ 46182206 |
| 53 | ≤ 281 | 117 | ≤ 15692 | 181 | ≤ 878475 | 245 | ≤ 49179951 |
| 54 | ≤ 299 | 118 | ≤ 16711 | 182 | ≤ 935498 | 246 | ≤ 52372284 |
| 55 | ≤ 318 | 119 | ≤ 17795 | 183 | ≤ 996222 | 247 | ≤ 55771835 |
| 56 | ≤ 339 | 120 | ≤ 18951 | 184 | ≤ 1060888 | 248 | ≤ 59392055 |
| 57 | ≤ 361 | 121 | ≤ 20181 | 185 | ≤ 1129752 | 249 | ≤ 63247269 |
| 58 | ≤ 384 | 122 | ≤ 21491 | 186 | ≤ 1203085 | 250 | ≤ 67352729 |
| 59 | ≤ 409 | 123 | ≤ 22885 | 187 | ≤ 1281179 | 251 | ≤ 71724679 |
| 60 | ≤ 436 | 124 | ≤ 24371 | 188 | ≤ 1364342 | 252 | ≤ 76380419 |
| 61 | ≤ 464 | 125 | ≤ 25953 | 189 | ≤ 1452903 | 253 | ≤ 81338368 |
| 62 | ≤ 494 | 126 | ≤ 27638 | 190 | ≤ 1547213 | 254 | > 81338368 |
| 63 | ≤ 526 | 127 | ≤ 29431 | 191 | ≤ 1647644 | 255 | Reserved |

[TS 38.321, clause 6.2.1]

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 000000 | CCCH |
| 000001–100000 | Identity of the logical channel |
| 100001–110110 | Reserved |
| 110111 | Configured Grant Confirmation |
| 111000 | Multiple Entry PHR |
| 111001 | Single Entry PHR |
| 111010 | C-RNTI |
| 111011 | Short Truncated BSR |
| 111100 | Long Truncated BSR |
| 111101 | Short BSR |
| 111110 | Long BSR |
| 111111 | Padding |

[TS 38.323, clause 5.6]

For the purpose of MAC buffer status reporting, the transmitting PDCP entity shall consider the following as PDCP data volume:

- the PDCP SDUs for which no PDCP Data PDUs have been constructed;

- the PDCP Data PDUs that have not been submitted to lower layers;

- the PDCP Control PDUs;

- for AM DRBs, the PDCP SDUs to be retransmitted according to subclause 5.1.2;

- for AM DRBs, the PDCP Data PDUs to be retransmitted according to subclause 5.5.

[TS 38.322, clause 5.5]For the purpose of MAC buffer status reporting, the UE shall consider the following as RLC data volume:

- RLC SDUs and RLC SDU segments that have not yet been included in an RLC data PDU;

- RLC data PDUs that are pending for initial transmission;

- RLC data PDUs that are pending for retransmission (RLC AM).

In addition, if a STATUS PDU has been triggered and *t-StatusProhibit* is not running or has expired, the UE shall estimate the size of the STATUS PDU that will be transmitted in the next transmission opportunity, and consider this as part of RLC data volume.

7.1.1.3.4.3 Test description

7.1.1.3.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 AM DRBs on NR cell configured according to Table 7.1.1.3.4.3.1-1.

Table 7.1.1.3.4.3.1-1: Logical Channel Configuration Settings

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value DRB1 | Value DRB2 | Value DRB3 |
| LogicalChannelIdentity | LCH4((DRB-Identity +3) | LCH5(DRB-Identity +3) | LCH6(DRB-Identity +3) |
| Priority | 8 | 7 | 6 |
| prioritizedBitRate | 0 kB/s | 0 kB/s | 0 kB/s |
| logicalChannelGroup | 2 (LCG ID#2) | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.4.3.2 Test procedure sequence

Table 7.1.1.3.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | The SS transmits a MAC PDU containing two RLC SDUs of size 12 bytes on LCH4 | <-- | MAC PDU (2 RLC SDUs on LCH4) | - | - |
| 3 | SS allocates an UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 4 | Check: Does the UE transmit a Short BSR with ‘LCG ID’ field set to ‘2’ and ‘Buffer size’ field set to value ‘4’ or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID=‘2’, Buffer Size=’4’ or bigger)) | 2,5 | P |
| 5 | Wait for retxBSR-Timer expiry on UE side. | - | - | - | - |
| 6 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 7 | The SS responds to the scheduling request in step 6 by an UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 8 | Check: Does the UE transmit a Short BSR with ‘LCG ID’ field set to ‘2’ and ‘Buffer size’ field set to value ‘4’ or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID=‘2’, Buffer Size=’4’ or bigger)) | 4,5 | P |
| 9 | The SS transmits a MAC PDU containing one RLC SDU of size 12 bytes on LCH5 | <-- | MAC PDU (1 RLC SDU on LCH5) | - | - |
| 10 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 11 | The SS respond to the scheduling request in step 10 by an UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 12 | Check: Does the UE transmit a Short BSR with ‘LCG ID’ field set to ‘2’ and ‘Buffer size#1’ field set to value ‘5’ or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID=‘2’, Buffer Size=’5’ or bigger)) | 3,5 | P |
| 13 | The SS transmits a MAC PDU containing two RLC SDUs of size 5 bytes on LCH6 | <-- | MAC PDU (2 RLC SDUs on LCH6) | - | - |
| 14 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 15 | The SS responds to the scheduling request in step 14 by one UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 16 | Check: Does the UE transmit a Long BSR with ‘Buffer size#1’ field set to value ‘1’, ‘Buffer size#2’ field set to value ‘20’ or bigger? (Note 3) | --> | MAC PDU (MAC Long BSR (Buffer size#1=’1’ or bigger, Buffer size#2=’20’ or bigger) | 1,5 | P |
| 17 | Wait for retxBSR-Timer expiry on the UE side. | - |  | - | - |
| 18 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 19 | SS allocates an UL Grant of 608 bits. (Note 4) | <-- | (UL Grant, 608 bits) | - | - |
| - | EXCEPTION: Steps 20a1 to 20b1 describe behaviour that depends on the UE capability; the 'lower case letter' identifies a step sequence that take place if a capability is supported | - | - | - | - |
| 20a1 | IF NOT pc\_supportOfRedCap\_r17 THEN  Check: Does the UE transmit a MAC PDU including five RLC SDUs and BSR? (Note 5) | --> | MAC PDU (17-Byte 2 MAC sub PDUs from LCH4, 17-Byte 1 MAC sub PDU from LCH5 and 10-Byte 2 MAC Sub PDUs from LCH6) | - | - |
| 20b1 | ELSE IF pc\_supportOfRedCap\_r17 THEN  Check: Does the UE transmit a MAC PDU including five RLC SDUs and BSR? (Note 5) | --> | MAC PDU (16-Byte 2 MAC sub PDUs from LCH4, 16-Byte 1 MAC sub PDU from LCH5 and 9-Byte 2 MAC Sub PDUs from LCH6) | - | - |
| 21 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=’000100’) | <-- | RLC STATUS PDU (ACK\_SN=2) | - | - |
| 22 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=’000101’) | <-- | RLC STATUS PDU (ACK\_SN=1) | - | - |
| 23 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=’000110’) | <-- | RLC STATUS PDU (ACK\_SN=2) | - | - |
| 24 | The SS transmits a MAC PDU containing two MAC SDUs, the first containing a 8 byte RLC SDU with LCID set to LCH4 and the second containing a 7 byte RLC SDU with LCID set to LCH6. | <-- | MAC PDU | - | - |
| 25 | The UE sends Scheduling Request | --> | (SR) | - | - |
| 26 | The SS transmits an uplink grant of size 256 bits. (Note 6) | <-- | (UL grant, 256 bits) | - | - |
| - | EXCEPTION: Steps 27a1 to 27b1 describe behaviour that depends on the UE capability; the 'lower case letter' identifies a step sequence that take place if a capability is supported | - | - | - | - |
| 27a1 | IF NOT pc\_supportOfRedCap\_r17 THEN  Check: Does the UE return a MAC PDU of length 256 bits including RLC SDUs, Padding and Short BSR or LongBSR with Buffer size(s) set to ‘0’? (Note 5) | --> | MAC PDU (13-Byte MAC Sub PDU from LC 4 and 12-Byte MAC Sub PDU from LCH6 and 5-Byte MAC Sub PDU containing Long BSR and 2-Byte MAC Sub PDU containing Padding)  Or  MAC PDU (13-Byte MAC Sub PDU from LCH4 and 12-Byte MAC Sub PDU from LCH6 and 2-Byte MAC Sub PDU containing short BSR and 5-Byte MAC Sub PDU containing Padding) | 8 | P |
| 27b1 | ELSE IF pc\_supportOfRedCap\_r17 THEN  Check: Does the UE return a MAC PDU of length 256 bits including RLC SDUs, Padding and Short BSR or LongBSR with Buffer size(s) set to ‘0’? (Note 5) | --> | MAC PDU (12-Byte MAC Sub PDU from LC 4 and 11-Byte MAC Sub PDU from LCH6 and 5-Byte MAC Sub PDU containing Long BSR and 4-Byte MAC Sub PDU containing Padding)  Or  MAC PDU (12-Byte MAC Sub PDU from LCH4 and 11-Byte MAC Sub PDU from LCH6 and 2-Byte MAC Sub PDU containing short BSR and 7-Byte MAC Sub PDU containing Padding) | 8 | P |
| 28 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=LCH4) | <-- | RLC STATUS PDU (ACK\_SN=3) | - | - |
| 29 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=LCH6) | <-- | RLC STATUS PDU (ACK\_SN=3) | - | - |
| Note 1: 40 bits enables UE to transmit a MAC PDU with a 1 byte MAC BSR header and a Short BSR (1 byte) or a 2 bytes MAC BSR header and a Long BSR (3 bytes with 2 LCG configured).  Note 2: UE triggers a Short BSR of type "Regular BSR" to report buffer status for one LCG for that TTI. The UE should not send any of the received RLC SDUs (segmented) due to Regular BSR has higher priority than U-plane logical channels.  Note 3: UE triggers and transmit a Long BSR of type "Regular BSR". The UL grant would be enough for UE to transmit one RLC SDU as received in step 8, but Regular BSR has higher priority than U-plane logical channels.  Note 4: If pc\_supportOfRedCap\_r17=false, the UE has 46 bytes of RLC SDU data (received in steps 2, 9 and 13) in the transmission buffer.608 bits enables UE to transmit user data in MAC PDU 2 RLC SDUs of 12 bytes on LCH4, each 3 Bytes RLC Header and 2 Bytes MAC Header resulting in 2 MAC Sub PDUs of 17 Bytes Each. Similarly one 17 Bytes MAC Sub PDU for 12 Bytes RLC SDU on LCH5. Two 5 Bytes RLC SDUs on LCH6 with 3 Bytes RLC header each and 2 Bytes MAC header each, will result in 2 MAC sub PDUs of 10 bytes each. Total comes to 17+17+17+10+10 +3 B LongBSR(2 Bytes LongBSR header + 1 Byte LongBSR) + 2 B padding =76 Bytes. If pc\_supportOfRedCap\_r17=true, the UE has 46 bytes of RLC SDU data (received in steps 2, 9 and 13) in the transmission buffer.608 bits enables UE to transmit user data in MAC PDU 2 RLC SDUs of 12 bytes on LCH4, each 2Bytes RLC Header and 2 Bytes MAC Header resulting in 2 MAC Sub PDUs of 16 Bytes Each. Similarly one 16 Bytes MAC Sub PDU for 12 Bytes RLC SDU on LCH5. Two 5 Bytes RLC SDUs on LCH6 with 2 Bytes RLC header each and 2 Bytes MAC header each, will result in 2 MAC sub PDUs of 9 bytes each. Total comes to 16 + 16 + 16 + 9 + 9 + (3 B LongBSR + 7 B padding) or (2 B ShortBSR + 8 B padding) =76 Bytes.  Note 5: The MAC SDUs for the different logical channels may be in any order in the MAC PDU.  Note 6: If pc\_supportOfRedCap\_r17=false, UL grant of 256 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to enable UE to transmit two MAC SDUs of size 11 and 10 bytes in a MAC PDU (8 bytes RLC SDU + 3 bytes AMD PDU header +2 Bytes MAC sub Header + 7 bytes RLC SDU+ 3 bytes AMD PDU header+2 Bytes MAC sub Header + 2 Bytes Long BSR MAC Sub Header + 3 Bytes Long BSR + 2 Bytes MAC Padding Sub PDU) or (8 bytes RLC SDU + 3 bytes AMD PDU header +2 Bytes MAC sub Header + 7 bytes RLC SDU+ 3 bytes AMD PDU header+2 Bytes MAC sub Header + 1 Byte Short BSR MAC Sub Header + 1 Byte Short BSR + 7 Bytes MAC Padding Sub PDU) = 32 Bytes. If pc\_supportOfRedCap\_r17=true, UL grant of 256 bits (LRBs & IMCS as per 38.523-3 [3] annex B) is chosen to enable UE to transmit two MAC SDUs of size 10 and 9 bytes in a MAC PDU (8 bytes RLC SDU + 2 bytes AMD PDU header +2 Bytes MAC sub Header + 7 bytes RLC SDU+ 2 bytes AMD PDU header+2 Bytes MAC sub Header + 2 Bytes Long BSR MAC Sub Header + 3 Bytes Long BSR + 4 Bytes MAC Padding Sub PDU) or (8 bytes RLC SDU + 2 bytes AMD PDU header +2 Bytes MAC sub Header + 7 bytes RLC SDU+ 2 bytes AMD PDU header+2 Bytes MAC sub Header + 1 Byte Short BSR MAC Sub Header + 1 Byte Short BSR + 7 Bytes MAC Padding Sub PDU) = 32 Bytes. | | | | | |

7.1.1.3.4.3.3 Specific message contents

Table 7.1.1.3.4.3.3: MAC-CellGroupConfig (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], clause Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | infinity |  |  |
| retxBSR-Timer | sf320 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.5 Correct handling of MAC control information / Buffer Status / UL resources are allocated / Padding BSR

7.1.1.3.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is equal to the size of a Short BSR plus its subheader and the UE has available data for transmission from more than one LCG in the TTI where the BSR is transmitted }

**then** { UE reports a Truncated short BSR of the LCG with the highest priority logical channel with data available for transmission }

}

(2)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is larger than the size of a Short BSR plus its subheader but smaller than the size of a Long BSR plus its subheader and the UE has available data for transmission from more than one LCG in the TTI where the BSR is transmitted }

**then** { UE reports a Truncated long BSR }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is equal to or larger than the size of a Short BSR plus its subheader but smaller than the size of a Long BSR plus its subheader and the UE has available data for transmission from only one LCG in the TTI where the BSR is transmitted }

**then** { UE reports a Short BSR }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is equal to or larger than the size of a Long BSR plus its subheader }

**then** { UE reports a long BSR }

}

7.1.1.3.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.5, 6.1.3.1 and 6.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.5]

The Buffer Status reporting (BSR) procedure is used to provide the serving gNB with information about UL data volume in the MAC entity.

RRC configures the following parameters to control the BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *logicalChannelSR-Delay*;

- *logicalChannelSR-DelayTimer*;

- *logicalChannelGroup*.

Each logical channel may be allocated to an LCG using the *logicalChannelGroup*. The maximum number of LCGs is eight.

The MAC entity determines the amount of UL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4].

A BSR shall be triggered if any of the following events occur:

- the MAC entity has new UL data available for a logical channel which belongs to an LCG; and either

- the new UL data belongs to a logical channel with higher priority than the priority of any logical channel containing available UL data which belong to any LCG; or

- none of the logical channels which belong to an LCG contains any available UL data.

in which case the BSR is referred below to as 'Regular BSR';

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC CE plus its subheader, in which case the BSR is referred below to as 'Padding BSR';

- *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains UL data, in which case the BSR is referred below to as 'Regular BSR';

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as 'Periodic BSR'.

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic BSR, the MAC entity shall:

1> if more than one LCG has data available for transmission when the BSR is to be transmitted:

2> report Long BSR for all LCGs which have data available for transmission.

1> else:

2> report Short BSR.

For Padding BSR:

1> if the number of padding bits is equal to or larger than the size of the Short BSR plus its subheader but smaller than the size of the Long BSR plus its subheader:

2> if more than one LCG has data available for transmission when the BSR is to be transmitted:

3> if the number of padding bits is equal to the size of the Short BSR plus its subheader:

4> report Short Truncated BSR of the LCG with the highest priority logical channel with data available for transmission.

3> else:

4> report Long Truncated BSR of the LCG(s) with the logical channels having data available for transmission following a decreasing order of priority, and in case of equal priority, in increasing order of LCGID.

2> else:

3> report Short BSR;

1> else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader:

2> report Long BSR for all LCGs which have data available for transmission.

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

A MAC PDU shall contain at most one BSR MAC CE, even when multiple events have triggered a BSR by the time. The Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of a grant for transmission of new data on any UL-SCH.

All triggered BSRs may be cancelled when the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the BSR MAC control element plus its subheader. All triggered BSRs shall be cancelled when a BSR is included in a MAC PDU for transmission.

The MAC entity shall transmit at most one BSR in one MAC PDU. Padding BSR shall not be included when the MAC PDU contains a Regular or Periodic BSR.

[TS 38.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC CEs consist of either:

- Short BSR format (fixed size); or

- Long BSR format (variable size); or

- Short Truncated BSR format (fixed size); or

- Long Truncated BSR format (variable size).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in Table 6.2.1-2.

The fields in the BSR MAC CE are defined as follows:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose buffer status is being reported. The length of the field is 3 bits;

- LCGi: For the Long BSR format, this field indicates the presence of the Buffer Size field for the logical channel group i. The LCGi field set to "1" indicates that the Buffer Size field for the logical channel group i is reported. The LCGi field set to "0" indicates that the Buffer Size field for the logical channel group i is not reported. For the Long Truncated BSR format, this field indicates whether logical channel group i has data available. The LCGi field set to "1" indicates that logical channel group i has data available. The LCGi field set to "0" indicates that logical channel group i does not have data available;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4] across all logical channels of a logical channel group after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field for the Short BSR format and the Short Truncated BSR format is 5 bits. The length of this field for the Long BSR format and the Long Truncated BSR format is 8 bits. The values for the 5-bit and 8-bit Buffer Size fields are shown in Tables 6.1.3.1-1 and 6.1.3.1-2, respectively. For the Long BSR format and the Long Truncated BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Long Truncated BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the Long Truncated BSR format can be zero.



Figure 6.1.3.1-1: Short BSR and Short Truncated BSR MAC CE



Figure 6.1.3.1-2: Long BSR and Long Truncated BSR MAC CE

Table 6.1.3.1-1: Buffer size levels (in bytes) for 5-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 8 | ≤ 102 | 16 | ≤ 1446 | 24 | ≤ 20516 |
| 1 | ≤ 10 | 9 | ≤ 142 | 17 | ≤ 2014 | 25 | ≤ 28581 |
| 2 | ≤ 14 | 10 | ≤ 198 | 18 | ≤ 2806 | 26 | ≤ 39818 |
| 3 | ≤ 20 | 11 | ≤ 276 | 19 | ≤ 3909 | 27 | ≤ 55474 |
| 4 | ≤ 28 | 12 | ≤ 384 | 20 | ≤ 5446 | 28 | ≤ 77284 |
| 5 | ≤ 38 | 13 | ≤ 535 | 21 | ≤ 7587 | 29 | ≤ 107669 |
| 6 | ≤ 53 | 14 | ≤ 745 | 22 | ≤ 10570 | 30 | ≤ 150000 |
| 7 | ≤ 74 | 15 | ≤ 1038 | 23 | ≤ 14726 | 31 | > 150000 |

Table 6.1.3.1-2: Buffer size levels (in bytes) for 8-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 64 | ≤ 560 | 128 | ≤ 31342 | 192 | ≤ 1754595 |
| 1 | ≤ 10 | 65 | ≤ 597 | 129 | ≤ 33376 | 193 | ≤ 1868488 |
| 2 | ≤ 11 | 66 | ≤ 635 | 130 | ≤ 35543 | 194 | ≤ 1989774 |
| 3 | ≤ 12 | 67 | ≤ 677 | 131 | ≤ 37850 | 195 | ≤ 2118933 |
| 4 | ≤ 13 | 68 | ≤ 720 | 132 | ≤ 40307 | 196 | ≤ 2256475 |
| 5 | ≤ 14 | 69 | ≤ 767 | 133 | ≤ 42923 | 197 | ≤ 2402946 |
| 6 | ≤ 15 | 70 | ≤ 817 | 134 | ≤ 45709 | 198 | ≤ 2558924 |
| 7 | ≤ 16 | 71 | ≤ 870 | 135 | ≤ 48676 | 199 | ≤ 2725027 |
| 8 | ≤ 17 | 72 | ≤ 926 | 136 | ≤ 51836 | 200 | ≤ 2901912 |
| 9 | ≤ 18 | 73 | ≤ 987 | 137 | ≤ 55200 | 201 | ≤ 3090279 |
| 10 | ≤ 19 | 74 | ≤ 1051 | 138 | ≤ 58784 | 202 | ≤ 3290873 |
| 11 | ≤ 20 | 75 | ≤ 1119 | 139 | ≤ 62599 | 203 | ≤ 3504487 |
| 12 | ≤ 22 | 76 | ≤ 1191 | 140 | ≤ 66663 | 204 | ≤ 3731968 |
| 13 | ≤ 23 | 77 | ≤ 1269 | 141 | ≤ 70990 | 205 | ≤ 3974215 |
| 14 | ≤ 25 | 78 | ≤ 1351 | 142 | ≤ 75598 | 206 | ≤ 4232186 |
| 15 | ≤ 26 | 79 | ≤ 1439 | 143 | ≤ 80505 | 207 | ≤ 4506902 |
| 16 | ≤ 28 | 80 | ≤ 1532 | 144 | ≤ 85730 | 208 | ≤ 4799451 |
| 17 | ≤ 30 | 81 | ≤ 1631 | 145 | ≤ 91295 | 209 | ≤ 5110989 |
| 18 | ≤ 32 | 82 | ≤ 1737 | 146 | ≤ 97221 | 210 | ≤ 5442750 |
| 19 | ≤ 34 | 83 | ≤ 1850 | 147 | ≤ 103532 | 211 | ≤ 5796046 |
| 20 | ≤ 36 | 84 | ≤ 1970 | 148 | ≤ 110252 | 212 | ≤ 6172275 |
| 21 | ≤ 38 | 85 | ≤ 2098 | 149 | ≤ 117409 | 213 | ≤ 6572925 |
| 22 | ≤ 40 | 86 | ≤ 2234 | 150 | ≤ 125030 | 214 | ≤ 6999582 |
| 23 | ≤ 43 | 87 | ≤ 2379 | 151 | ≤ 133146 | 215 | ≤ 7453933 |
| 24 | ≤ 46 | 88 | ≤ 2533 | 152 | ≤ 141789 | 216 | ≤ 7937777 |
| 25 | ≤ 49 | 89 | ≤ 2698 | 153 | ≤ 150992 | 217 | ≤ 8453028 |
| 26 | ≤ 52 | 90 | ≤ 2873 | 154 | ≤ 160793 | 218 | ≤ 9001725 |
| 27 | ≤ 55 | 91 | ≤ 3059 | 155 | ≤ 171231 | 219 | ≤ 9586039 |
| 28 | ≤ 59 | 92 | ≤ 3258 | 156 | ≤ 182345 | 220 | ≤ 10208280 |
| 29 | ≤ 62 | 93 | ≤ 3469 | 157 | ≤ 194182 | 221 | ≤ 10870913 |
| 30 | ≤ 66 | 94 | ≤ 3694 | 158 | ≤ 206786 | 222 | ≤ 11576557 |
| 31 | ≤ 71 | 95 | ≤ 3934 | 159 | ≤ 220209 | 223 | ≤ 12328006 |
| 32 | ≤ 75 | 96 | ≤ 4189 | 160 | ≤ 234503 | 224 | ≤ 13128233 |
| 33 | ≤ 80 | 97 | ≤ 4461 | 161 | ≤ 249725 | 225 | ≤ 13980403 |
| 34 | ≤ 85 | 98 | ≤ 4751 | 162 | ≤ 265935 | 226 | ≤ 14887889 |
| 35 | ≤ 91 | 99 | ≤ 5059 | 163 | ≤ 283197 | 227 | ≤ 15854280 |
| 36 | ≤ 97 | 100 | ≤ 5387 | 164 | ≤ 301579 | 228 | ≤ 16883401 |
| 37 | ≤ 103 | 101 | ≤ 5737 | 165 | ≤ 321155 | 229 | ≤ 17979324 |
| 38 | ≤ 110 | 102 | ≤ 6109 | 166 | ≤ 342002 | 230 | ≤ 19146385 |
| 39 | ≤ 117 | 103 | ≤ 6506 | 167 | ≤ 364202 | 231 | ≤ 20389201 |
| 40 | ≤ 124 | 104 | ≤ 6928 | 168 | ≤ 387842 | 232 | ≤ 21712690 |
| 41 | ≤ 132 | 105 | ≤ 7378 | 169 | ≤ 413018 | 233 | ≤ 23122088 |
| 42 | ≤ 141 | 106 | ≤ 7857 | 170 | ≤ 439827 | 234 | ≤ 24622972 |
| 43 | ≤ 150 | 107 | ≤ 8367 | 171 | ≤ 468377 | 235 | ≤ 26221280 |
| 44 | ≤ 160 | 108 | ≤ 8910 | 172 | ≤ 498780 | 236 | ≤ 27923336 |
| 45 | ≤ 170 | 109 | ≤ 9488 | 173 | ≤ 531156 | 237 | ≤ 29735875 |
| 46 | ≤ 181 | 110 | ≤ 10104 | 174 | ≤ 565634 | 238 | ≤ 31666069 |
| 47 | ≤ 193 | 111 | ≤ 10760 | 175 | ≤ 602350 | 239 | ≤ 33721553 |
| 48 | ≤ 205 | 112 | ≤ 11458 | 176 | ≤ 641449 | 240 | ≤ 35910462 |
| 49 | ≤ 218 | 113 | ≤ 12202 | 177 | ≤ 683087 | 241 | ≤ 38241455 |
| 50 | ≤ 233 | 114 | ≤ 12994 | 178 | ≤ 727427 | 242 | ≤ 40723756 |
| 51 | ≤ 248 | 115 | ≤ 13838 | 179 | ≤ 774645 | 243 | ≤ 43367187 |
| 52 | ≤ 264 | 116 | ≤ 14736 | 180 | ≤ 824928 | 244 | ≤ 46182206 |
| 53 | ≤ 281 | 117 | ≤ 15692 | 181 | ≤ 878475 | 245 | ≤ 49179951 |
| 54 | ≤ 299 | 118 | ≤ 16711 | 182 | ≤ 935498 | 246 | ≤ 52372284 |
| 55 | ≤ 318 | 119 | ≤ 17795 | 183 | ≤ 996222 | 247 | ≤ 55771835 |
| 56 | ≤ 339 | 120 | ≤ 18951 | 184 | ≤ 1060888 | 248 | ≤ 59392055 |
| 57 | ≤ 361 | 121 | ≤ 20181 | 185 | ≤ 1129752 | 249 | ≤ 63247269 |
| 58 | ≤ 384 | 122 | ≤ 21491 | 186 | ≤ 1203085 | 250 | ≤ 67352729 |
| 59 | ≤ 409 | 123 | ≤ 22885 | 187 | ≤ 1281179 | 251 | ≤ 71724679 |
| 60 | ≤ 436 | 124 | ≤ 24371 | 188 | ≤ 1364342 | 252 | ≤ 76380419 |
| 61 | ≤ 464 | 125 | ≤ 25953 | 189 | ≤ 1452903 | 253 | ≤ 81338368 |
| 62 | ≤ 494 | 126 | ≤ 27638 | 190 | ≤ 1547213 | 254 | > 81338368 |
| 63 | ≤ 526 | 127 | ≤ 29431 | 191 | ≤ 1647644 | 255 | Reserved |

[TS 38.321, clause 6.2.1]

Table 6.2.1-2: Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 000000 | CCCH |
| 000001–100000 | Identity of the logical channel |
| 100001–110110 | Reserved |
| 110111 | Configured Grant Confirmation |
| 111000 | Multiple Entry PHR |
| 111001 | Single Entry PHR |
| 111010 | C-RNTI |
| 111011 | Short Truncated BSR |
| 111100 | Long Truncated BSR |
| 111101 | Short BSR |
| 111110 | Long BSR |
| 111111 | Padding |

7.1.1.3.5.3 Test description

7.1.1.3.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 2 AM DRBs on NR cell configured according to Table 7.1.1.3.5.3.1-1.

Table 7.1.1.3.5.3.1-1: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.5.3.2 Test procedure sequence

Table 7.1.1.3.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| - | EXCEPTION: Step 2 shall be repeated for 3 times | - | - | - | - |
| 2 | The SS transmits a MAC PDU including an RLC PDU of size 13 bytes on LCH5. | <-- | MAC PDU (RLC SDU on LCH5) | - | - |
| 3 | The SS transmits a MAC PDU including an RLC PDU of size 12 bytes on LCH4. | <-- | MAC PDU (RLC SDU on LCH4) | - | - |
| 4 | UE transmits a Scheduling Request on PUCCH. | --> | (SR) | - | - |
| 5 | The SS sends an uplink grant of size 40 bits. (Note 1) | <-- | (UL grant) | - | - |
| 6 | The UE transmit a Long BSR report. | --> | MAC PDU (Long BSR header (LCID=’ 111110’), Long BSR) | - | - |
| 7 | The SS sends an uplink grant of size 136 bits. (Note 2) | <-- | (UL grant) | - | - |
| 8 | Check: Does UE transmit a MAC PDU containing an RLC SDU and a short truncated BSR indicating pending data (‘Buffer size’ field > ‘0’) for logicalChannelGroup 1 (‘LCG ID’ field set to ‘01’)? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, short truncated BSR header (LCID=’ 111011’), short truncatedBSR(LCG ID =’01’, Buffer size>’0’)) | 1 | P |
| 9 | The SS sends an uplink grant of size 152 bits. (Note 3) | <-- | (UL grant) | - | - |
| 10 | Check: Does UE transmit a MAC PDU containing an RLC SDU and a long truncated BSR indicating pending data available for LCG1 and LCG2 and ‘Buffer size’ field > ‘0’ for logicalChannelGroup 1? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, long truncated BSR header (LCID=’ 111100’), long truncatedBSR( LCG1=1, LCG2=1, Buffer size1>’0’)) | 2 | P |
| 11 | The SS sends an uplink grant of size 136 bits.  (Note 4) | <-- | (UL grant) | - | - |
| 12 | Check: Does UE transmit a MAC PDU containing an RLC SDU and with a Short BSR indicating pending data (‘Buffer size’ field > ‘0’) for logicalChannelGroup 2 (‘LCG ID’ field =’10’)? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, Short BSR header(LCID=’11101’), Short BSR(LCG ID =’10’,Buffer size>’0’)) | 3 | P |
| 12A | SS transmits an RLC STATUS PDU to acknowledge correctly received data (LCID=LCH5) | <-- | RLC STATUS PDU (ACK\_SN=3) | - | - |
| 13 | The SS sends an uplink grant of size 160 bits. (Note 5) | <-- | (UL grant) | - | - |
| 14 | Check: Does UE transmit a MAC PDU containing a RLC SDU and a Long BSR? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, Long BSR header (LCID=’11110’), Long BSR)) | 4 | P |
| 15 | SS transmits an RLC STATUS PDU to acknowledge correctly received data (LCID=LCH4) | <-- | RLC STATUS PDU (ACK\_SN=1) | - | - |
| Note 1: 40 bits (LRBs & IMCS as per 38.523-3[3] annex B) enables UE to transmit a MAC PDU with a MAC BSR header (1 byte) and a Short BSR (1 byte) or a MAC BSR header (2 bytes) a Long BSR (3 bytes when 2 LCG configured).  Note 2: UE triggers a truncated Short BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 13 Bytes MAC SDU + 1 Byte Short truncated BSR sub header + 1 Byte Short truncated BSR = 17 bytes)  Note 3: UE triggers a truncated Long BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 13 Bytes MAC SDU + 2 Bytes Long truncated BSR sub header + 2 Bytes Long truncated BSR = 19 bytes)  Note 4: UE triggers a Short BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 13 Bytes MAC SDU + 1 Byte Short BSR sub header + 1 Byte short BSR = 17 bytes)  Note 5: UE triggers a long BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 12 Bytes MAC SDU + 2 Bytes long BSR sub header + 1 Byte long BSR + 1 byte Padding sub header + 2 bytes Padding = 20 bytes) | | | | | |

7.1.1.3.5.3.3 Specific message contents

None

##### 7.1.1.3.6 Correct handling of MAC control information / Buffer status / Periodic BSR timer expires

7.1.1.3.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { periodicBSR-Timer expires and more than one LCG has buffered data }

**then** { UE triggers a Periodic BSR and reports Long BSR and restarts the periodicBSR-Timer }

}

(2)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { periodicBSR-Timer expires and one LCG has buffered data }

**then** { UE triggers a Periodic BSR and reports Short BSR and restarts the periodicBSR-Timer }

}

7.1.1.3.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.5, 6.1.3.1 and 6.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.5]

The Buffer Status reporting (BSR) procedure is used to provide the serving gNB with information about UL data volume in the MAC entity.

RRC configures the following parameters to control the BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *logicalChannelSR-Delay*;

- *logicalChannelSR-DelayTimer*;

- *logicalChannelGroup*.

Each logical channel may be allocated to an LCG using the *logicalChannelGroup*. The maximum number of LCGs is eight.

The MAC entity determines the amount of UL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4].

A BSR shall be triggered if any of the following events occur:

- the MAC entity has new UL data available for a logical channel which belongs to an LCG; and either

- the new UL data belongs to a logical channel with higher priority than the priority of any logical channel containing available UL data which belong to any LCG; or

- none of the logical channels which belong to an LCG contains any available UL data.

in which case the BSR is referred below to as 'Regular BSR';

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC CE plus its subheader, in which case the BSR is referred below to as 'Padding BSR';

- *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains UL data, in which case the BSR is referred below to as 'Regular BSR';

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as 'Periodic BSR'.

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic BSR, the MAC entity shall:

1> if more than one LCG has data available for transmission when the BSR is to be transmitted:

2> report Long BSR for all LCGs which have data available for transmission.

1> else:

2> report Short BSR.

For Padding BSR:

1> if the number of padding bits is equal to or larger than the size of the Short BSR plus its subheader but smaller than the size of the Long BSR plus its subheader:

2> if more than one LCG has data available for transmission when the BSR is to be transmitted:

3> if the number of padding bits is equal to the size of the Short BSR plus its subheader:

4> report Short Truncated BSR of the LCG with the highest priority logical channel with data available for transmission.

3> else:

4> report Long Truncated BSR of the LCG(s) with the logical channels having data available for transmission following a decreasing order of priority, and in case of equal priority, in increasing order of LCGID.

2> else:

3> report Short BSR;

1> else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader:

2> report Long BSR for all LCGs which have data available for transmission.

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

A MAC PDU shall contain at most one BSR MAC CE, even when multiple events have triggered a BSR by the time. The Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of a grant for transmission of new data on any UL-SCH.

All triggered BSRs may be cancelled when the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the BSR MAC control element plus its subheader. All triggered BSRs shall be cancelled when a BSR is included in a MAC PDU for transmission.

The MAC entity shall transmit at most one BSR in one MAC PDU. Padding BSR shall not be included when the MAC PDU contains a Regular or Periodic BSR.

[TS 38.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC CEs consist of either:

- Short BSR format (fixed size); or

- Long BSR format (variable size); or

- Short Truncated BSR format (fixed size); or

- Long Truncated BSR format (variable size).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in Table 6.2.1-2.

The fields in the BSR MAC CE are defined as follows:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose buffer status is being reported. The length of the field is 3 bits;

- LCGi: For the Long BSR format, this field indicates the presence of the Buffer Size field for the logical channel group i. The LCGi field set to "1" indicates that the Buffer Size field for the logical channel group i is reported. The LCGi field set to "0" indicates that the Buffer Size field for the logical channel group i is not reported. For the Long Truncated BSR format, this field indicates whether logical channel group i has data available. The LCGi field set to "1" indicates that logical channel group i has data available. The LCGi field set to "0" indicates that logical channel group i does not have data available;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4] across all logical channels of a logical channel group after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field for the Short BSR format and the Short Truncated BSR format is 5 bits. The length of this field for the Long BSR format and the Long Truncated BSR format is 8 bits. The values for the 5-bit and 8-bit Buffer Size fields are shown in Tables 6.1.3.1-1 and 6.1.3.1-2, respectively. For the Long BSR format and the Long Truncated BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Long Truncated BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the Long Truncated BSR format can be zero.



Figure 6.1.3.1-1: Short BSR and Short Truncated BSR MAC CE



Figure 6.1.3.1-2: Long BSR and Long Truncated BSR MAC CE

Table 6.1.3.1-1: Buffer size levels (in bytes) for 5-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 8 | ≤ 102 | 16 | ≤ 1446 | 24 | ≤ 20516 |
| 1 | ≤ 10 | 9 | ≤ 142 | 17 | ≤ 2014 | 25 | ≤ 28581 |
| 2 | ≤ 14 | 10 | ≤ 198 | 18 | ≤ 2806 | 26 | ≤ 39818 |
| 3 | ≤ 20 | 11 | ≤ 276 | 19 | ≤ 3909 | 27 | ≤ 55474 |
| 4 | ≤ 28 | 12 | ≤ 384 | 20 | ≤ 5446 | 28 | ≤ 77284 |
| 5 | ≤ 38 | 13 | ≤ 535 | 21 | ≤ 7587 | 29 | ≤ 107669 |
| 6 | ≤ 53 | 14 | ≤ 745 | 22 | ≤ 10570 | 30 | ≤ 150000 |
| 7 | ≤ 74 | 15 | ≤ 1038 | 23 | ≤ 14726 | 31 | > 150000 |

Table 6.1.3.1-2: Buffer size levels (in bytes) for 8-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 64 | ≤ 526 | 128 | ≤ 29431 | 192 | ≤ 1647644 |
| 1 | ≤ 10 | 65 | ≤ 560 | 129 | ≤ 31342 | 193 | ≤ 1754595 |
| 2 | ≤ 11 | 66 | ≤ 597 | 130 | ≤ 33376 | 194 | ≤ 1868488 |
| 3 | ≤ 12 | 67 | ≤ 635 | 131 | ≤ 35543 | 195 | ≤ 1989774 |
| 4 | ≤ 13 | 68 | ≤ 677 | 132 | ≤ 37850 | 196 | ≤ 2118933 |
| 5 | ≤ 13 | 69 | ≤ 720 | 133 | ≤ 40307 | 197 | ≤ 2256475 |
| 6 | ≤ 14 | 70 | ≤ 767 | 134 | ≤ 42923 | 198 | ≤ 2402946 |
| 7 | ≤ 15 | 71 | ≤ 817 | 135 | ≤ 45709 | 199 | ≤ 2558924 |
| 8 | ≤ 16 | 72 | ≤ 870 | 136 | ≤ 48676 | 200 | ≤ 2725027 |
| 9 | ≤ 17 | 73 | ≤ 926 | 137 | ≤ 51836 | 201 | ≤ 2901912 |
| 10 | ≤ 18 | 74 | ≤ 987 | 138 | ≤ 55200 | 202 | ≤ 3090279 |
| 11 | ≤ 19 | 75 | ≤ 1051 | 139 | ≤ 58784 | 203 | ≤ 3290873 |
| 12 | ≤ 20 | 76 | ≤ 1119 | 140 | ≤ 62599 | 204 | ≤ 3504487 |
| 13 | ≤ 22 | 77 | ≤ 1191 | 141 | ≤ 66663 | 205 | ≤ 3731968 |
| 14 | ≤ 23 | 78 | ≤ 1269 | 142 | ≤ 70990 | 206 | ≤ 3974215 |
| 15 | ≤ 25 | 79 | ≤ 1351 | 143 | ≤ 75598 | 207 | ≤ 4232186 |
| 16 | ≤ 26 | 80 | ≤ 1439 | 144 | ≤ 80505 | 208 | ≤ 4506902 |
| 17 | ≤ 28 | 81 | ≤ 1532 | 145 | ≤ 85730 | 209 | ≤ 4799451 |
| 18 | ≤ 30 | 82 | ≤ 1631 | 146 | ≤ 91295 | 210 | ≤ 5110989 |
| 19 | ≤ 32 | 83 | ≤ 1737 | 147 | ≤ 97221 | 211 | ≤ 5442750 |
| 20 | ≤ 34 | 84 | ≤ 1850 | 148 | ≤ 103532 | 212 | ≤ 5796046 |
| 21 | ≤ 36 | 85 | ≤ 1970 | 149 | ≤ 110252 | 213 | ≤ 6172275 |
| 22 | ≤ 38 | 86 | ≤ 2098 | 150 | ≤ 117409 | 214 | ≤ 6572925 |
| 23 | ≤ 40 | 87 | ≤ 2234 | 151 | ≤ 125030 | 215 | ≤ 6999582 |
| 24 | ≤ 43 | 88 | ≤ 2379 | 152 | ≤ 133146 | 216 | ≤ 7453933 |
| 25 | ≤ 46 | 89 | ≤ 2533 | 153 | ≤ 141789 | 217 | ≤ 7937777 |
| 26 | ≤ 49 | 90 | ≤ 2698 | 154 | ≤ 150992 | 218 | ≤ 8453028 |
| 27 | ≤ 52 | 91 | ≤ 2873 | 155 | ≤ 160793 | 219 | ≤ 9001725 |
| 28 | ≤ 55 | 92 | ≤ 3059 | 156 | ≤ 171231 | 220 | ≤ 9586039 |
| 29 | ≤ 59 | 93 | ≤ 3258 | 157 | ≤ 182345 | 221 | ≤ 10208280 |
| 30 | ≤ 62 | 94 | ≤ 3469 | 158 | ≤ 194182 | 222 | ≤ 10870913 |
| 31 | ≤ 66 | 95 | ≤ 3694 | 159 | ≤ 206786 | 223 | ≤ 11576557 |
| 32 | ≤ 71 | 96 | ≤ 3934 | 160 | ≤ 220209 | 224 | ≤ 12328006 |
| 33 | ≤ 75 | 97 | ≤ 4189 | 161 | ≤ 234503 | 225 | ≤ 13128233 |
| 34 | ≤ 80 | 98 | ≤ 4461 | 162 | ≤ 249725 | 226 | ≤ 13980403 |
| 35 | ≤ 85 | 99 | ≤ 4751 | 163 | ≤ 265935 | 227 | ≤ 14887889 |
| 36 | ≤ 91 | 100 | ≤ 5059 | 164 | ≤ 283197 | 228 | ≤ 15854280 |
| 37 | ≤ 97 | 101 | ≤ 5387 | 165 | ≤ 301579 | 229 | ≤ 16883401 |
| 38 | ≤ 103 | 102 | ≤ 5737 | 166 | ≤ 321155 | 230 | ≤ 17979324 |
| 39 | ≤ 110 | 103 | ≤ 6109 | 167 | ≤ 342002 | 231 | ≤ 19146385 |
| 40 | ≤ 117 | 104 | ≤ 6506 | 168 | ≤ 364202 | 232 | ≤ 20389201 |
| 41 | ≤ 124 | 105 | ≤ 6928 | 169 | ≤ 387842 | 233 | ≤ 21712690 |
| 42 | ≤ 132 | 106 | ≤ 7378 | 170 | ≤ 413018 | 234 | ≤ 23122088 |
| 43 | ≤ 141 | 107 | ≤ 7857 | 171 | ≤ 439827 | 235 | ≤ 24622972 |
| 44 | ≤ 150 | 108 | ≤ 8367 | 172 | ≤ 468377 | 236 | ≤ 26221280 |
| 45 | ≤ 160 | 109 | ≤ 8910 | 173 | ≤ 498780 | 237 | ≤ 27923336 |
| 46 | ≤ 170 | 110 | ≤ 9488 | 174 | ≤ 531156 | 238 | ≤ 29735875 |
| 47 | ≤ 181 | 111 | ≤ 10104 | 175 | ≤ 565634 | 239 | ≤ 31666069 |
| 48 | ≤ 193 | 112 | ≤ 10760 | 176 | ≤ 602350 | 240 | ≤ 33721553 |
| 49 | ≤ 205 | 113 | ≤ 11458 | 177 | ≤ 641449 | 241 | ≤ 35910462 |
| 50 | ≤ 218 | 114 | ≤ 12202 | 178 | ≤ 683087 | 242 | ≤ 38241455 |
| 51 | ≤ 233 | 115 | ≤ 12994 | 179 | ≤ 727427 | 243 | ≤ 40723756 |
| 52 | ≤ 248 | 116 | ≤ 13838 | 180 | ≤ 774645 | 244 | ≤ 43367187 |
| 53 | ≤ 264 | 117 | ≤ 14736 | 181 | ≤ 824928 | 245 | ≤ 46182206 |
| 54 | ≤ 281 | 118 | ≤ 15692 | 182 | ≤ 878475 | 246 | ≤ 49179951 |
| 55 | ≤ 299 | 119 | ≤ 16711 | 183 | ≤ 935498 | 247 | ≤ 52372284 |
| 56 | ≤ 318 | 120 | ≤ 17795 | 184 | ≤ 996222 | 248 | ≤ 55771835 |
| 57 | ≤ 339 | 121 | ≤ 18951 | 185 | ≤ 1060888 | 249 | ≤ 59392055 |
| 58 | ≤ 361 | 122 | ≤ 20181 | 186 | ≤ 1129752 | 250 | ≤ 63247269 |
| 59 | ≤ 384 | 123 | ≤ 21491 | 187 | ≤ 1203085 | 251 | ≤ 67352729 |
| 60 | ≤ 409 | 124 | ≤ 22885 | 188 | ≤ 1281179 | 252 | ≤ 71724679 |
| 61 | ≤ 436 | 125 | ≤ 24371 | 189 | ≤ 1364342 | 253 | ≤ 76380419 |
| 62 | ≤ 464 | 126 | ≤ 25953 | 190 | ≤ 1452903 | 254 | ≤ 81338368 |
| 63 | ≤ 494 | 127 | ≤ 27638 | 191 | ≤ 1547213 | 255 | > 81338368 |

[TS 38.321, clause 6.2.1]

Table 6.2.1-2: Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 000000 | CCCH |
| 000001–100000 | Identity of the logical channel |
| 100001–110110 | Reserved |
| 110111 | Configured Grant Confirmation |
| 111000 | Multiple Entry PHR |
| 111001 | Single Entry PHR |
| 111010 | C-RNTI |
| 111011 | Short Truncated BSR |
| 111100 | Long Truncated BSR |
| 111101 | Short BSR |
| 111110 | Long BSR |
| 111111 | Padding |

7.1.1.3.6.3 Test description

7.1.1.3.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 2 SN terminated SCG bearers configured according to Table 7.1.1.3.6.3.1-1.

Table 7.1.1.3.6.3.1-1: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.6.3.2 Test procedure sequence

Table 7.1.1.3.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | The SS transmits a MAC PDU containing an RLC PDU on LCH4 (LCG ID 2), which contains 1 RLC SDU of size 14 bytes. | <-- | MAC PDU (RLC PDU) |  |  |
| 3 | The SS sends an uplink grant of size 32 bits. (Note 1) | <-- | (UL grant) | - | - |
| 4 | The UE transmits a short BSR report and restarts *periodicBSR-Timer* | --> | MAC PDU ((LCID=’ 111101’, LCG ID='10', Buffer size index > 0) | - | - |
| - | EXCEPTION: Steps 5 to 7 shall be repeated two times (Note 2) | - | - | - | - |
| 5 | Wait for periodicBSR-Timer expiry. | - | - | - | - |
| 6 | The SS sends an uplink grant of size 32 bits | - | - | - | - |
| 7 | Check: Does UE transmit a MAC PDU containing a Short BSR with ‘LCG ID’ field set to ‘10’ (logicalChannelGroup 2) and Buffer Size Index > 0? | --> | MAC PDU (LCID=’111101’, LCG ID=’10’, Buffer Size index > 0) | 2 | P |
| 8 | The SS transmits a MAC PDU containing an RLC PDU on LCH5 (LCG ID 1), which contains 1 RLC SDU of size 14 bytes. | <-- | MAC PDU (RLC PDU) | - | - |
| 9 | The SS sends an uplink grant of size 40 bits (Note 3) | <-- | (UL grant) | - | - |
| 10 | The UE transmits a long BSR report with ‘Buffer size#1’ (LCG ID=1) and ‘Buffer size#2’ (LCG ID=2) fields set to value > ‘0’ | --> | MAC PDU (( ‘Buffer size#1 index’ > 0, ‘Buffer size#2 index=’ >0’) | - | - |
| - | EXCEPTION: Step 11 to 13 shall be repeated twice. (Note 4) | - | - | - | - |
| 11 | Wait for periodicBSR-Timer expiry. | - | - | - | - |
| 12 | The SS sends an uplink grant of size 40 bits | - | - | - | - |
| 13 | Check: Does UE transmit a MAC PDU containing a Long BSR with ‘Buffer size#1’ (LCG ID=1) and ‘Buffer size#2’ (LCG ID=2) fields set to value > ‘0’? | --> | MAC PDU | 1 | P |
| 14 | The SS transmits 1 UL grant of size 320 bits to enable the UE to loopback RLC SDU on LCH4 and LCH5. |  |  | - | - |
| 15 | The UE transmits MAC PDU containing the remaining RLC SDUs as sent by the SS in steps 2 and 8. | --> | MAC PDU | - | - |
| Note 1: SS transmits an UL grant of 32 bits(LRBs & IMCS as per 38.523-3[3] annex B) to allow UE to transmit a Regular BSR triggered by the new data received logicalChannelGroup 1 in step 2.  Note 2: One short BSR due to first expiry of *periodicBSR-Timer* and one short BSR due to second expire of *periodicBSR-Timer*.  Note 3: SS transmits an UL grant of 40 bits(LRBs & IMCS as per 38.523-3[3] annex B) to allow UE to transmit a Regular BSR triggered by the new data received on higher priority logicalChannelGroup 1 in step 8.  Note 4: One long BSR due to expire of *periodicBSR-Timer* and one long BSR due to second expiry of *periodicBSR-Timer.* | | | | | |

7.1.1.3.6.3.3 Specific message contents

Table 7.1.1.3.6.3.3: MAC-CellGroupConfig (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.308 [6], clause Table 4.6.3-49 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | sf160 |  |  |
| retxBSR-Timer | sf10240 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.7 UE power headroom reporting / Periodic reporting / DL pathloss change reporting

7.1.1.3.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { *phr-PeriodicTimer* is configured in UE }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element }

}

(2)

**with** { UE in RRC\_CONNECTED state with periodic power headroom reporting configured }

**ensure that** {

**when** { *phr-PeriodicTimer* expires **and** UL resources allocated for new transmission }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element }

}

(3)

**with** { UE in RRC\_CONNECTED state with periodic power headroom reporting configured }

**ensure that** {

**when** { power headroom reporting is disabled }

**then** { UE stops transmitting Power Headroom MAC Control Element }

}

(4)

**with** { UE in RRC\_Connected state with Power headroom reporting for *phr-Tx-PowerFactorChange* configured }

**ensure that** {

**when** { the DL Pathloss has changed more than *phr-Tx-PowerFactorChange* dB **and** *phr-ProhibitTimer* is running }

**then** { UE does not transmit a MAC PDU containing Power Headroom MAC Control Element }

}

(5)

**with** { UE in RRC\_Connected state with Power headroom reporting for *phr-Tx-PowerFactorChange* configured }

**ensure that** {

**when** { *phr-ProhibitTimer* expires **and** power headroom report is triggered due to DL Pathloss change }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element }

}

7.1.1.3.7.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321 clause 5.4.6 and 6.1.3.8. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving gNB with the following information:

- Type 1 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell;

- Type 2 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH and PUCCH transmission on SpCell of the other MAC entity (i.e. E-UTRA MAC entity in EN-DC case only);

- Type 3 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for SRS transmission per activated Serving Cell.

RRC controls Power Headroom reporting by configuring the following parameters:

- *phr-PeriodicTimer*;

- *phr-ProhibitTimer*;

- *phr-Tx-PowerFactorChange*;

- *phr-Type2PCell*;

- *phr-Type2OtherCell*;

- *phr-ModeOtherCG*;

- *multiplePHR*.

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between.

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink;

- addition of the PSCell (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*;

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in subclause 5.4.3.1:

2> if *multiplePHR* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity:

4> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in subclause 7.7 of TS 38.213 [6];

4> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

4> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to real by upper layers:

5> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

3> if *phr-Type2OtherCell* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to real by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in subclause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell;

3> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in subclause 6.1.3.8 based on the values reported by the physical layer.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

[TS 38.321, clause 6.1.3.8]

The Single Entry PHR MAC CE is identified by a MAC PDU subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of two octet defined as follows (figure 6.1.3.8-1):

- R: Reserved bit, set to "0";

- Power Headroom (PH): This field indicates the power headroom level. The length of the field is 6 bits. The reported PH and the corresponding power headroom levels are shown in Table 6.1.3.8-1 below (the corresponding measured values in dB are specified in TS 38.133 [11]);

- PCMAX,f,c: This field indicates the PCMAX,f,c (as specified in TS 38.213 [6]) used for calculation of the preceding PH field. The reported PCMAX,f,c and the corresponding nominal UE transmit power levels are shown in Table 6.1.3.8-2 (the corresponding measured values in dBm are specified in TS 38.133 [11]).



Figure 6.1.3.8-1: Single Entry PHR MAC CE

Table 6.1.3.8-1: Power Headroom levels for PHR

|  |  |
| --- | --- |
| PH | Power Headroom Level |
| 0 | POWER\_HEADROOM\_0 |
| 1 | POWER\_HEADROOM\_1 |
| 2 | POWER\_HEADROOM\_2 |
| 3 | POWER\_HEADROOM\_3 |
| … | … |
| 60 | POWER\_HEADROOM\_60 |
| 61 | POWER\_HEADROOM\_61 |
| 62 | POWER\_HEADROOM\_62 |
| 63 | POWER\_HEADROOM\_63 |

Table 6.1.3.8-2: Nominal UE transmit power level for PHR

|  |  |
| --- | --- |
| PCMAXf,,c | Nominal UE transmit power level |
| 0 | PCMAX\_C\_00 |
| 1 | PCMAX\_C\_01 |
| 2 | PCMAX\_C\_02 |
| … | … |
| 61 | PCMAX\_C\_61 |
| 62 | PCMAX\_C\_62 |
| 63 | PCMAX\_C\_63 |

7.1.1.3.7.3 Test description

7.1.1.3.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.3.7.3.2 Test procedure sequence

Table 7.1.1.3.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits UL grant to the UE at every 10ms in PDCCH occasion. | <-- | - | - | - |
| 2 | SS transmits NR *RRCReconfiguration*message to configure specific Power Headroom parameters for NR Cell(Note 1). | <-- | *(RRCReconfiguration)* | - | - |
| 3 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element?  (Note 2, 5) | --> | MAC PDU | 1 | P |
| 4 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the setup of Power Headroom parameters.  (Note 2,3) | --> | *(RRCReconfigurationComplete)* | - | - |
| 5 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element 500ms after step 3? (Note 5) | --> | MAC PDU | 2 | P |
| 6 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 7 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters.(Note 3) | --> | *(RRCReconfigurationComplete)* | - | - |
| 8 | Check: for 2 seconds, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 3 | F |
| 9 | SS transmits NR *RRCReconfiguration*message to configure specific Power Headroom parameters for NR Cell.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 10 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element?  (Note 4, 5) | --> | MAC PDU | 1 | P |
| 11 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the setup of Power Headroom parameters.  (Note 3,4) | --> | *(RRCReconfigurationComplete)* | - | - |
| 12 | Wait for T1= 20% of *prohibitPHR-Timer*. | - | - | - | - |
| 13 | Reduce SS power level for NR Cell so as to cause a DL\_Pathloss change at UE by 5dB. | - | - | - | - |
| 14 | Check: for 80% of *prohibitPHR-Timer* since step 10, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 4 | F |
| 15 | Check: after *prohibitPHR-Timer* after step 10, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 5 | P |
| 16 | Increase SS power level for NR Cell so as to cause a DL\_Pathloss change at UE by 5dB. | - | - | - | - |
| 17 | Check: for 80% of *prohibitPHR-Timer* since step 15, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 4 | F |
| 18 | Check: after *prohibitPHR-Timer* after step 15, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 5 | P |
| 19 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 20 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters.(Note 3) | --> | *(RRCReconfigurationComplete)* | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration* 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: Steps 3 and 4 can happen in any order.  Note 3: for EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 4: Steps 10 and 11 can happen in any order.  Note 5: For NR5GC the received MAC PDU will contain Single-entry PHR MAC CE. For EN-DC/NE-DC the received MAC PDU will contain Multiple-Entry PHR MAC CE. | | | | | |

7.1.1.3.7.3.3 Specific message contents

Table 7.1.1.3.7.3.3-1: RRCReconfiguration(step 2 Table 7.1.1.3.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR  NE-DC |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-2: CellGroupConfig (Table 7.1.1.3.7.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| phr-PeriodicTimer | sf500 |  |  |
| phr-ProhibitTimer | sf1000 |  |  |
| phr-Tx-PowerFactorChange | infinity |  |  |
| multiplePHR | false |  |  |
| multiplePHR | true |  | EN-DC  NE-DC |
| phr-Type2PCell | false |  |  |
| phr-Type2OtherCell | false |  |  |
| phr-ModeOtherCG | real |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-3: RRCReconfiguration(step 6,19 Table 7.1.1.3.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR  NE-DC |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-4: CellGroupConfig(Table 7.1.1.3.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-5: RRCReconfiguration(step 9 Table 7.1.1.3.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR  NE-DC |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-6: CellGroupConfig(Table 7.1.1.3.7.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| phr-PeriodicTimer | infinity |  |  |
| phr-ProhibitTimer | sf1000 |  |  |
| phr-Tx-PowerFactorChange | 3dB |  |  |
| multiplePHR | false |  |  |
| multiplePHR | true |  | EN-DC  NE-DC |
| phr-Type2PCell | false |  |  |
| phr-Type2OtherCell | false |  |  |
| phr-ModeOtherCG | real |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.8 UE power headroom reporting / SCell activation / DL pathloss change reporting

###### 7.1.1.3.8.1 UE power headroom reporting / SCell activation / DL pathloss change reporting/ Intra-band Contiguous CA

7.1.1.3.8.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state with multiple Power headroom reporting and an SCell with uplink is configured }

**ensure that** {

**when** { *UE receives an Activation MAC Control Element activating the SCell* }

**then** { UE transmits a MAC PDU containing Power Headroom Report MAC Control Element including PH type1 for SpCell and Scell }

}

(2)

**with** { UE in RRC\_Connected state with multiple Power headroom reporting for phr-dl-PathlossChange configured }

**ensure that** {

**when** { *the DL Pathloss changes and phr-ProhibitTimer is running*  }

**then** { UE does not transmit a MAC PDU containing Power Headroom Report MAC Control Element including PH type1 for SpCell and Scell }

}

(3)

**with** { UE in RRC\_Connected state with Power headroom reporting for phr-dl-PathlossChange configured }

**ensure that** {

**when** { phr-ProhibitTimer expires and power headroom report is triggered due to DL Pathloss change }

**then** { UE transmits a MAC PDU containing Power Headroom Report MAC Control Element including PH type1 for SpCell and Scell }

}

7.1.1.3.8.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321 clause 5.4.6 and 6.1.3.8. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving gNB with the following information:

- Type 1 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell;

- Type 2 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH and PUCCH transmission on SpCell of the other MAC entity (i.e. E-UTRA MAC entity in EN-DC, NE-DC, and NGEN-DC cases);

- Type 3 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for SRS transmission per activated Serving Cell.

RRC controls Power Headroom reporting by configuring the following parameters:

- *phr-PeriodicTimer*;

- *phr-ProhibitTimer*;

- *phr-Tx-PowerFactorChange*;

- *phr-Type2OtherCell*;

- *phr-ModeOtherCG*;

- *multiplePHR*.

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between.

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink;

- addition of the PSCell (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*;

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in clause 5.4.3.1:

2> if *multiplePHR* with value *true* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity:

4> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell and clause 5.1.1.2 of TS 36.213 [17] for E-UTRA Serving Cell;

4> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

4> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to *real* by upper layers:

5> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

3> if *phr-Type2OtherCell* with value *true* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to *real* by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in clause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell;

3> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in clause 6.1.3.8 based on the values reported by the physical layer.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

[TS 38.321, clause 6.1.3.9]

The Multiple Entry PHR MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-2.

It has a variable size, and includes the bitmap, a Type 2 PH field and an octet containing the associated PCMAX,f,c field (if reported) for SpCell of the other MAC entity, a Type 1 PH field and an octet containing the associated PCMAX,f,c field (if reported) for the PCell. It further includes, in ascending order based on the *ServCellIndex*, one or multiple of Type X PH fields and octets containing the associated PCMAX,f,c fields (if reported) for Serving Cells other than PCell indicated in the bitmap. X is either 1 or 3 according to TS 38.213 [6] and TS 36.213 [17].

The presence of Type 2 PH field for SpCell of the other MAC entity is configured by *phr-Type2OtherCell* with value *true*.

A single octet bitmap is used for indicating the presence of PH per Serving Cell when the highest *ServCellIndex* of Serving Cell with configured uplink is less than 8, otherwise four octets are used.

The MAC entity determines whether PH value for an activated Serving Cell is based on real transmission or a reference format by considering the configured grant(s) and downlink control information which has been received until and including the PDCCH occasion in which the first UL grant for a new transmission that can accommodate the MAC CE for PHR as a result of LCP as defined in clause 5.4.3.1 is received since a PHR has been triggered if the PHR MAC CE is reported on an uplink grant received on the PDCCH or until the first uplink symbol of PUSCH transmission minus PUSCH preparation time as defined in clause 7.7 of TS 38.213 [6] if the PHR MAC CE is reported on a configured grant.

For a band combination in which the UE does not support dynamic power sharing, the UE may omit the octets containing Power Headroom field and PCMAX,f,c field for Serving Cells in the other MAC entity except for the PCell in the other MAC entity and the reported values of Power Headroom and PCMAX,f,c for the PCell are up to UE implementation.

The PHR MAC CEs are defined as follows:

- Ci: This field indicates the presence of a PH field for the Serving Cell with *ServCellIndex* i as specified in TS 38.331 [5]. The Ci field set to 1 indicates that a PH field for the Serving Cell with *ServCellIndex* i is reported. The Ci field set to 0 indicates that a PH field for the Serving Cell with *ServCellIndex* i is not reported;

- R: Reserved bit, set to 0;

- V: This field indicates if the PH value is based on a real transmission or a reference format. For Type 1 PH, the V field set to 0 indicates real transmission on PUSCH and the V field set to 1 indicates that a PUSCH reference format is used. For Type 2 PH, the V field set to 0 indicates real transmission on PUCCH and the V field set to 1 indicates that a PUCCH reference format is used. For Type 3 PH, the V field set to 0 indicates real transmission on SRS and the V field set to 1 indicates that an SRS reference format is used. Furthermore, for Type 1, Type 2, and Type 3 PH, the V field set to 0 indicates the presence of the octet containing the associated PCMAX,f,c field, and the V field set to 1 indicates that the octet containing the associated PCMAX,f,c field is omitted;

- Power Headroom (PH): This field indicates the power headroom level. The length of the field is 6 bits. The reported PH and the corresponding power headroom levels are shown in Table 6.1.3.8-1 (the corresponding measured values in dB for the NR Serving Cell are specified in TS 38.133 [11] while the corresponding measured values in dB for the E-UTRA Serving Cell are specified in TS 36.133 [12]);

- P: This field indicates whether the MAC entity applies power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]). The MAC entity shall set the P field to 1 if the corresponding PCMAX,f,c field would have had a different value if no power backoff due to power management had been applied;

- PCMAX,f,c: If present, this field indicates the PCMAX,f,c (as specified in TS 38.213 [6]) for the NR Serving Cell and the PCMAX,c or P̃CMAX,c (as specified in TS 36.213 [17]) for the E-UTRA Serving Cell used for calculation of the preceding PH field. The reported PCMAX,f,c and the corresponding nominal UE transmit power levels are shown in Table 6.1.3.8-2 (the corresponding measured values in dBm for the NR Serving Cell are specified in TS 38.133 [11] while the corresponding measured values in dBm for the E-UTRA Serving Cell are specified in TS 36.133 [12]).



Figure 6.1.3.9-1: Multiple Entry PHR MAC CE with the highest *ServCellIndex* of Serving Cell with configured uplink is less than 8

7.1.1.3.8.1.3 Test description

7.1.1.3.8.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*) System information combination NR-4 and in addition NR Cell 3 is configured as NR Active Scell.

7.1.1.3.8.1.3.2 Test procedure sequence

Table 7.1.1.3.8.1.3.2-0: Cell configuration power level changes over time for conducted test environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 3 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 |  |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -99 | -88 |  |
| **T2** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 |  |
| **T3** | Cell-specific RS EPRE | dBm/SCS | -88 | -99 |  |
| **T4** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 |  |

Table 7.1.1.3.8.1.3.2-0A: Cell configuration power level changes over time for OTA test environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 3 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -91 | -82 |  |
| **T2** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T3** | Cell-specific RS EPRE | dBm/SCS | -82 | -91 |  |
| **T4** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |

Table 7.1.1.3.8.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits an RRCReconfiguration message toconfigure SCell (NR Cell 3). Note 1 | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 3 | The SS is configured for Uplink Grant Allocation Type 2. SS is configured to transmit UL grant for UE at every 10 ms. | - | - | - | - |
| 4 | SS transmits an RRCReconfiguration message to provide Power Headroom parameters. Note 1 | <-- | RRCReconfiguration | - | - |
|  | EXCEPTION: In parallel with step 5, UE executes parallel behaviour defined in Table 7.1.1.3.8.1.3.2-2 | - | *-* | - | - |
| 5 | The UE transmits RRCReconfigurationComplete message to confirm the setup of Power Headroom parameters. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 6 | The SS transmits an Activation MAC control element to activate SCell. | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=1)) | - | - |
| 7 | Check: Does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 1 | P |
| 8 | Void | - | - | - | - |
| 9 | SS adjusts cell levels according to row T1 of Table 7.1.1.3.8.3.1.2-0/0A. | - | - | - | - |
| 10 | Check: For 80% of *prohibitPHR-Timer* since step 7, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE? | --> | MAC PDU | 2 | F |
| 11 | Check: After *prohibitPHR-Timer* after step 7, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 12 | SS adjusts cell levels according to row T2 of Table 7.1.1.3.8.1.3.2-0/0A. | - | - | - | - |
| 13 | Check: For 80% of *prohibitPHR-Timer* since step 11, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE ? | --> | MAC PDU | 2 | F |
| 14 | Check: After *prohibitPHR-Timer* after step 11, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 15 | SS adjusts cell levels according to row T3 of Table 7.1.1.3.8.1.3.2-0/0A. | - | - | - | - |
| 16 | Check: For 80% of *prohibitPHR-Timer* since step 14, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing? | --> | MAC PDU | 2 | F |
| 17 | Check: After *prohibitPHR-Timer* after step 14, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 18 | SS adjusts cell levels according to row T4 of Table 7.1.1.3.8.1.3.2-0/0A. | - | - | - | - |
| 19 | Check: For 80% of *prohibitPHR-Timer* since step 17, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE? | --> | MAC PDU | 2 | F |
| 20 | Check: After *prohibitPHR-Timer* after step 17, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 21 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 22 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters.(Note 3) | --> | *(RRCReconfigurationComplete)* | - | - |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 3: For EN-DC the Type 1 PHR report for EUTRA Pcell is also included. | | | | | |

Table 7.1.1.3.8.1.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The UE transmits a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell. | --> | MAC PDU | - | - |

7.1.1.3.8.1.3.3 Specific message contents

Table 7.1.1.3.8.1.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.3.8.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| c1 CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-2: CellGroupConfig (Table 7.1.1.3.8.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19. | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| sCellToAddModList SEQUENCE (SIZE (1..maxMeasId)) OF SCellConfig { | 1 entry |  |  |
| SCellConfig[1] SEQUENCE { |  | entry 1 |  |
| sCellIndex | SCellIndex as per TS 38.508-1 [4] table 4.6.3-154 |  |  |
| sCellConfigCommon | ServingCellConfigCommon |  |  |
| sCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-3: ServingCellConfigCommon (Table 7.1.1.3.8.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 3 |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-3A: Void

Table 7.1.1.3.8.1.3.3-4: *RRCReconfiguration* ( Step 4, Table 7.1.1.3.8.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-5: CellGroupConfig (Table 7.1.1.3.8.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | CellGroupId as per TS 38.508-1 [4] table 4.6.3-20 |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| phr-PeriodicTimer | infinity |  |  |
| phr-ProhibitTimer | sf1000 |  |  |
| phr-Tx-PowerFactorChange | 3db |  |  |
| multiplePHR | true |  |  |
| dummy | true |  |  |
| phr-Type2OtherCell | false |  |  |
| phr-ModeOtherCG | real |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-6: ServingCellConfig (Table 7.1.1.3.8.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-7: *BWP-UplinkDedicated*(Table 7.1.1.3.8.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config | Not present |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-8: ServingCellConfigCommon (Table 7.1.1.3.8.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 3 |  |  |
| uplinkConfigCommon | UplinkConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-9: UplinkConfigCommon (Table 7.1.1.3.8.1.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| UplinkConfigCommon ::= SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-10: BWP-UplinkCommon (Table 7.1.1.3.8.1.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| pucch-ConfigCommon | Not present |  |  |
| } |  |  |  |

###### 7.1.1.3.8.2 UE power headroom reporting / SCell activation / DL pathloss change reporting / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.1.3.8.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA

- Cells configuration: NR Cell 10 replaces NR Cell 3

###### 7.1.1.3.8.3 UE power headroom reporting / SCell activation / DL pathloss change reporting / Intra-band non-Contiguous CA

The scope and description of the present TC is the same as test case 7.1.1.3.8.1 with the following differences:

- CA configuration: Intra-band non-Contiguous CA replaces Intra-band Contiguous CA.

##### 7.1.1.3.9 Correct Handling of UL HARQ process / PUSCH Repetition Type A / PUSCH Aggregation

7.1.1.3.9.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and PUSCH Aggregation > 1 }

**ensure that** {

**when** { UE receives an UL Grant with toggled NDI and has data available for transmission }

**then** { UE transmits a new MAC PDU and repeats the MAC PDU *pusch-AggregationFactor*-1 times after first transmission and selects the redundancy version correctly }

}

7.1.1.3.9.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PUSCH mapping type** | **Normal cyclic prefix** | | | **Extended cyclic prefix** | | |
| ***S*** | ***L*** | ***S+L*** | ***S*** | ***L*** | ***S+L*** |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the correponding HARQ process, if configured.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in subclause 5.8.2;

4> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if the *configuredGrantTimer* for the corresponding HARQ process is not running:

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

where CURRENT\_symbol=(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a repetition bundle that takes place.

NOTE 2: A HARQ process is configured for a configured uplink grant if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*.

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response, HARQ process identifier 0 is used.

When the MAC entity is configured with *pusch-AggregationFactor* > 1, the parameter *pusch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic grant. After the initial transmission, *pusch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle. When the MAC entity is configured with *repK* > 1, the parameter *repK* provides the number of transmissions of a TB within a bundle of the configured uplink grant. After the initial transmission, HARQ retransmissions follow within a bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *pusch-AggregationFactor* for a dynamic grant and *repK* for a configured uplink grant, respectively. Each transmission within a bundle is a separate uplink grant after the initial uplink grant within a bundle is delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant, the sequence of redundancy versions is determined according to subclause 6.1.4 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to subclause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to subclause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a new transmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is a configured uplink grant; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH of the uplink grant overlaps with a PUSCH of another uplink grant received on the PDCCH for this Serving Cell:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on either PDCCH, Random Access Response, or RRC. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle.

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

1> if the MAC PDU was obtained from the Msg3 buffer; or

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer:

2> instruct the physical layer to generate a transmission according to the stored uplink grant.

7.1.1.3.9.3 Test description

7.1.1.3.9.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.9.3.1-1.

Table 7.1.1.3.9.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.9.3.2 Test procedure sequence

Table 7.1.1.3.9.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0A | SS transmits in the indicated downlink assignment an NR RRCReconfiguration. (Note 1) | <--- | - | - | - |
| 0B | UE transmits NR RRCReconfigurationComplete message to the SS. (Note 2) | --> | - | - | - |
| 1 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 2 | The UE transmits a Scheduling Request. | --> | (SR) | - | - |
| 3 | The SS allocates an UL Grant for HARQ process 1, sufficient for one RLC SDU to be looped back in a slot n, and NDI indicates new transmission and DCI scheduling the PUSCH indicates rvID = 0. | <-- | UL Grant | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n+4 and repeats in following pusch-AggregationFactor-1 slots with same resource allocation but different redundancy version (Note 3), if the slot can be used for uplink transmission (Note 4) | --> | MAC PDU | 1 | P |
| 5 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 4. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row.  Note 4: Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions. | | | | | |

7.1.1.3.9.3.3 Specific message contents

Table 7.1.1.3.9.3.3-0A: *RRCReconfiguration* (step 0A, Table 7.1.1.3.9.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs ::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-0B: *CellGroupConfig* (Table 7.1.1.3.9.3.3-0A: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  |  |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-1: *ServingCellConfig* (Table 7.1.1.3.9.3.3-0B: *CellGroupConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-2: *BWP-UplinkDedicated* (Table 7.1.1.3.9.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pusch-Config CHOICE { | Not present |  |  |
| Setup | PUSCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-3: *PUSCH-Config* (Table 7.1.1.3.9.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| pusch-AggregationFactor | n4 |  |  |
|  | n8 |  | (TDD AND SCS15) OR FR2 |
| } |  |  |  |

##### 7.1.1.3.10 Correct Handling of HARQ process / Multiple CORESETPoolIndex

7.1.1.3.10.1. Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with PDCCH-Config that contains two different values of CORESETPoolIndex in ControlResourceSet }

**ensure that** {

**when** { UE receives PDCCHs that schedule two PUSCHs non-overlapping in time domain, and the PDCCHs are associated to different ControlResourceSets having different values of CORESETPoolIndex }

**then** { UE sends PUSCHs following the scheduling information of PDCCHs }

}

(2)

**with**(UE in RRC\_CONNECTED state and is configured with PDCCH-Config that contains two different values of CORESETPoolIndex in ControlResourceSet)

**ensure that** {

**when**{ UE receives PDCCHs that schedule two overlapping in time domain PDSCHs and non-overlapping in frequency domain, and the PDCCHs are associated to different ControlResourceSets having different values of CORESETPoolIndex }

**then** { UE Receives PDSCHs following the scheduling information of PDCCHs }

}

7.1.1.3.10.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214, clauses 5.18.10 and 6.1.20. Unless otherwise stated these are Rel-16 requirements.

[TS 38.214, clause 5.11]

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet*, the UE may expect to receive multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain. The UE may expect the reception of full/partially-overlapped PDSCHs in time only when PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *CORESETPoolIndex*. For a *ControlResourceSet* without *CORESETPoolIndex*, the UE may assume that the *ControlResourceSet* is assigned with *CORESETPoolIndex* as 0. When the UE is scheduled with full/partially/non-overlapped PDSCHs in time and frequency domain, the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH, the UE is expected to be scheduled with the same active BWP and the same SCS. When the UE is scheduled with full/partially-overlapped PDSCHs in time and frequency domain, the UE can be scheduled with at most two codewords simultaneously. When PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *CORESETPoolIndex,* the following operations are allowed:

- For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH associated with a value of *CORESETpoolIndex* ending in symbol *i*, the UE can be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH associated with a different value of *CORESETpoolIndex* that ends later than symbol *i*.

- In a given scheduled cell, the UE can receive a first PDSCH in slot *i*, with the corresponding HARQ-ACK assigned to be transmitted in slot *j*, and a second PDSCH associated with a value of *CORESETpoolindex* different from that of the first PDSCH starting later than the first PDSCH with its corresponding HARQ-ACK assigned to be transmitted in a slot before slot *j*.

If PDCCHs that schedule corresponding PDSCHs are associated to the same or different *ControlResourceSets* having the same value of *CORESETPoolIndex*, the UE procedure for receiving the PDSCH upon detection of a PDCCH follows Clause 5.1.

[TS 38.214, clause 6.1]

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet* for the active BWP of a serving cell and PDCCHs that schedule two non-overlapping in time domain PUSCHs are associated to different *ControlResourceSets* having different values of *CORESETPoolIndex,* for any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start a first PUSCH transmission starting in symbol *j* by a PDCCH associated with a value of *CORESETpoolIndex* ending in symbol *i*, the UE can be scheduled to transmit a PUSCH starting earlier than the end of the first PUSCH by a PDCCH associated with a different value of *CORESETpoolIndex* that ends later than symbol *i*.

7.1.1.3.10.3 Test description

7.1.1.3.10.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.3.10.3.2 Test procedure sequence

Table 7.1.1.3.10.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits NR *RRCReconfiguration* message to configure two different values of *CORESETPoolIndex* in *ControlResourceSet*, (Note1) | <-- | - | - | - |
| 2 | The UE transmitNR *RRCReconfigurationComplete* messages (Note 2) | --> | - | - | - |
| 3 | The SS transmits 2 MAC PDU’s on PDSCH’s scheduled by two different values of CORESETPoolIndex in ControlResourceSet. The PDSCHs are scheduled as overlapping in time domain, but non-overlapping in frequency domain. | <-- | MAC PDU 1, MAC PDU 2 | - | - |
| 4 | 100 ms after step 4, the SS transmits a two UL grants scheduling two non-overlapping in time domain PUSCHs associated to different ControlResourceSets having different values of CORESETPoolIndex | <-- | (UL Grant 1, UL Grant 2) | - | - |
| 5 | Check: Does the UE transmit 2 MAC PDU’s loop backed from step 3? | --> | MAC PDU 1, MAC PDU 2 | 1,2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.3.10.3.3 Specific message contents

Table 7.1.1.3.10.3.3-1: *PDCCH-Config* (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 2 entries |  |  |
| ControlResourceSet[1] | ControlResourceSetid1 | entry 1 |  |
| ControlResourceSet[2] | ControlResourceSetid2 | entry 2 |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace { | 2 entries |  |  | |
| SearchSpace[1] | SearchSpace with condition USS | entry 1 |  | |
| SearchSpace[2] | SearchSpace with condition USS and searchSpaceId =3 | entry 2 |  | |
| } |  |  |  |

Table 7.1.1.3.10.3.3-2: *ControlResourceSetId1* (Table 7.1.1.3.10.3.3-1: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| coresetPoolIndex-r16 | 0 |  |  |
| } |  |  |  |

Table 7.1.1.3.10.3.3-3: *ControlResourceSetId2* (Table 7.1.1.3.10.3.3-1: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 2 |  |  |
| coresetPoolIndex-r16 | 1 |  |  |
| } |  |  |  |

Table 7.1.1.3.10.3.3-4: *PDSCH-Config* (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| *dataScramblingIdentityPDSCH2-r16* | 7 | Randomly selected |  |
| } |  |  |  |

Table 7.1.1.3.10.3.3-5: *PhysicalCellGroupConfig* (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-106 | | | |
| Information Element | Value/remark | Comment | Condition |
| PhysicalCellGroupConfig ::= SEQUENCE { |  |  |  |
| ackNackFeedbackMode-r16 | joint |  |  |
| } |  |  |  |

##### 7.1.1.3.11 Correct handling of UL grant prioritization

7.1.1.3.11.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED and configured with *lch-basedPrioritization，*and a resource conflict happened when the UE is sending data based on a UL grant which is addressed to CS-RNTI with NDI = 1 or C-RNTI }

**ensure that** {

**when** { the data causes the resource conflict is based on a configured UL grant whose priority is lower than or equal to the UL grant’s }

**then** { UE determines the UL grant to be prioritized and sends the corresponding MAC PDU.}

}

(2)

**with** { UE in RRC\_CONNECTED and configured with *lch-basedPrioritization，*a resource conflict happened when the UE is sending data based on a UL grant which is addressed to CS-RNTI with NDI = 1 or C-RNTI, and UE determines the UL grant to be prioritized }

**ensure that** {

**when** { UE sends out the MAC PDU associated with the prioritized grant }

**then** { autonomously re-transmit the MAC PDU associated with the de-prioritized grant.}

}

7.1.1.3.11.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.1 and 5.4.2.1. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.4.1]

…

For the MAC entity configured with *lch-basedPrioritization*, priority of an uplink grant is determined by the highest priority among priorities of the logical channels with data available that are multiplexed or can be multiplexed in the MAC PDU, according to the mapping restrictions as described in clause 5.4.3.1.2. The priority of an uplink grant for which no data for logical channels is multiplexed or can be multiplexed in the MAC PDU is lower than either the priority of an uplink grant for which data for any logical channels is multiplexed or can be multiplexed in the MAC PDU or the priority of the logical channel triggering an SR.

If the corresponding PUSCH transmission of a configured uplink grant is cancelled by CI-RNTI as specified in clause 11.2A of TS 38.213 [6] or cancelled by a high PHY-priority PUCCH transmission as specified in clause 9 of TS 38.213 [6], this uplink grant is considered as a de-prioritized uplink grant.

When the MAC entity is configured with *lch-basedPrioritization*, for each uplink grant whose associated PUSCH can be transmitted by lower layers, the MAC entity shall:

1> if this uplink grant is addressed to CS-RNTI with NDI = 1 or C-RNTI:

2> if there is no overlapping PUSCH duration of a configured uplink grant which was not already de-prioritized, in the same BWP whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission which was not already de-prioritized and the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> consider this uplink grant as a prioritized uplink grant;

3> consider the other overlapping uplink grant(s), if any, as a de-prioritized uplink grant(s);

3> consider the other overlapping SR transmission(s), if any, as a de-prioritized SR transmission(s).

1> else if this uplink grant is a configured uplink grant:

2> if there is no overlapping PUSCH duration of another configured uplink grant which was not already de-prioritized, in the same BWP, whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUSCH duration of an uplink grant addressed to CS-RNTI with NDI = 1 or C-RNTI which was not already de-prioritized, in the same BWP, whose priority is higher than or equal to the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission which was not already de-prioritized and the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> consider this uplink grant as a prioritized uplink grant;

3> consider the other overlapping uplink grant(s), if any, as a de-prioritized uplink grant(s);

3> consider the other overlapping SR transmission(s), if any, as a de-prioritized SR transmission(s).

NOTE 6: If the MAC entity is configured with *lch-basedPrioritization* and if there is overlapping PUSCH duration of at least two configured uplink grants whose priorities are equal, the prioritized uplink grant is determined by UE implementation.

NOTE 7: If the MAC entity is not configured with *lch-basedPrioritzation* and if there is overlapping PUSCH duration of at least two configured uplink grants, it is up to UE implementation to choose one of the configured uplink grants.

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

NOTE: When a single DCI is used to schedule multiple PUSCH, the UE is allowed to map generated TB(s) internally to different HARQ processes in case of LBT failure(s), i.e. UE may transmit a new TB on any HARQ process in the grants that have the same TBS, the same RV and the NDIs indicate new transmission.

The number of transmissions of a TB within a bundle of the dynamic grant or configured grant is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

- For a configured grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.3 of TS 38.214 [7].

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response (i.e. in a MAC RAR or a fallback RAR); or

2> if the uplink grant was determined as specified in clause 5.1.2a for the transmission of the MSGA payload; or

2> if the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the MSGA buffer and the uplink grant determined as specified in clause 5.1.2a for the transmission of the MSGA payload was selected; or

3> if there is a MAC PDU in the MSGA buffer and the uplink grant was received in a fallbackRAR and this fallbackRAR successfully completed the Random Access procedure:

4> obtain the MAC PDU to transmit from the MSGA buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a fallbackRAR:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a MAC RAR; or:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

4> if the uplink grant size does not match with size of the obtained MAC PDU; and

4> if the Random Access procedure was successfully completed upon receiving the uplink grant:

5> indicate to the Multiplexing and assembly entity to include MAC subPDU(s) carrying MAC SDU from the obtained MAC PDU in the subsequent uplink transmission;

5> obtain the MAC PDU to transmit from the Multiplexing and assembly entity.

3> else if this uplink grant is a configured grant configured with *autonomousTx*; and

3> if the previous configured uplink grant, in the BWP, for this HARQ process was not prioritized; and

3> if a MAC PDU had already been obtained for this HARQ process; and

3> if the uplink grant size matches with size of the obtained MAC PDU; and

3> if a transmission of the obtained MAC PDU has not been performed:

4> consider the MAC PDU has been obtained.

3> else if the MAC entity is not configured with *lch-basedPrioritization*; or

3> if this uplink grant is a prioritized uplink grant:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

5> if the uplink grant is a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

6> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if *cg-RetransmissionTimer* is configured for the identified HARQ process; and

5> if the transmission is performed and LBT failure indication is received from lower layers:

6> consider the identified HARQ process as pending.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with a PUSCH duration of another uplink grant received on the PDCCH or an uplink grant received in a Random Access Response (i.e. MAC RAR or fallbackRAR) or an uplink grant determined as specified in clause 5.1.2a for MSGA payload for this Serving Cell; or:

3> if the MAC entity is configured with *lch-basedPrioritization* and this uplink grant is not a prioritized uplink grant:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the uplink grant is a configured uplink grant:

5> if the identified HARQ process is pending:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

5> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the identified HARQ process is pending and the transmission is performed and LBT failure indication is not received from lower layers:

5> consider the identified HARQ process as not pending.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

When *configuredGrantTimer* or *cg-RetransmissionTimer* is started or restarted by a PUSCH transmission, it shall be started at the beginning of the first symbol of the PUSCH transmission.

7.1.1.3.11.3 Test description

7.1.1.3.11.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that the UM DRB is configured and the logical channels are configured according to 7.1.1.3.11.3.1-1.

Table 7.1.1.3.11.3.1-2: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 6 | 7 |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.11.3.2 Test procedure sequence

Table 7.1.1.3.11.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR RRCReconfiguration message to configure type 2 configured uplink grant. | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits NR RRCReconfigurationComplete. | --> | RRCReconfigurationComplete | - | - |
| 3 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 4 | SS transmits a MAC PDU including a RLC SDU-1 on LCH 4. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 5 | The SS allocates an UL Grant (with size 384 bits that only sufficient for one RLC SDU to be looped back in a Slot) for one HARQ process X and NDI indicates new transmission redundancy version to be used as 0. | <-- | (UL Grant (C-RNTI)) | - | - |
| 6 | The UE transmit a MAC PDU including the RLC SDU-1, in HARQ process X. | --> | MAC PDU | - | - |
| 7 | SS transmits a MAC PDU including a RLC SDU-2 on LCH 5. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 8 | SS transmits a configured UL Grant (with size 384 bits that only sufficient for one RLC SDU to be looped back in a Slot), on PDCCH with the CS-RNTI assigned to the UE, allowing the UE to return the RLC SDU-2 (as received in step 5) in Slot P. | <-- | (UL Grant (CS-RNTI)) | - | - |
| 9 | The SS transmits an UL grant corresponding to slot for HARQ process X, with NDI not toggled and redundancy version to be used as 1. (Note 3) | <-- | (UL Grant (C-RNTI)) | - | - |
| 10 | Check: Does the UE retransmit the MAC PDU including RLC SDU-1 in slot P? | --> | MAC PDU | 1 | P |
| 11 | Check: Does the UE transmit the MAC PDU including RLC SDU-2 after slot P? | --> | MAC PDU | 2 | P |
| 12 | The SS transmits a PDCCH [for UL configured grant type 2 explicit release] using UE’s CS-RNTI in Symbol ‘S’ of slot ‘p’ with NDI=0. Where (z+5x< p <z+6x). | <-- | PDCCH [for UL configured grant type 2 explicit release] | - | - |
| Note 1: Void.  Note 2: Void*.*  Note 3: The UL grant slot is equal to the configured slot in step 8*.* | | | | | |

7.1.1.3.11.3.3 Specific message contents

Table 7.1.1.3.11.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.3.11.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.11.3.3-2: *CellGroupConfig* (Table 7.1.1.3.11.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig | MAC-CellGroupConfig | Table 7.1.1.3.11.3.3-3 |  |
| physicalCellGroupConfig | PhysicalCellGroupConfig | Table 7.1.1.3.11.3.3-4 |  |
| spCellConfig SEQUENCE{ |  |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 10 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1 [4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym80x14 |  | 15kHz |
| periodicity | Sym160x14 |  | 30kHz |
| periodicity | Sym320x14 |  | 60kHz |
| periodicity | Sym640x14 |  | 120kHz |
| autonomousTx-r16 | enabled |  |  |
| } |  |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| PUSCH-TimeDomainResourceAllocationList SEQUENCE { |  |  |  |
| k2 | n8 |  | FR1 and FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 0011011 |  | FR1 |
| startSymbolAndLength | 0001110 |  | FR2 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.11.3.3-3: MAC-CellGroupConfig(Table 7.1.1.3.11.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| lch-BasedPrioritization-r16 | enabled |  |  |
| } |  |  |  |

Table 7.1.1.3.11.3.3-4: PhysicalCellGroupConfig(Table 7.1.1.3.11.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-106 | | | |
| Information Element | Value/remark | Comment | Condition |
| PhysicalCellGroupConfig ::= SEQUENCE { |  |  |  |
| cs-RNTI | ‘FFE0’H |  |  |
| } |  |  |  |

##### 7.1.1.3.12 Correct Handling of UL HARQ process / PUSCH Repetition Type B

7.1.1.3.12.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with PUSCH repetition type B}

**ensure that** {

**when** { UE receives an UL Grant with toggled NDI and has data available for transmission }

**then** { UE transmits a new MAC PDU and repeats the MAC PDU in proper actual transmission times after first transmission and selects the redundancy version correctly }

}

7.1.1.3.12.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clause 5.4.2.1. Unless otherwise stated these are Rel-16 requirements.

[TS 38.214, clause 6.1.2.1]

- for PUSCH scheduled by DCI format 0\_1, if *pusch-RepTypeIndicatorDCI-0-1* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. For PUSCH scheduled by DCI format 0\_2, if *pusch-RepTypeIndicatorDCI-0-2* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. Otherwise, the UE applies PUSCH repetition Type A procedure when determining the time domain resource allocation for PUSCH scheduled by PDCCH.

- For PUSCH repetition Type A, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- For PUSCH repetition Type B, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are provided by *startSymbol* and *length* of the indexed row of the resource allocation table, respectively.

- For PUSCH repetition Type A, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

- For PUSCH repetition Type B, the PUSCH mapping type is set to Type B.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*;

- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*;

- otherwise *K=1*.

If a UE is configured with higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, the UE does not expect to be configured with *pusch-AggregationFactor*.

For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, … *K*-1, is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or *n*th actual repetition (repetition Type B) | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

When transmitting MsgA PUSCH on a non-initial UL BWP, if the UE is configured with *startSymbolAndLengthMsgA-PO*, the UE shall determine the *S* and *L* from *startSymbolAndLengthMsgA-PO*.

When transmitting MsgA PUSCH, if the UE is not configured with *startSymbolAndLengthMsgA-PO*, and if the TDRA list *PUSCH-TimeDomainResourceAllocationList* is provided in *PUSCH-ConfigCommon*, the UE shall use *msgA-PUSCH-TimeDomainAllocation* to indicate which values are used in the list. If *PUSCH-TimeDomainResourceAllocationList* is not provided in *PUSCH-ConfigCommon*, the UE shall use parameters *S* and *L* from table 6.1.2.1.1-2 or table 6.1.2.1.1-3 where *msgA-PUSCH-TimeDomainAllocation* indicates which values are used in the list. The time offset for PUSCH transmission is described in [6, TS38.213].

For PUSCH repetition Type A, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213].

For PUSCH repetition Type B, except for PUSCH transmitting CSI report(s) with no transport block, the number of nominal repetitions is given by *numberOfRepetitions*. For the *n*-th nominal repetition, *n* = *0*, …, *numberOfRepetitions* - 1,

- The slot where the nominal repetition starts is given by , and the starting symbol relative to the start of the slot is given by .

- The slot where the nominal repetition ends is given by , and the ending symbol relative to the start of the slot is given by .

Here is the slot where the PUSCH transmission starts, and is the number of symbols per slot as defined in Clause 4.3.2 of [4, TS38.211].

For PUSCH repetition Type B, the UE determines invalid symbol(s) for PUSCH repetition Type B transmission as follows:

- A symbol that is indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* is considered as an invalid symbol for PUSCH repetition Type B transmission.

- For operation in unpaired spectrum, symbols indicated by *ssb-PositionsInBurst* in SIB1 or *ssb-PositionsInBurst* in *ServingCellConfigCommon* for reception of SS/PBCH blocks are considered as invalid symbols for PUSCH repetition Type B transmission.

- For operation in unpaired spectrum, symbol(s) indicated by *pdcch-ConfigSIB1* in *MIB* for a CORESET for Type0-PDCCH CSS set are considered as invalid symbol(s) for PUSCH repetition Type B transmission.

- For operation in unpaired spectrum, if *numberOfInvalidSymbolsForDL-UL-Switching* is configured, *numberOfInvalidSymbolsForDL-UL-Switching* symbol(s) after the last symbol that is indicated as downlink in each consecutive set of all symbols that are indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* are considered as invalid symbol(s) for PUSCH repetition Type B transmission. The symbol(s) given by *numberOfInvalidSymbolsForDL-UL-Switching* are defined using the reference SCS configuration *referenceSubcarrierSpacing* provided in *tdd-UL-DL-ConfigurationCommon*.

- The UE may be configured with the higher layer parameter *invalidSymbolPattern*, which provides a symbol level bitmap spanning one or two slots (higher layer parameter *symbols* given by *invalidSymbolPattern*). A bit value equal to 1 in the symbol level bitmap *symbols* indicates that the corresponding symbol is an invalid symbol for PUSCH repetition Type B transmission. The UE may be additionally configured with a time-domain pattern (higher layer parameter *periodicityAndPattern* given by *invalidSymbolPattern*), where each bit of *periodicityAndPattern* corresponds to a unit equal to a duration of the symbol level bitmap *symbols*, and a bit value equal to 1 indicates that the symbol level bitmap *symbols* is present in the unit. The *periodicityAndPattern* can be {1, 2, 4, 5, 8, 10, 20 or 40} units long, but maximum of 40 msec. The first symbol of *periodicityAndPattern* every 40 msec/P periods is a first symbol in frame 𝑛𝑓 mod 4 = 0, where P is the duration of *periodicityAndPattern-r16* in units of msec. When *periodicityAndPattern* is not configured, for a symbol level bitmap spanning two slots, the bits of the first and second slots correspond respectively to even and odd slots of a radio frame, and for a symbol level bitmap spanning one slot, the bits of the slot correspond to every slot of a radio frame. If *invalidSymbolPattern* is configured, when the UE applies the invalid symbol pattern is determined as follows:

- if the PUSCH is scheduled by DCI format 0\_1, or corresponds to a Type 2 configured grant activated by DCI format 0\_1, and if *invalidSymbolPatternIndicatorDCI-0-1* is configured,

- if invalid symbol pattern indicator field is set 1, the UE applies the invalid symbol pattern;

- otherwise, the UE does not apply the invalid symbol pattern;

- if the PUSCH is scheduled by DCI format 0\_2, or corresponds to a Type 2 configured grant activated by DCI format 0\_2, and if *invalidSymbolPatternIndicatorDCI-0-2* is configured,

- if invalid symbol pattern indicator field is set 1, the UE applies the invalid symbol pattern;

- otherwise, the UE does not apply the invalid symbol pattern;

- otherwise, the UE applies the invalid symbol pattern.

- If the UE

- is configured with multiple serving cells and is provided *half-duplex-behavior* = 'enable', and

- is not capable of simultaneous transmission and reception on any of the multiple serving cells, and

- indicates support of capability for half-duplex operation in CA with unpaired spectrum, and

- is not configured to monitor PDCCH for detection of DCI format 2-0 on any of the multiple serving cells,

- a symbol is considered as an invalid symbol in any of the multiple serving cells for PUSCH repetition Type B transmission if the symbol is indicated to the UE for reception of SS/PBCH blocks in any of the multiple serving cells by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, and

a symbol is considered as an invalid symbol in any of the multiple serving cells for PUSCH repetition Type B transmission with Type 1 or Type 2 configured grant except for the first Type 2 PUSCH transmission (including all repetitions) after activation if the symbol is indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* on the reference cell, or the UE is configured by higher layers to receive PDCCH, PDSCH, or CSI-RS on the reference cell in the symbol.

For PUSCH repetition Type B, after determining the invalid symbol(s) for PUSCH repetition type B transmission for each of the *K* nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of all potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of *L*=1. An actual repetition is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213]. The redundancy version to be applied on the *n*th actual repetition (with the counting including the actual repetitions that are omitted) is determined according to table 6.1.2.1-2.

For PUSCH repetition Type B, when a UE receives a DCI that schedules aperiodic CSI report(s) or activates semi-persistent CSI report(s) on PUSCH with no transport block by a '*CSI request'* field on a DCI, the number of nominal repetitions is always assumed to be 1, regardless of the value of *numberOfRepetitions*. When the UE is scheduled to transmit a PUSCH repetition Type B with no transport block and with aperiodic or semi-persistent CSI report(s) by a '*CSI request'* field on a DCI, the first nominal repetition is expected to be the same as the first actual repetition. For PUSCH repetition Type B carrying semi-persistent CSI report(s) without a corresponding PDCCH after being activated on PUSCH by a '*CSI request'* field on a DCI, if the first nominal repetition is not the same as the first actual repetition, the first nominal repetition is omitted; otherwise, the first nominal repetition is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213].

For PUSCH repetition Type B, when a UE is scheduled to transmit a transport block and aperiodic CSI report(s) on PUSCH by a '*CSI request'* field on a DCI, the CSI report(s) is multiplexed only on the first actual repetition. The UE does not expect that the first actual repetition has a single symbol duration.

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI scheduling PUSCH or provided in a DCI activating a configured grant Type 2 PUSCH, or as provided by *mcsAndTBS* as described in Clause 6.1.2.3 for a configured grant Type 1 PUSCH to determine the modulation order  and target code rate (*R*) based on the procedure defined in Clause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version for PUSCH scheduled by DCI, or determine the redundancy version according to Clause 6.1.2.3.1 for configured grant Type 1 and Type 2 PUSCH,

and second

- use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Clause 6.1.4.2.

When the UE is scheduled with multiple PUSCHs by a DCI, as described in clause 6.1.2.1, the bits of *rv* field and NDI field, respectively, in the DCI are one to one mapped to the scheduled PUSCH(s) with the corresponding transport block(s) in the scheduled order where the LSB bits of the *rv* field and NDI field, respectively, correspond to the last scheduled PUSCH.

Within a cell group, a UE is not required to handle PUSCH(s) transmissions in slot *sj* in serving cell-*j*, and for *j* = 0,1,2.. *J-1*, slot *sj* overlapping with any given point in time, if the following condition is not satisfied at that point in time:

,

where

*- J* is the number of configured serving cells belong to a frequency range

- for the *j-th* serving cell,

*- M* is the number of TB(s) transmitted in slot-*sj*. For PUSCH repetition Type B, each actual repetition is counted separately.

*- Tslotμ(j)* =10-3/2*μ(j*), where *μ(j)* is the numerology for PUSCH(s) in slot *sj* of the *j*-th serving cell.

- for the *m*-th TB,

*- A* is the number of bits in the transport block as defined in Clause 6.2.1 [5, TS 38.212]

*- C* is the total number of code blocks for the transport block defined in Clause 5.2.2 [5, TS 38.212].

- is the number of scheduled code blocks for the transport block as defined in Clause 5.4.2.1 [5,38.212]

- [Mbps] is computed as the maximum data rate summed over all the carriers in the frequency range for any signalled band combination and feature set consistent with the configured servings cells, where the data rate value is given by the formula in Clause 4.1.2 in [13, TS 38.306], including the scaling factor *f(i).*

For a *j*-th serving cell, if higher layer parameter *processingType2Enabled* of *PUSCH-ServingCellConfig* is configured for the serving cell and set to 'enable'*,* or if at least one *IMCS > W* for a PUSCH, where *W* = 28 for MCS tables 5.1.3.1-1 and 5.1.3.1-3, and *W* = 27 for MCS tables 5.1.3.1-2, 6.1.4.1-1, and 6.1.4.1-2, or if it is an actual repetition for PUSCH repetition Type B, the UE is not required to handle PUSCH transmissions, if the following condition is not satisfied:

where

- is the number of symbols assigned to the PUSCH

- *M* is the number of TB in the PUSCH

- where μ is the numerology of the PUSCH

- for the *m*-th TB,

- *A* is the number of bits in the transport block as defined in Clause 6.2.1 [5, TS 38.212]

- *C* is the total number of code blocks for the transport block defined in Clause 5.2.2 [5, TS 38.212]

- is the number of scheduled code blocks for the transport block as defined in Clause 5.4.2.1 [5, TS 38.212]

- [Mbps] is computed as the maximum data rate for a carrier in the frequency band of the serving cell for any signalled band combination and feature set consistent with the serving cell, where the data rate value is given by the formula in Clause 4.1.2 in [13, TS 38.306], including the scaling factor *f(i)*

- each actual repetition for PUSCH repetition type B is treated as one PUSCH*.*

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

NOTE: When a single DCI is used to schedule multiple PUSCH, the UE is allowed to map generated TB(s) internally to different HARQ processes in case of LBT failure(s), i.e. UE may transmit a new TB on any HARQ process in the grants that have the same TBS, the same RV and the NDIs indicate new transmission.

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

- For a configured grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.3 of TS 38.214 [7].

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response (i.e. in a MAC RAR or a fallback RAR); or

2> if the uplink grant was determined as specified in clause 5.1.2a for the transmission of the MSGA payload; or

2> if the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the MSGA buffer and the uplink grant determined as specified in clause 5.1.2a for the transmission of the MSGA payload was selected; or

3> if there is a MAC PDU in the MSGA buffer and the uplink grant was received in a fallbackRAR and this fallbackRAR successfully completed the Random Access procedure:

4> obtain the MAC PDU to transmit from the MSGA buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a fallbackRAR:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a MAC RAR; or:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

4> if the uplink grant size does not match with size of the obtained MAC PDU; and

4> if the Random Access procedure was successfully completed upon receiving the uplink grant:

5> indicate to the Multiplexing and assembly entity to include MAC subPDU(s) carrying MAC SDU from the obtained MAC PDU in the subsequent uplink transmission;

5> obtain the MAC PDU to transmit from the Multiplexing and assembly entity.

3> else if this uplink grant is a configured grant configured with *autonomousTx*; and

3> if the previous configured uplink grant, in the BWP, for this HARQ process was not prioritized; and

3> if a MAC PDU had already been obtained for this HARQ process; and

3> if the uplink grant size matches with size of the obtained MAC PDU; and

3> if none of PUSCH transmission(s) of the obtained MAC PDU has been completely performed:

4> consider the MAC PDU has been obtained.

3> else if the MAC entity is not configured with *lch-basedPrioritization*; or

3> if this uplink grant is a prioritized uplink grant:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

5> if the uplink grant is a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

6> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if *cg-RetransmissionTimer* is configured for the identified HARQ process; and

5> if the transmission is performed and LBT failure indication is received from lower layers:

6> consider the identified HARQ process as pending.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with a PUSCH duration of another uplink grant received on the PDCCH or an uplink grant received in a Random Access Response (i.e. MAC RAR or fallbackRAR) or an uplink grant determined as specified in clause 5.1.2a for MSGA payload for this Serving Cell; or:

3> if the MAC entity is configured with *lch-basedPrioritization* and this uplink grant is not a prioritized uplink grant:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the uplink grant is a configured uplink grant:

5> if the identified HARQ process is pending:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

5> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the identified HARQ process is pending and the transmission is performed and LBT failure indication is not received from lower layers:

5> consider the identified HARQ process as not pending.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

When *configuredGrantTimer* or *cg-RetransmissionTimer* is started or restarted by a PUSCH transmission, it shall be started at the beginning of the first symbol of the PUSCH transmission.

7.1.1.3.12.3 Test description

7.1.1.3.12.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.3.12.3.2 Test procedure sequence

Table 7.1.1.3.12.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| 0A | SS transmits in the indicated downlink assignment an NR RRCReconfiguration. (Note 1) | <--- | - | - | - |
| 0B | UE transmits NR RRCReconfigurationComplete message to the SS. (Note 2) | --> | - | - | - |
| 1 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 2 | The UE transmits a Scheduling Request. | --> | (SR) | - | - |
| 3 | The SS allocates an UL Grant for HARQ process 1, sufficient for one RLC SDU to be looped back in a slot n, NDI indicates new transmission, DCI scheduling the PUSCH indicates rvID = 0 and invalid symbol pattern indicator set to 1. The slot n is selected such that slot n+k2-r16 is the first UL slot in subframe m satisfying (m mod 20) = 9 for SCS=15kHz (except for HD\_FDD) and SCS=120kHz and  (m mod 20) = 8 for SCS=30kHz and HD\_FDD. (Note 5) (Note 6) (Note 7) | <-- | UL Grant | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n+4 and repeats in actual repetitions according to Table 7.1.1.3.12.3.2-2 with same resource allocation but different redundancy version (Note 3), if the slot can be used for uplink transmission (Note 4) | --> | MAC PDU | 1 | P |
| 5 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 4. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The redundancy version for the first transmission and all possible actual repetitions (including skipped ones) are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row.  Note 4: Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions.  Note 5: The UL grant is set to 384 bits: LRBs = 24 & IMCS = 2 (with PUSCH-duration=4 and PUSCH mapping Type B).  Note 6: HD\_FDD means pc\_halfDuplexFDD\_TypeA\_RedCap\_r17=true (i.e HD\_FDD UE are performing test on FDD band).  Note 7: k2-r16 is configured in Table 7.1.1.3.12.3.3-3. | | | | | |

Table 7.1.1.3.12.3.2-2: Transmitted actual repetition in each nominal repetition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Nominal repetition 0  (NOTE 1) | Nominal repetition 1  (NOTE 1) | Nominal repetition 2  (NOTE 2) | Nominal repetition 3  (NOTE 3) |
| FR1 TDD SCS=15kHz | Actual repetition 0 | Actual repetition 0 | N/A (NOTE 4, 5) | N/A (NOTE 6) |
| FR1 FDD SCS=15kHz | Actual repetition 0 | Actual repetition 0 | Actual repetition 1 (NOTE 4, 7) | Actual repetition 0 |
| FR1 TDD SCS=30kHz | Actual repetition 0 | Actual repetition 0 | Actual repetition 1 (NOTE 4) | Actual repetition 0 |
| FR2 SCS=120kHz | Actual repetition 0 | Actual repetition 0 | N/A (NOTE 4, 5) | N/A (NOTE 6) |
| NOTE 1: The nominal repetition is in slot n+k2-r16 and only one actual repetition expected.  NOTE 2: The nominal repetition is split into two actual repetitions in slot n+ k2-r16 and n+ k2-r16+1 respectively.  NOTE 3: The nominal repetition is in slot n+ k2-r16+1 and only one actual repetition expected.  NOTE 4: The actual repetition 0 is skipped due to only 1 valid symbol left according to invalidSymbolPattern-r16.  NOTE 5: The actual repetition 1 is skipped due to being located in DL symbols  NOTE 6: The actual repetition 0 is skipped due to being located in DL symbols  NOTE 7: The SS may not be able to decode the MAC PDU and may only detect a CRC error as there are less symbols available for transmission of the TBS | | | | |

7.1.1.3.12.3.3 Specific message contents

Table 7.1.1.3.12.3.3-0A: *RRCReconfiguration* (step 0A, Table 7.1.1.3.12.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs ::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-0B: *CellGroupConfig* (Table 7.1.1.3.12.3.3-0A: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  |  |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-1: *ServingCellConfig* (Table 7.1.1.3.12.3.3-0B: *CellGroupConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-2: *BWP-UplinkDedicated* (Table 7.1.1.3.12.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup | PUSCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-3: *PUSCH-Config* (Table 7.1.1.3.12.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF SEQUENCE { | 1 entry |  |  |
| k2-r16[1] | 4 |  |  |
|  | 3 |  | HD\_FDD |
| puschAllocationList-r16[1] SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF SEQUENCE { | 1 entry |  |  |
| mappingType-r16[1] | Not present |  |  |
| startSymbolAndLength-r16[1] | Not present |  |  |
| startSymbol-r16[1] | 4 |  |  |
| length-r16[1] | 4 |  |  |
| numberOfRepetitions-r16[1] | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| invalidSymbolPatternIndicatorDCI-0-1-r16 | enabled |  |  |
| pusch-RepTypeIndicatorDCI-0-1-r16 | pusch-RepTypeB |  |  |
| invalidSymbolPattern-r16 SEQUENCE { |  |  |  |
| symbols-r16 CHOICE { |  |  |  |
| oneSlot | 00000000000001 |  |  |
| } |  |  |  |
| periodicityAndPattern-r16 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| HD\_FDD | pc\_halfDuplexFDD\_TypeA\_RedCap\_r17 (i.e HD\_FDD UE are performing test on FDD band) |

Table 7.1.1.3.12.3.3-4: *DMRS-UplinkConfig*

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-51 |

##### 7.1.1.3.13 Logical channel prioritization handling with Mapping restrictions / physical layer priority

7.1.1.3.13.1 Test Purpose (TP)

(1)

**with** {UE in RRC\_CONNECTED state with allowedPHY-PriorityIndex configured}

**ensure that** {

**when** { UE is scheduled by DCI including priority indicator}

**then** { UE serves the logical channels according to their priority and configured PHY priority}

}

7.1.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.331, clause 6.3.2, TS 38.321, clause 5.4.3.1.2, 5.4.3.1.3, TS 38.213 clause 9, TS 38.212 clause 7.3.1.1.3. Unless otherwise stated these are Rel-16 requirements.

[TS 38.331, clause 6.3.2]

|  |
| --- |
| ***allowedPHY-PriorityIndex***  This restriction applies only when the UL grant is a dynamic grant. If the field is present and the dynamic grant has a PHY-priority index, UL MAC SDUs from this logical channel can only be mapped to the dynamic grants indicating PHY-priority index equal to the values configured by this field. If the field is present and the dynamic grant does not have a PHY-priority index, UL MAC SDUs from this logical channel can only be mapped to this dynamic grant if the value of the field is *p0*, see TS 38.213 [13], clause 9. If the field is not present, UL MAC SDUs from this logical channel can be mapped to any dynamic grants. Corresponds to "allowedPHY-PriorityIndex" as specified in TS 38.321 [3]. |

[TS 38.321, clause 5.4.3.1.2]

The MAC entity shall, when a new transmission is performed:

1> select the logical channels for each UL grant that satisfy all the following conditions:

2> the set of allowed Subcarrier Spacing index values in *allowedSCS-List*, if configured, includes the Subcarrier Spacing index associated to the UL grant; and

2> *maxPUSCH-Duration*, if configured, is larger than or equal to the PUSCH transmission duration associated to the UL grant; and

2> *configuredGrantType1Allowed*, if configured, is set to *true* in case the UL grant is a Configured Grant Type 1; and

2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant. Does not apply to logical channels associated with a DRB configured with PDCP duplication within the same MAC entity (i.e. CA duplication) when CA duplication is deactivated for this DRB in this MAC entity; and

2> *allowedCG-List*, if configured, includes the configured grant index associated to the UL grant; and

2> *allowedPHY-PriorityIndex*, if configured, includes the priority index (as specified in clause 9 of TS 38.213 [6]) associated to the dynamic UL grant.

NOTE: The Subcarrier Spacing index, PUSCH transmission duration, Cell information, and priority index are included in Uplink transmission information received from lower layers for the corresponding scheduled uplink transmission.

[TS 38.321, clause 5.4.3.1.3]

Before the successful completion of the Random Access procedure initiated for DAPS handover, the target MAC entity shall not select the logical channel(s) corresponding to non-DAPS DRB(s) for the uplink grant received in a Random Access Response or the uplink grant for the transmission of the MSGA payload.

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in clause 5.4.3.1.2 for the UL grant with *Bj* > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to *infinity*, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement *Bj* by the total size of MAC SDUs served to logical channel *j* above;

2> if any resources remain, all the logical channels selected in clause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of *Bj*) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

NOTE 1: The value of *Bj* can be negative.

If the MAC entity is requested to simultaneously transmit multiple MAC PDUs, or if the MAC entity receives the multiple UL grants within one or more coinciding PDCCH occasions (i.e. on different Serving Cells), it is up to UE implementation in which order the grants are processed.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given a UL grant size that is equal to or larger than 8 bytes while having data available and allowed (according to clause 5.4.3.1) for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall:

1> if the MAC entity is configured with *enhancedSkipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or if the MAC entity is configured with *enhancedSkipUplinkTxConfigured* with value *true* and the grant indicated to the HARQ entity is a configured uplink grant; and

1> if the MAC entity is not configured with *lch-basedPrioritization*; and

1> if there is no UCI to be multiplexed on this PUSCH transmission as specified in TS 38.213 [6]; and

1> if there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

1> if the MAC PDU includes zero MAC SDUs; and

1> if the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR:

2> not generate a MAC PDU for the HARQ entity.

1> else if the MAC entity is configured with *skipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

1> if there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

1> if the MAC PDU includes zero MAC SDUs; and

1> if the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR:

2> not generate a MAC PDU for the HARQ entity.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE or BFR MAC CE or Multiple Entry Configured Grant Confirmation MAC CE;

- Sidelink Configured Grant Confirmation MAC CE;

- LBT failure MAC CE;

- MAC CE for SL-BSR prioritized according to clause 5.22.1.6;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- MAC CE for the number of Desired Guard Symbols;

- MAC CE for Pre-emptive BSR;

- MAC CE for SL-BSR, with exception of SL-BSR prioritized according to clause 5.22.1.6 and SL-BSR included for padding;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding;

- MAC CE for SL-BSR included for padding.

NOTE 2: Prioritization among Configured Grant Confirmation MAC CE, Multiple Entry Configured Grant Confirmation MAC CE, and BFR MAC CE is up to UE implementation.

The MAC entity shall prioritize any MAC CE listed in a higher order than 'data from any Logical Channel, except data from UL-CCCH' over transmission of NR sidelink communication.

[TS 38.213, clause 9]

A PUSCH or a PUCCH transmission, including repetitions if any, can be of priority index 0 or of priority index 1. For a configured grant PUSCH transmission, a UE determines a priority index from *phy-PriorityIndex*, if provided. For a PUCCH transmission with HARQ-ACK information corresponding to a SPS PDSCH reception or a SPS PDSCH release, a UE determines a priority index from *harq-CodebookID*, if provided. For a PUCCH transmission with SR, a UE determines the corresponding priority as described in Clause 9.2.4. For a PUSCH transmission with semi-persistent CSI report, a UE determines a priority index from a priority indicator field, if provided, in a DCI format that activates the semi-persistent CSI report. If a priority index is not provided to a UE for a PUSCH or a PUCCH transmission, the priority index is 0.

7.1.1.3.13.3 Test description

7.1.1.3.13.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 UM bearers configured according to Table 7.1.1.3.13.3.1-1.

Table 7.1.1.3.13.3.1-1: Priority, PBR and Bucket Delay settings

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DRB | priority | prioritisedBitRate (kbytes/s) | bucketSizeDuration (ms) | allowedPHY-PriorityIndex-r16 |
| DRB1 | 6 | infinity | 100 | p0 |
| DRB2 | 7 | infinity | 100 | p1 |
| DRB3 | 8 | infinity | 100 | p1 |

7.1.1.3.13.3.2 Test procedure sequence

Table 7.1.1.3.13.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
|  |  |  |  |  |  |
| 0A | SS transmits NR *RRCReconfiguration* message to enable DCI priority indicator (Note 2) | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| 0B | The UE transmits NR *RRCReconfigurationComplete* message. (Note 3) | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| 1 | The SS transmits 2 equal size RLC SDUs each on DRB1, DRB2, DRB3. | <-- | (RLC SDUs) | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 100 ms after Step 1 (Note1), the SS transmits 4 UL grant of suitable size to receive one loop back RLC SDU on one logical channel every 20 ms with Priority indicator =1 | <-- | (UL grants) | - | - |
| 3 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB2? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 4 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB2? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 5 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 6 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 7 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 100 ms after Step 2 (Note1), the SS transmits 2 UL grant of suitable size to receive one loop back RLC SDU on one logical channel every 20 ms with Priority indicator=0 | <-- | (UL grants) | - | - |
| 8 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 9 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| Note 1: This wait time will ensure that a) all octets have been completely received by the UE on all 3 DRBs before the first UL grant is received and b) the Bjs for each logical channel have reached their maximum value i.e. the bucket size of the corresponding logical channel before the first UL grant is received.  Note 2: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 3: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.* | | | | | |

7.1.1.3.13.3.3 Specific message contents

Table 7.1.1.3.13.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

##### 7.1.1.3.14 Correct Handling of UL HARQ process / PUSCH Repetition Type A enhancement

###### 7.1.1.3.14.1 Correct Handling of UL HARQ process / PUSCH Repetition Type A enhancement / Increased maximum repetition number / dynamic grant

7.1.1.3.14.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and supporting dynamic indication of increased maximum number of PUSCH Type A repetitions.}

**ensure that** {

**when** { UE has data available for transmission, UE receives an UL Grant with toggled NDI which also indicates numberOfRepetitionsExt-r17 > 16 }

**then** { UE transmits a new MAC PDU and repeats sending the MAC PDU in the next *numberOfRepetitionsExt-r17*-1 slots after first transmission and selects the redundancy version correctly }

}

7.1.1.3.14.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report by a DCI or by a RAR UL grant or fallbackRAR UL grant, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI or the *PUSCH time resource allocation* field value *m* of the RAR UL grant or of the fallbackRAR UL grant provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, the number of slots used for TBS determination (if *numberOfSlotsTBoMS* is present in the resource allocation table), and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

…

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

…

For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*;

- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*;

- otherwise *K=1*.

- the number of slots used for TBS determination *N* is equal to 1.

…

For unpaired spectrum:

- Otherwise, the UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

For PUSCH repetition Type A, in case *K>1*,

- If the PUSCH is scheduled by DCI format 0\_1 or 0\_2

…

- Otherwise, the same symbol allocation is applied across the consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot.

…

For a PUSCH transmission scheduled by DCI format 0\_1, or 0\_2, or 0\_0 with CRC scrambled by TC-RNTI, the redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, …-1, is determined according to table 6.1.2.1-2.

…

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or TB processing over multiple slots) or *n*th actual repetition (repetition Type B) | | | |
| *((n-(n mod N))/N)* mod 4 = 0 | *((n-(n mod N))/N)* mod 4 = 1 | *((n-(n mod N))/N)* mod 4 = 2 | *((n-(n mod N))/N)* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

…

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

…

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

…

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

…

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant or the uplink grant received in a MAC RAR is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

…

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, and uplink grant received in a MAC RAR bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant or uplink grant received in a MAC RAR unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant or uplink grant received in a MAC RAR, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

…

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

…

2> else (i.e. retransmission):

…

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

….

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. If *cg-SDT-RetransmissionTimer* is configured, retransmission for the initial CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

…

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

…

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:

2> if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or

…

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

…

7.1.1.3.14.1.3 Test description

7.1.1.3.14.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.14.1.3.1-1.

**Table 7.1.1.3.14.1.3.1-1: RLC parameters**

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.14.1.3.2 Test procedure sequence

**Table 7.1.1.3.14.1.3.2-1: Main behaviour**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message to config PUSCH TDRA table including numberOfRepetitionsExt-r17.  NOTE: For EN-DC. the RRCReconfiguration message is embedded in RRCConnectionReconfiguration specified in 36.508 [7] Table 4.6.1-8 with condition EN-DC\_EmbedNR\_RRCRecon. | <--- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | UE transmits an RRCReconfigurationComplete message.  NOTE: For EN-DC, the RRCReconfigurationComplete message is embedded in RRCConnectionReconfigurationComplete specified in 36.508 [7] Table 4.6.1-9 with condition MCG\_and\_SCG | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 4 | The UE transmits a Scheduling Request. | --> | Scheduling Request | - | - |
| 5 | The SS allocates an UL Grant which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in a slot (denote as slot n1);  - HARQ process number indicates HARQ process #1;  - NDI indicates new transmission;  - RV indicates rvID = 0;  - TDRA indicates the 1st entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 6 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n1+4 and repeat transmitting this MAC PDU in every slot which is suitable for UL transmission in the next consecutive 19 slots with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions | --> | MAC PDU | 1 | P |
| 7 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 3. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| 8 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 9 | The UE transmits a Scheduling Request. | --> | Scheduling Request | - | - |
| 10 | The SS allocates an UL Grant which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in a slot (denote as slot n2);  - HARQ process number indicates HARQ process #1;  - NDI indicates new transmission;  - RV indicates rvID = 2;  - TDRA indicates the 2nd entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 11 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n2+4 and repeat transmitting this MAC PDU in every slot which is suitable for UL transmission in the next consecutive 31 slots with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {2, 3, 1, 0} according to TS 38.214 [15] Table 6.1.2.1-2, second row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions | --> | MAC PDU | 1 | P |
| 12 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 8. | <-- | MAC PDU (RLC STATUS PDU) | - |  |

7.1.1.3.14.1.3.3 Specific message contents

**Table 7.1.1.3.14.1.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.3.14.1.3.2-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | Table 7.1.1.3.14.1.3.3-2 | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | Table 7.1.1.3.14.1.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.1.3.3-2: *CellGroupConfig* (Table 7.1.1.3.14.1.3.3-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  | NR |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig | Table 7.1.1.3.14.1.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.1.3.3-3: *ServingCellConfig* (Table 7.1.1.3.14.1.3.3-2)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup | PUSCH-TimeDomainResourceAllocationList | Table 7.1.1.3.14.1.3.3-4 |  |
| } |  |  |  |
| pusch-RepTypeIndicatorDCI-0-1-r16 | pusch-RepTypeA |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.14.1.3.3-4: *PUSCH-TimeDomainResourceAllocationList* (Table 7.1.1.3.14.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-122A | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList-r16 ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF PUSCH-TimeDomainResourceAllocation-r16 | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[1] SEQUENCE { |  | entry 1 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfRepetitionsExt-r17 | n20 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[2] SEQUENCE { |  | entry 2 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfRepetitionsExt-r17 | n32 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.14.1.3.3-5: Physical layer parameters for DCI format 0\_1 (Step 5 & 10, Table 7.1.1.3.14.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.3.6.1.1.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| Time domain resource assignment | Indicating the 1st entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “0” | Step 5 |
|  | Indicating the 2nd entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “1” | Step 10 |
| Redundancy version | RV #0 to be used | “00” | Step 5 |
|  | RV #2 to be used | “10” | Step 10 |

###### 7.1.1.3.14.2 Correct Handling of UL HARQ process / PUSCH Repetition Type A enhancement / Increased maximum repetition number / configured grant

7.1.1.3.14.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and supporting configured grant based transmission with increased maximum number of PUSCH Type A repetitions.}

**ensure that** {

**when** { UE has data available for transmission and is provided a UL configured grant with repK-v1710 }

**then** { UE transmits a new MAC PDU and repeats sending the MAC PDU in the next repK-v1710-1 slots after first transmission and selects the redundancy version correctly }

}

7.1.1.3.14.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214, clause 6.1.2.1]

…

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

…

For unpaired spectrum:

…

- Otherwise, the UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.2.3]

When PUSCH resource allocation is semi-statically configured by higher layer parameter *configuredGrantConfig* in *BWP-UplinkDedicated* information element, and the PUSCH transmission corresponding to a configured grant, the following higher layer parameters are applied in the transmission:

- For Type 1 PUSCH transmissions with a configured grant, the following parameters are given in *configuredGrantConfig* unless mentioned otherwise:

- For the determination of the PUSCH repetition type, if the higher layer parameter *pusch-RepTypeIndicator* in *rrc-ConfiguredUplinkGrant* is configured and set to 'pusch-RepTypeB', PUSCH repetition type B is applied; otherwise, PUSCH repetition type A is applied;

- For PUSCH repetition type A, the selection of the time domain resource allocation table follows the rules for DCI format 0\_0 on UE specific search space, as defined in Clause 6.1.2.1.1.

…

- The higher layer parameter *timeDomainAllocation* value *m* provides a row index *m*+1 pointing to the determined time domain resource allocation table, where the start symbol and length are determined following the procedure defined in Clause 6.1.2.1;

…

- For Type 2 PUSCH transmissions with a configured grant: the resource allocation follows the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI.

- The PUSCH repetition type and the time domain resource allocation table are determined by the PUSCH repetition type and the time domain resource allocation table associated with the UL grant received on the DCI, respectively, as defined in Clause 6.1.2.1. The value of Koffset, if configured, is applied when determining the first transmission opportunity.

For PUSCH transmissions with a Type 1 or Type 2 configured grant, the number of (nominal) repetitions *K* to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise *K* is provided by the higher layer configured parameters *repK.*

…

The UE shall not transmit anything on the resources configured by *configuredGrantConfig* if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.

A set of allowed periodicities *P* are defined in [12, TS 38.331]. The higher layer parameter *cg-nrofSlots*, provides the number of consecutive slots allocated within a configured grant period. The higher layer parameter *cg-nrofPUSCH-InSlot* provides the number of consecutive PUSCH allocations within a slot, where the first PUSCH allocation follows the higher layer parameter *timeDomainAllocation* for Type 1 PUSCH transmission or the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI for Type 2 PUSCH transmissions, and the remaining PUSCH allocations have the same length and PUSCH mapping type, and are appended following the previous allocations without any gaps. The same combination of start symbol and length and PUSCH mapping type repeats over the consecutively allocated slots.

,,,

[TS 38.214, clause 6.1.2.3.1]

The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant.

The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If *cg-RetransmissionTimer* is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE. If the parameter *repK-RV* is not provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If the parameter *repK-RV* is provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(((n-mod(n, N))/N)-1,4)+1)th* value in the configured RV sequence, where *N*=1. If a configured grant configuration is configured with *startingFromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at

- the first transmission occasion of the *K* repetitions if the configured RV sequence is {0,2,3,1},

- any of the transmission occasions of the *K* repetitions that are associated with RV=0 if the configured RV sequence is {0,3,0,3},

- any of the transmission occasions of the *K* repetitions if the configured RV sequence is {0,0,0,0}, except the last transmission occasion when *K≥8*.

…

For any RV sequence, the repetitions shall be terminated after transmitting *K* repetitions, or at the last transmission occasion among the *K* repetitions within the period *P*, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first. In addition, the UE shall terminate the repetition of a transport block in a PUSCH transmission if the UE receives a DCI format 0\_1 with DFI flag provided and set to '1', and if in this DCI the UE detects ACK for the HARQ process corresponding to that transport block.

The UE is not expected to be configured with the time duration for the transmission of *K* repetitions larger than the time duration derived by the periodicity *P*. If the UE determines that, for a transmission occasion, the number of symbols available for the PUSCH transmission in a slot is smaller than transmission duration *L*, the UE does not transmit the PUSCH in the transmission occasion.

For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*

- For unpaired spectrum:

…

- Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.

- For paired spectrum and SUL band:

- The UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.

…

A Type 1 or Type 2 PUSCH transmission with a configured grant in a slot is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

…

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

…

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in clause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if the *configuredGrantTimer* for the corresponding HARQ process is not running:

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

where CURRENT\_symbol = (SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a bundle of configured uplink grant.

NOTE 2: A HARQ process is configured for a configured uplink grant if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*.

NOTE 3: If the MAC entity receives both a grant in a Random Access Response and an overlapping grant for its C-RNTI or CS-RNTI, requiring concurrent transmissions on the SpCell, the MAC entity may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or CS-RNTI.

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

…

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant or the uplink grant received in a MAC RAR is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

…

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, and uplink grant received in a MAC RAR bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant or uplink grant received in a MAC RAR unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant or uplink grant received in a MAC RAR, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

…

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

…

2> else (i.e. retransmission):

…

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

….

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. If *cg-SDT-RetransmissionTimer* is configured, retransmission for the initial CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

…

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

…

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:

2> if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or

…

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

…

[38.321 clause 5.8.2]

There are two types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;

- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation.

Type 1 and Type 2 are configured by RRC for a Serving Cell per BWP. Multiple configurations can be active simultaneously only on different Serving Cells. For Type 2, activation and deactivation are independent among the Serving Cells. For the same Serving Cell, the MAC entity is configured with either Type 1 or Type 2.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *periodicity*: periodicity of the configured grant Type 1;

- *timeDomainOffset*: Offset of a resource with respect to SFN = 0 in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]);

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

RRC configures the following parameters when the configured grant Type 2 is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *periodicity*: periodicity of the configured grant Type 2;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

Upon configuration of a configured grant Type 1 for a BWP of a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated BWP of the Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset* and *S* (derived from *SLIV* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
 (*timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
[(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

…

7.1.1.3.14.2.3 Test description

7.1.1.3.14.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.14.2.3.1-1.

**Table 7.1.1.3.14.2.3.1-1: RLC parameters**

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.14.2.3.2 Test procedure sequence

**Table 7.1.1.3.14.2.3.2-1: Main behaviour**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message including ConfiguredGrantConfig.  NOTE: For EN-DC. the RRCReconfiguration message is embedded in RRCConnectionReconfiguration specified in 36.508 [7] Table 4.6.1-8 with condition EN-DC\_EmbedNR\_RRCRecon. | <--- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | UE transmits an RRCReconfigurationComplete message.  NOTE: For EN-DC, the RRCReconfigurationComplete message is embedded in RRCConnectionReconfigurationComplete specified in 36.508 [7] Table 4.6.1-9 with condition MCG\_and\_SCG | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | IF pc\_type1\_PUSCH\_RepetitionMultiSlots = FALSE, the SS sends a DCI to activate the configured grant which is sufficient to transmit the MAC SDU to loop back in a slot. |  |  |  |  |
| 4 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit a MAC PDU including one RLC SDU and repeat transmitting this MAC PDU in every slot which is suitable for UL transmission in the next consecutive 31 slots with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to repK-RV. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions | --> | MAC PDU | 1 | P |
| 6 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 4. | <-- | MAC PDU (RLC STATUS PDU) | - |  |

7.1.1.3.14.2.3.3 Specific message contents

**Table 7.1.1.3.14.2.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.3.14.2.3.2-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | Table 7.1.1.3.14.2.3.3-2 | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | Table 7.1.1.3.14.2.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.2.3.3-2: *CellGroupConfig* (Table 7.1.1.3.14.2.3.3-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  | NR |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig | Table 7.1.1.3.14.2.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.2.3.3-3: *ServingCellConfig* (Table 7.1.1.3.14.2.3.3-2)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup | ConfiguredGrantConfig | Table 7.1.1.3.14.2.3.3-4 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.14.2.3.3-5: *ConfiguredGrantConfig* (Table 7.1.1.3.14.2.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-26 with condition CG\_Config\_Type1 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ConfiguredGrantConfig ::= SEQUENCE { |  |  |  |
| repK-RV | s1-0231 |  |  |
| rrc-ConfiguredUplinkGrant | Not present |  | NOT pc\_type1\_PUSCH\_RepetitionMultiSlots |
| repK-v1710 | n32 |  |  |
| } |  |  |  |

###### 7.1.1.3.14.3 Correct Handling of UL HARQ process / PUSCH Repetition Type A enhancement / repetition based on available slots / dynamic grant

7.1.1.3.14.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with availableSlotCounting-r17.}

**ensure that** {

**when** { UE has data available for transmission, UE receives an UL Grant with toggled NDI which also indicates numberOfRepetitions > 1 }

**then** { UE transmits repetitions of PUSCH on available UL slots and selects the redundancy version correctly }

}

7.1.1.3.14.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report by a DCI or by a RAR UL grant or fallbackRAR UL grant, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI or the *PUSCH time resource allocation* field value *m* of the RAR UL grant or of the fallbackRAR UL grant provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, the number of slots used for TBS determination (if *numberOfSlotsTBoMS* is present in the resource allocation table), and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

…

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

…

For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*;

- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*;

- otherwise *K=1*.

- the number of slots used for TBS determination *N* is equal to 1.

…

For unpaired spectrum:

- When *AvailableSlotCounting* is enabled, and in case *K>1,* the UE determines slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, based on *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* *and ssb-PositionsInBurst*, and the TDRA information field value in the DCI format 0\_1 or 0\_2.

- A slot is not counted in the number of slots for PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

For PUSCH repetition Type A, in case *K>1*,

- If the PUSCH is scheduled by DCI format 0\_1 or 0\_2

- if *AvailableSlotCounting* is enabled, the same symbol allocation is applied across the slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the slots determined for the PUSCH transmission, applying the same symbol allocation in each slot.

…

For a PUSCH transmission scheduled by DCI format 0\_1, or 0\_2, or 0\_0 with CRC scrambled by TC-RNTI, the redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, …-1, is determined according to table 6.1.2.1-2.

…

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or TB processing over multiple slots) or *n*th actual repetition (repetition Type B) | | | |
| *((n-(n mod N))/N)* mod 4 = 0 | *((n-(n mod N))/N)* mod 4 = 1 | *((n-(n mod N))/N)* mod 4 = 2 | *((n-(n mod N))/N)* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

…

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

…

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

…

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

…

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant or the uplink grant received in a MAC RAR is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

…

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, and uplink grant received in a MAC RAR bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant or uplink grant received in a MAC RAR unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant or uplink grant received in a MAC RAR, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

…

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

…

2> else (i.e. retransmission):

…

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

….

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. If *cg-SDT-RetransmissionTimer* is configured, retransmission for the initial CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

…

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

…

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:

2> if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or

…

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

…

7.1.1.3.14.3.3 Test description

7.1.1.3.14.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.14.3.3.1-1.

**Table 7.1.1.3.14.3.3.1-1: RLC parameters**

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.14.3.3.2 Test procedure sequence

**Table 7.1.1.3.14.3.3.2-1: Main behaviour**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message to config AvailableSlotCounting and PUSCH TDRA table including numberOfRepetitionsExt-r17.  NOTE: For EN-DC. the RRCReconfiguration message is embedded in RRCConnectionReconfiguration specified in 36.508 [7] Table 4.6.1-8 with condition EN-DC\_EmbedNR\_RRCRecon. | <--- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | UE transmits an RRCReconfigurationComplete message.  NOTE: For EN-DC, the RRCReconfigurationComplete message is embedded in RRCConnectionReconfigurationComplete specified in 36.508 [7] Table 4.6.1-9 with condition MCG\_and\_SCG | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 4 | The UE transmits a Scheduling Request. | --> | Scheduling Request | - | - |
| 5 | The SS allocates an UL Grant which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in a slot (denote as slot n1);  - HARQ process number indicates HARQ process #1;  - NDI indicates new transmission;  - RV indicates rvID = 0;  - TDRA indicates the 1st entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 6 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n1+4 and repeat transmitting this MAC PDU in the next 3 slots which are suitable for UL transmission with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions | --> | MAC PDU | 1 | P |
| 7 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 3. | <-- | MAC PDU (RLC STATUS PDU) | - |  |

7.1.1.3.14.3.3.3 Specific message contents

**Table 7.1.1.3.14.3.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.3.14.3.3.2-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | Table 7.1.1.3.14.3.3.3-2 | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | Table 7.1.1.3.14.3.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.3.3.3-2: *CellGroupConfig* (Table 7.1.1.3.14.3.3.3-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  | NR |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig | Table 7.1.1.3.14.3.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.3.3.3-3: *ServingCellConfig* (Table 7.1.1.3.14.3.3.3-2)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup | PUSCH-TimeDomainResourceAllocationList | Table 7.1.1.3.14.3.3.3-4 |  |
| } |  |  |  |
| pusch-RepTypeIndicatorDCI-0-1-r16 | pusch-RepTypeA |  |  |
| availableSlotCounting-r17 | enabled |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.14.3.3.3-4: *PUSCH-TimeDomainResourceAllocationList* (Table 7.1.1.3.14.3.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-122A | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList-r16 ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF PUSCH-TimeDomainResourceAllocation-r16 | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[1] SEQUENCE { |  | entry 1 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfRepetitionsExt-r17 | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[2] SEQUENCE { |  | entry 2 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfRepetitionsExt-r17 | n8 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.14.3.3.3-5: Physical layer parameters for DCI format 0\_1 (Step 5, Table 7.1.1.3.14.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.3.6.1.1.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| Time domain resource assignment | Indicating the 1st entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “0” |  |
| Redundancy version | RV #0 to be used | “00” |  |

###### 7.1.1.3.14.4 Correct Handling of UL HARQ process / PUSCH Repetition Type A enhancement / repetition based on available slots / configured grant

7.1.1.3.14.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with availableSlotCounting-r17.}

**ensure that** {

**when** { UE has data available for transmission, UE is provided a UL configured grant with repK }

**then** { UE transmits repetitions of PUSCH on available UL slots and selects the redundancy version correctly }

}

7.1.1.3.14.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214, clause 6.1.2.1]

…

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

…

For unpaired spectrum:

- When *AvailableSlotCounting* is enabled, and in case *K>1,* the UE determines slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, based on *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* *and ssb-PositionsInBurst*, and the TDRA information field value in the DCI format 0\_1 or 0\_2.

- A slot is not counted in the number of slots for PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.2.3]

When PUSCH resource allocation is semi-statically configured by higher layer parameter *configuredGrantConfig* in *BWP-UplinkDedicated* information element, and the PUSCH transmission corresponding to a configured grant, the following higher layer parameters are applied in the transmission:

- For Type 1 PUSCH transmissions with a configured grant, the following parameters are given in *configuredGrantConfig* unless mentioned otherwise:

- For the determination of the PUSCH repetition type, if the higher layer parameter *pusch-RepTypeIndicator* in *rrc-ConfiguredUplinkGrant* is configured and set to 'pusch-RepTypeB', PUSCH repetition type B is applied; otherwise, PUSCH repetition type A is applied.

- For PUSCH repetition type A, the selection of the time domain resource allocation table follows the rules for DCI format 0\_0 on UE specific search space, as defined in Clause 6.1.2.1.1.

…

- The higher layer parameter *timeDomainAllocation* value *m* provides a row index *m*+1 pointing to the determined time domain resource allocation table, where the start symbol and length are determined following the procedure defined in Clause 6.1.2.1;

…

- For Type 2 PUSCH transmissions with a configured grant: the resource allocation follows the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI.

- The PUSCH repetition type and the time domain resource allocation table are determined by the PUSCH repetition type, and the time domain resource allocation table associated with the UL grant received on the DCI, respectively, as defined in Clause 6.1.2.1. The value of Koffset, if configured, is applied when determining the first transmission opportunity.

For PUSCH transmissions with a Type 1 or Type 2 configured grant, the number of (nominal) repetitions *K* to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise, *K* is provided by the higher layer configured parameters *repK.*

…

The UE shall not transmit anything on the resources configured by *configuredGrantConfig* if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.

A set of allowed periodicities *P* are defined in [12, TS 38.331]. The higher layer parameter *cg-nrofSlots*, provides the number of consecutive slots allocated within a configured grant period. The higher layer parameter *cg-nrofPUSCH-InSlot* provides the number of consecutive PUSCH allocations within a slot, where the first PUSCH allocation follows the higher layer parameter *timeDomainAllocation* for Type 1 PUSCH transmission or the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI for Type 2 PUSCH transmissions, and the remaining PUSCH allocations have the same length and PUSCH mapping type, and are appended following the previous allocations without any gaps. The same combination of start symbol and length and PUSCH mapping type repeats over the consecutively allocated slots.

,,,

[TS 38.214, clause 6.1.2.3.1]

The procedures described in this clause apply to PUSCH transmissions of PUSCH repetition Type A with a Type 1 or Type 2 configured grant.

The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If *cg-RetransmissionTimer* is provided, the redundancy version for uplink transmission with a configured grant is determined by the UE. If the parameter *repK-RV* is not provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If the parameter *repK-RV* is provided in the *configuredGrantConfig* and *cg-RetransmissionTimer* is not provided, for the *n*th transmission occasion among *K* repetitions, *n*=1, 2, …, *K*, it is associated with *(mod(((n-mod(n, N))/N)-1,4)+1)th* value in the configured RV sequence, where *N*=1. If a configured grant configuration is configured with *startingFromRV0* set to *'off'*, the initial transmission of a transport block may only start at the first transmission occasion of the *K* repetitions. Otherwise, the initial transmission of a transport block may start at

- the first transmission occasion of the *K* repetitions if the configured RV sequence is {0,2,3,1},

- any of the transmission occasions of the *K* repetitions that are associated with RV=0 if the configured RV sequence is {0,3,0,3},

- any of the transmission occasions of the *K* repetitions if the configured RV sequence is {0,0,0,0}, except the last transmission occasion when *K≥8*.

…

For any RV sequence, the repetitions shall be terminated after transmitting *K* repetitions, or at the last transmission occasion among the *K* repetitions within the period *P*, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first. In addition, the UE shall terminate the repetition of a transport block in a PUSCH transmission if the UE receives a DCI format 0\_1 with DFI flag provided and set to '1', and if in this DCI the UE detects ACK for the HARQ process corresponding to that transport block.

The UE is not expected to be configured with the time duration for the transmission of *K* repetitions larger than the time duration derived by the periodicity *P*. If the UE determines that, for a transmission occasion, the number of symbols available for the PUSCH transmission in a slot is smaller than transmission duration *L*, the UE does not transmit the PUSCH in the transmission occasion.

For both Type 1 and Type 2 PUSCH transmissions with a configured grant, when *K >* 1*,*

- For unpaired spectrum:

…

- Otherwise, the UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.

- For paired spectrum and SUL band:

- The UE shall repeat the TB across the consecutive slots applying the same symbol allocation in each slot, except if the UE is provided with higher layer parameters *cg-nrofSlots* and *cg-nrofPUSCH-InSlot*, in which case the UE repeats the TB in the *repK* earliest consecutive transmission occasion candidates within the same configuration.

…

A Type 1 or Type 2 PUSCH transmission with a configured grant in a slot is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

…

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

…

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in clause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if the *configuredGrantTimer* for the corresponding HARQ process is not running:

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

where CURRENT\_symbol = (SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a bundle of configured uplink grant.

NOTE 2: A HARQ process is configured for a configured uplink grant if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*.

NOTE 3: If the MAC entity receives both a grant in a Random Access Response and an overlapping grant for its C-RNTI or CS-RNTI, requiring concurrent transmissions on the SpCell, the MAC entity may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or CS-RNTI.

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

…

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant or the uplink grant received in a MAC RAR is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

…

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, and uplink grant received in a MAC RAR bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant or uplink grant received in a MAC RAR unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant or uplink grant received in a MAC RAR, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

…

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

…

2> else (i.e. retransmission):

…

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

….

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. If *cg-SDT-RetransmissionTimer* is configured, retransmission for the initial CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

…

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

…

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:

2> if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or

…

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

…

[38.321 clause 5.8.2]

There are two types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;

- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation.

Type 1 and Type 2 are configured by RRC for a Serving Cell per BWP. Multiple configurations can be active simultaneously only on different Serving Cells. For Type 2, activation and deactivation are independent among the Serving Cells. For the same Serving Cell, the MAC entity is configured with either Type 1 or Type 2.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *periodicity*: periodicity of the configured grant Type 1;

- *timeDomainOffset*: Offset of a resource with respect to SFN = 0 in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]);

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

RRC configures the following parameters when the configured grant Type 2 is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *periodicity*: periodicity of the configured grant Type 2;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

Upon configuration of a configured grant Type 1 for a BWP of a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated BWP of the Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset* and *S* (derived from *SLIV* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
 (*timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
[(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

…

7.1.1.3.14.4.3 Test description

7.1.1.3.14.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.14.4.3.1-1.

**Table 7.1.1.3.14.4.3.1-1: RLC parameters**

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.14.4.3.2 Test procedure sequence

**Table 7.1.1.3.14.4.3.2-1: Main behaviour**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message including ConfiguredGrantConfig and availableSlotCounting-r17.  NOTE: For EN-DC. the RRCReconfiguration message is embedded in RRCConnectionReconfiguration specified in 36.508 [7] Table 4.6.1-8 with condition EN-DC\_EmbedNR\_RRCRecon. | <--- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | UE transmits an RRCReconfigurationComplete message.  NOTE: For EN-DC, the RRCReconfigurationComplete message is embedded in RRCConnectionReconfigurationComplete specified in 36.508 [7] Table 4.6.1-9 with condition MCG\_and\_SCG | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | IF pc\_type1\_PUSCH\_RepetitionMultiSlots = FALSE, the SS sends a DCI to activate the configured grant which is sufficient to transmit the MAC SDU to loop back in a slot. |  |  |  |  |
| 4 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit a MAC PDU including one RLC SDU and repeat transmitting this MAC PDU in the next 3 slots which are suitable for UL transmission with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to repK-RV. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions | --> | MAC PDU | 1 | P |
| 6 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 4. | <-- | MAC PDU (RLC STATUS PDU) | - |  |

7.1.1.3.14.4.3.3 Specific message contents

**Table 7.1.1.3.14.4.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.3.14.4.3.2-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | Table 7.1.1.3.14.4.3.3-2 | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | Table 7.1.1.3.14.4.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.4.3.3-2: *CellGroupConfig* (Table 7.1.1.3.14.4.3.3-1)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  | NR |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig | Table 7.1.1.3.14.4.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.3.14.4.3.3-3: *ServingCellConfig* (Table 7.1.1.3.14.4.3.3-2)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| availableSlotCounting-r17 | true |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup | ConfiguredGrantConfig | Table 7.1.1.3.14.4.3.3-4 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.14.4.3.3-5: *ConfiguredGrantConfig* (Table 7.1.1.3.14.4.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-26 with condition CG\_Config\_Type1 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ConfiguredGrantConfig ::= SEQUENCE { |  |  |  |
| repK | n4 |  |  |
| repK-RV | s1-0231 |  |  |
| rrc-ConfiguredUplinkGrant | Not present |  | NOT pc\_type1\_PUSCH\_RepetitionMultiSlots |
| } |  |  |  |

##### 7.1.1.3.15 Correct Handling of UL HARQ process / TBoMS procedure

###### 7.1.1.3.15.1 Correct Handling of UL HARQ process / TBoMS procedure / DG and CG based transmission

7.1.1.3.15.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and supporting TB processing over multi-slot.}

**ensure that** {

**when** { UE has data available for transmission and receives an UL Grant with toggled NDI which indicates TBoMS transmission }

**then** { UE transmits a new MAC PDU in numberOfSlotsTBoMS available slots and selects the redundancy version correctly }

}

(2)

**with** { UE in RRC\_CONNECTED state and supporting TB processing over multi-slot.}

**ensure that** {

**when** { UE has data available for transmission and receives an DCI activating Type 2 configured grant which indicates TBoMS transmission }

**then** { UE transmits a new MAC PDU in numberOfSlotsTBoMS available slots and selects the redundancy version correctly }

}

7.1.1.3.15.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report by a DCI or by a RAR UL grant or fallbackRAR UL grant, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI or the *PUSCH time resource allocation* field value *m* of the RAR UL grant or of the fallbackRAR UL grant provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, the number of slots used for TBS determination (if *numberOfSlotsTBoMS* is present in the resource allocation table), and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

…

- For PUSCH repetition Type A and TB processing over multiple slots, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

…

- For PUSCH repetition Type A and TB processing over multiple slots, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For TB processing over multiple slots, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1,

- the number of slots used for TBS determination *N* is indicated by *numberOfSlotsTBoMS.*

- the number of repetitions *K* of the number of slots *N* used for TBS determination is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions *K* is equal to *numberOfRepetitions*;

- otherwise, *K=1*.

- when the UE supports repetition of TB processing over multiple slots, the UE does not expect that is larger than 32.

…

For unpaired spectrum:

…

- The UE determines slots for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst*, and the TDRA information field value in the DCI format 0\_1 or 0\_2.

- A slot is not counted in the number of slots for a PUSCH transmission of TB processing over multiple slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

If a UE would transmit a PUSCH of PUSCH repetition Type A when *AvailableSlotCounting* is enabled and K>1 or a TB processing over multiple slots over slots, and the UE does not transmit the PUSCH of a TB processing over multiple slots or the PUSCH repetition Type A in a slot from the slots, according to Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213], the UE counts the slots in the number of slots.

For TB processing over multiple slots:

- For unpaired spectrum, the same symbol allocation is applied across the slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the slots determined for the PUSCH transmission, applying the same symbol allocation in each slot.

- For paired spectrum or supplementary uplink band, the same symbol allocation is applied across the consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the consecutive slots applying the same symbol allocation in each slot.

…

For a PUSCH transmission scheduled by DCI format 0\_1, or 0\_2, or 0\_0 with CRC scrambled by TC-RNTI, the redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, …-1, is determined according to table 6.1.2.1-2.

…

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or TB processing over multiple slots) or *n*th actual repetition (repetition Type B) | | | |
| *((n-(n mod N))/N)* mod 4 = 0 | *((n-(n mod N))/N)* mod 4 = 1 | *((n-(n mod N))/N)* mod 4 = 2 | *((n-(n mod N))/N)* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.2.3]

When PUSCH resource allocation is semi-statically configured by higher layer parameter *configuredGrantConfig* in *BWP-UplinkDedicated* information element, and the PUSCH transmission corresponding to a configured grant, the following higher layer parameters are applied in the transmission:

…

- For Type 2 PUSCH transmissions with a configured grant: the resource allocation follows the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI.

- The PUSCH repetition type and the time domain resource allocation table are determined by the PUSCH repetition type and the time domain resource allocation table associated with the UL grant received on the DCI, respectively, as defined in Clause 6.1.2.1. The value of Koffset, if configured, is applied when determining the first transmission opportunity.

For PUSCH transmissions with a Type 1 or Type 2 configured grant, the number of (nominal) repetitions *K* to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise *K* is provided by the higher layer configured parameters *repK.*

…

The UE shall not transmit anything on the resources configured by *configuredGrantConfig* if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.

…

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

…

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

…

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

…

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

…

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant or the uplink grant received in a MAC RAR is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

…

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, and uplink grant received in a MAC RAR bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant or uplink grant received in a MAC RAR unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant or uplink grant received in a MAC RAR, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

…

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

…

2> else (i.e. retransmission):

…

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

….

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. If *cg-SDT-RetransmissionTimer* is configured, retransmission for the initial CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

…

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

…

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:

2> if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or

…

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

…

7.1.1.3.15.1.3 Test description

7.1.1.3.15.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.15.1.3.1-1.

Table 7.1.1.3.15.1.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.15.1.3.2 Test procedure sequence

Table 7.1.1.3.15.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message to config Type 2 configured grant and PUSCH TDRA table including numberOfSlotsTBoMS-r17.  NOTE: For EN-DC. the RRCReconfiguration message is embedded in RRCConnectionReconfiguration specified in 36.508 [7] Table 4.6.1-8 with condition EN-DC\_EmbedNR\_RRCRecon. | <--- | NR RRC: RRCReconfiguration | - | - |
| 2 | UE transmits an RRCReconfigurationComplete message.  NOTE: For EN-DC, the RRCReconfigurationComplete message is embedded in RRCConnectionReconfigurationComplete specified in 36.508 [7] Table 4.6.1-9 with condition MCG\_and\_SCG | --> | NR RRC: RRCReconfigurationComplete | - | - |
| 3 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 4 | The UE transmits a Scheduling Request. | --> | Scheduling Request | - | - |
| 5 | The SS allocates an UL Grant in slot n which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in 4 slots;  - HARQ process number indicates HARQ process #1;  - NDI indicates new transmission;  - RV indicates rvID = 0;  - TDRA indicates the 1st entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 6 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1, RV 0, and in 4 slots suitable for UL transmission which start from n+4?  NOTE: Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL transmission | --> | MAC PDU | 1 | P |
| 7 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 3. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| 8 | The SS sends a DCI to activate the configured grant which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in 2 slots.  - TDRA indicates the 2nd entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 9 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in RV 0, and in 2 slots associated with RV=0 and suitable for UL transmission?  NOTE: The redundancy version for the UL transmission is set in the following order {0, 2, 3, 1} according to repK-RV. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL transmission. | --> | MAC PDU | 2 | P |
| 11 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 7. | <-- | MAC PDU (RLC STATUS PDU) | - |  |

7.1.1.3.15.1.3.3 Specific message contents

Table 7.1.1.3.15.1.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.3.15.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | Table 7.1.1.3.15.1.3.3-2 | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | Table 7.1.1.3.15.1.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.1.3.3-2: *CellGroupConfig* (Table 7.1.1.3.15.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  | NR |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig | Table 7.1.1.3.15.1.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.1.3.3-3: *ServingCellConfig* (Table 7.1.1.3.15.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup | PUSCH-TimeDomainResourceAllocationList | Table 7.1.1.3.15.1.3.3-4 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup | ConfiguredGrantConfig | Table 7.1.1.3.15.1.3.3-5 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.1.3.3-4: *PUSCH-TimeDomainResourceAllocationList* (Table 7.1.1.3.15.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-122A | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList-r16 ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF PUSCH-TimeDomainResourceAllocation-r16 | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[1] SEQUENCE { |  | entry 1 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfSlotsTBoMS-r17 | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[2] SEQUENCE { |  | entry 2 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfSlotsTBoMS-r17 | n2 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.1.3.3-5: *ConfiguredGrantConfig* (Table 7.1.1.3.15.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-26 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ConfiguredGrantConfig ::= SEQUENCE { |  |  |  |
| repK-RV | s1-0231 |  |  |
| startingFromRV0 | on |  |  |
| } |  |  |  |

Table 7.1.1.3.15.1.3.3-6: Physical layer parameters for DCI format 0\_1 (Step 5 & 8, Table 7.1.1.3.15.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.3.6.1.1.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| Time domain resource assignment | Indicating the 1st entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “0” | Step 5 |
|  | Indicating the 2nd entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “1” | Step 8 |

###### 7.1.1.3.15.2 Correct Handling of UL HARQ process / TBoMS procedure / Repetition of TBoMS

7.1.1.3.15.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and supporting repetition of TBoMS.}

**ensure that** {

**when** { UE has data available for transmission and receives an UL Grant with toggled NDI which indicates TBoMS transmission and repetition }

**then** { UE transmits a new MAC PDU in numberOfSlotsTBoMS available slots, and then repeats the MAC PDU in numberOfRepetitions-1 times after first transmission and selects the redundancy version correctly. Each transmission uses numberOfSlotsTBoMS available slots }

}

(2)

**with** { UE in RRC\_CONNECTED state and supporting repetition of TBoMS.}

**ensure that** {

**when** { UE has data available for transmission and receives an DCI activating Type 2 configured grant which indicates TBoMS transmission and repK }

**then** { UE transmits a new MAC PDU in numberOfSlotsTBoMS available slots, and then repeats the MAC PDU in repK-1 times after first transmission and selects the redundancy version correctly. Each transmission uses numberOfSlotsTBoMS available slots }

}

7.1.1.3.15.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report by a DCI or by a RAR UL grant or fallbackRAR UL grant, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI or the *PUSCH time resource allocation* field value *m* of the RAR UL grant or of the fallbackRAR UL grant provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, the number of slots used for TBS determination (if *numberOfSlotsTBoMS* is present in the resource allocation table), and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

…

- For PUSCH repetition Type A and TB processing over multiple slots, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

…

- For PUSCH repetition Type A and TB processing over multiple slots, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For TB processing over multiple slots, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1,

- the number of slots used for TBS determination *N* is indicated by *numberOfSlotsTBoMS.*

- the number of repetitions *K* of the number of slots *N* used for TBS determination is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions *K* is equal to *numberOfRepetitions*;

- otherwise, *K=1*.

- when the UE supports repetition of TB processing over multiple slots, the UE does not expect that is larger than 32.

…

For unpaired spectrum:

…

- The UE determines slots for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst*, and the TDRA information field value in the DCI format 0\_1 or 0\_2.

- A slot is not counted in the number of slots for a PUSCH transmission of TB processing over multiple slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

If a UE would transmit a PUSCH of PUSCH repetition Type A when *AvailableSlotCounting* is enabled and K>1 or a TB processing over multiple slots over slots, and the UE does not transmit the PUSCH of a TB processing over multiple slots or the PUSCH repetition Type A in a slot from the slots, according to Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213], the UE counts the slots in the number of slots.

For TB processing over multiple slots:

- For unpaired spectrum, the same symbol allocation is applied across the slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the slots determined for the PUSCH transmission, applying the same symbol allocation in each slot.

- For paired spectrum or supplementary uplink band, the same symbol allocation is applied across the consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the consecutive slots applying the same symbol allocation in each slot.

…

For a PUSCH transmission scheduled by DCI format 0\_1, or 0\_2, or 0\_0 with CRC scrambled by TC-RNTI, the redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, …-1, is determined according to table 6.1.2.1-2.

…

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or TB processing over multiple slots) or *n*th actual repetition (repetition Type B) | | | |
| *((n-(n mod N))/N)* mod 4 = 0 | *((n-(n mod N))/N)* mod 4 = 1 | *((n-(n mod N))/N)* mod 4 = 2 | *((n-(n mod N))/N)* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.2.3]

When PUSCH resource allocation is semi-statically configured by higher layer parameter *configuredGrantConfig* in *BWP-UplinkDedicated* information element, and the PUSCH transmission corresponding to a configured grant, the following higher layer parameters are applied in the transmission:

…

- For Type 2 PUSCH transmissions with a configured grant: the resource allocation follows the higher layer configuration according to [10, TS 38.321], and UL grant received on the DCI.

- The PUSCH repetition type and the time domain resource allocation table are determined by the PUSCH repetition type and the time domain resource allocation table associated with the UL grant received on the DCI, respectively, as defined in Clause 6.1.2.1. The value of Koffset, if configured, is applied when determining the first transmission opportunity.

For PUSCH transmissions with a Type 1 or Type 2 configured grant, the number of (nominal) repetitions *K* to be applied to the transmitted transport block is provided by the indexed row in the time domain resource allocation table if *numberOfRepetitions* is present in the table; otherwise *K* is provided by the higher layer configured parameters *repK.*

…

The UE shall not transmit anything on the resources configured by *configuredGrantConfig* if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.

…

[TS 38.214, clause 6.1.2.3.3]

The procedures described in this clause apply to PUSCH transmissions of TB processing over multiple slots with a Type 2 configured grant.

The higher layer parameter *repK-RV* defines the redundancy version pattern to be applied to the repetitions. If the parameter *repK-RV* is not provided in the *configuredGrantConfig*, the redundancy version for uplink transmissions with a configured grant shall be set to 0. If the parameter *repK-RV* is provided in the *configuredGrantConfig*, the *n*th transmission occasion among transmissions occasions, *n*=0,1, …,  *-1*, is associated with *(mod((n-mod(n, N))/N,4)+1)th* value in the configured RV sequence. When *K*=1, or when *K*>1 and the configured grant configuration is configured with startingFromRV0 set to 'off', the initial transmission of the transport block may only start at the first transmission occasion of the transmission occasions. Otherwise, the initial transmission of the transport block may start at

- The first transmission occasion of the transmission occasions if the configured RV sequence is {0,2,3,1}.

- Any transmission occasion n associated with RV=0, and for which n mod N =0, if the configured RV sequence is {0,3,0,3} or {0,0,0,0}.

The UE is not expected to be configured with the time duration for transmissions larger than the time duration derived by the periodicity *P*. If the UE determines that, for a transmission occasion, the number of symbols available in a slot for the PUSCH transmission of TB processing over multiple slots is smaller than transmission duration *L*, the UE does not transmit the PUSCH in the transmission occasion.

For unpaired spectrum:

- The UE determines slots for a PUSCH transmission of TB processing over multiple slots with a Type 2 configured grant activated by DCI format 0\_1 or 0\_2, based on *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst*, and the TDRA information field value in the DCI format 0\_1 or 0\_2.

- A slot is not counted in the number of slots for a PUSCH transmission of TB processing over multiple slots with a Type 2 configured grant activated by DCI format 0\_1 or 0\_2 if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of TB processing over multiple slots with a Type 2 configured grant activated by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

- For the case of a reduced capability half-duplex UE, the UE determines slots for a PUSCH transmission of TB processing over multiple slots with a Type 2 configured grant activated by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2. A slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot does not start or end at least or , respectively, from the last or first symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

For Type 2 PUSCH transmission with a configured grant of TB processing over multiple slots*,* the UE shall transmit the TB across the slots determined for the PUSCH transmission applying the same symbol allocation in each slot. A Type 2 PUSCH transmission with a configured grant of TB processing over multiple slots is omitted in a slot according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order  and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

…

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

…

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

…

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

…

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant or the uplink grant received in a MAC RAR is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

…

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, and uplink grant received in a MAC RAR bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant or uplink grant received in a MAC RAR unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant or uplink grant received in a MAC RAR, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

…

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

…

2> else (i.e. retransmission):

…

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

….

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* or *cg-SDT-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. If *cg-SDT-RetransmissionTimer* is configured, retransmission for the initial CG-SDT transmission with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.

…

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

…

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:

2> if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or

…

3> instruct the physical layer to generate a transmission according to the stored uplink grant.

…

7.1.1.3.15.2.3 Test description

7.1.1.3.15.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.15.2.3.1-1.

Table 7.1.1.3.15.2.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.15.2.3.2 Test procedure sequence

Table 7.1.1.3.15.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message to config Type 2 configured grant with repK and PUSCH TDRA table including numberOfSlotsTBoMS-r17 and numberOfRepetitions.  NOTE: For EN-DC. the RRCReconfiguration message is embedded in RRCConnectionReconfiguration specified in 36.508 [7] Table 4.6.1-8 with condition EN-DC\_EmbedNR\_RRCRecon. | <--- | NR RRC: RRCReconfiguration | - | - |
| 2 | UE transmits an RRCReconfigurationComplete message.  NOTE: For EN-DC, the RRCReconfigurationComplete message is embedded in RRCConnectionReconfigurationComplete specified in 36.508 [7] Table 4.6.1-9 with condition MCG\_and\_SCG | --> | NR RRC: RRCReconfigurationComplete | - | - |
| 3 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 4 | The UE transmits a Scheduling Request. | --> | Scheduling Request | - | - |
| 5 | The SS allocates an UL Grant in slot n which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in 4 slots;  - HARQ process number indicates HARQ process #1;  - NDI indicates new transmission;  - RV indicates rvID = 0;  - TDRA indicates the 1st entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 6 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1, RV 0, and in 4 slots suitable for UL transmission which start from n+4, and repeat transmitting this MAC PDU 7 times, each on 4 slots suitable for UL transmission and with same resource allocation but different redundancy version?  NOTE: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions | --> | MAC PDU | 1 | P |
| 7 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 3. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| 8 | The SS sends a DCI to activate the configured grant which satisfies following conditions:  - sufficient to transmit the MAC SDU to loop back in 2 slots.  - TDRA indicates the 2nd entry in pusch-TimeDomainAllocationList | <-- | DCI format 0\_1 | - | - |
| 9 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a MAC PDU including one RLC SDU in 2 slots associated with RV0 and suitable for UL transmission? and repeat transmitting this MAC PDU 15 times, each on 2 slots suitable for UL transmission and with same resource allocation but different redundancy version?  NOTE: The redundancy version for the UL transmission is set in the following order {0, 2, 3, 1} according to repK-RV. Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL transmission. | --> | MAC PDU | 2 | P |
| 11 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 7. | <-- | MAC PDU (RLC STATUS PDU) | - |  |

7.1.1.3.15.2.3.3 Specific message contents

Table 7.1.1.3.15.2.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.3.15.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | Table 7.1.1.3.15.2.3.3-2 | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | Table 7.1.1.3.15.2.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.2.3.3-2: *CellGroupConfig* (Table 7.1.1.3.15.2.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  | NR |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig | Table 7.1.1.3.15.2.3.3-3 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.2.3.3-3: *ServingCellConfig* (Table 7.1.1.3.15.2.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup | PUSCH-TimeDomainResourceAllocationList | Table 7.1.1.3.15.2.3.3-4 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup | ConfiguredGrantConfig | Table 7.1.1.3.15.2.3.3-5 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.2.3.3-4: *PUSCH-TimeDomainResourceAllocationList* (Table 7.1.1.3.15.2.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-122A | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList-r16 ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF PUSCH-TimeDomainResourceAllocation-r16 | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[1] SEQUENCE { |  | entry 1 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfRepetitions-r16 | n8 |  |  |
| numberOfSlotsTBoMS-r17 | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[2] SEQUENCE { |  | entry 2 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfSlotsTBoMS-r17 | n2 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.15.2.3.3-5: *ConfiguredGrantConfig* (Table 7.1.1.3.15.2.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-26 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ConfiguredGrantConfig ::= SEQUENCE { |  |  |  |
| repK-RV | s1-0231 |  |  |
| startingFromRV0 | on |  |  |
| repK-v1710 | n16 |  |  |
| } |  |  |  |

Table 7.1.1.3.15.2.3.3-6: Physical layer parameters for DCI format 0\_1 (Step 5 & 8, Table 7.1.1.3.15.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.3.6.1.1.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| Time domain resource assignment | Indicating the 1st entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “0” | Step 5 |
|  | Indicating the 2nd entry of pusch-TimeDomainAllocationListDCI-0-1-r16 to be used. | “1” | Step 8 |

##### 7.1.1.3.16 Correct Handling of UL grant / DRB configured with survival time

###### 7.1.1.3.16.1 Correct Handling of UL grant / DRB configured with survival time / Split DRB

7.1.1.3.16.1.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_CONNECTED state to a serving cell with running *timeAlignmentTimer* and having split DRB configured with *survivalTimeStateSupport* and PDCP duplication configured }

**ensure that** {

**when** { UE receives uplink grant addressed to CS-RNTI with NDI=1 for a logical channel associated with the split DRB }

**then** { UE activates PDCP duplication for all RLC entities of the split DRB }

}

7.1.1.3.16.1.2 Conformance requirements

References: The conformance requirements covered in the current TC is specified in: TS 38.321 clause 5.4.1 and 5.10. Unless otherwise stated, these are Rel-17 features.

[TS 38.321, clause 5.4.1]

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> if a logical channel associated with a DRB configured with *survivalTimeStateSupport* is multiplexed in the MAC PDU stored in the HARQ buffer for the corresponding HARQ process:

4> trigger activation of PDCP duplication for all configured RLC entities of the DRB.

[TS 38.321, clause 5.10]

If one or more DRBs are configured with PDCP duplication, the network may activate and deactivate the PDCP duplication for all or a subset of associated RLC entities for the configured DRB(s).

The PDCP duplication for all associated RLC entities for the configured DRB(s) is activated by:

- receiving an uplink grant addressed to CS-RNTI with NDI=1 for a logical channel associated with the DRB configured with *survivalTimeStateSupport*, described in clause 5.4.1.

The MAC entity shall for each DRB configured with PDCP duplication:

1> if activation of a PDCP duplication for all configured RLC entities is triggered for the DRB as specified in clause 5.4.1:

2> indicate the activation of PDCP duplication for all configured RLC entities of the DRB to upper layers.

7.1.1.3.16.1.3 Test Description

7.1.1.3.16.1.3.1 Pre-test conditions

Pre-test conditions as in clause 7.1.3.0 with execution conditions pc\_NG\_RAN\_NR and Connectivity (NR-DC) with following exceptions.

System Simulator:

- None.

UE:

- None.

Preamble:

- Generic procedure parameters: Bearers (MCG(s) and split).

7.1.1.3.16.1.3.2 Test procedure sequence

Table 7.1.1.3.16.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS sends a PDCP Data PDU on the split DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| 2 | SS allocates an UL Grant with the CS-RNTI assigned to the UE with NDI=1 for the AM RLC primary entity. The SS UL grant allocation for the AM RLC secondary entity is not impacted. | <-- | (UL Grant (CS-RNTI and NDI=1)) | - | - |
| - | EXCEPTION: Steps 3 and 4 below may occur in any sequence | - | - | - | - |
| 3 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 1 | P |
| 4 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity? | --> | PDCP DATA PDU | 1 | P |

7.1.1.3.16.1.3.3 Specific message contents

Table 7.1.1.3.16.1.3.3-1: *PDCP-Config* (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-99 with condition NR\_split | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| survivalTimeStateSupport-r17 | true |  |  |
| } |  |  |  |

###### 7.1.1.3.16.2 Correct Handling of UL grant / DRB configured with survival time / MCG or SCG DRB / Intra-band contiguous CA

7.1.1.3.16.2.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_CONNECTED state to a serving cell with running *timeAlignmentTimer* and having DRB configured with *survivalTimeStateSupport* and PDCP CA duplication configured }

**ensure that** {

**when** { UE receives uplink grant addressed to CS-RNTI with NDI=1 for a logical channel associated with the DRB }

**then** { UE activates PDCP duplication for all RLC entities of the DRB }

}

7.1.1.3.16.2.2 Conformance requirements

References: The conformance requirements covered in the current TC is specified in: TS 38.321 clause 5.4.1 and 5.10. Unless otherwise stated, these are Rel-17 features.

[TS 38.321, clause 5.4.1]

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* or a running *cg-SDT-TimeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> if a logical channel associated with a DRB configured with *survivalTimeStateSupport* is multiplexed in the MAC PDU stored in the HARQ buffer for the corresponding HARQ process:

4> trigger activation of PDCP duplication for all configured RLC entities of the DRB.

[TS 38.321, clause 5.10]

If one or more DRBs are configured with PDCP duplication, the network may activate and deactivate the PDCP duplication for all or a subset of associated RLC entities for the configured DRB(s).

The PDCP duplication for all associated RLC entities for the configured DRB(s) is activated by:

- receiving an uplink grant addressed to CS-RNTI with NDI=1 for a logical channel associated with the DRB configured with *survivalTimeStateSupport*, described in clause 5.4.1.

The MAC entity shall for each DRB configured with PDCP duplication:

1> if activation of a PDCP duplication for all configured RLC entities is triggered for the DRB as specified in clause 5.4.1:

2> indicate the activation of PDCP duplication for all configured RLC entities of the DRB to upper layers.

7.1.1.3.16.2.3 Test Description

7.1.1.3.16.2.3.1 Pre-test conditions

Pre test conditions as in clause 7.1.3.0 with execution conditions pc\_NG\_RAN\_NR with following exceptions.

System Simulator:

- NR Cell 3, SCell suitable for intra band contiguous CA.

UE:

- None.

Preamble:

- None.

7.1.1.3.16.2.3.2 Test procedure sequence

Table 7.1.1.3.16.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an NR *RRCReconfiguration* message to add SCells, to configure parameters for PDCP CA duplication and configure DRB with survival time | <-- | *RRCReconfiguration* | - | - |
| 2 | UE transmits NR *RRCReconfigurationComplete* message. | --> | *RRCReconfigurationComplete* | - | - |
| 3 | The SS transmits a SCell Activation MAC-CE on PCell (NR Cell 1) to activate NR SCell (NR Cell 3). | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=1)) | - | - |
| 4 | The SS sends a PDCP Data PDU on the DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| 5 | SS transmits an UL Grant with the CS-RNTI assigned to the UE with NDI=1 on the AM RLC primary entity. The SS UL grant allocation for the AM RLC secondary entity is not impacted. | <-- | (UL Grant (CS-RNTI and NDI=1)) | - | - |
| - | EXCEPTION: Steps 6 and 7 below may occur in any sequence | - | - | - | - |
| 6 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 1 | P |
| 7 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity? | --> | PDCP DATA PDU | 1 | P |
|  |  |  |  |  |  |

7.1.1.3.16.2.3.3 Specific message contents

Table 7.1.1.3.16.2.3.3-1: *RRCReconfiguration* (Step1, Table 7.1.1.3.16.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13: RRCReconfiguration with condition SCell\_add | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.16.2.3.3-2: *RadioBearerConfig* (Table 7.1.1.3.16.2.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-132: *RadioBearerConfig* | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| drb-Identity | DRB-Identity with condition DRBn |  |  |
| pdcp-Config | PDCP-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.16.2.3.3-3: *PDCP-Config* (Table 7.1.1.3.16.2.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-99 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| moreThanOneRLC SEQUENCE { |  |  |  |
| primaryPath SEQUENCE { |  |  |  |
| cellGroup | 0 |  |  |
| logicalChannel | LogicalChannelIdentity |  |  |
| } |  |  |  |
| pdcp-Duplication | false |  |  |
| } |  |  |  |
| survivalTimeStateSupport-r17 | true |  |  |
| } |  |  |  |

Table 7.1.1.3.16.2.3.3-4: *CellGroupConfig* (Table 7.1.1.3.16.2.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19: *CellGroupConfig* with condition SCell\_add | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 2 entries |  |  |
| RLC-BearerConfig[1] | RLC-BearerConfig-1 | entry 1 |  |
| RLC-BearerConfig[2] | RLC-BearerConfig-2 | entry 2 |  |
| } |  |  |  |
|  |  |  |  |

Table 7.1.1.3.16.2.3.3-5: *RLC-BearerConfig-1* (Table 7.1.1.3.16.2.3.3-4)

|  |
| --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-148: *RLC-BearerConfig* with condition AM |

Table 7.1.1.3.16.2.3.3-6: *LogicalChannelConfig* (Table 7.1.1.3.16.2.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-66: *LogicalChannelConfig* with condition HI | | | |
| Information Element | Value/remark | Comment | Condition |
| LogicalChannelConfig ::= SEQUENCE { |  |  |  |
| ul-SpecificParameters SEQUENCE { |  |  |  |
| allowedServingCells SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex { | 1 entry |  |  |
| ServCellIndex[1] | ServCellIndex of PCell | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.16.2.3.3-7: *RLC-BearerConfig-2* (Table 7.1.1.3.16.2.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-148: *RLC-BearerConfig* with condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-BearerConfig ::= SEQUENCE { |  |  |  |
| logicalChannelIdentity | LogicalChannelIdentity with condition DRBj+1 |  |  |
| servedRadioBearer CHOICE { |  |  |  |
| drb-Identity | DRB-Identity with condition DRBj |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.16.2.3.3-8: *LogicalChannelConfig* (Table 7.1.1.3.16.2.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-66: *LogicalChannelConfig* with condition HI | | | |
| Information Element | Value/remark | Comment | Condition |
| LogicalChannelConfig ::= SEQUENCE { |  |  |  |
| ul-SpecificParameters SEQUENCE { |  |  |  |
| allowedServingCells SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex { | 1 entry |  |  |
| ServCellIndex[1] | ServCellIndex of SCell | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

###### 7.1.1.3.16.3 Correct Handling of UL grant / DRB configured with survival time / MCG or SCG DRB / Intra-band non-contiguous CA

7.1.1.3.16.3.1 Test Purpose (TP)

Same as TC 7.1.1.3.16.2 but applied to Intra-band non-contiguous CA.

7.1.1.3.16.3.2 Conformance requirements

Same as TC 7.1.1.3.16.2 but applied to Intra-band non-contiguous CA.

7.1.1.3.16.3.3 Test Description

7.1.1.3.16.3.3.1 Pre-test conditions

Same as TC 7.1.1.3.16.2 with the following differences:

- CA configuration: Intra-band non-contiguous replaces Intra-band Contiguous CA

7.1.1.3.16.3.3.2 Test procedure sequence

Same as TC 7.1.1.3.16.2 with the following differences:

- CA configuration: Intra-band non-contiguous replaces Intra-band Contiguous CA

7.1.1.3.16.3.3.3 Specific message contents

Same as TC 7.1.1.3.16.2 with the following differences:

- CA configuration: Intra-band non-contiguous replaces Intra-band Contiguous CA

###### 7.1.1.3.16.4 Correct Handling of UL grant / DRB configured with survival time / MCG or SCG DRB / Inter-band CA

7.1.1.3.16.4.1 Test Purpose (TP)

Same as TC 7.1.1.3.16.2 but applied to Inter-band CA.

7.1.1.3.16.4.2 Conformance requirements

Same as TC 7.1.1.3.16.2 but applied to Inter-band CA.

7.1.1.3.16.4.3 Test Description

7.1.1.3.16.4.3.1 Pre-test conditions

Same as TC 7.1.1.3.16.2 with the following differences:

- CA configuration: Inter-band replaces Intra-band Contiguous CA

- Cells configuration: NR Cell 10 replaces NR Cell 3

7.1.1.3.16.4.3.2 Test procedure sequence

Same as TC 7.1.1.3.16.2 with the following differences:

- CA configuration: Inter-band replaces Intra-band Contiguous CA

7.1.1.3.16.4.3.3 Specific message contents

Same as TC 7.1.1.3.16.2 with the following differences:

- CA configuration: Inter-band replaces Intra-band Contiguous CA

#### 7.1.1.4 Transport Size Selection

##### 7.1.1.4.1 DL-SCH Transport Block Size Selection

###### 7.1.1.4.1.0 Common parameters for DL-SCH Transport Block Size Selection

Table 7.1.1.4.1.0-1: PDSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-103 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-TimeDomainResourceAllocationList ::= SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation { | 2 entries |  |  |
| PDSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 |  |
| k0 | Not present |  |  |
| mappingType | typeA |  |  |
| startSymbolAndLength | 53 | S=2, L=12 |  |
| } |  |  |  |
| PDSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 |  |
| k0 | Not present |  |  |
| mappingType | typeA |  |  |
| startSymbolAndLength | 86 | S=2, L=7 |  |
| } |  |  |  |
| } |  |  |  |

###### 7.1.1.4.1.1 DL-SCH Transport Block Size selection / DCI format 1\_0

7.1.1.4.1.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_0 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.1, TS 38.214 clause 5.1.2.1, 5.1.2.2, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.2.1]

DCI format 1\_0 is used for the scheduling of PDSCH in one DL cell.

The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Frequency domain resource assignment – bits

-  is the size of the active DL bandwidth part in case DCI format 1\_0 is monitored in the UE specific search space and satisfying

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

otherwise,  is the size of the initial DL bandwidth part.

If the CRC of the DCI format 1\_0 is scrambled by C-RNTI and the "Frequency domain resource assignment" field are of all ones, the DCI format 1\_0 is for random access procedure initiated by a PDCCH order, with all remaining fields set as follows:

- Random Access Preamble index – 6 bits according to *ra-PreambleIndex* in Subclause 5.1.2 of [8, TS38.321]

- UL/SUL indicator – 1 bit. If the value of the “Random Access Preamble index” is not all zeros and if the UE is configured with SUL in the cell, this field indicates which UL carrier in the cell to transmit the PRACH according to Table 7.3.1.1.1-1; otherwise, this field is reserved

- SS/PBCH index – 6 bits. If the value of the “Random Access Preamble index” is not all zeros, this field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission; otherwise, this field is reserved.

- PRACH Mask index – 4 bits. If the value of the “Random Access Preamble index” is not all zeros, this field indicates the RACH occasion associated with the SS/PBCH indicated by “SS/PBCH index” for the PRACH transmission, according to Subclause 5.1.1 of [8, TS38.321]; otherwise, this field is reserved

- Reserved bits – 10 bits

Otherwise, all remaining fields are set as follows:

- Time domain resource assignment – 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.1.2-33

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- Downlink assignment index – 2 bits as defined in Subclause 9.1.3 of [5, TS38.213], as counter DAI

- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |

[38.214 clause 5.1.2.2]

Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, then downlink resource allocation type 1 is used.

[38.214 clause 5.1.2.2.2]

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks within the active bandwidth part of size  PRBs except for the case when DCI format 1\_0 is decoded in any common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, or P-RNTI,

if the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with a DCI format 1\_1 and the CRC is scrambled by C-RNTI or CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with new-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled with C-RNTI, and the PDSCH is assigned by a PDCCH in a UE-specific search space

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with new-RNTI, and the PDSCH is scheduled with new-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', the PDSCH is scheduled with CS-RNTI, and the PDSCH is assigned by a PDCCH with DCI format 1\_1

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-config* set to 'qam64LowSE', and the PDSCH is scheduled with CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

End

The UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then a transport block is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block, otherwise the transport block is enabled. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or as described for format 1\_0 in Subclause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 0, 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.1.3 Test description

7.1.1.4.1.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of nPRB up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

NOTE: If pc\_supportOfRedCap\_r17=true, the FR1 test channel bandwidth is MIN {20MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]} and the FR2 test channel bandwidth is MIN {100MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}

7.1.1.4.1.1.3.2 Test procedure sequence

Table 7.1.1.4.1.1.3.2-1: Maximum TBS for different UE categories for non-RedCap UE

|  |  |
| --- | --- |
| **UE Category** | **Maximum number of bits of a UL-SCH transport block received within a TTI** |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.1.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤12128 note 2 | | 1 | | 8\*FLOOR((TBS– 128)/8) | |
| 12129 ≤ TBS≤24200 | | 2 | | 8\*FLOOR((TBS– 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS– 272)/24) | |
| 36273 ≤ TBS ≤48344 | | 4 | | 8\*FLOOR((TBS– 344)/32) | |
| 48345≤ TBS ≤60416 | | 5 | | 8\*FLOOR((TBS– 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS–488)/48) | |
| 72489 ≤ TBS ≤84560 | | 7 | | 8\*FLOOR((TBS– 560)/56) | |
| 84561 ≤ TBS≤96632 | | 8 | | 8\*FLOOR((TBS–632)/64) | |
| 96633< TBS ≤108704 | | 9 | | 8\*FLOOR((TBS–704)/72) | |
| 108705 ≤ TBS ≤120776 | | 10 | | 8\*FLOOR((TBS– 776)/80) | |
| 120777≤ TBS ≤132848 | | 11 | | 8\*FLOOR((TBS–848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS– 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS– 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS– 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS– 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS– 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS– 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS– 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS– 1424)/152) | |
| TBS> 229424 | | 20 | | 8\*FLOOR((TBS–1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;  MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.1.1.3.2-2A: Number of downlink PDCP SDUs and PDCP SDU size used as test data for RedCap UE

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 120 ≤ TBS ≤ 12112 note 2 | 1 | 8\*FLOOR((TBS– 112)/8) |
| 12113 ≤ TBS≤ 24168 | 2 | 8\*FLOOR((TBS– 168)/16) |
| 24169 ≤ TBS ≤ 36224 | 3 | 8\*FLOOR((TBS– 224)/24) |
| 36225 ≤ TBS ≤ 48280 | 4 | 8\*FLOOR((TBS– 280)/32) |
| 48281 ≤ TBS ≤ 60336 | 5 | 8\*FLOOR((TBS– 336)/40) |
| 60337 ≤ TBS ≤ 72392 | 6 | 8\*FLOOR((TBS– 392)/48) |
| 72393 ≤ TBS ≤ 84448 | 7 | 8\*FLOOR((TBS– 448)/56) |
| 84449 ≤ TBS≤ 96504 | 8 | 8\*FLOOR((TBS– 504)/64) |
| 96505 < TBS ≤ 108560 | 9 | 8\*FLOOR((TBS– 560)/72) |
| 108561 ≤ TBS ≤ 120616 | 10 | 8\*FLOOR((TBS– 616)/80) |
| 120617 ≤ TBS ≤ 132672 | 11 | 8\*FLOOR((TBS– 672)/88) |
| 132673 ≤ TBS ≤ 144728 | 12 | 8\*FLOOR((TBS– 728)/96) |
| 144729 ≤ TBS ≤ 156784 | 13 | 8\*FLOOR((TBS– 784)/104) |
| 156785 ≤ TBS ≤ 168840 | 14 | 8\*FLOOR((TBS– 840)/112) |
| 168841 ≤ TBS ≤ 180896 | 15 | 8\*FLOOR((TBS– 896)/120) |
| 180897 ≤ TBS ≤ 192952 | 16 | 8\*FLOOR((TBS– 952)/128) |
| 192953≤ TBS ≤ 205008 | 17 | 8\*FLOOR((TBS– 1008)/136) |
| 205009 ≤ TBS ≤ 217064 | 18 | 8\*FLOOR((TBS– 1064)/144) |
| 217065 ≤ TBS ≤ 229120 | 19 | 8\*FLOOR((TBS– 1120)/152) |
| TBS > 229120 | 20 | 8\*FLOOR((TBS– 1176)/160) |
| NOTE 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12). The PDCP SDU size of each PDCP SDU is: PDCP SDU size = (TBS - N\*PDCP header size - N\*AMD PDU header size - N\*MAC header size - Size of Timing Advance - RLC Status PDU size- MAC header for RLC Status PDU) / N, where PDCP header size is 16 bits for the RLC AM and 12-bit SN case; AMD PDU header size is 16 bits with 12 bit SN; MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken. Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits. This gives: PDCP SDU size = 8\*FLOOR((TBS - N\*16- N\*16 - N\*24 -56 )/(8\*N)) bits.  NOTE 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 120 bits. | | |

Table 7.1.1.4.1.1.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 |  |
| mcs-Table | qam64 |  |
| *xoh-PDSCH* | Not Present | Results in value 0(xoh0) |

Table 7.1.1.4.1.1.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  1 to  in BWP, time domain resource as per table 7.1.1.4.1.0-1 and  from 0 to 28.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.1.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.1.1.3.2-2/2A (Note 1). | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.1.1.3.2-2/2A (Note 2). | - | - | - | - |
| 3 | The SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_0 and values of S, L,and  *nPRB*. | <-- | MAC PDU (NxPDCP SDUs)  DCI: (DCI Format 1\_0, S, L,and  *nPRB.*) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |
| NOTE 1: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.1.1.3.2-2 is used and X =136. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.1.1.3.2-2A is used and X=120.  NOTE 2: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.1.1.3.2-2 is used. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.1.1.3.2-2A is used. | | | | | |

7.1.1.4.1.1.3.3 Specific message contents

None.

###### 7.1.1.4.1.2 Void

###### 7.1.1.4.1.3 DL-SCH transport block size selection / DCI format 1\_1 / RA type 0/RA Type 1 / 2 Codewords enabled

7.1.1.4.1.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and maxNrofCodeWordsScheduledByDCI set to 'n2' }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

(2)

**with** { UE in RRC\_CONNECTED state and maxNrofCodeWordsScheduledByDCI set to 'n2' }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.2, TS 38.214 clause 5.1.2.1, 5.1.2.2.1, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.2.2]

DCI format 1\_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Carrier indicator – 0 or 3 bits as defined in Subclause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs  configured by higher layers, excluding the initial DL bandwidth part. The bit width for this field is determined as bits, where

-  if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active DL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Subclause 5.1.2.2.1 of [6, TS38.214],

- bits if only resource allocation type 1 is configured, or

-  bits if both resource allocation type 0 and 1 are configured.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the**** LSBs provide the resource allocation as defined in Subclause 5.1.2.2.1 of [6, TS38.214].

- For resource allocation type 1, the LSBs provide the resource allocation as defined in Subclause 5.1.2.2.2 of [6, TS38.214]

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the “Frequency domain resource assignment” field of the active bandwidth part is smaller than the bit width of the “Frequency domain resource assignment” field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-AllocationList*.

- VRB-to-PRB mapping – 0 or 1 bit

- 0 bit if only resource allocation type 0 is configured;

- 1 bit according to Table 7.3.1.1.2-33 otherwise, only applicable to resource allocation type 1, as defined in Subclause 7.3.1.6 of [4, TS38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingType* is not configured or is set to ‘static’, or 1 bit if the higher layer parameter *prb-BundlingType* is set to ‘dynamic’, according to Subclause 5.1.2.3 of [6, TS38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameter *rateMatchPattern*.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Subclause 5.1.4.2 of [6, TS38.214]. The bit width for this field is determined as bits, where is the number of ZP CSI-RS resource sets in the higher layer parameter*zp-CSI-RS-Resource*.

For transport block 1:

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

For transport block 2 (only present if *maxNrofCodeWordsScheduledByDCI* equals 2

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the value of *maxNrofCodeWordsScheduledByDCI* for the indicated bandwidth part equals 2 and the value of *maxNrofCodeWordsScheduledByDCI* for the active bandwidth part equals 1, the UE assumes zeros are padded when interpreting the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 according to Subclause 12 of [5, TS38.213], and the UE ignores the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 for the indicated bandwidth part.

- HARQ process number – 4 bits

- Downlink assignment index – number of bits as defined in the following

- 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 3 0, 1, 2, or bits as defined in Subclause 9.2.3 of [5, TS38.213]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK.*

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports  shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of  and .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* is not enabled; otherwise 3 bits as defined in Subclause 5.1.5 of [6, TS38.214].

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “Transmission configuration indication” field is not present in the DCI format 1\_1, the UE assumes *tci-PresentInDCI* is not enabled for the indicated bandwidth part.

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits as defined in Subclause 5.1.7 of [6, TS38.214], determined by the higher layer parameters *maxCodeBlockGroupsPerTransportBlock* and *Number-MCS-HARQ-DL-DCI* for the PDSCH.

- CBG flushing out information (CBGFI) – 0 or 1 bit as defined in Subclause 5.1.7 of [6, TS38.214], determined by higher layer parameter *codeBlockGroupFlushIndicator*.

- DMRS sequence initialization – 1 bit if both *scramblingID0* and *scramblingID1* are configured in *DMRS-DownlinkConfig* for  selection defined in Subclause 7.4.1.1.1 of [4, TS38.211]; 0 bit otherwise.

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Posiition* = 3 | | | | | | |

[TS 38.214, clause 5.1.2.2.1]

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured for PDSCH and the size of the carrier bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a downlink carrier bandwidth part *i* of size PRBs is given by , where

- the size of the first RBG is ,

- the size of last RBG is if  and *P* otherwise,

- the size of all other RBGs is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency and starting at the lowest frequency of the carrier bandwidth part. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

[TS 38.214, clause 5.1.2.2.2]

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated localized or distributed virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 1\_0 is decoded in the common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, or P-RNTI,

if the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with a DCI format 1\_1 and the CRC is scrambled by C-RNTI or CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with new-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled with C-RNTI, and the PDSCH is assigned by a PDCCH in a UE-specific search space

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with new-RNTI, and the PDSCH is scheduled with new-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', the PDSCH is scheduled with CS-RNTI, and the PDSCH is assigned by a PDCCH with DCI format 1\_1

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-config* set to 'qam64LowSE', and the PDSCH is scheduled with CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

End

The UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then a transport block is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block, otherwise the transport block is enabled. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or as described for format 1\_0 in Subclause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 0, 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.3.3 Test description

7.1.1.4.1.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value).

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.1.3.3.2 Test procedure sequence

Table 7.1.1.4.1.3.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| **UE Category** | **Maximum number of bits of a UL-SCH transport block received within a TTI** |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.3.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 192 ≤ TBS ≤12184 note 2 | 1 | 8\*FLOOR((TBS– 184)/8) |
| 12185≤ TBS≤24256 | 2 | 8\*FLOOR((TBS– 256)/16) |
| 24257≤ TBS ≤ 36328 | 3 | 8\*FLOOR((TBS– 328)/24) |
| 36329 ≤ TBS ≤48400 | 4 | 8\*FLOOR((TBS–400)/32) |
| 48401≤ TBS ≤60472 | 5 | 8\*FLOOR((TBS– 472)/40) |
| 60473 ≤ TBS ≤ 72544 | 6 | 8\*FLOOR((TBS– 544)/48) |
| 72545≤ TBS ≤84616 | 7 | 8\*FLOOR((TBS– 616)/56) |
| 84617 ≤ TBS≤96688 | 8 | 8\*FLOOR((TBS– 688)/64) |
| 96689< TBS ≤108760 | 9 | 8\*FLOOR((TBS– 760)/72) |
| 108761 ≤ TBS ≤120832 | 10 | 8\*FLOOR((TBS–832)/80) |
| 120833≤ TBS ≤132904 | 11 | 8\*FLOOR((TBS– 904)/88) |
| 132905 ≤ TBS ≤ 144976 | 12 | 8\*FLOOR((TBS– 976)/96) |
| TBS> 144976 | 13 | 8\*FLOOR((TBS– 1048)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU – 32 bit Additional RLC header with SO if one RLC SDU gets split in 2 TBS and 24 bit MAC header for this additional PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). IF RLC SDU does not get split the 32 bits additional padding gets added instead  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24– N\*24 -112 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 192 bits. | | |

Table 7.1.1.4.1.3.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| **=** | **Nominal RBG size *P (Configuration1)*** | **Size of last RBG** | **Allowed Values** |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160, 168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160, 169,176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158, 160,174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.1.3.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comments | Condition |
| number of layers (ʋ) | 1 |  |  |
| mcs-Table | qam64 |  |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PDSCH |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 1-5 |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 6-10 |
| maxNrofCodeWordsScheduledByDCI | n2 | both codewords enabled |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.1.3.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  as per table 7.1.1.4.1.3.3.2-2A in BWP, time domain resource as per table 7.1.1.4.1.0-1 and  from 0 to 28.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.3.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 0 and values of S, L, ,  and  *nPRB.* | <-- | Transport block 1:  MAC PDU  Transport block 2:  MAC PDU  DCI: (DCI Format 1\_1, S, L,,  and  *nPRB.*) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PDSCH-Config* with IE resourceAllocation set to resourceAllocationType1 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of  1 to  in BWP, time domain resource as per table 7.1.1.4.1.0-1 and  from 0 to 28. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.3.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 8 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 1 and values of S, L, ,  and  *nPRB.* | <-- | Transport block 1:  MAC PDU  Transport block 2:  MAC PDU  DCI: (DCI Format 1\_1, S, L,,  and  *nPRB.*) | - | - |
| 9 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 10 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.4.1.3.3.3 Specific message contents

None.

###### 7.1.1.4.1.4 DL-SCH transport block size selection / DCI format 1\_1 / RA type 0/RA Type 1 / 2 Codewords enabled / 256QAM

7.1.1.4.1.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state, maxNrofCodeWordsScheduledByDCI set to 'n2' and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

(2)

**with** { UE in RRC\_CONNECTED state, maxNrofCodeWordsScheduledByDCI set to 'n2' and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.2, TS 38.214 clauses 5.1.2.1, 5.1.2.2.1, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.2.2]

DCI format 1\_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Carrier indicator – 0 or 3 bits as defined in Subclause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs  configured by higher layers, excluding the initial DL bandwidth part. The bit width for this field is determined as bits, where

-  if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active DL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Subclause 5.1.2.2.1 of [6, TS38.214],

- bits if only resource allocation type 1 is configured, or

-  bits if both resource allocation type 0 and 1 are configured.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the**** LSBs provide the resource allocation as defined in Subclause 5.1.2.2.1 of [6, TS38.214].

- For resource allocation type 1, the LSBs provide the resource allocation as defined in Subclause 5.1.2.2.2 of [6, TS38.214]

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the “Frequency domain resource assignment” field of the active bandwidth part is smaller than the bit width of the “Frequency domain resource assignment” field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-AllocationList*.

- VRB-to-PRB mapping – 0 or 1 bit

- 0 bit if only resource allocation type 0 is configured;

- 1 bit according to Table 7.3.1.1.2-33 otherwise, only applicable to resource allocation type 1, as defined in Subclause 7.3.1.6 of [4, TS38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingType* is not configured or is set to ‘static’, or 1 bit if the higher layer parameter *prb-BundlingType* is set to ‘dynamic’, according to Subclause 5.1.2.3 of [6, TS38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameter *rateMatchPattern*.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Subclause 5.1.4.2 of [6, TS38.214]. The bit width for this field is determined as bits, where is the number of ZP CSI-RS resource sets in the higher layer parameter*zp-CSI-RS-Resource*.

For transport block 1:

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

For transport block 2 (only present if *maxNrofCodeWordsScheduledByDCI* equals 2

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the value of *maxNrofCodeWordsScheduledByDCI* for the indicated bandwidth part equals 2 and the value of *maxNrofCodeWordsScheduledByDCI* for the active bandwidth part equals 1, the UE assumes zeros are padded when interpreting the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 according to Subclause 12 of [5, TS38.213], and the UE ignores the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 for the indicated bandwidth part.

- HARQ process number – 4 bits

- Downlink assignment index – number of bits as defined in the following

- 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK.*

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports  shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of  and .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* is not enabled; otherwise 3 bits as defined in Subclause 5.1.5 of [6, TS38.214].

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “Transmission configuration indication” field is not present in the DCI format 1\_1, the UE assumes *tci-PresentInDCI* is not enabled for the indicated bandwidth part.

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits as defined in Subclause 5.1.7 of [6, TS38.214], determined by the higher layer parameters *maxCodeBlockGroupsPerTransportBlock* and *Number-MCS-HARQ-DL-DCI* for the PDSCH.

- CBG flushing out information (CBGFI) – 0 or 1 bit as defined in Subclause 5.1.7 of [6, TS38.214], determined by higher layer parameter *codeBlockGroupFlushIndicator*.

- DMRS sequence initialization – 1 bit if both *scramblingID0* and *scramblingID1* are configured in *DMRS-DownlinkConfig* for  selection defined in Subclause 7.4.1.1.1 of [4, TS38.211]; 0 bit otherwise.

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3  (Note 1)} | {3,…,14} | {3,…,14} | {0,1,2,3  (Note 1)} | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Posiition* = 3 | | | | | | |

[TS 38.214, clause 5.1.2.2.1]

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured for PDSCH and the size of the carrier bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a downlink carrier bandwidth part *i* of size PRBs is given by , where

- the size of the first RBG is ,

- the size of last RBG is if  and *P* otherwise,

- the size of all other RBGs is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency and starting at the lowest frequency of the carrier bandwidth part. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

[TS 38.214, clause 5.1.2.2.2]

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated localized or distributed virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 1\_0 is decoded in the common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, or P-RNTI,

if the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with a DCI format 1\_1 and the CRC is scrambled by C-RNTI or CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with new-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled with C-RNTI, and the PDSCH is assigned by a PDCCH in a UE-specific search space

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with new-RNTI, and the PDSCH is scheduled with new-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', the PDSCH is scheduled with CS-RNTI, and the PDSCH is assigned by a PDCCH with DCI format 1\_1

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-config* set to 'qam64LowSE', and the PDSCH is scheduled with CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

End

The UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

…

Table 5.1.3.1-2: MCS index table 2 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 193 | 0.3770 |
| 2 | 2 | 308 | 0.6016 |
| 3 | 2 | 449 | 0.8770 |
| 4 | 2 | 602 | 1.1758 |
| 5 | 4 | 378 | 1.4766 |
| 6 | 4 | 434 | 1.6953 |
| 7 | 4 | 490 | 1.9141 |
| 8 | 4 | 553 | 2.1602 |
| 9 | 4 | 616 | 2.4063 |
| 10 | 4 | 658 | 2.5703 |
| 11 | 6 | 466 | 2.7305 |
| 12 | 6 | 517 | 3.0293 |
| 13 | 6 | 567 | 3.3223 |
| 14 | 6 | 616 | 3.6094 |
| 15 | 6 | 666 | 3.9023 |
| 16 | 6 | 719 | 4.2129 |
| 17 | 6 | 772 | 4.5234 |
| 18 | 6 | 822 | 4.8164 |
| 19 | 6 | 873 | 5.1152 |
| 20 | 8 | 682.5 | 5.3320 |
| 21 | 8 | 711 | 5.5547 |
| 22 | 8 | 754 | 5.8906 |
| 23 | 8 | 797 | 6.2266 |
| 24 | 8 | 841 | 6.5703 |
| 25 | 8 | 885 | 6.9141 |
| 26 | 8 | 916.5 | 7.1602 |
| 27 | 8 | 948 | 7.4063 |
| 28 | 2 | reserved | |
| 29 | 4 | reserved | |
| 30 | 6 | reserved | |
| 31 | 8 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then a transport block is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block, otherwise the transport block is enabled. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or as described for format 1\_0 in Subclause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 0, 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.4.3 Test description

7.1.1.4.1.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value).

Test frequency NRf1 is as specified in TS 38.508-1[4] clause 4.3.1 using the common highest UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1[4] clause 6.2.3.1.

7.1.1.4.1.4.3.2 Test procedure sequence

Table 7.1.1.4.1.4.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.4.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits] (Note 1) |
| 192 ≤ TBS ≤12184 note 2 | 1 | 8\*FLOOR((TBS– 184)/8) |
| 12185≤ TBS≤24256 | 2 | 8\*FLOOR((TBS– 256)/16) |
| 24257≤ TBS ≤ 36328 | 3 | 8\*FLOOR((TBS– 328)/24) |
| 36329 ≤ TBS ≤48400 | 4 | 8\*FLOOR((TBS–400)/32) |
| 48401≤ TBS ≤60472 | 5 | 8\*FLOOR((TBS– 472)/40) |
| 60473 ≤ TBS ≤ 72544 | 6 | 8\*FLOOR((TBS– 544)/48) |
| 72545≤ TBS ≤84616 | 7 | 8\*FLOOR((TBS– 616)/56) |
| 84617 ≤ TBS≤96688 | 8 | 8\*FLOOR((TBS– 688)/64) |
| 96689< TBS ≤108760 | 9 | 8\*FLOOR((TBS– 760)/72) |
| 108761 ≤ TBS ≤120832 | 10 | 8\*FLOOR((TBS–832)/80) |
| 120833≤ TBS ≤132904 | 11 | 8\*FLOOR((TBS– 904)/88) |
| 132905 ≤ TBS ≤ 144976 | 12 | 8\*FLOOR((TBS– 976)/96) |
| 144785 ≤ TBS ≤ 157048 | 13 | 8\*FLOOR((TBS– 1048)/104) |
| 157049 ≤ TBS≤ 169120 | 14 | 8\*FLOOR((TBS– 1120)/112) |
| 169121< TBS ≤ 181192 | 15 | 8\*FLOOR((TBS– 1192)/120) |
| 181193 ≤ TBS ≤193264 | 16 | 8\*FLOOR((TBS– 1264)/128) |
| 193337 ≤ TBS ≤ 205336 | 17 | 8\*FLOOR((TBS– 1336)/136) |
| 205409 ≤ TBS ≤ 217408 | 18 | 8\*FLOOR((TBS– 1408)/144) |
| TBS> 217408 | 19 | 8\*FLOOR((TBS– 1480)/152) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU – 32 bit Additional RLC header with SO if one RLC SDU gets split in 2 TBS and 24 bit MAC header for this additional PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). IF RLC SDU does not get split the 32 bits additional padding gets added instead  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24– N\*24 -112 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 192 bits. | | |

Table 7.1.1.4.1.4.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| = | Nominal RBG size *P (Configuration1)* | Size of last RBG | Allowed Values |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160,168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160,169, 176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158,160, 174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.1.4.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comments | Condition |
| PDSCH mappingType | typeA |  |  |
| starting symbol *S* | 0 0r 3 to avoid clash with PDCCH symbols |  |  |
| number of consecutive symbols *L* | 3..14-S |  |  |
| k0 | 0 or 1 (if S=0) |  |  |
| number of layers (ʋ) | 1 |  |  |
| mcs-Table | qam256 |  |  |
| *xoh-PDSCH* | Not present | Results in value 0(xoh0) |  |
| dmrs-AdditionalPosition | pos0 | Results in 1 DMRS symbol per two carrier ()for Duration in symbols >=3 (TS 38.211 [24], table 7.4.1.1.2-3) |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PDSCH |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 1-5 |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 6-10 |
| maxNrofCodeWordsScheduledByDCI | n2 | both codewords enabled |  |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.1.4.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  as per Table 7.1.1.4.1.4.3.2-2A in BWP, time domain resource as per table 7.1.1.4.1.0-1 and  from 0 to 27.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.4.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.4.3.2-2. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.4.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 0 and values of S, L, ,  and  *nPRB.* | <-- | Transport block 1: MAC PDU  Transport block 2: MAC PDU  DCI: (DCI Format 1\_1, S, L,,  and nPRB.) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PDSCH-Config* with IE resourceAllocation set to resourceAllocationType1 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of  1 to  in BWP, time domain resource length L 3 to 14-S and  from 0 to 27. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.4.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.4.3.2-2 | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.4.3.2-2. | - | - | - | - |
| 8 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 1 and values of S, L, ,  and  *nPRB.* | <-- | Transport block 1: MAC PDU  Transport block 2: MAC PDU  DCI: (DCI Format 1\_1, S, L,,  and nPRB.) | - | - |
| 9 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 10 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.4.1.4.3.3 Specific message contents

None.

###### 7.1.1.4.1.5 DL-SCH transport block size selection / DCI format 1\_2

7.1.1.4.1.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_2 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.3, TS 38.214 clause 5.1.2.1, 5.1.2.2, 5.1.2.2.1, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.212, clause 7.3.1.2.3]

DCI format 1\_2 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format.

- Carrier indicator – 0, 1, 2 or 3 bits determined by higher layer parameter *carrierIndicatorSizeDCI-1-2*, as defined in Clause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs configured by higher layers, excluding the initial DL bandwidth part. The bitwidth for this field is determined as bits, where

- if , in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following:

- bits if only resource allocation type 0 is configured, where is defined in Clause 5.1.2.2.1 of [6, TS 38.214];

- bits if only resource allocation type 1 is configured, or bits if *resourceAllocationDCI-1-2-r16* is configured as '*dynamicSwitch'*, where , is the size of the active DL bandwidth part, is defined as in clause 4.4.4.4 of [4, TS 38.211] and is determined by higher layer parameter *resourceAllocationType1GranularityDCI-1-2*. If the higher layer parameter *resourceAllocationType1GranularityDCI-1-2* is not configured, is equal to 1.

- If *resourceAllocationDCI-1-2-r16* is configured as '*dynamicSwitch'*, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Clause 5.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the LSBs provide the resource allocation as defined in Clause 5.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if *resourceAllocationDCI-1-2-r16* is configured as '*dynamicSwitch'* for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bitwidth of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bitwidth of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Clause 5.1.2.1 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationListDCI-1-2* if the higher layer parameter is configured, or *I* is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationList* if the higher layer parameter *pdsch-TimeDomainAllocationList* is configured when the higher layer parameter *pdsch-TimeDomainAllocationListDCI-1-2* is not configured; otherwise *I* is the number of entries in the default table.

- VRB-to-PRB mapping – 0 or 1 bit:

- 0 bit if the higher layer parameter *vrb-ToPRB-InterleaverDCI-1-2* is not configured;

- 1 bit according to Table 7.3.1.2.2-5 otherwise, only applicable to resource allocation type 1, as defined in Clause 7.3.1.6 of [4, TS 38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingTypeDCI-1-2* is not configured or is set to 'static', or 1 bit if the higher layer parameter *prb-BundlingTypeDCI-1-2* is set to 'dynamic' according to Clause 5.1.2.3 of [6, TS 38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1DCI-1-2* and *rateMatchPatternGroup2DCI-1-2*, where the MSB is used to indicate *rateMatchPatternGroup1DCI-1-2* and the LSB is used to indicate *rateMatchPatternGroup2DCI-1-2* when there are two groups.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured by higher layer parameter *aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2*.

- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-DCI-1-2*

- If 0 bit is configured, *rvid* to be applied is 0;

- 1 bit according to Table 7.3.1.2.3-1;

- 2 bits according to Table 7.3.1.1.1-2.

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-1-2*

- Downlink assignment index – 0, 1, 2 or 4 bits

- 0 bit if the higher layer parameter *downlinkAssignmentIndexDCI-1-2* is not configured;

- 1, 2 or 4 bits determined by higher layer parameter *downlinkAssignmentIndexDCI-1-2* otherwise,

- 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI

- 4 bits if one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, and the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode = joint*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI.

- 1 or 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, when the UE is not configured with *coresetPoolIndex* or the value of *coresetPoolIndex* is the same for all CORESETs if *coresetPoolIndex* is provided or the UE is not configured with *ackNackFeedbackMode = joint,* where the 1 bit or 2 bits are the counter DAI.

If higher layer parameter *priorityIndicatorDCI-1-2* is configured, if the bit width of the Downlink assignment index in DCI format 1\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 1\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 1\_2 for the two HARQ-ACK codebooks are the same.

- TPC command for scheduled PUCCH – 2 bits as defined in Clause 7.2.1 of [5, TS 38.213]

- PUCCH resource indicator – 0 or 1 or 2 or 3 bits determined by higher layer parameter *numberOfBitsForPUCCH-ResourceIndicatorDCI-1-2*

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *DL-DataToUL-ACK-DCI-1-2.*

If higher layer parameter *priorityIndicatorDCI-1-2* is configured, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for the two HARQ-ACK codebooks are the same.

- Antenna port(s) – 0, 4, 5, or 6 bits

- 0 bit if higher layer parameter *antennaPortsFieldPresenceDCI-1-2* is notconfigured;

- Otherwise 4, 5 or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4. If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* andis configured with higher layer parameter *antennaPortsFieldPresenceDCI-1-2*, the bitwidth of this field equals, where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .

If a UE is not configured with higher layer parameter *antennaPortsFieldPresenceDCI-1-2*, antenna port(s) are defined assuming bit field index value 0 in Tables 7.3.1.2.2-1/2/3/4.

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentDCI-1-2* is not configured; otherwise 1 or 2 or 3 bits determined by higher layer parameter *tci-PresentDCI-1-2* as defined in Clause 5.1.5 of [6, TS38.214].

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part,

- if the higher layer parameter *tci-PresentDCI-1-2* is not configured for the CORESET used for the PDCCH carrying the DCI format 1\_2,

- the UE assumes *tci-PresentDCI-1-2* is not configured for all CORESETs in the indicated bandwidth part;

- otherwise,

- the UE assumes *tci-PresentDCI-1-2* is configured for all CORESETs in the indicated bandwidth part with the same value configured for the CORESET used for the PDCCH carrying the DCI format 1\_2.

- SRS request – 0, 1, 2 or 3 bits

- 0 bit if the higher layer parameter *srs-RequestDCI-1-2* is not configured;

- 1 bit as defined by Table 7.3.1.1.3-1 if the higher layer parameter *srs-RequestDCI-1-2 = 1* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 2 bits if the higher layer parameter *srs-RequestDCI-1-2 = 1* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second bit is defined by Table 7.3.1.1.3-1;

- 2 bits as defined by Table 7.3.1.1.2-24 if the higher layer parameter *srs-RequestDCI-1-2 = 2* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 3 bits if the higher layer parameter *srs-RequestDCI-1-2 = 2* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24;

- DMRS sequence initialization – 0 or 1 bit

- 0 bit if the higher layer parameter *dmrs-SequenceInitializationDCI-1-2* is not configured;

- 1 bit otherwise.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-1-2* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

If DCI formats 1\_2 are monitored in multiple search spaces associated with multiple CORESETs in a BWP for scheduling the same serving cell, zeros shall be appended until the payload size of the DCI formats 1\_2 monitored in the multiple search spaces equal to the maximum payload size of the DCI format 1\_2 monitored in the multiple search spaces.

Table 7.3.1.2.3-1: Redundancy version

|  |  |
| --- | --- |
| Value of the Redundancy version field | Value of  to be applied |
| 0 | 0 |
| 1 | 3 |

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in Clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is *Ks*, where , if UE is configured with ca-SlotOffset for at least one of the scheduled and scheduling cell, and *Ks* = , otherwise, and where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- and are the and the, respectively, which are determined by higher-layer configured ca-SlotOffset, for the cell receiving the PDCCH respectively, and are the and the, respectively, which are determined by higher-layer configured ca-SlotOffset for the cell receiving the PDSCH, as defined in clause 4.5 of [4, TS 38.211].

- The reference point *S0* for starting symbol *S* is defined as:

- if configured with *referenceOfSLIVDCI-1-2*, and when receiving PDSCH scheduled by DCI format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI with *K0=0*, and PDSCH mapping Type B, the starting symbol *S* is relative to the starting symbol *S0* of the PDCCH monitoring occasion where DCI format 1\_2 is detected;

- otherwise, the starting symbol *S* is relative to the start of the slot using *S0=0.*

- The number of consecutive symbols *L* counting from the starting symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- the PDSCH mapping type is set to Type A or Type B as defined in Clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 satisfying  for normal cyclic prefix and  for extended cyclic prefix as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,…,13} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Position* = 3 | | | | | | |

[38.214 clause 5.1.2.2]

Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, then downlink resource allocation type 1 is used.

If the scheduling DCI is configured to indicate the downlink resource allocation type as part of the '*Frequency domain resource assignment'* field by setting a higher layer parameter *resourceAllocation* in *PDSCH-Config* to 'dynamicSwitch', for DCI format 1\_1 or setting a higher layer parameter *resourceAllocationDCI-1-2* in *PDSCH-Config* to 'dynamicSwitch' for DCI format 1\_2, the UE shall use downlink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the downlink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* for DCI format 1\_1 or by the higher layer parameter *resourceAllocationDCI-1-2* for DCI format 1\_2.

[38.214 clause 5.1.2.2.1]

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured by *PDSCH-Config* and the size of the bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

[38.214 clause 5.1.2.2.2]

When the scheduling grant is received with DCI format 1\_2, a downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block group *RBGstart*=0, 1, …, *NRBG*-1 and a length in terms of virtually contiguously allocated resource block groups *LRBGs*=1, …, *NRBG*, where the resource block groups are defined as in 5.1.2.2.1 with *P* defined by *resourceAllocationType1GranularityDCI-1-2* if the UE is configured with higher layer parameter *resourceAllocationType1GranularityDCI-1-2*, and *P*=1 otherwise*.* The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, MSGB-RNTI, or P-RNTI, or for the PDSCH scheduled without corresponding PDCCH transmissions using the higher-layer-provided PDSCH configuration *SPS-Config*,

if the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with MCS-C-RNTI, the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

…

Table 5.1.3.1-3: MCS index table 3 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| **0** | 2 | 30 | 0.0586 |
| **1** | 2 | 40 | 0.0781 |
| **2** | 2 | 50 | 0.0977 |
| **3** | 2 | 64 | 0.1250 |
| **4** | 2 | 78 | 0.1523 |
| **5** | 2 | 99 | 0.1934 |
| **6** | 2 | 120 | 0.2344 |
| **7** | 2 | 157 | 0.3066 |
| **8** | 2 | 193 | 0.3770 |
| **9** | 2 | 251 | 0.4902 |
| **10** | 2 | 308 | 0.6016 |
| **11** | 2 | 379 | 0.7402 |
| **12** | 2 | 449 | 0.8770 |
| **13** | 2 | 526 | 1.0273 |
| **14** | 2 | 602 | 1.1758 |
| **15** | 4 | 340 | 1.3281 |
| **16** | 4 | 378 | 1.4766 |
| **17** | 4 | 434 | 1.6953 |
| **18** | 4 | 490 | 1.9141 |
| **19** | 4 | 553 | 2.1602 |
| **20** | 4 | 616 | 2.4063 |
| **21** | 6 | 438 | 2.5664 |
| **22** | 6 | 466 | 2.7305 |
| **23** | 6 | 517 | 3.0293 |
| **24** | 6 | 567 | 3.3223 |
| **25** | 6 | 616 | 3.6094 |
| **26** | 6 | 666 | 3.9023 |
| **27** | 6 | 719 | 4.2129 |
| **28** | 6 | 772 | 4.5234 |
| **29** | 2 | reserved | |
| **30** | 4 | reserved | |
| **31** | 6 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then one of the two transport blocks is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or format 1\_2 or as described for format 1\_0 in Clause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI, MSGB-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Unquantized intermediate variable (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-1 find the closest TBS that is not less than .

Table 5.1.3.2-1: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.5.3 Test description

7.1.1.4.1.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.1.5.3.2 Test procedure sequence

Table 7.1.1.4.1.5.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| **UE Category** | **Maximum number of bits of a UL-SCH transport block received within a TTI** |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.5.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 136 ≤ TBS ≤ 12128 (Note 2) | 1 | 8\*FLOOR((TBS– 128)/8) |
| 12129 ≤ TBS≤ 24200 | 2 | 8\*FLOOR((TBS– 200)/16) |
| 24201 ≤ TBS ≤ 36272 | 3 | 8\*FLOOR((TBS– 272)/24) |
| 36273 ≤ TBS ≤ 48344 | 4 | 8\*FLOOR((TBS– 344)/32) |
| 48345 ≤ TBS ≤ 60416 | 5 | 8\*FLOOR((TBS– 416)/40) |
| 60417 ≤ TBS ≤ 72488 | 6 | 8\*FLOOR((TBS– 488)/48) |
| 72489 ≤ TBS ≤ 84560 | 7 | 8\*FLOOR((TBS– 560)/56) |
| 84561 ≤ TBS≤ 96632 | 8 | 8\*FLOOR((TBS– 632)/64) |
| 96633 ≤ TBS ≤ 108704 | 9 | 8\*FLOOR((TBS– 704)/72) |
| 10705 ≤ TBS ≤ 120776 | 10 | 8\*FLOOR((TBS– 776)/80) |
| 120777 ≤ TBS ≤ 132848 | 11 | 8\*FLOOR((TBS– 848)/88) |
| 132849 ≤ TBS ≤ 144920 | 12 | 8\*FLOOR((TBS– 920)/96) |
| TBS> 144920 | 13 | 8\*FLOOR((TBS– 992)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;  MAC header size for AMD PDU = 16 or 24 bits depending on L= 8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24 - N\*24 – N\*24 - 56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | |

Table 7.1.1.4.1.5.3.2-2A: Void

Table 7.1.1.4.1.5.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| resourceAllocationType1GranularityDCI-1-2-r16 | Not Present | granularity ‘P’ is 1 PRB |
| mcs-TableDCI-1-2-r16 | Not present | qam64 per default |

Table 7.1.1.4.1.5.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  in BWP, time domain resource as per table 7.1.1.4.1.0-1 and  from 0 to 28.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.5.3.2-1 and larger than or equal to 132 bits as specified in Table 7.1.1.4.1.5.3.2-2. | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.1.5.3.2-2. | - | - | - | - |
| 3 | The SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_2 and UL Grant DCI 0\_2 and values of S, L,and *nPRB*. | <-- | MAC PDU (NxPDCP SDUs)  DCI: (DCI Format 1\_2, DCI Format 0\_2, S, L,and *nPRB.*) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |

7.1.1.4.1.5.3.3 Specific message contents

Table 7.1.1.4.1.5.3.3-1: PDSCH-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2-r16 CHOICE { |  |  |  |
| setup | DMRS-DownlinkConfig |  |  |
| } |  |  |  |
| harq-ProcessNumberSizeDCI-1-2-r16 | 3 | nrofHARQ-ProcessesForPDSCH is 8 |  |
| numberOfBitsForRV-DCI-1-2-r16 | 2 |  |  |
| prb-BundlingTypeDCI-1-2-r16 |  |  |  |
| staticBundling SEQUENCE { |  |  |  |
| bundleSize | wideband |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocationDCI-1-2-r16 | resourceAllocationType1 |  |  |
| } |  |  |  |

Table 7.1.1.4.1.5.3.3-2: *PhysicalCellGroupConfig*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-106 | | | |
| Information Element | Value/remark | Comment | Condition |
| PhysicalCellGroupConfig ::= SEQUENCE { |  |  |  |
| downlinkAssignmentIndexDCI-1-2-r16 | 2 | pdsch-HARQ-ACK-Codebook=dynamic  ackNackFeedbackMode = Not present |  |
| } |  |  |  |

Table 7.1.1.4.1.5.3.3-3: *PUCCH-Config*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| numberOfBitsForPUCCH-ResourceIndicatorDCI-1-2-r16 | 3 |  |  |
| } |  |  |  |

Table 7.1.1.4.1.5.3.3-4: PUSCH-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2-r16 CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2-r16 CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| harq-ProcessNumberSizeDCI-0-2-r16 | 3 | nrofHARQ-ProcessesForPUSCH is 8 |  |
| numberOfBitsForRV-DCI-0-2-r16 | 2 |  |  |
| resourceAllocationDCI-0-2-r16 | resourceAllocationType1 |  |  |
| } |  |  |  |

##### 7.1.1.4.2 UL-SCH Transport Block Size Selection

###### 7.1.1.4.2.0 Common parameters for UL-SCH Transport Block Size Selection

Table 7.1.1.4.2.0-1: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation { | 2 entry |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 | FR1 |
| k2 | 2 |  | FR1 |
|  | 4 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 52 | Start symbol(S)=10, Length(L)=4 | FR1 |
| startSymbolAndLength | 42 | Start symbol(S)=0, Length(L)=4 | FR2 |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 | FR1 |
| k2 | 2 |  | FR1 |
|  | 4 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.4.2.0-2: *PUSCH-Config*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig | See Table 7.1.1.4.2.0-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.4.2.0-3: *DMRS-UplinkConfig*

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-51 |

Table 7.1.1.4.2.0-4: *SchedulingRequestResourceConfig*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508 [4], Table 4.6.3-157 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceId | SchedulingRequestResourceId |  |  |
| schedulingRequestID | SchedulingRequestId |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl40 | 9 | With SCS = kHz15 results in repetition every 40 ms | SCS15 |
| sl80 | 9 | With SCS = kHz30 results in repetition every 40 ms | SCS30 |
| sl320 | 9 | With SCS = kHz120 results in repetition every 40 ms | SCS120 |
| } |  |  |  |
| resource | 6 | ID of the PUCCH resource as configured by PUCCH-Config (Table 4.6.3-84) |  |
| } |  |  |  |

Table 7.1.1.4.2.0-5: Void

Table 7.1.1.4.2.0-6: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms160 |

###### 7.1.1.4.2.1 UL-SCH Transport Block Size selection / DCI format 0\_0 / Transform precoding disabled

7.1.1.4.2.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_0 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and modulation and coding }

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.1]

DCI format 0\_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –  bits where

-  is the size of the active UL bandwidth part in case DCI format 0\_0 is monitored in the UE specific search space and satisfying

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

- otherwise,  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1 and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is not configured on both UL and SUL the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured;

- If the UL/SUL indicator is not present in DCI format 0\_0, the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by TC-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –bits where

-  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if  and  otherwise

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214], using Table 5.1.3.1-1

- New data indicator – 1 bit, reserved

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits, reserved

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit if the cell has two ULs and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If 1 bit, reserved, and the corresponding PUSCH is always on the same UL carrier as the previous transmission of the same TB

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space and satisfies both of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in UE specific search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

- if *mcs-Table* in *PUSCH-Config* is set to 'qam256', and PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-Table* in *PUSCH-Config* is set to 'qam64LowSE', the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled and , the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-5 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2 Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.1.3 Test description

7.1.1.4.2.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of nPRB up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in clause 4.3.1 of TS 38.508-1 [4] using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in clause 6.2.3.1 of TS 38.508-1 [4].

NOTE: If pc\_supportOfRedCap\_r17=true, the FR1 test channel bandwidth is MIN {20MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}, and the FR2 test channel bandwidth is MIN {100MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}.

7.1.1.4.2.1.3.2 Test procedure sequence

Table 7.1.1.4.2.1.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.1.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data for non-RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤12128 note 2 | | 1 | | 8\*FLOOR((TBS – 128)/8) | |
| 12129 ≤ TBS ≤24200 | | 2 | | 8\*FLOOR((TBS – 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS – 272)/24) | |
| 36273 ≤ TBS ≤48344 | | 4 | | 8\*FLOOR((TBS – 344)/32) | |
| 48345≤ TBS ≤60416 | | 5 | | 8\*FLOOR((TBS – 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS – 488)/48) | |
| 72489 ≤ TBS ≤84560 | | 7 | | 8\*FLOOR((TBS – 560)/56) | |
| 84561 ≤ TBS ≤96632 | | 8 | | 8\*FLOOR((TBS – 632)/64) | |
| 96633< TBS ≤108704 | | 9 | | 8\*FLOOR((TBS – 704)/72) | |
| 108705 ≤ TBS ≤120776 | | 10 | | 8\*FLOOR((TBS – 776)/80) | |
| 120777≤ TBS ≤132848 | | 11 | | 8\*FLOOR((TBS –848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS – 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS – 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS – 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS – 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS – 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS – 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS – 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS – 1424)/152) | |
| TBS > 229424 | | 20 | | 8\*FLOOR((TBS – 1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.2.1.3.2-2A: Number of uplink PDCP SDUs and PDCP SDU size used as test data for RedCap UE

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 120 ≤ TBS ≤ 12112 note 2 | 1 | 8\*FLOOR((TBS – 112)/8) |
| 12113 ≤ TBS ≤ 24168 | 2 | 8\*FLOOR((TBS – 168)/16) |
| 24169 ≤ TBS ≤ 36224 | 3 | 8\*FLOOR((TBS – 224)/24) |
| 36225 ≤ TBS ≤ 48280 | 4 | 8\*FLOOR((TBS – 280)/32) |
| 48281≤ TBS ≤ 60336 | 5 | 8\*FLOOR((TBS – 336)/40) |
| 60337 ≤ TBS ≤ 72392 | 6 | 8\*FLOOR((TBS – 392)/48) |
| 72393 ≤ TBS ≤ 84448 | 7 | 8\*FLOOR((TBS – 448)/56) |
| 84449 ≤ TBS ≤ 96504 | 8 | 8\*FLOOR((TBS – 504)/64) |
| 96505 < TBS ≤ 1108560 | 9 | 8\*FLOOR((TBS – 560)/72) |
| 108561 ≤ TBS ≤ 120616 | 10 | 8\*FLOOR((TBS – 616)/80) |
| 120617 ≤ TBS ≤ 132672 | 11 | 8\*FLOOR((TBS – 672)/88) |
| 132673 ≤ TBS ≤ 144728 | 12 | 8\*FLOOR((TBS – 728)/96) |
| 144729 ≤ TBS ≤ 156784 | 13 | 8\*FLOOR((TBS – 784)/104) |
| 156785 ≤ TBS ≤ 168840 | 14 | 8\*FLOOR((TBS – 840)/112) |
| 168841 ≤ TBS ≤ 180896 | 15 | 8\*FLOOR((TBS – 896)/120) |
| 180897 ≤ TBS ≤ 192952 | 16 | 8\*FLOOR((TBS – 952)/128) |
| 192953 ≤ TBS ≤ 205008 | 17 | 8\*FLOOR((TBS – 1008)/136) |
| 205009 ≤ TBS ≤ 217064 | 18 | 8\*FLOOR((TBS – 1064)/144) |
| 217065 ≤ TBS ≤ 229120 | 19 | 8\*FLOOR((TBS – 1120)/152) |
| TBS > 229120 | 20 | 8\*FLOOR((TBS – 1176)/160) |
| NOTE 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in clause 9.9.4.12 of TS 24.301 [21]).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS - N\*PDCP header size - N\*AMD PDU header size - N\*MAC header size - Size of Timing Advance - RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 16 bits for the RLC AM and 12-bit SN case;  AMD PDU header size is 16 bits with 12 bit SN;  MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:  PDCP SDU size = 8\*FLOOR ((TBS - N\*16- N\*16 - N\*24 -56 )/(8\*N)) bits.  NOTE 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 120 bits. | | |

Table 7.1.1.4.2.1.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 |  |
| mcs-Table | qam64 |  |

Table 7.1.1.4.2.1.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and  from 0 to 28. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.1.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.2.1.3.2-2/2A. (Note 3)  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 2)  Skip the execution of steps for > 27 and  < 5.  (Note 1) | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.1.3.2-2/2A. (Note 4) | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request, , SS transmits UL Grant DCI 0\_0, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI Format 0\_0, S, L,and *nPRB.*) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N x PDCP SDU) | 1 | P |
| Note 1: For > 27 and  < 5, the combination results in higher coding rate and therefore leading to CRC errors in decoding UL data.  Note 2: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15].  Note 3: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.1.3.2-2 is used and X =136. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.1.3.2-2A is used and X=120.  Note 4: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.1.3.2-2 is used. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.1.3.2-2A is used. | | | | | |

7.1.1.4.2.1.3.3 Specific message contents

None.

###### 7.1.1.4.2.2 Void

###### 7.1.1.4.2.3 UL-SCH transport block size selection / DCI format 0\_1 / RA type 0/RA Type 1 / Transform precoding disabled

7.1.1.4.2.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.1, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.2]

DCI format 0\_1 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0 or 3 bits, as defined in Subclause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with SUL in the cell or UEs configured with SUL in the cell but only PUCCH carrier in the cell is configured for PUSCH transmission; 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs  configured by higher layers, excluding the initial UL bandwidth part. The bit width for this field is determined as bits, where

-  if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active UL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Subclause 6.1.2.2.1 of [6, TS 38.214],

- bits if only resource allocation type 1 is configured, or  bits if both resource allocation type 0 and 1 are configured.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the  LSBs provide the resource allocation as defined in Subclause 6.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the  LSBs provide the resource allocation as follows:

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bit width of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* the number of entries in the higher layer parameter *pusch-AllocationList.*

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if only resource allocation type 0 is configured or if the higher layer parameter *frequencyHopping* is not configured;

- 1 bit according to Table 7.3.1.1.2-34 otherwise, only applicable to resource allocation type 1, as defined in Subclause 6.3 of [6, TS 38.214].

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits:

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS38.213]

- SRS resource indicator – or  bits, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', and  is the maximum number of supported layers for the PUSCH.

-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*nonCodeBook*';

-  bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*'.

- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *maxRank* and *codebookSubset*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebookmaxRank* and *codebookSubset,* and according to the values of higher layer parameters.

- Antenna ports – number of bits determined by the following

- 2 bits as defined by Tables 7.3.1.1.2-6, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=1;

- 4 bits as defined by Tables 7.3.1.1.2-7, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=2;

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-UplinkForPUSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of  and .

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSize*.

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits determined by higher layer parameter *maxCodeBlockGroupsPerTransportBlock* for PUSCH.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured and *transformPrecoder*=*disabled*, or if *transformPrecoder*=*enabled*, or if *maxRank=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) for transmission of one PT-RS port and two PT-RS ports respectively, and the DMRS ports are indicated by the Antenna ports field.

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “PTRS-DMRS association” field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the “PTRS-DMRS association” field is not present for the indicated bandwidth part.*betaOffsets = semiStatic*

- beta\_offset indicator – 0 if the higher layer parameter ; otherwise 2 bits as defined by Table 9.3-3 in [5, TS 38.213].

- DMRS sequence initialization – 0 if the higher layer parameter *transformPrecoder=enabled*; 1 bit if the higher layer parameter *transformPrecoder=disabled* and both *scramblingID0* and *scramblingID1* are configured in *DMRS-UplinkConfig*, for  selection defined in Subclause 6.4.1.1.1.1 of [4, TS 38.211].

- UL-SCH indicator – 1 bit. A value of “1” indicates UL-SCH shall be transmitted on the PUSCH and a value of “0” indicates UL-SCH shall not be transmitted on the PUSCH.

For a UE configured with SUL in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in format 0\_1 for the SUL is not equal to the number of information bits in format 0\_1 for the non-SUL, zeros shall be appended to smaller format 0\_1 until the payload size equals that of the larger format 0\_1.

Table 7.3.1.1.2-1: Bandwidth part indicator

|  |  |
| --- | --- |
| Value of BWP indicator field | Bandwidth part |
| 2 bits |
| 00 | First bandwidth part configured by higher layers |
| 01 | Second bandwidth part configured by higher layers |
| 10 | Third bandwidth part configured by higher layers |
| 11 | Fourth bandwidth part configured by higher layers |

Table 7.3.1.1.2-2: Precoding information and number of layers, for 4 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2 or 3 or 4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 |
| … | … | … | … | … | … |
| 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 |
| 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 |
| 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 |
| 12 | 1 layer: TPMI=4 | 12 | 1 layer: TPMI=4 | 12-15 | reserved |
| … | … | … | … |  |  |
| 19 | 1 layer: TPMI=11 | 19 | 1 layer: TPMI=11 |  |  |
| 20 | 2 layers: TPMI=6 | 20 | 2 layers: TPMI=6 |  |  |
| … | … | … | … |  |  |
| 27 | 2 layers: TPMI=13 | 27 | 2 layers: TPMI=13 |  |  |
| 28 | 3 layers: TPMI=1 | 28 | 3 layers: TPMI=1 |  |  |
| 29 | 3 layers: TPMI=2 | 29 | 3 layers: TPMI=2 |  |  |
| 30 | 4 layers: TPMI=1 | 30 | 4 layers: TPMI=1 |  |  |
| 31 | 4 layers: TPMI=2 | 31 | 4 layers: TPMI=2 |  |  |
| 32 | 1 layers: TPMI=12 |  |  |  |  |
| … | … |  |  |  |  |
| 47 | 1 layers: TPMI=27 |  |  |  |  |
| 48 | 2 layers: TPMI=14 |  |  |  |  |
| … | … |  |  |  |  |
| 55 | 2 layers: TPMI=21 |  |  |  |  |
| 56 | 3 layers: TPMI=3 |  |  |  |  |
| … | … |  |  |  |  |
| 59 | 3 layers: TPMI=6 |  |  |  |  |
| 60 | 4 layers: TPMI=3 |  |  |  |  |
| 61 | 4 layers: TPMI=4 |  |  |  |  |
| 62-63 | reserved |  |  |  |  |

Table 7.3.1.1.2-3: Precoding information and number of layers for 4 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder=disabled* and *maxRank* = 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 1 layer: TPMI=4 | 4 | 1 layer: TPMI=4 |  |  |
| … | … | … | … |  |  |
| 11 | 1 layer: TPMI=11 | 11 | 1 layer: TPMI=11 |  |  |
| 12 | 1 layers: TPMI=12 | 12-15 | reserved |  |  |
| … | … |  |  |  |  |
| 27 | 1 layers: TPMI=27 |  |  |  |  |
| 28-31 | reserved |  |  |  |  |

Table 7.3.1.1.2-4: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 2 layers: TPMI=0 | 2 | 2 layers: TPMI=0 |
| 3 | 1 layer: TPMI=2 | 3 | reserved |
| 4 | 1 layer: TPMI=3 |  |  |
| 5 | 1 layer: TPMI=4 |  |  |
| 6 | 1 layer: TPMI=5 |  |  |
| 7 | 2 layers: TPMI=1 |  |  |
| 8 | 2 layers: TPMI=2 |  |  |
| 9-15 | reserved |  |  |

Table 7.3.1.1.2-5: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder= disabled* and *maxRank* = 1

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 1 layer: TPMI=2 |  |  |
| 3 | 1 layer: TPMI=3 |  |  |
| 4 | 1 layer: TPMI=4 |  |  |
| 5 | 1 layer: TPMI=5 |  |  |
| 6-7 | reserved |  |  |

...

Table 7.3.1.1.2-33: VRB-to-PRB mapping

|  |  |
| --- | --- |
| Bit field mapped to index | VRB-to-PRB mapping |
| 0 | Non-interleaved |
| 1 | Interleaved |

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.1]

In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size*configured for PUSCH and the size of the carrier bandwidth part as defined in Table 6.1.2.2.1-1.

Table 6.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Carrier Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | *2* | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a uplink carrier bandwidth part *i* of sizePRBs is given by  where

- the size of the first RBG is ,

- the size of the last RBG is if and *P* otherwise.

- the size of all other RBG is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency of the carrier bandwidth part and starting at the lowest frequency. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB of the bitmap. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

- if *mcs-Table* in *PUSCH-Config* is set to 'qam256', and PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-Table* in *PUSCH-Config* is set to 'qam64LowSE', the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.3.3 Test description

7.1.1.4.2.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of nPRB up to maximum value).

Test frequency NRf1 is as specified in clause 4.3.1 of TS 38.508-1 [4] using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in clause 6.2.3.1 of TS 38.508-1 [4].

NOTE: If pc\_supportOfRedCap\_r17=true, the FR1 test channel bandwidth is MIN {20MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}, and the FR2 test channel bandwidth is MIN {100MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}.

7.1.1.4.2.3.3.2 Test procedure sequence

Table 7.1.1.4.2.3.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.3.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data for non-RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤ 12128 note 2 | | 1 | | 8\*FLOOR((TBS – 128)/8) | |
| 12129 ≤ TBS ≤ 24200 | | 2 | | 8\*FLOOR((TBS – 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS – 272)/24) | |
| 36273 ≤ TBS ≤ 48344 | | 4 | | 8\*FLOOR((TBS – 344)/32) | |
| 48345 ≤ TBS ≤ 60416 | | 5 | | 8\*FLOOR((TBS – 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS – 488)/48) | |
| 72489 ≤ TBS ≤ 84560 | | 7 | | 8\*FLOOR((TBS – 560)/56) | |
| 84561 ≤ TBS ≤ 96632 | | 8 | | 8\*FLOOR((TBS – 632)/64) | |
| 96633 < TBS ≤ 108704 | | 9 | | 8\*FLOOR((TBS –704)/72) | |
| 108705 ≤ TBS ≤ 120776 | | 10 | | 8\*FLOOR((TBS – 776)/80) | |
| 120777 ≤ TBS ≤ 132848 | | 11 | | 8\*FLOOR((TBS –848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS – 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS – 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS – 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS – 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS – 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS – 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS – 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS – 1424)/152) | |
| TBS > 229424 | | 20 | | 8\*FLOOR((TBS – 1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.2.3.3.2-2AA: Number of downlink PDCP SDUs and PDCP SDU size used as test data for RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 120 ≤ TBS ≤ 12112 note 2 | | 1 | | 8\*FLOOR((TBS – 112)/8) | |
| 12113 ≤ TBS ≤ 24168 | | 2 | | 8\*FLOOR((TBS – 168)/16) | |
| 24169 ≤ TBS ≤ 36224 | | 3 | | 8\*FLOOR((TBS – 224)/24) | |
| 36225 ≤ TBS ≤ 48280 | | 4 | | 8\*FLOOR((TBS – 280)/32) | |
| 48281 ≤ TBS ≤ 60336 | | 5 | | 8\*FLOOR((TBS – 336)/40) | |
| 60337 ≤ TBS ≤ 72392 | | 6 | | 8\*FLOOR((TBS – 392)/48) | |
| 72393 ≤ TBS ≤ 84448 | | 7 | | 8\*FLOOR((TBS – 448)/56) | |
| 84449 ≤ TBS ≤ 96504 | | 8 | | 8\*FLOOR((TBS – 504)/64) | |
| 96505 < TBS ≤ 108560 | | 9 | | 8\*FLOOR((TBS – 560)/72) | |
| 108561 ≤ TBS ≤ 120616 | | 10 | | 8\*FLOOR((TBS – 616)/80) | |
| 120617 ≤ TBS ≤ 132672 | | 11 | | 8\*FLOOR((TBS – 672)/88) | |
| 132673 ≤ TBS ≤ 144728 | | 12 | | 8\*FLOOR((TBS – 728)/96) | |
| 144729 ≤ TBS ≤ 156784 | | 13 | | 8\*FLOOR((TBS – 784)/104) | |
| 156785 ≤ TBS ≤ 168840 | | 14 | | 8\*FLOOR((TBS – 840)/112) | |
| 168841 ≤ TBS ≤ 180896 | | 15 | | 8\*FLOOR((TBS – 896)/120) | |
| 180897 ≤ TBS ≤ 192952 | | 16 | | 8\*FLOOR((TBS – 952)/128) | |
| 192953≤ TBS ≤ 205008 | | 17 | | 8\*FLOOR((TBS – 1008)/136) | |
| 205009 ≤ TBS ≤ 217064 | | 18 | | 8\*FLOOR((TBS – 1064)/144) | |
| 217065 ≤ TBS ≤ 229120 | | 19 | | 8\*FLOOR((TBS – 1120)/152) | |
| TBS> 229120 | | 20 | | 8\*FLOOR((TBS – 1176)/160) | |
| NOTE 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in clause 9.9.4.12 of TS 24.301 [21]). The PDCP SDU size of each PDCP SDU is: PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where: PDCP header size is 16 bits for the RLC AM and 12-bit SN case; AMD PDU header size is 16 bits with 12 bit SN; MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken. Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits. This gives: PDCP SDU size = 8\*FLOOR ((TBS – N\*16- N\*16 – N\*24 -56)/(8\*N)) bits.  NOTE 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 120 bits. | | | | | |

Table 7.1.1.4.2.3.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| **=** | **Nominal RBG size *P (Configuration1)*** | **Size of last RBG** | **Allowed Values** |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160, 168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160, 169,176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158, 160,174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.2.3.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comment | Condition |
| mcs-Table | qam64 |  |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PUSCH |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND Steps 1-5 |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND pc\_ra\_Type0\_PUSCH AND Steps 6-10 |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.2.3.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and  from 0 to 28. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and*nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.3.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.2.3.3.2-2/2AA. (Note 5)  Skip the execution of steps 2 to 5 for which the value of satisfies the condition 3824 <  < 3825.(Note 4)  Skip the execution of steps 1 to 5 for > 27 and  < 5. (Note3) | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.3.3.2-2/2AA. (Note 6) | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request, SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB* | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | (NxPDCP SDUs) | 2 | P |
| - | EXCEPTION : Steps 5Aa1 to 10 are executed if pc\_ra\_Type0\_PUSCH | - | *-* | - | - |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PUSCH-Config* with IE resourceAllocation set toresourceAllocationType0 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message.(Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of  as per table 7.1.1.4.2.3.3.2-2A in BWP, time domain resource length L 3 to 14-S and  from 0 to 28. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.3.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.2.3.3.2-2/2AA. (Note 5)  Skip the execution of steps 7 to 10 for which the value of satisfies the condition 3824 <  < 3825. (Note 4)  Skip the execution of steps 6 to 10 for > 27 and  < 5. (Note 3) | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.3.3.2-2/2AA. (Note 6) | - | - | - | - |
| 8 | The SS transmits all PDCP SDUs (NSDUs) as created in step 7 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 9 | After the reception of 2 Scheduling Request SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 10 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 8 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 9? | --> | (NxPDCP SDUs) | 1 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For > 27 and  < 5, the combination results in higher coding rate and therefore leading to CRC errors in decoding UL data.  Note 4: Depending upon UE implementation of TBS determination as per clause 5.1.3.2 of TS 38.214 [15], 3824 <  < 3825, different step may be used by UEs for TBS determintation. When Resource Allocation Type is RA Type 1, =5,=123 and Time Domain Allocation Symbols = 4, the resulting  is 3824.05.  Note 5: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.3.3.2-2 is used and X =136. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.3.3.2-2AA is used and X=120.  Note 6: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.3.3.2-2 is used. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.3.3.2-2AA is used. | | | | | |

7.1.1.4.2.3.3.3 Specific message contents

None.

###### 7.1.1.4.2.4 UL-SCH transport block size selection / DCI format 0\_1 / RA type 0/RA Type 1 / 256QAM / Transform precoding disabled

7.1.1.4.2.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

(2)

**with** { UE in RRC\_CONNECTED state and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.1, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.2]

DCI format 0\_1 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0 or 3 bits, as defined in Subclause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with SUL in the cell or UEs configured with SUL in the cell but only PUCCH carrier in the cell is configured for PUSCH transmission; 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs  configured by higher layers, excluding the initial UL bandwidth part. The bit width for this field is determined as bits, where

-  if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active UL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Subclause 6.1.2.2.1 of [6, TS 38.214],

- bits if only resource allocation type 1 is configured, or  bits if both resource allocation type 0 and 1 are configured.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the  LSBs provide the resource allocation as defined in Subclause 6.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the  LSBs provide the resource allocation as follows:

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bit width of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* the number of entries in the higher layer parameter *pusch-AllocationList.*

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if only resource allocation type 0 is configured or if the higher layer parameter *frequencyHopping* is not configured;

- 1 bit according to Table 7.3.1.1.2-34 otherwise, only applicable to resource allocation type 1, as defined in Subclause 6.3 of [6, TS 38.214].

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits:

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS38.213]

- SRS resource indicator – or  bits, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', and  is the maximum number of supported layers for the PUSCH.

-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*nonCodeBook*';

-  bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*'.

- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *maxRank* and *codebookSubset*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *maxRank* and *codebookSubset*.

- Antenna ports – number of bits determined by the following

- 2 bits as defined by Tables 7.3.1.1.2-6, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=1;

- 4 bits as defined by Tables 7.3.1.1.2-7, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=2;

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-UplinkForPUSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of  and .

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSize*.

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits determined by higher layer parameter *maxCodeBlockGroupsPerTransportBlock* for PUSCH.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured and *transformPrecoder*=*disabled*, or if *transformPrecoder*=*enabled*, or if *maxRank=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) for transmission of one PT-RS port and two PT-RS ports respectively, and the DMRS ports are indicated by the Antenna ports field.

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “PTRS-DMRS association” field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the “PTRS-DMRS association” field is not present for the indicated bandwidth part.

- beta\_offset indicator – 0 if the higher layer parameter *betaOffsets = semiStatic*; otherwise 2 bits as defined by Table 9.3-3 in [5, TS 38.213].

- DMRS sequence initialization – 0 if the higher layer parameter *transformPrecoder=enabled*; 1 bit if the higher layer parameter *transformPrecoder=disabled* and both *scramblingID0* and *scramblingID1* are configured in *DMRS-UplinkConfig*, for  selection defined in Subclause 6.4.1.1.1.1 of [4, TS 38.211].

- UL-SCH indicator – 1 bit. A value of “1” indicates UL-SCH shall be transmitted on the PUSCH and a value of “0” indicates UL-SCH shall not be transmitted on the PUSCH.

For a UE configured with SUL in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in format 0\_1 for the SUL is not equal to the number of information bits in format 0\_1 for the non-SUL, zeros shall be appended to smaller format 0\_1 until the payload size equals that of the larger format 0\_1.

Table 7.3.1.1.2-1: Bandwidth part indicator

|  |  |
| --- | --- |
| Value of BWP indicator field | Bandwidth part |
| 2 bits |
| 00 | First bandwidth part configured by higher layers |
| 01 | Second bandwidth part configured by higher layers |
| 10 | Third bandwidth part configured by higher layers |
| 11 | Fourth bandwidth part configured by higher layers |

Table 7.3.1.1.2-2: Precoding information and number of layers, for 4 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2 or 3 or 4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 |
| … | … | … | … | … | … |
| 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 |
| 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 |
| 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 |
| 12 | 1 layer: TPMI=4 | 12 | 1 layer: TPMI=4 | 12-15 | reserved |
| … | … | … | … |  |  |
| 19 | 1 layer: TPMI=11 | 19 | 1 layer: TPMI=11 |  |  |
| 20 | 2 layers: TPMI=6 | 20 | 2 layers: TPMI=6 |  |  |
| … | … | … | … |  |  |
| 27 | 2 layers: TPMI=13 | 27 | 2 layers: TPMI=13 |  |  |
| 28 | 3 layers: TPMI=1 | 28 | 3 layers: TPMI=1 |  |  |
| 29 | 3 layers: TPMI=2 | 29 | 3 layers: TPMI=2 |  |  |
| 30 | 4 layers: TPMI=1 | 30 | 4 layers: TPMI=1 |  |  |
| 31 | 4 layers: TPMI=2 | 31 | 4 layers: TPMI=2 |  |  |
| 32 | 1 layers: TPMI=12 |  |  |  |  |
| … | … |  |  |  |  |
| 47 | 1 layers: TPMI=27 |  |  |  |  |
| 48 | 2 layers: TPMI=14 |  |  |  |  |
| … | … |  |  |  |  |
| 55 | 2 layers: TPMI=21 |  |  |  |  |
| 56 | 3 layers: TPMI=3 |  |  |  |  |
| … | … |  |  |  |  |
| 59 | 3 layers: TPMI=6 |  |  |  |  |
| 60 | 4 layers: TPMI=3 |  |  |  |  |
| 61 | 4 layers: TPMI=4 |  |  |  |  |
| 62-63 | reserved |  |  |  |  |

Table 7.3.1.1.2-3: Precoding information and number of layers for 4 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder=disabled* and *maxRank* = 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 1 layer: TPMI=4 | 4 | 1 layer: TPMI=4 |  |  |
| … | … | … | … |  |  |
| 11 | 1 layer: TPMI=11 | 11 | 1 layer: TPMI=11 |  |  |
| 12 | 1 layers: TPMI=12 | 12-15 | reserved |  |  |
| … | … |  |  |  |  |
| 27 | 1 layers: TPMI=27 |  |  |  |  |
| 28-31 | reserved |  |  |  |  |

Table 7.3.1.1.2-4: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 2 layers: TPMI=0 | 2 | 2 layers: TPMI=0 |
| 3 | 1 layer: TPMI=2 | 3 | reserved |
| 4 | 1 layer: TPMI=3 |  |  |
| 5 | 1 layer: TPMI=4 |  |  |
| 6 | 1 layer: TPMI=5 |  |  |
| 7 | 2 layers: TPMI=1 |  |  |
| 8 | 2 layers: TPMI=2 |  |  |
| 9-15 | reserved |  |  |

Table 7.3.1.1.2-5: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder= disabled* and *maxRank* = 1

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 1 layer: TPMI=2 |  |  |
| 3 | 1 layer: TPMI=3 |  |  |
| 4 | 1 layer: TPMI=4 |  |  |
| 5 | 1 layer: TPMI=5 |  |  |
| 6-7 | reserved |  |  |

...

Table 7.3.1.1.2-33: VRB-to-PRB mapping

|  |  |
| --- | --- |
| Bit field mapped to index | VRB-to-PRB mapping |
| 0 | Non-interleaved |
| 1 | Interleaved |

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m*d of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.1]

In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size*configured for PUSCH and the size of the carrier bandwidth part as defined in Table 6.1.2.2.1-1.

Table 6.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Carrier Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | *2* | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a uplink carrier bandwidth part *i* of sizePRBs is given by  where

- the size of the first RBG is ,

- the size of the last RBG is if and *P* otherwise.

- the size of all other RBG is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency of the carrier bandwidth part and starting at the lowest frequency. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB of the bitmap. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

- if *mcs-Table* in *PUSCH-Config* is set to 'qam256', and PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-Table* in *PUSCH-Config* is set to 'qam64LowSE', the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-2: MCS index table 2 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 193 | 0.3770 |
| 2 | 2 | 308 | 0.6016 |
| 3 | 2 | 449 | 0.8770 |
| 4 | 2 | 602 | 1.1758 |
| 5 | 4 | 378 | 1.4766 |
| 6 | 4 | 434 | 1.6953 |
| 7 | 4 | 490 | 1.9141 |
| 8 | 4 | 553 | 2.1602 |
| 9 | 4 | 616 | 2.4063 |
| 10 | 4 | 658 | 2.5703 |
| 11 | 6 | 466 | 2.7305 |
| 12 | 6 | 517 | 3.0293 |
| 13 | 6 | 567 | 3.3223 |
| 14 | 6 | 616 | 3.6094 |
| 15 | 6 | 666 | 3.9023 |
| 16 | 6 | 719 | 4.2129 |
| 17 | 6 | 772 | 4.5234 |
| 18 | 6 | 822 | 4.8164 |
| 19 | 6 | 873 | 5.1152 |
| 20 | 8 | 682.5 | 5.3320 |
| 21 | 8 | 711 | 5.5547 |
| 22 | 8 | 754 | 5.8906 |
| 23 | 8 | 797 | 6.2266 |
| 24 | 8 | 841 | 6.5703 |
| 25 | 8 | 885 | 6.9141 |
| 26 | 8 | 916.5 | 7.1602 |
| 27 | 8 | 948 | 7.4063 |
| 28 | 2 | reserved | |
| 29 | 4 | reserved | |
| 30 | 6 | reserved | |
| 31 | 8 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.4.3 Test description

7.1.1.4.2.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of nPRB up to maximum value).

Test frequency NRf1 is as specified in clause 4.3.1 of TS 38.508-1 [4] using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in clause 6.2.3.1 of TS 38.508-1 [4].

NOTE: If pc\_supportOfRedCap\_r17=true, the FR1 test channel bandwidth is MIN {20MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}, and the FR2 test channel bandwidth is MIN {100MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}

7.1.1.4.2.4.3.2 Test procedure sequence

Table 7.1.1.4.2.4.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.4.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data for non-RedCap UE

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 136 ≤ TBS ≤ 12128 note 2 | 1 | 8\*FLOOR((TBS – 128)/8) |
| 12129 ≤ TBS ≤ 24200 | 2 | 8\*FLOOR((TBS – 200)/16) |
| 24201 ≤ TBS ≤ 36272 | 3 | 8\*FLOOR((TBS – 272)/24) |
| 36273 ≤ TBS ≤ 48344 | 4 | 8\*FLOOR((TBS – 344)/32) |
| 48345 ≤ TBS ≤ 60416 | 5 | 8\*FLOOR((TBS – 416)/40) |
| 60417 ≤ TBS ≤ 72488 | 6 | 8\*FLOOR((TBS – 488)/48) |
| 72489 ≤ TBS ≤ 84560 | 7 | 8\*FLOOR((TBS – 560)/56) |
| 84561 ≤ TBS ≤ 96632 | 8 | 8\*FLOOR((TBS – 632)/64) |
| 96633 < TBS ≤ 108704 | 9 | 8\*FLOOR((TBS –704)/72) |
| 108705 ≤ TBS ≤ 120776 | 10 | 8\*FLOOR((TBS – 776)/80) |
| 120777 ≤ TBS ≤ 132848 | 11 | 8\*FLOOR((TBS – 848)/88) |
| 132849 ≤ TBS ≤ 144920 | 12 | 8\*FLOOR((TBS – 920)/96) |
| TBS > 144920 | 13 | 8\*FLOOR((TBS – 992)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | |

Table 7.1.1.4.2.4.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data for non-RedCap UE

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 120 ≤ TBS ≤ 12112 note 2 | 1 | 8\*FLOOR((TBS – 112)/8) |
| 12113 ≤ TBS ≤24168 | 2 | 8\*FLOOR((TBS – 168)/16) |
| 24169 ≤ TBS ≤ 36224 | 3 | 8\*FLOOR((TBS – 224)/24) |
| 36225 ≤ TBS ≤ 48280 | 4 | 8\*FLOOR((TBS – 280)/32) |
| 48281≤ TBS ≤ 60336 | 5 | 8\*FLOOR((TBS – 336)/40) |
| 60337 ≤ TBS ≤ 72392 | 6 | 8\*FLOOR((TBS – 392)/48) |
| 72393 ≤ TBS ≤ 84448 | 7 | 8\*FLOOR((TBS – 448)/56) |
| 84449 ≤ TBS ≤ 96504 | 8 | 8\*FLOOR((TBS – 504)/64) |
| 96505 < TBS ≤ 108560 | 9 | 8\*FLOOR((TBS – 560)/72) |
| 108561 ≤ TBS ≤ 120616 | 10 | 8\*FLOOR((TBS – 616)/80) |
| 120617 ≤ TBS ≤ 132672 | 11 | 8\*FLOOR((TBS – 672)/88) |
| 132673 ≤ TBS ≤ 144728 | 12 | 8\*FLOOR((TBS – 728)/96) |
| TBS > 144728 | 13 | 8\*FLOOR((TBS – 784)/104) |
| NOTE 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in clause 9.9.4.12 of TS 24.301 [21]). The PDCP SDU size of each PDCP SDU is: PDCP SDU size = (TBS - N\*PDCP header size - N\*AMD PDU header size - N\*MAC header size - Size of Timing Advance - RLC Status PDU size- MAC header for RLC Status PDU) / N, where: PDCP header size is 16 bits for the RLC AM and 12-bit SN case; AMD PDU header size is 16 bits with 12 bit SN; MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken. Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits. This gives: PDCP SDU size = 8\*FLOOR((TBS - N\*16- N\*16 - N\*24 -56 )/(8\*N)) bits.  NOTE 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 120 bits. | | |

Table 7.1.1.4.2.4.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| = | Nominal RBG size *P (Configuration1)* | Size of last RBG | Allowed Values |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160,168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160,169, 176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158,160, 174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.2.4.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comment | Condition |
| number of layers (ʋ) | 1 |  |  |
| mcs-Table | qam256 |  |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PUSCH |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND Steps 1-5 |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND pc\_ra\_Type0\_PUSCH AND Steps 6-10 |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.2.4.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and  from 0 to 27. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.4.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.2.4.3.2-2/2AA. (Note 4)  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 3) | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.4.3.2-2/2AA. (Note 5) | - | - | - | - |
| 3 | After 300ms, the SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After 60ms of step 3 SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | (NxPDCP SDUs) | 2 | P |
| - | EXCEPTION : Steps 5Aa1 to 10 are executed if pc\_ra\_Type0\_PUSCH | - | *-* | - | - |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PUSCH-Config* with IE resourceAllocation set to resourceAllocationType0 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of  as per Table 7.1.1.4.2.4.3.2-2A in BWP, time domain resource length L 3 to 14-S and  from 0 to 27. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.4.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.2.4.3.2-2/2AA. (Note 4)  Skip the execution of steps 7 to 10 for which the TBS size equal to 3824 or 3840. (Note 3) | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.4.3.2-2/2AA. (Note 5) | - | - | - | - |
| 8 | After 300ms, the SS transmits all PDCP SDUs (NSDUs) as created in step 7 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 9 | After 60ms of step 8 SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 10 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 8 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | (NxPDCP SDUs) | 1 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15].  Note 4: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.3.3.2-2 is used and X =136. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.3.3.2-2AA is used and X=120.  Note 5: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.3.3.2-2 is used. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.3.3.2-2AA is used. | | | | | |

7.1.1.4.2.4.3.3 Specific message contents

[None].

###### 7.1.1.4.2.5 UL-SCH Transport Block Size selection / DCI format 0\_0 / Transform precoding and 64QAM

7.1.1.4.2.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and transform precoding enabled}

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_0 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and modulation and coding }

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.1]

DCI format 0\_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –  bits where

-  is the size of the active UL bandwidth part in case DCI format 0\_0 is monitored in the UE specific search space and satisfying

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

- otherwise,  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1 and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is not configured on both UL and SUL the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured;

- If the UL/SUL indicator is not present in DCI format 0\_0, the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by TC-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –bits where

-  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if  and  otherwise

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214], using Table 5.1.3.1-1

- New data indicator – 1 bit, reserved

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits, reserved

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit if the cell has two ULs and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If 1 bit, reserved, and the corresponding PUSCH is always on the same UL carrier as the previous transmission of the same TB

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space and satisfies both of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in UE specific search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.2]

n uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

...

else

- if *mcs-TableTransformPrecoder* in *PUSCH-Config* is set to 'qam256', and the PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1.-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-TableTransformPrecoder* in *PUSCH-Config* is set to 'qam64LowSE', and the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 6.1.4.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 6.1.4.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-TableTransformPrecoder* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-TableTransformPrecoder* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 6.1.4.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 6.1.4.1-1to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

end

For Table 6.1.4.1-1 and Table 6.1.4.1-2, if higher layer parameter *PUSCH-tp-pi2BPSK* is configured, *q* = 1 otherwise *q*=2.

Table 6.1.4.1-1: MCS index table for PUSCH with transform precoding and 64QAM

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order *Qm* | Target code Rate R x 1024 | Spectral  efficiency |
| **0** | q | 240/ q | 0.2344 |
| **1** | q | 314/ q | 0.3066 |
| **2** | 2 | 193 | 0.3770 |
| **3** | 2 | 251 | 0.4902 |
| **4** | 2 | 308 | 0.6016 |
| **5** | 2 | 379 | 0.7402 |
| **6** | 2 | 449 | 0.8770 |
| **7** | 2 | 526 | 1.0273 |
| **8** | 2 | 602 | 1.1758 |
| **9** | 2 | 679 | 1.3262 |
| **10** | ~~4~~ | 340 | 1.3281 |
| **11** | 4 | 378 | 1.4766 |
| **12** | 4 | 434 | 1.6953 |
| **13** | 4 | 490 | 1.9141 |
| **14** | 4 | 553 | 2.1602 |
| **15** | 4 | 616 | 2.4063 |
| **16** | 4 | 658 | 2.5703 |
| **17** | 6 | 466 | 2.7305 |
| **18** | 6 | 517 | 3.0293 |
| **19** | 6 | 567 | 3.3223 |
| **20** | 6 | 616 | 3.6094 |
| **21** | 6 | 666 | 3.9023 |
| **22** | 6 | 719 | 4.2129 |
| **23** | 6 | 772 | 4.5234 |
| **24** | 6 | 822 | 4.8164 |
| **25** | 6 | 873 | 5.1152 |
| **26** | 6 | 910 | 5.3320 |
| **27** | 6 | 948 | 5.5547 |
| **28** | q | reserved | |
| **29** | 2 | reserved | |
| **30** | 4 | reserved | |
| **31** | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in*PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.5.3 Test description

7.1.1.4.2.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of nPRB up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in clause 4.3.1 of TS 38.508-1 [4] using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in clause 6.2.3.1 of TS 38.508-1 [4].

NOTE: If pc\_supportOfRedCap\_r17=true, the FR1 test channel bandwidth is MIN {20MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}, and the FR2 test channel bandwidth is MIN {100MHz, common highest mandatory UL and DL channel bandwidth in clause 4.3.1 of TS 38.508-1 [4]}

7.1.1.4.2.5.3.2 Test procedure sequence

Table 7.1.1.4.2.5.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.5.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data for non-RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤ 12128 note 2 | | 1 | | 8\*FLOOR((TBS – 128)/8) | |
| 12129 ≤ TBS ≤ 24200 | | 2 | | 8\*FLOOR((TBS – 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS – 272)/24) | |
| 36273 ≤ TBS ≤ 48344 | | 4 | | 8\*FLOOR((TBS – 344)/32) | |
| 48345≤ TBS ≤ 60416 | | 5 | | 8\*FLOOR((TBS – 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS – 488)/48) | |
| 72489 ≤ TBS ≤ 84560 | | 7 | | 8\*FLOOR((TBS – 560)/56) | |
| 84561 ≤ TBS ≤ 96632 | | 8 | | 8\*FLOOR((TBS – 632)/64) | |
| 96633 < TBS ≤ 108704 | | 9 | | 8\*FLOOR((TBS – 704)/72) | |
| 108705 ≤ TBS ≤ 120776 | | 10 | | 8\*FLOOR((TBS – 776)/80) | |
| 120777 ≤ TBS ≤ 132848 | | 11 | | 8\*FLOOR((TBS – 848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS – 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS – 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS – 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS – 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS – 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS – 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS – 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS – 1424)/152) | |
| TBS > 229424 | | 20 | | 8\*FLOOR((TBS – 1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.2.5.3.2-2A: Number of uplink PDCP SDUs and PDCP SDU size used as test data for RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 120 ≤ TBS ≤ 12112 note 2 | | 1 | | 8\*FLOOR((TBS – 112)/8) | |
| 12113 ≤ TBS ≤ 24168 | | 2 | | 8\*FLOOR((TBS – 168)/16) | |
| 24169 ≤ TBS ≤ 36224 | | 3 | | 8\*FLOOR((TBS – 224)/24) | |
| 36225 ≤ TBS ≤ 48280 | | 4 | | 8\*FLOOR((TBS – 280)/32) | |
| 48281≤ TBS ≤ 60336 | | 5 | | 8\*FLOOR((TBS – 336)/40) | |
| 60337 ≤ TBS ≤ 72392 | | 6 | | 8\*FLOOR((TBS – 392)/48) | |
| 72393 ≤ TBS ≤ 84448 | | 7 | | 8\*FLOOR((TBS – 448)/56) | |
| 84449 ≤ TBS ≤ 96504 | | 8 | | 8\*FLOOR((TBS – 504)/64) | |
| 96505 < TBS ≤ 108560 | | 9 | | 8\*FLOOR((TBS – 560)/72) | |
| 108561 ≤ TBS ≤ 120616 | | 10 | | 8\*FLOOR((TBS – 616)/80) | |
| 120617 ≤ TBS ≤ 132672 | | 11 | | 8\*FLOOR((TBS – 672)/88) | |
| 132673 ≤ TBS ≤ 144728 | | 12 | | 8\*FLOOR((TBS – 728)/96) | |
| 144729 ≤ TBS ≤ 156784 | | 13 | | 8\*FLOOR((TBS – 784)/104) | |
| 156785 ≤ TBS ≤ 168840 | | 14 | | 8\*FLOOR((TBS – 840)/112) | |
| 168841 ≤ TBS ≤ 180896 | | 15 | | 8\*FLOOR((TBS – 896)/120) | |
| 180897 ≤ TBS ≤ 192952 | | 16 | | 8\*FLOOR((TBS – 952)/128) | |
| 192953 ≤ TBS ≤ 205008 | | 17 | | 8\*FLOOR((TBS – 1008)/136) | |
| 205009 ≤ TBS ≤ 217064 | | 18 | | 8\*FLOOR((TBS – 1064)/144) | |
| 217065 ≤ TBS ≤ 229120 | | 19 | | 8\*FLOOR((TBS – 1120)/152) | |
| TBS > 229120 | | 20 | | 8\*FLOOR((TBS – 1176)/160) | |
| NOTE 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in clause 9.9.4.12 of TS 24.301 [21]). The PDCP SDU size of each PDCP SDU is: PDCP SDU size = (TBS - N\*PDCP header size - N\*AMD PDU header size - N\*MAC header size - Size of Timing Advance - RLC Status PDU size- MAC header for RLC Status PDU) / N, where: PDCP header size is 16 bits for the RLC AM and 12-bit SN case; AMD PDU header size is 16 bits with 12 bit SN; MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken. Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits. This gives: PDCP SDU size = 8\*FLOOR((TBS - N\*16- N\*16 - N\*24 -56 )/(8\*N)) bits.  NOTE 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 120 bits. | | | | | |

Table 7.1.1.4.2.5.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 |  |
| *transformPrecoder* | enabled |  |

Table 7.1.1.4.2.5.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and  from 0 to 27. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.5.3.2-1 and larger than or equal to X bits as specified in Table 7.1.1.4.2.5.3.2-2/2A. (Note 3)  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 1)  Skip the execution of steps 1 to 5 for > 27 and  < 5. (Note2) | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.5.3.2-2/2A. (Note 4) | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request , SS transmits UL Grant DCI 0\_0, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI Format 0\_0, S, L,and *nPRB.*) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N x PDCP SDU) | 1 | P |
| Note 1: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15].  Note 2: For > 27 and  < 5, the resulting TBS is very small leading to CRC errors in decoding UL data.  Note 3: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.5.3.2-2 is used and X =136. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.5.3.2-2AA is used and X=120.  Note 4: For pc\_supportOfRedCap\_r17=false, Table 7.1.1.4.2.5.3.2-2 is used. For pc\_supportOfRedCap\_r17=true, Table 7.1.1.4.2.5.3.2-2AA is used. | | | | | |

7.1.1.4.2.5.3.3 Specific message contents

None.

###### 7.1.1.4.2.6 UL-SCH Transport Block Size selection / DCI format 0\_2

7.1.1.4.2.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_2 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and modulation and coding}

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.3, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.1, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.212, clause 7.3.1.1.3]

DCI format 0\_2 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_2 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0, 1, 2 or 3 bits determined by higher layer parameter *carrierIndicatorSizeDCI-0-2*, as defined in Clause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell or UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell but only one carrier in the cell is configured for PUSCH transmission; otherwise, 1 bit as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs configured by higher layers, excluding the initial UL bandwidth part. The bitwidth for this field is determined as bits, where

- if , in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following:

- bits if only resource allocation type 0 is configured, where is defined in Clause 6.1.2.2.1 of [6, TS 38.214]

- bits if only resource allocation type 1 is configured, or bits if *resourceAllocationDCI-0-2-r16* is configured as '*dynamicSwitch'*, where is the size of the active UL bandwidth part, is defined as in clause 4.4.4.4 of [4, TS 38.211] and is given by higher layer parameter *resourceAllocationType1GranularityDCI-0-2.* If the higher layer parameter *resourceAllocationType1GranularityDCI-0-2* is not configured, is equal to 1.

- If *resourceAllocationDCI-0-2-r16* is configured as '*dynamicSwitch'*, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Clause 6.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the LSBs provide the resource allocation as follows:

- For PUSCH hopping with resource allocation type 1:

- MSB bits are used to indicate the frequency offset according to Clause 6.3 of [6, TS 38.214], where if the higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* contains two offset values and if the higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* contains four offset values

- bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

- bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if *resourceAllocationDCI-0-2-r16* is configured as '*dynamicSwitch'* for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bitwidth of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bitwidth of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, 4, 5 or 6 bits as defined in Clause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-2* if the higher layer parameter is configured, or *I* is the number of entries in the higher layer parameter *PUSCH-TimeDomainResourceAllocationList* if the higher layer parameter *PUSCH-TimeDomainResourceAllocationList* is configured and the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-2* is not configured; otherwise *I* is the number of entries in the default table*.*

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if the higher layer parameter *frequencyHoppingDCI-0-2* is not configured;

- 1 bit according to Table 7.3.1.1.1-3 otherwise, only applicable to resource allocation type 1, as defined in Clause 6.3 of [6, TS 38.214].

- Modulation and coding scheme –5 bits as defined in Clause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-DCI-0-2*

- If 0 bit is configured, *rvid* to be applied is 0;

- 1 bit according to Table 7.3.1.2.3-1;

- 2 bits according to Table 7.3.1.1.1-2.

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-0-2*

- Downlink assignment index – 0, 1, 2 or 4 bits

- 0 bit if the higher layer parameter *downlinkAssignmentIndexDCI-0-2* is not configured;

- 1, 2 or 4 bits otherwise,

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorDCI-0-2* is configured, if the bit width of the Downlink assignment index in DCI format 0\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 0\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 0\_2 for the two HARQ-ACK codebooks are the same.

- TPC command for scheduled PUSCH – 2 bits as defined in Clause 7.1.1 of [5, TS38.213]

- SRS resource indicator – or bits, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*',

-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*nonCodeBook*' and

- if UE supports operation with *maxMIMO-LayersDCI-0-2* and the higher layer parameter *maxMIMO-LayersDCI-0-2* of *PUSCH-ServingCellConfig* of the serving cell is configured, *Lmax* is given by that parameter

- otherwise, *Lmax* is given by the maximum number of layers for PUSCH supported by the UE for the serving cell for non-codebook based operation.

- bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*'.

- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2*, and *codebookSubsetDCI-0-2*;

- 4 or 5 bits according to Table 7.3.1.1.2-2A for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1,* the values of higher layer parameters *maxRankDCI-0-2=2,* transform precoder is disabled, and according to the value of higher layer parameter *codebookSubsetDCI-0-2*;

- 4 or 6 bits according to Table 7.3.1.1.2-2B for 4 antenna ports, if *txConfig = codebook, ul-FullPowerTransmission =fullpowerMode1,* the values of higher layer parameters *maxRankDCI-0-2=3 or 4,* transform precoder is disabled, and according to the value of higher layer parameter *codebookSubsetDCI-0-2*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2* and *codebookSubsetDCI-0-2*;

- 3 or 4 bits according to Table 7.3.1.1.2-3A for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1*, *maxRankDCI-0-2=1*, and according to whether transform precoder is enabled or disabled, and the value of higher layer parameter *codebookSubsetDCI-0-2*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2* and *codebookSubsetDCI-0-2*;

- 2 bits according to Table 7.3.1.1.2-4A for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1*, transform precoder is disabled, the *maxRankDCI-0-2=2*, and *codebookSubsetDCI-0-2=nonCoherent*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2* and *codebookSubsetDCI-0-2*;

- 2 bits according to Table 7.3.1.1.2-5A for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1*, *maxRankDCI-0-2=1*, and according to whether transform precoder is enabled or disabled, and the value of higher layer parameter *codebookSubsetDCI-0-2*.

For the higher layer parameter *txConfig=codebook*, if *ul-FullPowerTransmission* is configured to *fullpowerMode2*, the values of higher layer parameters *maxRankDCI-0-2* is configured to be larger than 2, and at least one SRS resource with 4 antenna ports is configured in an SRS resource set with usage set to 'codebook' and an SRS resource with 2 antenna ports is indicated via SRI in the same SRS resource set, then Table 7.3.1.1.2-4 is used.

For the higher layer parameter *txConfig = codebook*, if different SRS resources with different number of antenna ports are configured, the bitwidth is determined according to the maximum number of ports in an SRS resource among the configured SRS resources in an SRS resource set with usage set to 'codebook'. If the number of ports for a configured SRS resource in the set is less than the maximum number of ports in an SRS resource among the configured SRS resources, a number of most significant bits with value set to '0' are inserted to the field.

- Antenna ports – number of bits determined by the following:

- 0 bit if higher layer parameter *antennaPortsFieldPresenceDCI-0-2* is notconfigured;

- 2, 3, 4, or 5 bits otherwise,

- 2 bits as defined by Tables 7.3.1.1.2-6, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=1, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 2 bits as defined by 7.3.1.1.2-6A, if transform precoder is enabled, and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=1, where nSCID is the scrambling identity for antenna ports defined in Clause 6.4.1.1.1.2, in [4, TS38.211];

- 4 bits as defined by Tables 7.3.1.1.2-7, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=2, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 4 bits as defined by Tables 7.3.1.1.2-7A, if transform precoder is enabled, and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=2, where *nSCID* is the scrambling identity for antenna ports defined in Clause 6.4.1.1.1.2, in [4, TS38.211];

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2* and *dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2* and is configured with *antennaPortsFieldPresenceDCI-0-2*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2* and is the "Antenna ports" bitwidthderived according to *dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2*. A number of zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of and .

If a UE is not configured with higher layer parameter *antennaPortsFieldPresenceDCI-0-2,* antenna port(s) are defined assuming bit field index value 0 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23.

- SRS request – 0, 1, 2 or 3 bits

- 0 bit if the higher layer parameter *srs-RequestDCI-0-2* is not configured;

- 1 bit as defined by Table 7.3.1.1.3-1 if higher layer parameter *srs-RequestDCI-0-2 = 1* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 2 bits if higher layer parameter *srs-RequestDCI-0-2 = 1* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second bit is defined by Table 7.3.1.1.3-1;

- 2 bits as defined by Table 7.3.1.1.2-24 if higher layer parameter *srs-RequestDCI-0-2 = 2* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 3 bits if higher layer parameter *srs-RequestDCI-0-2 = 2* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24;

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSizeDCI-0-2*.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured in either *dmrs-UplinkForPUSCH-MappingTypeA* or *dmrs-UplinkForPUSCH-MappingTypeB* and transform precoder is disabled, or if transform precoder is enabled, or if *maxRankDCI-0-2=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) when one PT-RS port and two PT-RS ports are configured by *maxNrofPorts* in *PTRS-UplinkConfig* respectively, and the DMRS ports are indicated by the Antenna ports field.

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and the "PTRS-DMRS association" field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the "PTRS-DMRS association" field is not present for the indicated bandwidth part.

- beta\_offset indicator – 0 bit if the higher layer parameter *betaOffsets = semiStatic*; otherwise 1 bit if 2 offset indexes are configured by higher layer parameter *dynamicDCI-0-2* as defined by Table 9.3-3A in [5, TS 38.213], and 2 bits if 4 offset indexes are configured by higher layer parameter *dynamicDCI-0-2* as defined by Table 9.3-3 in [5, TS 38.213].

When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorDCI-0-2* is configured, if the bit width of the beta\_offset indicator in DCI format 0\_2 for one HARQ-ACK codebook is not equal to that of the beta\_offset indicator in DCI format 0\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller beta\_offset indicator until the bit width of the beta\_offset indicator in DCI format 0\_2 for the two HARQ-ACK codebooks are the same.

- DMRS sequence initialization – 0 or 1 bit

- 0 bit if the higher layer parameter *dmrs-SequenceInitializationDCI-0-2* is not configured or if transform precoder is enabled;

- 1 bit if transform precoder is disabled and the higher layer parameter *dmrs-SequenceInitializationDCI-0-2* is configured.

- UL-SCH indicator – 1 bit. A value of "1" indicates UL-SCH shall be transmitted on the PUSCH and a value of "0" indicates UL-SCH shall not be transmitted on the PUSCH. Except for DCI format 0\_2 with CRC scrambled by SP-CSI-RNTI, a UE is not expected to receive a DCI format 0\_2 with UL-SCH indicator of "0" and CSI request of all zero(s).

- Open-loop power control parameter set indication – 0 or 1 or 2 bits.

- 0 bit if the higher layer parameter *p0-PUSCH-SetList* is not configured;

- 1 or 2 bits otherwise,

- 1 bit if SRS resource indicator is present in the DCI format 0\_2;

- 1 or 2 bits as determined by higher layer parameter *olpc-ParameterSetDCI-0-2* if SRS resource indicator is not present in the DCI format 0\_2;

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-0-2* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

- Invalid symbol pattern indicator – 0 bit if higher layer parameter *invalidSymbolPatternIndicatorDCI-0-2* is not configured; otherwise 1 bit as defined in Clause 6.1.2.1 in [6, TS 38.214].

A UE does not expect that the bit width of a field in DCI format 0\_2 with CRC scrambled by CS-RNTI is larger than corresponding bit width of same field in DCI format 0\_2 with CRC scrambled by C-RNTI for the same serving cell. If the bit width of a field in the DCI format 0\_2 with CRC scrambled by CS-RNTI is not equal to that of the corresponding field in the DCI format 0\_2 with CRC scrambled by C-RNTI for the same serving cell, a number of most significant bits with value set to '0' are inserted to the field in DCI format 0\_2 with CRC scrambled by CS-RNTI until the bit width equals that of the corresponding field in the DCI format 0\_2 with CRC scrambled by C-RNTI for the same serving cell.

Table 7.3.1.1.3-1: 1 bit SRS request in DCI format 0\_2 and DCI format 1\_2

|  |  |
| --- | --- |
| Value of SRS request field | Triggered aperiodic SRS resource set(s) for DCI format 0\_2 and 1\_2 |
| 0 | No aperiodic SRS resource set triggered |
| 1 | SRS resource set(s) configured with higher layer parameter *aperiodicSRS-ResourceTrigger* set to 1 or an entry in *aperiodicSRS-ResourceTriggerList* set to 1 |

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report(s) by a '*CSI request'* field on a DCI, the '*Time domain resource assignment'* field value *m* of the DCI provides a row index *m* + 1to the allocated table as defined in Clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and the *K2* value is determined as , where  are the corresponding list entries of the higher layer parameter

- reportSlotOffsetListDCI-0-2, if PUSCH is scheduled by DCI format 0\_2 and reportSlotOffsetListDCI-0-2 is configured;

- *reportSlotOffsetListDCI-0-1*, if PUSCH is scheduled by DCI format 0\_1 and *reportSlotOffsetListDCI-0-1* is configured;

- *reportSlotOffsetList*, otherwise;

in *CSI-ReportConfig* for the  triggered CSI Reporting Settings and  is the *(m+1)*th entry of .

- The slot *Ks* where the UE shall transmit the PUSCH is determined by *K2* as *Ks* =, if UE is configured with ca-SlotOffset for at least one of the scheduled and scheduling cell, *Ks* =, otherwise, and where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively,

- and are the and the, respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell receiving the PDCCH, and are the and the,respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell transmitting the PUSCH, as defined in clause 4.5 of [4, TS 38.211], and

- for PUSCH scheduled by DCI format 0\_1, if *pusch-RepTypeIndicatorDCI-0-1* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. For PUSCH scheduled by DCI format 0\_2, if *pusch-RepTypeIndicatorDCI-0-2* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. Otherwise, the UE applies PUSCH repetition Type A procedure when determining the time domain resource allocation for PUSCH scheduled by PDCCH.

- For PUSCH repetition Type A, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- For PUSCH repetition Type B, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are provided by *startSymbol* and *length* of the indexed row of the resource allocation table, respectively.

- For PUSCH repetition Type A, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

- For PUSCH repetition Type B, the PUSCH mapping type is set to Type B.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*;

- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*;

- otherwise *K=1*.

If a UE is configured with higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, the UE does not expect to be configured with *pusch-AggregationFactor*.

For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, … *K*-1, is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or *n*th actual repetition (repetition Type B) | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI except for a PUSCH transmission scheduled by a RAR UL grant or fallbackRAR UL grant, in which case the frequency domain resource allocation is determined according to clause 8.3 of [6, 38.213] or a MsgA PUSCH transmission with frequency domain resource allocation determined according to clause 8.1A of [6, 38.213]. Three uplink resource allocation schemes type 0, type 1 and type 2 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 and type 2 are supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the '*Frequency domain resource'* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to 'dynamicSwitch', for DCI format 0\_1 or setting a higher layer parameter *resourceAllocationDCI-0-2* in *pusch-Config* to 'dynamicSwitch' for DCI format 0\_2, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* for DCI format 0\_1 or the higher layer parameter *resourceAllocationDCI-0-2* for DCI format 0\_2. The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_1 and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured, uplink type 2 resource allocation is used.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used, except when any of the higher layer parameters *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured in which case uplink resource allocation type 2 is used.

The UE expects that either none or both of *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured.

If a bandwidth part indicator field is not configured in the scheduling DCI or the UE does not support active bandwidth part change via DCI, the RB indexing for uplink type 0, type 1 and type 2 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI and the UE supports active bandwidth part change via DCI, the RB indexing for uplink type 0, type 1, type 2 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part. RB numbering starts from the lowest RB in the determined uplink bandwidth part.

[38.214 clause 6.1.2.2.1]

In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured in *pusch-Config* and the size of the bandwidth part as defined in Table 6.1.2.2.1-1.

Table 6.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | *2* | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in any common search space in which case the size of the initial UL bandwidth part  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

When the DCI size for DCI format 0\_0 in USS is derived from the initial UL BWP with size  but applied to another active BWP with size of , an uplink type 1 resource block assignment field consists of a resource indication value (*RIV*) corresponding to a starting resource block and a length in terms of virtually contiguously allocated resource blocks .

The resource indication value is defined by

if  then



else



where, and where shall not exceed .

If , *K* is the maximum value from set {1, 2, 4, 8} which satisfies ; otherwise *K* = 1.

When the scheduling grant is received with DCI format 0\_2, an uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block group *RBGstart*=0, 1, …, *NRBG*-1 and a length in terms of virtually contiguously allocated resource block groups *LRBGs*=1, …, *NRBG*, where the resource block groups are defined as in 6.1.2.2.1 with *P* defined by *resourceAllocationType1GranularityDCI-0-2* if the UE is configured with higher layer parameter *resourceAllocationType1GranularityDCI-0-2*, and *P*=1 otherwise*.* The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 6.1.4.1]

For a PUSCH scheduled by RAR UL grant or

for a PUSCH scheduled by a fallbackRAR UL grant or

for a MsgA PUSCH transmission, or

for a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, or

for a PUSCH scheduled by a DCI format 0\_1 or DCI format 0\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, SP-CSI-RNTI, or

for a PUSCH with configured grant using CS-RNTI, and

if transform precoding is disabled for this PUSCH transmission according to Clause 6.1.3

- if *mcs-TableDCI-0-2* in *pusch-Config* is set to 'qam256', and PUSCH is scheduled by a PDCCH with DCI format 0\_2 with CRC scrambled by C-RNTI or SP-CSI-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel;

- elseif the UE is not configured with MCS-C-RNTI, *mcs-TableDCI-0-2* in *pusch-Config* is set to 'qam64LowSE', and the PUSCH is scheduled by a PDCCH by a PDCCH with DCI format 0\_2 with CRC scrambled by C-RNTI or SP-CSI-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-3: MCS index table 3 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| **0** | 2 | 30 | 0.0586 |
| **1** | 2 | 40 | 0.0781 |
| **2** | 2 | 50 | 0.0977 |
| **3** | 2 | 64 | 0.1250 |
| **4** | 2 | 78 | 0.1523 |
| **5** | 2 | 99 | 0.1934 |
| **6** | 2 | 120 | 0.2344 |
| **7** | 2 | 157 | 0.3066 |
| **8** | 2 | 193 | 0.3770 |
| **9** | 2 | 251 | 0.4902 |
| **10** | 2 | 308 | 0.6016 |
| **11** | 2 | 379 | 0.7402 |
| **12** | 2 | 449 | 0.8770 |
| **13** | 2 | 526 | 1.0273 |
| **14** | 2 | 602 | 1.1758 |
| **15** | 4 | 340 | 1.3281 |
| **16** | 4 | 378 | 1.4766 |
| **17** | 4 | 434 | 1.6953 |
| **18** | 4 | 490 | 1.9141 |
| **19** | 4 | 553 | 2.1602 |
| **20** | 4 | 616 | 2.4063 |
| **21** | 6 | 438 | 2.5664 |
| **22** | 6 | 466 | 2.7305 |
| **23** | 6 | 517 | 3.0293 |
| **24** | 6 | 567 | 3.3223 |
| **25** | 6 | 616 | 3.6094 |
| **26** | 6 | 666 | 3.9023 |
| **27** | 6 | 719 | 4.2129 |
| **28** | 6 | 772 | 4.5234 |
| **29** | 2 | reserved | |
| **30** | 4 | reserved | |
| **31** | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or

for a PUSCH scheduled by fallbackRAR UL grant or

for a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, or

for a PUSCH scheduled by a DCI format 0\_1 or DCI format 0\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or

for a PUSCH transmission with configured grant, or

for a MsgA PUSCH transmission,

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols *L* of the PUSCH allocation according to Clause 6.1.2.1 for scheduled PUSCH or Clause 6.1.2.3 for configured PUSCH,  is the number of REs for DM-RS per PRB in the allocated duration including the overhead of the DM-RS CDM groups without data, as described for PUSCH with a configured grant in Clause 6.1.2.3 or as indicated by DCI format 0\_1 or DCI format 0\_2 or as described for DCI format 0\_0 in Clause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 6, 12, or 18), the  is assumed to be 0. For Msg3 or MsgA PUSCH transmission the  is always set to 0. In case of PUSCH repetition Type B,  is determined assuming a nominal repetition with the duration of *L* symbols without segmentation.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Clause 5.1.3.2

- For a PUSCH scheduled by fallbackRAR UL grant, UE assumes the TB size determined by the UL grant in the fallbackRAR shall be the same as the TB size used in the corresponding MsgA PUSCH transmission.

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant,

- the TBS shall be determined from *configuredGrantConfig* for a configured grant Type 1 PUSCH.

- the TBS shall be determined from the most recent PDCCH scheduling a configured grant Type 2 PUSCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant,

- the TBS shall be determined from *configuredGrantConfig* for a configured grant Type 1 PUSCH.

- the TBS shall be determined from the most recent PDCCH scheduling a configured grant Type 2 PUSCH.

[TS 38.214, clause 5.1.3.2]

2) Unquantized intermediate variable (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-1 find the closest TBS that is not less than .

Table 5.1.3.2-1: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.6.3 Test description

7.1.1.4.2.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.2.6.3.2 Test procedure sequence

Table 7.1.1.4.2.6.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.6.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 136 ≤ TBS ≤12128 note 2 | 1 | 8\*FLOOR((TBS– 128)/8) |
| 12129 ≤ TBS≤24200 | 2 | 8\*FLOOR((TBS– 200)/16) |
| 24201 ≤ TBS ≤ 36272 | 3 | 8\*FLOOR((TBS– 272)/24) |
| 36273 ≤ TBS ≤48344 | 4 | 8\*FLOOR((TBS– 344)/32) |
| 48345≤ TBS ≤60416 | 5 | 8\*FLOOR((TBS– 416)/40) |
| 60417 ≤ TBS ≤ 72488 | 6 | 8\*FLOOR((TBS–488)/48) |
| 72489 ≤ TBS ≤84560 | 7 | 8\*FLOOR((TBS– 560)/56) |
| 84561 ≤ TBS≤96632 | 8 | 8\*FLOOR((TBS–632)/64) |
| 96633< TBS ≤108704 | 9 | 8\*FLOOR((TBS–704)/72) |
| 10705 ≤ TBS ≤120776 | 10 | 8\*FLOOR((TBS– 776)/80) |
| 120777≤ TBS ≤132848 | 11 | 8\*FLOOR((TBS–848)/88) |
| 132849 ≤ TBS ≤ 144920 | 12 | 8\*FLOOR((TBS– 920)/96) |
| TBS> 144920 | 13 | 8\*FLOOR((TBS– 992)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | |

Table 7.1.1.4.2.6.3.2-2A: Void

Table 7.1.1.4.2.6.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comment | Condition |
| mcs-TableDCI-0-2-r16 | Not Present | qam64 per default |  |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.2.6.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of  1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and  from 0 to 28.  Skip the execution of steps for = 28 and  < 4.  (Note 1) | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.6.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.6.3.2-2.  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 2) | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.6.3.2-2. | - | - | - | - |
| 3 | After 300ms, the SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After 60ms of step 3, SS transmits UL Grant DCI 0\_2, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI Format 0\_2, S, L,and *nPRB.*) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N x PDCP SDU) | 1 | P |
| Note 1: For = 28 and  < 4, the resulting TBS is very small leading to CRC errors in decoding UL data.  Note 2: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15]. | | | | | |

7.1.1.4.2.6.3.3 Specific message contents

Table 7.1.1.4.2.6.3.3-1: PUSCH-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2-r16CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2-r16CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| harq-ProcessNumberSizeDCI-0-2-r16 | 4 | nrofHARQ-ProcessesForPUSCH is 16 |  |
| numberOfBitsForRV-DCI-0-2-r16 | 2 |  |  |
| resourceAllocationDCI-0-2-r16 | resourceAllocationType1 |  |  |
| } |  |  |  |

###### 7.1.1.4.2.7 UL-SCH Transport Block Size selection / TBoMS procedure

7.1.1.4.2.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and supporting TBoMS }

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_1 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment including numberOfSlotsTBoMS and modulation and coding }

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.7.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-17 requirements.

[TS 38.212, clause 7.3.1.1.2]

DCI format 0\_1 is used for the scheduling of one or multiple PUSCH in one cell, or indicating CG downlink feedback information (CG-DFI) to a UE.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

…

Otherwise, all the remaining fields are set as follows:

…

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active UL bandwidth part:

- If higher layer parameter *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is not configured

…

- bits if only resource allocation type 1 is configured, or  bits if *resourceAllocation* is configured as '*dynamicSwitch'*.

…

- For resource allocation type 1, the  LSBs provide the resource allocation as follows:

…

- For non-PUSCH hopping with resource allocation type 1:

-  bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]

…

- Time domain resource assignment – 0, 1, 2, 3, 4, 5, or 6 bits

…

- If the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-1* is configured or if the higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH* is configured, 0, 1, 2, 3, 4, 5 or 6 bits as defined in Clause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-1* or *pusch-TimeDomainAllocationListForMultiPUSCH*;

…

- Modulation and coding scheme – 5 bits as defined in Clause 6.1.4.1 of [6, TS 38.214]

…

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report by a DCI or by a RAR UL grant or fallbackRAR UL grant, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI or the *PUSCH time resource allocation* field value *m* of the RAR UL grant or of the fallbackRAR UL grant provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, the number of slots used for TBS determination (if *numberOfSlotsTBoMS* is present in the resource allocation table), and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

…

- for PUSCH scheduled by DCI format 0\_1 or DCI format 0\_2, if *numberOfSlotsTBoMS* is present and larger than 1, the UE applies TB processing over multiple slots procedure when determining the time domain resource allocation.

- For PUSCH repetition Type A and TB processing over multiple slots, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

…

- For PUSCH repetition Type A and TB processing over multiple slots, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

…

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For TB processing over multiple slots, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1,

- the number of slots used for TBS determination *N* is indicated by *numberOfSlotsTBoMS.*

- the number of repetitions *K* of the number of slots *N* used for TBS determination is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions *K* is equal to *numberOfRepetitions*;

- otherwise, *K=1*.

- when the UE supports repetition of TB processing over multiple slots, the UE does not expect that is larger than 32.

…

For unpaired spectrum:

…

- The UE determines slots for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationDedicated* and *ssb-PositionsInBurst*, and the TDRA information field value in the DCI format 0\_1 or 0\_2.

- A slot is not counted in the number of slots for a PUSCH transmission of TB processing over multiple slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.

…

For paired spectrum and SUL band:

- The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.

…

If a UE would transmit a PUSCH of PUSCH repetition Type A when *AvailableSlotCounting* is enabled and K>1 or a TB processing over multiple slots over slots, and the UE does not transmit the PUSCH of a TB processing over multiple slots or the PUSCH repetition Type A in a slot from the slots, according to Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213], the UE counts the slots in the number of slots.

…

For TB processing over multiple slots:

- For unpaired spectrum, the same symbol allocation is applied across the slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the slots determined for the PUSCH transmission, applying the same symbol allocation in each slot.

- For paired spectrum or supplementary uplink band, the same symbol allocation is applied across the consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the consecutive slots applying the same symbol allocation in each slot.

- For the case of reduced capability half-duplex UE, the same symbol allocation is applied across the slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the slots determined for the PUSCH transmission, applying the same symbol allocation in each slot.

…

For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, Clause 11.2A, Clause 15 and Clause 17.2 of [6, TS 38.213].

…

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI except for a PUSCH transmission scheduled by a RAR UL grant or fallbackRAR UL grant, in which case the frequency domain resource allocation is determined according to clause 8.3 of [6, 38.213] or a MsgA PUSCH transmission with frequency domain resource allocation determined according to clause 8.1A of [6, 38.213]. Three uplink resource allocation schemes type 0, type 1 and type 2 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 and type 2 are supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the '*Frequency domain resource'* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to 'dynamicSwitch', for DCI format 0\_1 or setting a higher layer parameter *resourceAllocationDCI-0-2* in *pusch-Config* to 'dynamicSwitch' for DCI format 0\_2, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* for DCI format 0\_1 or the higher layer parameter *resourceAllocationDCI-0-2* for DCI format 0\_2. The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_1 and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured, uplink type 2 resource allocation is used.

…

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

…

for a PUSCH scheduled by a DCI format 0\_1 or DCI format 0\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, SP-CSI-RNTI, or

…

if transform precoding is disabled for this PUSCH transmission according to Clause 6.1.3

…

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

…

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

…

for a PUSCH scheduled by a DCI format 0\_1 or DCI format 0\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or

…

if

…

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols *L* of the PUSCH allocation according to Clause 6.1.2.1 for scheduled PUSCH or Clause 6.1.2.3 for configured PUSCH,  is the number of REs for DM-RS per PRB in the allocated duration including the overhead of the DM-RS CDM groups without data, as described for PUSCH with a configured grant in Clause 6.1.2.3 or as indicated by DCI format 0\_1 or DCI format 0\_2 or as described for DCI format 0\_0 in Clause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 6, 12, or 18), the  is assumed to be 0. For Msg3 or MsgA PUSCH transmission the  is always set to 0. In case of PUSCH repetition Type B,  is determined assuming a nominal repetition with the duration of *L* symbols without segmentation.

- A UE determines the total number of REs allocated for PUSCH  as follows

- For TB processing over multiple slots, where  is the total number of allocated PRBs for the UE and *N* is the number of slots used for TBS determination indicated by *numberOfSlotsTBoMS*.

…

- Next, proceed with steps 2-4 as defined in Clause 5.1.3.2

…

[TS 38.214, clause 5.1.3.2]

2 Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.7.3 Test description

7.1.1.4.2.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of nPRB up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in clause 4.3.1 of TS 38.508-1 [4] using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in clause 6.2.3.1 of TS 38.508-1 [4].

7.1.1.4.2.7.3.2 Test procedure sequence

Table 7.1.1.4.2.7.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.7.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) | Number of MAC PDUs | MAC PDU size  [bits]  (Note 2) |
| 136 ≤ TBS ≤ 12128 (note 2) | 1 | 8\*FLOOR((TBS – 128)/8) | 1 | PDCP SDU size + 128 |
| 12129 < TBS ≤ 24200 | 2 | 8\*FLOOR((TBS – 200)/16) | 1 | 2\*PDCP SDU size + 200 |
| 24201 < TBS ≤ 36272 | 3 | 8\*FLOOR((TBS – 272)/24) | 1 | 3\*PDCP SDU size + 272 |
| 36273 < TBS ≤ 48344 | 4 | 8\*FLOOR((TBS – 344)/32) | 1 | 4\*PDCP SDU size + 344 |
| 48345 <TBS ≤ 60416 | 5 | 8\*FLOOR((TBS – 416)/40) | 1 | 5\*PDCP SDU size + 416 |
| 60417 < TBS ≤ 72488 | 6 | 8\*FLOOR((TBS – 488)/48) | 1 | 6\*PDCP SDU size + 488 |
| 72489 < TBS ≤ 84560 | 7 | 8\*FLOOR((TBS – 560)/56) | 1 | 7\*PDCP SDU size + 560 |
| 84561 < TBS ≤ 96632 | 8 | 8\*FLOOR((TBS – 632)/64) | 1 | 8\*PDCP SDU size + 632 |
| 96633 < TBS ≤ 108704 | 9 | 8\*FLOOR((TBS – 704)/72) | 1 | 9\*PDCP SDU size + 704 |
| 108705 < TBS ≤ 120776 | 10 | 8\*FLOOR((TBS – 776)/80) | 1 | 10\*PDCP SDU size + 776 |
| 120777 < TBS ≤ 132848 | 11 | 8\*FLOOR((TBS –848)/88) | 1 | 11\*PDCP SDU size + 848 |
| 132849 < TBS ≤ 144920 | 12 | 8\*FLOOR((TBS – 920)/96) | 1 | 12\*PDCP SDU size + 920 |
| 144921 < TBS ≤ 156992 | 13 | 8\*FLOOR((TBS – 992)/104) | 1 | 13\*PDCP SDU size + 992 |
| 156993 < TBS ≤ 169064 | 14 | 8\*FLOOR((TBS – 1064)/112) | 1 | 14\*PDCP SDU size + 1064 |
| 169065 < TBS ≤ 181136 | 15 | 8\*FLOOR((TBS – 1136)/120) | 1 | 15\*PDCP SDU size + 1136 |
| 181137 < TBS ≤ 193208 | 16 | 8\*FLOOR((TBS – 1208)/128) | 1 | 16\*PDCP SDU size + 1208 |
| 193209 < TBS ≤ 205280 | 17 | 8\*FLOOR((TBS – 1280)/136) | 1 | 17\*PDCP SDU size + 1280 |
| 205281 < TBS ≤ 217352 | 18 | 8\*FLOOR((TBS – 1352)/144) | 1 | 18\*PDCP SDU size + 1352 |
| 217353 < TBS ≤ 229424 | 19 | 8\*FLOOR((TBS – 1424)/152) | 1 | 19\*PDCP SDU size + 1424 |
| 229424 < TBS ≤ 241496 | 20 | 8\*FLOOR((TBS – 1496)/160) | 1 | 20\*PDCP SDU size + 1496 |
| 241496 < TBS ≤ 253568 | 21 | 8\*FLOOR((TBS – 1568)/168) | 2 | 10.5\*PDCP SDU size + 836 |
| 253568 < TBS ≤ 265640 | 22 | 8\*FLOOR((TBS – 1640)/176) | 2 | 11\*PDCP SDU size + 848 |
| 265640 < TBS ≤ 277712 | 23 | 8\*FLOOR((TBS – 1712)/184) | 2 | 11.5\*PDCP SDU size + 908 |
| 277712 < TBS ≤ 289784 | 24 | 8\*FLOOR((TBS – 1784)/192) | 2 | 12\*PDCP SDU size + 920 |
| 289784 < TBS ≤ 301856 | 25 | 8\*FLOOR((TBS – 1856)/200) | 2 | 12.5\*PDCP SDU size + 980 |
| 301856 < TBS ≤ 313928 | 26 | 8\*FLOOR((TBS – 1928)/208) | 2 | 13\*PDCP SDU size + 992 |
| 313928 < TBS ≤ 326000 | 27 | 8\*FLOOR((TBS – 2000)/216) | 2 | 13.5\*PDCP SDU size + 1052 |
| 326000 < TBS ≤ 338072 | 28 | 8\*FLOOR((TBS – 2072)/224) | 2 | 14\*PDCP SDU size + 1064 |
| 338072 < TBS ≤ 350144 | 29 | 8\*FLOOR((TBS – 2144)/232) | 2 | 14.5\*PDCP SDU size + 1124 |
| 350144 < TBS ≤ 362216 | 30 | 8\*FLOOR((TBS – 2216)/240) | 2 | 15\*PDCP SDU size + 1136 |
| 362216 < TBS ≤ 374288 | 31 | 8\*FLOOR((TBS – 2288)/248) | 2 | 15.5\*PDCP SDU size + 1196 |
| 374288 < TBS ≤ 386360 | 32 | 8\*FLOOR((TBS – 2360)/256) | 2 | 16\*PDCP SDU size + 1208 |
| 386360 < TBS ≤ 398432 | 33 | 8\*FLOOR((TBS – 2432)/264) | 2 | 16.5\*PDCP SDU size + 1268 |
| 398432 < TBS ≤ 410504 | 34 | 8\*FLOOR((TBS – 2504)/272) | 2 | 17\*PDCP SDU size + 1280 |
| 410504 < TBS ≤ 422576 | 35 | 8\*FLOOR((TBS – 2576)/280) | 2 | 17.5\*PDCP SDU size + 1340 |
| 422576 < TBS ≤ 434648 | 36 | 8\*FLOOR((TBS – 2648)/288) | 2 | 18\*PDCP SDU size + 1352 |
| 434648 < TBS ≤ 446720 | 37 | 8\*FLOOR((TBS – 2720)/296) | 2 | 18.5\*PDCP SDU size + 1412 |
| 446720 < TBS ≤ 458792 | 38 | 8\*FLOOR((TBS – 2792)/304) | 2 | 19\*PDCP SDU size + 1424 |
| 458792 < TBS ≤ 470864 | 39 | 8\*FLOOR((TBS – 2864)/312) | 2 | 19.5\*PDCP SDU size + 1484 |
| TBS > 470864 | 40 | 8\*FLOOR((TBS – 2936)/320) | 2 | 20\*PDCP SDU size + 1496 |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC subheader size –Timing Advance Command MAC CE size – MAC subheader for MAC CE size – RLC Status PDU size - MAC subheader for RLC Status PDU size) / N, where  PDCP header size = 24 bits for the RLC AM and 18-bit SN case;  AMD PDU header size = 24 bits for 18 bit SN case;   MAC header size for AMD PDU = 16 or 24 bits depending on L= 8 or 16 bits. Worst case 24 is taken.  Timing Advance Command MAC CE size + MAC subheader for MAC CE size = 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size + MAC subheader for RLC Status PDU size = 40 bits for 1 ACK\_SN case.  This gives:   PDCP SDU size = 8\*FLOOR((TBS –72\*N -56 )/(8\*N)) bits.  Note 2: M MAC PDUs are transmitted. Each MAC PDU consists ceil(N/M) RLC PDUs or RLC PDU segments.  The MAC PDU size of each MAC PDU is  MAC PDU size = (N\*PDCP SDU size + N\*PDCP header size) / M + CEIL(N / M)\*(AMD PDU header size + MAC header size for AMD PDU ) + Timing Advance Command MAC CE size + MAC subheader for MAC CE size + RLC Status PDU size + MAC subheader for RLC Status PDU size, where  N, PDCP SDU size, PDCP header size, AMD PDU header size, MAC header size for AMD PDU, Timing Advance Command MAC CE size, MAC subheader for MAC CE size, RLC Status PDU size, MAC subheader for RLC Status PDU size are same as in Note 1.  This gives:  MAC PDU size = (N/M)\*PDCP SDU size + 24\*N/M + 48\*CEIL(N/M) + 56  Note 3: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | |

Table 7.1.1.4.2.7.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 | TBoMS only supports 1 layer transmission |
| mcs-Table | qam64 |  |

Table 7.1.1.4.2.7.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| - | EXCEPTION: Steps 1-5 are repeated for allowed values of 1 to in BWP, time domain resource as per Table 7.1.1.4.2.7.3.3-2 and from 0 to 28. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] clause 6.1.4.2 based on the value of S, L, and . | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is no larger than UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.7.3.2-1 and no less than 136 bits as specified in Table 7.1.1.4.2.7.3.2-2.  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 2)  Skip the execution of steps for > 27 and < 5. (Note 1) | - | - | - | - |
| 2 | The SS creates N PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.7.3.2-2. | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs as created in step 2 in M MAC PDUs in accordance with Table 7.1.1.4.2.7.3.2-2. (Note 3) | <-- | M MAC PDUs (N PDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request, SS transmits UL Grant DCI 0\_1 providing values of S, L, and . | <-- | DCI format 0\_1(S, L, ) | - | - |
| 5 | Check: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N PDCP SDUs) | 1 | P |
| Note 1: For > 27 and < 5, the combination results in higher coding rate and therefore leading to CRC errors in decoding UL data.  Note 2: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15].  Note 3: For TBoMS, TBS is calculated based on all available resources in numberOfSlotsTBoMS slots. Then the TBS of UL-SCH may exceed the maximum TBS of DL-SCH. | | | | | |

7.1.1.4.2.7.3.3 Specific message contents

**Table 7.1.1.4.2.7.3.3-1: *ServingCellConfig* (Preamble)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup | PUSCH-TimeDomainResourceAllocationList | Table 7.1.1.4.2.7.3.3-2 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.4.2.7.3.3-2: *PUSCH-TimeDomainResourceAllocationList* (Table 7.1.1.4.2.7.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-122A | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList-r16 ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF PUSCH-TimeDomainResourceAllocation-r16 | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[1] SEQUENCE { |  | entry 1 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| startSymbolAndLength-r16 | 42 | start symbol(S)=0, Length(L)=4 |  |
| numberOfSlotsTBoMS-r17 | n2 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation-r16[2] SEQUENCE { |  | entry 2 |  |
| puschAllocationList-r16 SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF PUSCH-Allocation-r16 { | 1 entry |  |  |
| PUSCH-Allocation-r16[1] SEQUENCE { |  | entry 1 |  |
| numberOfSlotsTBoMS-r17 | n2 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |