# 7 Layer 2

For all layer 2 test cases, default values for periodicBSR-Timer, retxBSR-Timer and phr-Config shall be taken according to the condition no_periodic_BSR_or_PHR as specified in TS 36.508 subclause 4.8.2.1.5 unless test case specific values are given in the test case.

In all MAC and RLC handover test cases during the execution of generic test procedure defined in [18] section 4.5.3A following specific message content should be used for RRC Connection Reconfiguration message transmitted at step 8 of the table 4.5.3.3-1 [18]

**Table 7-1: PDCP-Config-DRB-AM**

| Information Element | Value/remark | Comment | Condition |
|---|---|---|---|
| PDCP-Config-DRB-AM ::= SEQUENCE { | | | |
| | | | |
| rlc-AM SEQUENCE { | | | |
| statusReportRequired | FALSE | | |
| } | | | |
| } | | | |

## 7.1 MAC

### 7.1.1 Mapping between logical channels and transport channels

#### 7.1.1.1 CCCH mapped to UL SCH/ DL-SCH / Reserved Logical Channel ID

##### 7.1.1.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
  when { UE receives a MAC PDU on DL SCH and addressed to its T-CRNTI but including a reserved value
for LCID }
    then { UE discards the MAC PDU }
            }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
 when { UE receives a MAC PDU on DL SCH and addressed to its T-CRNTI with value '00000'B as LCID }
    then { UE forwards to upper layers the disassembled and demultiplexed SDU on logical channel
CCCH }
            }
```

##### 7.1.1.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.11, 6.2.1 , 5.3.3 and 6.1.2.

[TS 36.321, clause 5.11]

When a MAC entity receives a MAC PDU for the UE's C-RNTI or Semi-Persistent Scheduling C-RNTI, containing reserved or invalid values, the MAC entity shall:

- discard the received PDU.

[TS 36.321, clause 6.2.1]

The MAC header is of variable size and consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC control element or padding as described in tables 6.2.1-1 and 6.2.1-2 for the DL and UL-SCH respectively. There is one LCID field for each MAC SDU, MAC control element or padding included in the MAC PDU. The LCID field size is 5 bits;

...

**Table 6.2.1-1: Values of LCID for DL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11011 | Reserved |
| 11100 | UE Contention Resolution Identity |
| 11101 | Timing Advance |
| 11110 | DRX Command |
| 11111 | Padding |

[TS 36.321, clause 5.3.3]

The UE shall disassemble and demultiplex a MAC PDU as defined in subclause 6.1.2.

[TS 36.321, clause 6.1.2]

A MAC PDU consists of a MAC header, zero or more MAC Service Data Units (MAC SDU), zero, or more MAC control elements, and optionally padding; as described in Figure 6.1.2-3.

Both the MAC header and the MAC SDUs are of variable sizes.

A MAC PDU header consists of one or more MAC PDU sub-headers; each subheader corresponds to either a MAC SDU, a MAC control element or padding.

A MAC PDU subheader consists of the six header fields R/R/E/LCID/F/L but for the last subheader in the MAC PDU and for fixed sized MAC control elements. The last subheader in the MAC PDU and sub-headers for fixed sized MAC control elements consist solely of the four header fields R/R/E/LCID. A MAC PDU subheader corresponding to padding consists of the four header fields R/R/E/LCID.

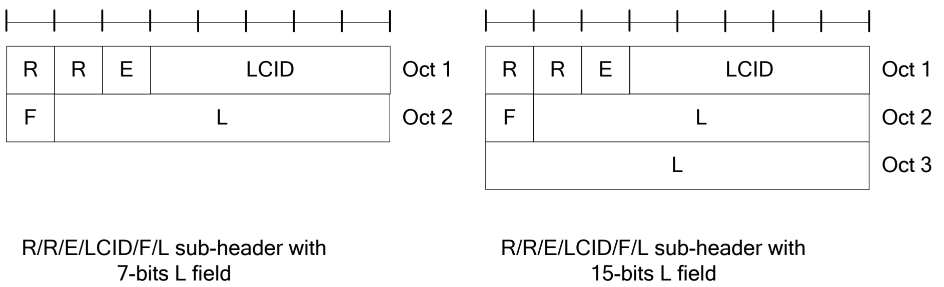


**Figure 6.1.2-1: R/R/E/LCID/F/L MAC subheader**

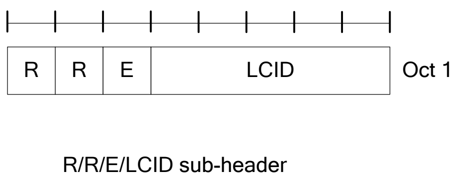


**Figure 6.1.2-2: R/R/E/LCID MAC subheader**

MAC PDU sub-headers have the same order as the corresponding MAC SDUs, MAC control elements and padding.

MAC control elements, are always placed before any MAC SDU.

Padding occurs at the end of the MAC PDU, except when single-byte or two-byte padding is required. Padding may have any value and the UE shall ignore it.

When single-byte or two-byte padding is required, one or two MAC PDU sub-headers corresponding to padding are placed at the beginning of the MAC PDU before any other MAC PDU subheader.

A maximum of one MAC PDU can be transmitted per TB per UE.

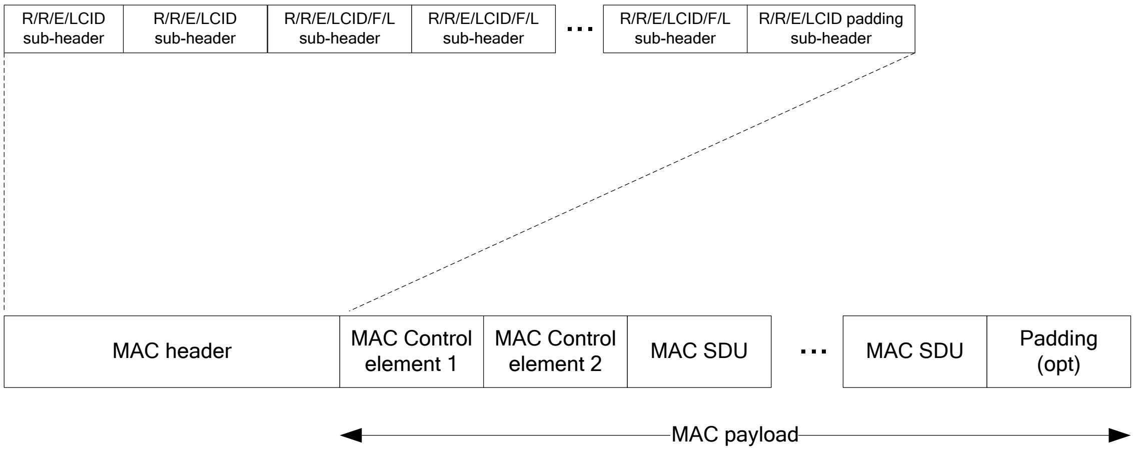


**Figure 6.1.2-3: Example of MAC PDU consisting of MAC header, MAC control elements, MAC SDUs and padding**

7.1.1.1.3 Test description

7.1.1.1.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode (state 2) according to [18].

7.1.1.1.3.2 Test procedure sequence

**Table 7.1.1.1.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| | EXCEPTION: Steps 1 to 4 shall be repeated for decreasing reserved LCID values from 01011 to 11011. | - | - | - | - |
| 1 | The SS transmits a *Paging* message including a matched identity. | <-- | - | - | - |
| 2 | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |
| 3 | The SS Transmits a valid MAC PDU containing *RRCConnectionSetup*, and Contention Resolution Identity MAC Control Element except for LCID in MAC Header set to reserved value 11011 or lower (depending on iteration number). | <-- | MAC PDU | - | - |
| | EXCEPTION: In parallel with step 4, UE may execute parallel behaviour defined in table 7.1.1.1.3.2-2 | - | - | - | - |
| 4 | Check: For 5 seconds after Step3, does the UE transmit *RRCConnectionSetupComplete* message? | --> | *RRCConnectionSetupComplete* | 1 | F |
| 5 | The SS transmits a *Paging* message including a matched identity. | <-- | - | - | - |
| 6 | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |
| 7 | The SS transmits a valid MAC PDU containing *RRCConnectionSetup*, and Contention Resolution Identity MAC Control Element and LCID in MAC Header set correctly to CCCH 00000 | <-- | MAC PDU | - | - |
| 8 | Check: does the UE transmit an *RRCConnectionSetupComplete* message including SERVICE REQUEST message? | --> | *RRCConnectionSetupComplete* | 2 | P |
| 9-12 | Steps 6 to 9 of the generic radio bearer establishment procedure (TS 36.508 4.5.3.3-1) are executed to successfully complete the service request procedure. | - | - | - | - |

**Table 7.1.1.1.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |

7.1.1.1.3.3 Specific message contents

None.

## 7.1.1.2 DTCH or DCCH mapped to UL SCH/ DL-SCH / Reserved Logical Channel ID

7.1.1.2.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_Connected state with DRB [Logical channel ID 3] established }
ensure that {
  when { UE receives a MAC PDU on DL SCH and addressed to its CRNTI but including a reserved value
for LCID }
    then { UE shall not forward the disassembled and demultiplexed SDU on the configured logical
channels }
            }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
 when { UE receives a MAC PDU on DL SCH and addressed to its CRNTI with value ‘00011’B as LCID }
    then { UE shall forward the disassembled and demultiplexed SDU on the corresponding logical channel }
           }
```

#### 7.1.1.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 6.2.1, 5.3.3 and 6.1.2.

[TS 36.321, clause 6.2.1]

[Rel-8]

The MAC header is of variable size and consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC control element or padding as described in tables 6.2.1-1 and 6.2.1-2 for the DL and UL-SCH respectively. There is one LCID field for each MAC SDU, MAC control element or padding included in the MAC PDU. The LCID field size is 5 bits;

...

**Table 6.2.1-1: Values of LCID for DL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11011 | Reserved |
| 11100 | UE Contention Resolution Identity |
| 11101 | Timing Advance |
| 11110 | DRX Command |
| 11111 | Padding |

[Rel-10]

The MAC header is of variable size and consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC control element or padding as described in tables 6.2.1-1, 6.2.1-2 and 6.2.1-4 for the DL-SCH, UL-SCH and MCH respectively. There is one LCID field for each MAC SDU, MAC control element or padding included in the MAC PDU. In addition to that, one or two additional LCID fields are included in the MAC PDU, when single-byte or two-byte padding is required but cannot be achieved by padding at the end of the MAC PDU. The LCID field size is 5 bits;

…

**Table 6.2.1-1 Values of LCID for DL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11010 | Reserved |
| 11011 | Activation/Deactivation |
| 11100 | UE Contention Resolution Identity |
| 11101 | Timing Advance Command |
| 11110 | DRX Command |
| 11111 | Padding |

[TS 36.321, clause 5.3.3]

The UE shall disassemble and demultiplex a MAC PDU as defined in subclause 6.1.2.

[TS 36.321, clause 6.1.2]

A MAC PDU consists of a MAC header, zero or more MAC Service Data Units (MAC SDU), zero, or more MAC control elements, and optionally padding; as described in Figure 6.1.2-3.

Both the MAC header and the MAC SDUs are of variable sizes.

A MAC PDU header consists of one or more MAC PDU sub-headers; each subheader corresponds to either a MAC SDU, a MAC control element or padding.

A MAC PDU subheader consists of the six header fields R/R/E/LCID/F/L but for the last subheader in the MAC PDU and for fixed sized MAC control elements. The last subheader in the MAC PDU and sub-headers for fixed sized MAC control elements consist solely of the four header fields R/R/E/LCID. A MAC PDU subheader corresponding to padding consists of the four header fields R/R/E/LCID.

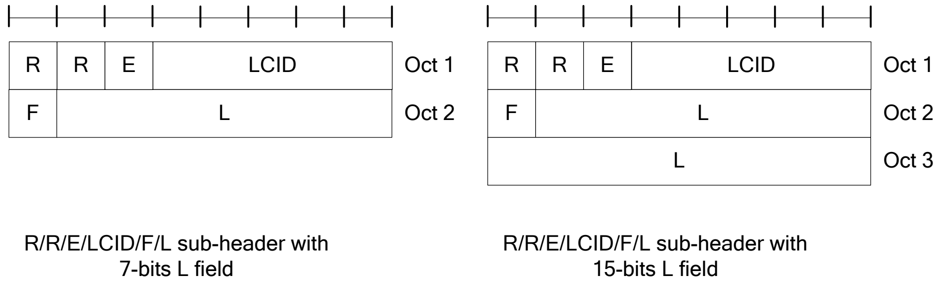


**Figure 6.1.2-1: R/R/E/LCID/F/L MAC subheader**

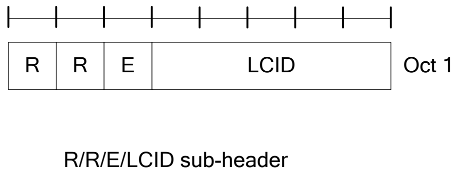


**Figure 6.1.2-2: R/R/E/LCID MAC subheader**

MAC PDU sub-headers have the same order as the corresponding MAC SDUs, MAC control elements and padding.

MAC control elements, are always placed before any MAC SDU.

Padding occurs at the end of the MAC PDU, except when single-byte or two-byte padding is required. Padding may have any value and the UE shall ignore it.

When single-byte or two-byte padding is required, one or two MAC PDU sub-headers corresponding to padding are placed at the beginning of the MAC PDU before any other MAC PDU subheader.

A maximum of one MAC PDU can be transmitted per TB per UE.

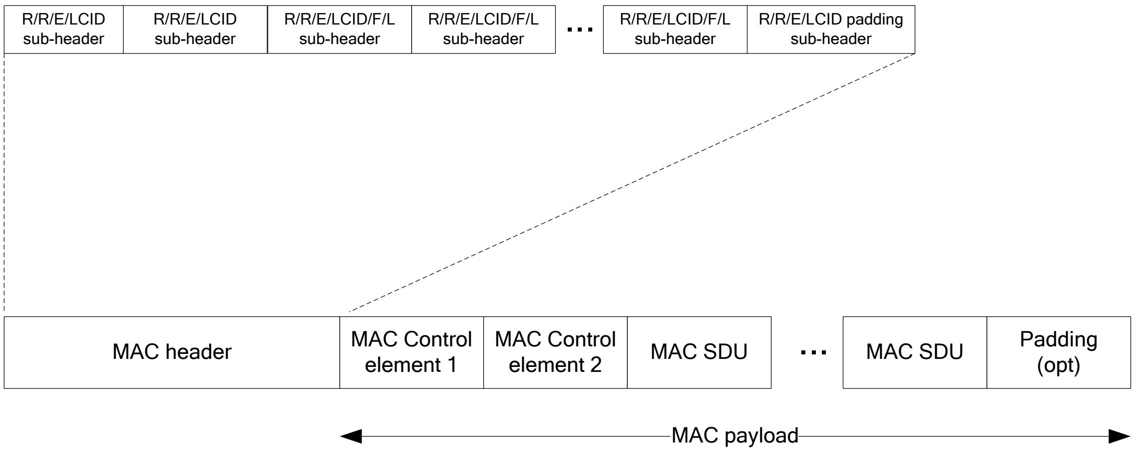


**Figure 6.1.2-3: Example of MAC PDU consisting of MAC header, MAC control elements, MAC SDUs and padding**

#### 7.1.1.2.3 Test description

##### 7.1.1.2.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

NOTE: In the following, the established DRB is assumed to have Logical channel ID 3

#### 7.1.1.2.3.2 Test procedure sequence

**Table 7.1.1.2.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| | EXCEPTION:<br>IF UE is Release 8 or Release 9, steps 1 and 2 are repeated for decreasing reserved LCID values from 01011 to 11011<br>ELSE IF UE is Release 10 onwards, steps 1 and 2 are repeated for decreasing reserved LCID values from 01011 to 11010. | - | - | - | - |
| 1 | The SS transmits a valid MAC PDU containing a RLC PDU except for LCID in MAC Header set to reserved value . | <-- | MAC PDU | - | - |
| 2 | Check: does the UE transmit a Scheduling Request on PUCCH within 5 seconds after step 1? | --> | (SR) | 1 | F |
| 3 | The SS Transmits a valid MAC PDU containing RLC PDU with LCID in MAC Header set correctly to DRB 00011. | <-- | MAC PDU | - | - |
| 4 | Check: does the UE transmit a Scheduling Request on PUCCH? | --> | (SR) | 2 | P |
| 5 | The SS sends an UL grant suitable for the loop back PDU to transmitted | <-- | (UL Grant) | - | - |
| 6 | Check: does the UE transmit a MAC PDU with LCID set to DRB 00011? | --> | MAC PDU | 2 | P |

#### 7.1.1.2.3.3 Specific message contents

None.

## 7.1.2 RACH

### 7.1.2.1 Correct selection of RACH parameters / Random access preamble and PRACH resource explicitly signalled to the UE by RRC / Non-contention based random access procedure

#### 7.1.2.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { SS sends an RRCConnectionReconfiguration message including RACH-ConfigDedicated information
element }
    then { UE sends a prach preamble given in the RACH-ConfigDedicated on the target cell }
           }
```

#### 7.1.2.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clauses 5.1.2 and 5.1.4.

[TS 36.321, clause 5.1.2]

The Random Access Resource selection procedure shall be performed as follows:

- If *ra-PreambleIndex* (Random Access Preamble) and *ra-PRACH-MaskIndex* (PRACH Mask Index) have been explicitly signalled and *ra-PreambleIndex* is not 000000:
  - the Random Access Preamble and the PRACH Mask Index are those explicitly signalled.

[TS 36.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the UE shall monitor the PDCCH for Random Access Response(s) identified by the RA-RNTI defined below, in the RA Response window which starts at the subframe that contains the end of the preamble transmission [7] plus three subframes and has length ra-ResponseWindowSize subframes. The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + t_id+10*f_id

Where t_id is the index of the first subframe of the specified PRACH (0≤ t_id <10), and f_id is the index of the specified PRACH within that subframe, in ascending order of frequency domain (0≤ f_id< 6). The UE may stop monitoring for Random Access Response(s) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted Random Access Preamble.

- If a downlink assignment for this TTI has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded, the UE shall regardless of the possible occurrence of a measurement gap:

...

  - if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble (see subclause 5.1.3), the UE shall:
    - consider this Random Access Response reception successful;
    - process the received Timing Advance Command (see subclause 5.2);
    - indicate the *preambleInitialReceivedTargetPower* and the amount of power ramping applied to the latest preamble transmission to lower layers (i.e., (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*);
    - process the received UL grant value and indicate it to the lower layers;
    - if *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC):
      - consider the Random Access procedure successfully completed.

#### 7.1.2.1.3 Test description

##### 7.1.2.1.3.1 Pre-test conditions

System Simulator:

- Cell 1 and Cell 2.

UE:

None.

Preamble:

- UE is in state Generic RB Established (state 3) according to [18] in cell 1.

##### 7.1.2.1.3.2 Test procedure sequence

Table 7.1.2.1.3.2-1 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 7.1.2.1.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 2 | Remark |
|---|---|---|---|---|---|
| T0 | Cell-specific RS EPRE | dBm/15k Hz | -85 | -91 | The power level values are such that measurement results for Cell 1 (M1) and Cell 2 (M2) satisfy exit condition for event A3 (M2 < M1). |
| T1 | Cell-specific RS EPRE | dBm/15k Hz | -85 | -79 | The power level values are such that measurement results for Cell 1 (M1) and Cell 2 (M2) satisfy entry condition for event A3 (M2 > M1). |

**Table 7.1.2.1.3.2-2: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 0A | The SS transmits an *RRCConnectionReconfiguration* message on Cell 1 to setup intra frequency measurement. | - | - | - | - |
| 0B | The UE transmits an *RRCConnectionReconfigurationComplete* message on Cell 1. | - | - | - | - |
| 0C | The SS changes Cell 1 and Cell 2 parameters according to the row "T1" in table 7.1.2.1.3.2-1. | - | - | - | - |
| 0D | The UE transmits a *MeasurementReport* message on Cell 1 to report event A3 with the measured RSRP, RSRQ value for Cell 2. | - | - | - | - |
| 1 | The SS transmits an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 2, including explicit Random Access Preamble. | - | - | - | - |
| 2 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 1 | P |
| 3 | The SS transmits Random Access Response on cell 2, with RAPID corresponding to *ra-PreambleIndex* in step 1 | <-- | Random Access Response | - | - |
| 4 | Check: Does the UE sends on cell 2, a MAC PDU containing *RRCConnectionReconfigurationComplete*? | --> | MAC PDU (*RRCConnectionReconfigurationComplete)* | 1 | P |
| 5 | Check: Does the test result of generic procedure in TS 36.508 subclause 6.4.2.3 indicates that UE is in E-UTRA RRC_CONNECTED state in cell 2? | - | - | 1 | - |

#### 7.1.2.1.3.3 Specific message contents

**Table 7.1.2.1.3.3-1: *RRCConnectionReconfiguration* (step 1, table 7.1.2.1.3.2-1)**

| Derivation Path: 36.508, Table 4.6.1-8, condition RBC-HO | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| mobilityControlInfo SEQUENCE { | MobilityControlInfo-HO | | |
| targetPhysCellId | PhysicalCellIdentity of Cell 2 (see 36.508 clause 4.4.4.2) | | |
| carrierFreq | Not present | | |
| rach-ConfigDedicated SEQUENCE { | | | |
| ra-PreambleIndex | 52 (see TS 36.211 Table 5.7.1-2) | | FDD |
| ra-PreambleIndex | 52 (see TS 36.211 Table 5.7.1-3) | | TDD |
| ra-PRACH-MaskIndex | 0 | All | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.2.2 Correct selection of RACH parameters / Random access preamble and PRACH resource explicitly signalled to the UE in PDCCH Order / Non-contention based random access procedure

#### 7.1.2.2.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { PDCCH control command is received providing Random Access Preamble }
    then { UE sends a prach preamble given in the PDCCH Order }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state and transmitted PRACH Preamble, after reception of PDCCH
order }
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 the Preamble given in the PDCCH Order }
            }
```

#### 7.1.2.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clauses 5.1.2 and 5.1.24.

[TS 36.321, clause 5.1.2]

The Random Access Resource selection procedure shall be performed as follows:

- If *ra-PreambleIndex* (Random Access Preamble) and *ra-PRACH-MaskIndex* (PRACH Mask Index) have been explicitly signalled and *ra-PreambleIndex* is not 000000:
  - the Random Access Preamble and the PRACH Mask Index are those explicitly signalled.

[TS 36.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the UE shall monitor the PDCCH for Random Access Response(s) identified by the RA-RNTI defined below, in the RA Response window which starts at the subframe that contains the end of the preamble transmission [7] plus three subframes and has length ra-ResponseWindowSize subframes. The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + t_id+10*f_id

Where t_id is the index of the first subframe of the specified PRACH ($0 \le t\_id < 10$), and f_id is the index of the specified PRACH within that subframe, in ascending order of frequency domain ($0 \le f\_id < 6$). The UE may stop monitoring for Random Access Response(s) after successful reception of a Random Access Response containing the Random Access Preamble identifiers that matches the transmitted Random Access Preamble.

- If a downlink assignment for this TTI has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded, the UE shall regardless of the possible occurrence of a measurement gap:

...

  - if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble (see subclause 5.1.3), the UE shall:
  - consider this Random Access Response reception successful;
    - process the received Timing Advance Command (see subclause 5.2);
    - indicate the *preambleInitialReceivedTargetPower* and the amount of power ramping applied to the latest preamble transmission to lower layers (i.e., (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*);
    - process the received UL grant value and indicate it to the lower layers;
    - if *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC):
      - consider the Random Access procedure successfully completed.

...

If no Random Access Response is received within the RA Response window, or if none of all received Random Access Responses contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, the Random Access Response reception is considered not successful and the UE shall:

  - increment PREAMBLE_TRANSMISSION_COUNTER by 1;
- If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
  - indicate a Random Access problem to upper layers
    - if in this Random Access procedure, the Random Access Preamble was selected by MAC:
      - based on the back off parameter in the UE, select a random back off time according to a uniform distribution between 0 and the Back off Parameter Value;
      - delay the subsequent Random Access transmission by the back off time;
  - proceed to the selection of a Random Access Resource (see subclause 5.1.2).

#### 7.1.2.2.3 Test description

##### 7.1.2.2.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) according to [18] in cell 1

7.1.2.2.3.2 Test procedure sequence

**Table 7.1.2.2.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a PDCCH order providing Random Access Preamble. | <-- | (PDCCH Order) | - | - |
| 2 | Check: does the UE transmit a preamble on PRACH using the same preamble index as given in step 1? | --> | (PRACH Preamble) | 1 | P |
| 3 | Check: does the UE transmit a preamble on PRACH after *ra-ResponseWindowSize* using the same preamble index as given in step 1? | --> | (PRACH Preamble) | 2 | P |
| 4 | Check: does the UE transmit a preamble on PRACH after *ra-ResponseWindowSize* using the same preamble index as given in step 1? | --> | (PRACH Preamble) | 2 | P |
| 5 | Check: does the UE transmit a preamble on PRACH after *ra-ResponseWindowSize* using the same preamble index as given in step 1? | --> | (PRACH Preamble) | 2 | P |
| 6 | The SS transmits Random Access Response with RAPID corresponding to Preamble in step 1. | <-- | Random Access Response | - | - |
| 7 | Check: does the test result of CALL generic procedure indicate that UE is in E-UTRA RRC_CONNECTED state? | - | - | 2 | - |

7.1.2.2.3.3 Specific message contents

**Table 7.1.2.2.3.3-1: *SystemInformationBlockType2* (all steps, table 7.1.2.2.3.2-1)**

| Derivation Path: 36.508 clause 4.4.3.3, Table Nr. 4.4.3.3.-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| ra-SupervisionInformation SEQUENCE { | | | |
| preambleTransMax | N4 | PREAMBLE_TRANS_MAX | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.2.3 Correct selection of RACH parameters / Preamble selected by MAC itself / Contention based random access procedure

7.1.2.3.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state }
ensure that {
  when { SS sends a Paging message to the UE and MAC PDU Size carrying CCCH PDU is less than messageSizeGroupA }
    then { UE transmits a random access preamble using a preamble in  group A of random access preambles indicated in SIB2 }
```

```
          }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state and has transmitted Msg3 }
ensure that {
  when { SS does not respond 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 }
            }
```

(3)

```
with { UE in E-UTRA RRC_IDLE state and has transmitted Msg3  }
ensure that {
  when { SS does not respond before contention resolution timer expiry after more than
preambleTransMax transmissions from UE }
    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 }
            }
```

(4)

```
with { UE in E-UTRA RRC_IDLE state }
ensure that {
  when {  UE has data available for transmission and the MAC PDU Size carrying this data is greater
than messageSizeGroupA }
    then { UE transmits a random access preamble using a preamble in group B of random access
preambles indicated in SIB2 }
           }
```

#### 7.1.2.3.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.1.2 and 5.1.5.

[TS 36.321, clause 5.1.2]

The Random Access Resource selection procedure shall be performed as follows:

- If *ra-PreambleIndex (Random Access Preamble) and ra-PRACH-MaskIndex (PRACH Mask Index)* have been explicitly signalled and *ra-PreambleIndex* is not 000000:

  ...

- else the Random Access Preamble shall be selected by the UE as follows:

  - If *Msg3 has not yet been transmitted, the UE shall*:

    - if Random Access Preambles group B exists and if the potential message size (data available for transmission plus MAC header and, where required, MAC control elements) is greater than *messageSizeGroupA* and if the pathloss is less than $P_{CMAX}$ – *preambleInitialReceivedTargetPower* – *deltaPreambleMsg3* – *messagePowerOffsetGroupB*, then:

  - select the Random Access Preambles group B;

    - else:

  - select the Random Access Preambles group A.

  - else, if Msg3 is being retransmitted, the UE shall, the UE shall:

    - select the same group of Random Access Preambles as was used for the preamble transmission attempt corresponding to the first transmission of Msg3.

  - randomly select a Random Access Preamble within the selected group. The random function shall be such that each of the allowed selections can be chosen with equal probability;

  - set PRACH Mask Index to 0.

- determine the next available subframe containing PRACH permitted by the restrictions given by the *prach-ConfigIndex* and PRACH Mask Index (see subclause 7.3) and physical layer timing requirements [2] (a UE may take into account the possible occurrence of measurement gaps when determining the next available PRACH subframe);
- if the transmission mode is TDD and the PRACH Mask Index is equal to zero:
  - if *ra-PreambleIndex* was explicitly signalled and the signalled random access preamble ID was not 000000 (i.e., not selected by MAC):
    - randomly select, with equal probability, one PRACH from the PRACHs available in the determined subframe.
  - else:
    - randomly select, with equal probability, one PRACH from the PRACHs available in the determined subframe and the next two consecutive subframes.
- else:
  - determine a PRACH within the determined subframe in accordance with the requirements of the PRACH Mask Index.
- proceed to the transmission of the Random Access Preamble (see subclause 5.1.3).

[TS 36.321, clause 5.1.5]

Contention Resolution is based on either C-RNTI on PDCCH or UE Contention Resolution Identity on DL-SCH..

Once Msg3 is transmitted, the UE shall:

- start *mac-ContentionResolutionTimer* and restart *mac-ContentionResolutionTimer* at each HARQ retransmission;
- regardless of the possible occurrence of a measurement gap, monitor the PDCCH until *mac-ContentionResolutionTimer* expires or is stopped;
- ...
- if *mac-ContentionResolutionTimer* expires:
  - discard the Temporary C-RNTI;
  - consider the Contention Resolution not successful.
- if the Contention Resolution is considered not successful the UE shall:
  - flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;
  - increment PREAMBLE_TRANSMISSION_COUNTER by 1;
  - If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
    - indicate a Random Access problem to upper layers.

  ...

  - proceed to the selection of a Random Access Resource (see subclause 5.1.2).

#### 7.1.2.3.3 Test description

##### 7.1.2.3.3.1 Pre-test conditions

System Simulator:

- Cell 1.
- System information set using parameters as specified in Table 7.1.2.3.3.3-1.

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode, Test Mode Activated (State 2A) according to [18].

7.1.2.3.3.2 Test procedure sequence

**Table 7.1.2.3.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a Paging message including a matched identity. | - | - | - | - |
| 2 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in SIB2 (*numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*)? | --> | PRACH Preamble | 1 | P |
| 3 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in SIB2 (*numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*)? | --> | PRACH Preamble | 1 | P |
| 4 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in SIB2 (*numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*)? | --> | PRACH Preamble | 1 | P |
| 5 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 4, including T-CRNTI and not including Back off Indicator sub header. | <-- | Random Access Response | - | - |
| 6 | The UE transmits an *RRCConnectionRequest* message. | --> | MAC PDU | - | - |
| 7 | Check: Does the UE transmit preamble on PRACH using a preamble belonging to group A? | --> | PRACH Preamble | 2 | P |
| 8 | Check: Does the UE continue to repeatedly transmit for 2s after step 2 a preamble belonging to group A?<br>Note: 2s is the value of T300. | --> | PRACH Preamble | 2, 3 | P |
| 9 | The UE is in state Loopback Activated (state 4) according to [18] using parameters as specified in Table 7.1.2.3.3.3-2 | - | - | - | - |
| 10 | The SS transmits a MAC PDU containing a PDCP SDU of size 320 bits[>208]. | <-- | MAC PDU | - | - |
| - | Exception: steps 11 and 12 are repeated dsr-TransMax times. | - | - | - | - |
| 11 | UE transmits a Scheduling Request. | --> | Scheduling Request | - | - |
| 12 | The SS does not allocate UL grant for the scheduling request in step 11. | - | - | - | - |
| 13 | Check: Does the UE transmit preamble on PRACH using a preamble in group B defined in SIB2 (*numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*)? | --> | PRACH Preamble | 4 | P |
| 14 | Check: Does the UE transmit preamble on PRACH using a preamble in group B defined in SIB2 (*numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*)? | --> | PRACH Preamble | 4 | P |
| 15 | Check: Does the UE transmit preamble on PRACH using a preamble in group B defined in SIB2 (*numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*)? | --> | PRACH Preamble | 4 | P |
| 16 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 15, including T-CRNTI and not including Back off Indicator sub header. | <-- | Random Access Response | - | - |
| 17 | The UE transmits a MAC PDU with C-RNTI containing loop backed PDCP SDU | -> | MAC PDU | - | - |
| 18 | The SS ignores the UL MAC PDU and does not allocate UL grant for the C-RNTI in step 17. | - | - | - | - |
| 19 | Check: Does the UE transmit preamble on PRACH using a preamble belonging to group B? | --> | PRACH Preamble | 2 | P |

| | | | | | |
|---|---|---|---|---|---|
| 20 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 19 | <-- | Random Access Response | - | - |
| 21 | The UE transmits a MAC PDU containing loop backed PDCP SDU | --> | MAC PDU | - | - |
| 22 | SS sends PDCCH transmission for UE C-RNTI | - | - | - | - |
| Note: Size of RRCConnectionRequest message is 45 bits, octet aligned =48 bits. With 8 bits of MAC Header the minimum size of MAC PDU carrying RRCConnectionRequest is 56 bits. | | | | | |

##### 7.1.2.3.3.3 Specific message contents

**Table 7.1.2.3.3.3-1: SystemInformationBlockType2 (all steps, table 7.1.2.3.3.2-1)**

| Derivation path: 36.508 clause 4.4.3.3, Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| preambleInformation SEQUENCE { | | | |
| numberOfRA-Preambles | n64 | | |
| preamblesGroupAConfig := {SEQUENCE { | | | |
| sizeOfRA-PreamblesGroupA | n28 | | |
| messageSizeGroupA | b208 | | |
| messagePowerOffsetGroupB | minusinfinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| ue-TimersAndConstants SEQUENCE{ | | | |
| t300 | ms2000 | T300 | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.2.3.3.3-2: RLC-Config-DRB-AM**

| Derivation path: 36.508 clause 4.8.2.1.3.2, Table 4.8.2.1.3.2-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RLC-Config-DRB-AM ::= CHOICE { | | | |
| am SEQUENCE { | | | |
| ul-AM-RLC SEQUENCE { | | | |
| t-PollRetransmit | ms200 | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.2.4 Random access procedure / Successful

##### 7.1.2.4.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state }
ensure that {
  when { The SS pages the UE with a matching identity }
    then { UE transmits a random access preamble in the next available Random Access occasion }
            }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state after transmission of a PRACH preamble }
ensure that {
  when { SS does not answer with a matching Random Access Response within ra-ResponseWindowSize }
```

```
    then { UE retransmits a PRACH preamble }
            }
```

(3)

```
with { SS transmits Random Access Response and UE send msg3 }
ensure that {
  when { SS ignores the RRCConnectionRequest and does not send any Response }
    then { UE select available PRACH resource to retransmits a PRACH preamble according to the
timing requirement }
            }
```

#### 7.1.2.4.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.1.2, 5.1.3 & 5.1.4.

[TS 36.321, clause 5.1.2]

The Random Access Resource selection procedure shall be performed as follows:

- If *ra-PreambleIndex* (Random Access Preamble) and *ra-PRACH-MaskIndex* (PRACH Mask Index) have been explicitly signalled and *ra-PreambleIndex* is not 000000:
  - the Random Access Preamble and the PRACH Mask Index are those explicitly signalled.
- else the Random Access Preamble shall be selected by the UE as follows:
  - If Msg3 has not yet been transmitted, the UE shall:
    - if Random Access Preambles group B exists and if the potential message size (data available for transmission plus MAC header and, where required, MAC control elements) is greater than *messageSizeGroup*A and if the pathloss is less than $P_{CMAX}$ – *preambleInitialReceivedTargetPower* – *deltaPreambleMsg3* – messagePowerOffsetGroupB, then:
  - select the Random Access Preambles group B;
    - else:
  - select the Random Access Preambles group A.
  - else, if Msg3 is being retransmitted, the UE shall:
    - select the same group of Random Access Preambles as was used for the preamble transmission attempt corresponding to the first transmission of Msg3.
  - randomly select a Random Access Preamble within the selected group. The random function shall be such that each of the allowed selections can be chosen with equal probability;
  - set PRACH Mask Index to 0.
- determine the next available subframe containing PRACH permitted by the restrictions given by the *prach-ConfigurationIndex* and the PRACH Mask Index (see subclause 7.3) (a UE may take into account the possible occurrence of measurement gaps when determining the next available PRACH subframe);
- if the transmission mode is TDD and the PRACH Mask Index is equal to zero:
  - if *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC):
    - randomly select, with equal probability, one PRACH from the PRACHs available in the determined subframe.
  - else:
    - randomly select, with equal probability, one PRACH from the PRACHs available in the determined subframe and the next two consecutive subframes.
- else:

  - determine a PRACH within the determined subframe in accordance with the requirements of the PRACH Mask Index.

  - proceed to the transmission of the Random Access Preamble (see subclause 5.1.3).

[TS 36.321, clause 5.1.3]

The random-access procedure shall be performed as follows:

- set PREAMBLE_RECEIVED_TARGET_POWER to *preambleInitialReceivedTargetPower* + DELTA_PREAMBLE + (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*;]

- instruct the physical layer to transmit a preamble using the selected PRACH, corresponding RA-RNTI, preamble index and PREAMBLE_RECEIVED_TARGET_POWER.

[TS 36.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the UE shall monitor the PDCCH for Random Access Response(s) identified by the RA-RNTI defined below, in the RA Response window which starts at the subframe that contains the end of the preamble transmission [7] plus three subframes and has length *ra-ResponseWindowSize* subframes The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= t1 + _id+10*f_id

Where t_id is the index of the first subframe of the specified PRACH ($0 \leq$ t_id <10), and f_id is the index of the specified PRACH within that subframe, in ascending order of frequency domain ($0 \leq$ f_id< 6). The UE may stop monitoring for Random Access Response(s) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted Random Access Preamble.

- If a downlink assignment for this TTI has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded, the UE shall regardless of the possible occurrence of a measurement gap:

  - if the Random Access Response contains a Back off Indicator sub header:

    - set the back off parameter value in the UE as indicated by the BI field of the Back off Indicator sub header and Table 7.2-1.

  - else, set the back off parameter value in the UE to 0 ms.

  - if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble (see subclause 5.1.3), the UE shall:

    - consider this Random Access Response reception successful;

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

    - indicate the*preambleInitialReceivedTargetPower* and the amount of power ramping applied to the latest preamble transmission to lower layers (i.e., (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*);

    - process the received UL grant value and indicate it to the lower layers;

    - if *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC):

      - consider the Random Access procedure successfully completed.

    - else, if the Random Access Preamble was selected by UE MAC:

      - set the Temporary C-RNTI to the value received in the Random Access Response message no later than at the time of the first transmission corresponding to the UL grant provided in the Random Access Response message;

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

- if the transmission is not being made for the CCCH logical channel, indicate to the Multiplexing and assembly entity to include a C-RNTI MAC control element in the subsequent uplink transmission;
- obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity and store it in the Msg3 buffer.

NOTE: When an uplink transmission is required, e.g., for contention resolution, the eNB should not provide a grant smaller than 56 bits in the Random Access Response.

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

If no Random Access Response is received within the RA Response window, or if none of all received Random Access Responses contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, the Random Access Response reception is considered not successful and the UE shall:

- increment PREAMBLE_TRANSMISSION_COUNTER by 1;
- If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
  - indicate a Random Access problem to upper layers.

...

- proceed to the selection of a Random Access Resource (see subclause 5.1.2).

TS 36.321, clause 6.1.5

A MAC PDU consists of a MAC header and one or more MAC Random Access Responses (MAC RAR) and optionally padding as described in figure 6.1.5-4.

The MAC header is of variable size.

A MAC PDU header consists of one or more MAC PDU sub-headers; each subheader corresponding to a MAC RAR except for the Backoff Indicator sub-header. If included, the Back off Indicator sub-header is only included once and is the first sub-header included within the MAC PDU header.

A MAC RAR consists of the four fields R/Timing Advance Command/UL Grant/Temporary C-RNTI (as described in figure 6.1.5-3).

Padding may occur after the last MAC RAR. Presence and length of padding is implicit based on TB size, size of MAC header and number of RARs.

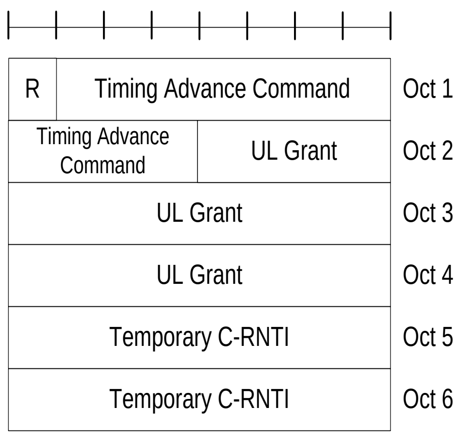


**Figure 6.1.5-3: MAC RAR**

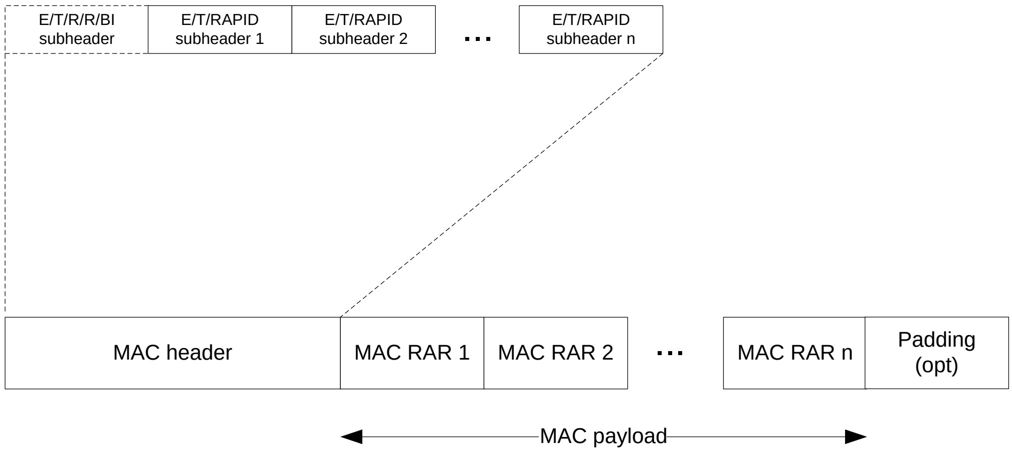


**Figure 6.1.5-4: Example of MAC PDU consisting of a MAC header and MAC RARs**

[TS 36.213, clause 6.1]

For the L1 random access procedure, UE's uplink transmission timing after a random access preamble transmission is as follows.

a. If a PDCCH with associated RA-RNTI is detected in subframe $n$, and the corresponding DL-SCH transport block contains a response to the transmitted preamble sequence, the UE shall, according to the information in the response, transmit an UL-SCH transport block in the first subframe $n+k_1$, $k_1 \geq 6$, if the UL delay field in section 6.2 is set to zero. The UE shall postpone the PUSCH transmission to the next available UL subframe if the field is set to 1.

[TS 36.213, clause 6.2]

The higher layers indicate the 20-bit UL Grant to the physical layer, as defined in [8]. This is referred to the Random Access Response Grant in the physical layer. The content of these 20 bits starting with the MSB and ending with the LSB are as follows:

- Hopping flag – 1 bit
- Fixed size resource block assignment – 10 bits
- Truncated modulation and coding scheme – 4 bits
- TPC command for scheduled PUSCH – 3 bits
- UL delay – 1 bit
- CQI request – 1 bit

…

The UL delay applies for both TDD and FDD and this field can be set to 0 or 1 to indicate whether the delay of PUSCH is introduced as shown in section 6.1.1.

#### 7.1.2.4.3.1 Pre-test conditions

System Simulator:

- Cell 1
- System information are set according to table 7.1.2.4.3.3-1

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode (state 2) according to [18].

7.1.2.4.3.2 Test procedure sequence

**Table 7.1.2.4.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a Paging message including a matched identity. | - | - | - | - |
| 2 | Check: does the UE transmit a preamble on PRACH, in frame number X, subframe number 2, 5, 8 (FDD)/2,3,8(TDD)? | --> | PRACH Preamble | 1 | P |
| 3 | Check: does the UE transmit a preamble on PRACH, in frame number X+1 or X+2, subframe number 2, 5, 8 (FDD)/ 2,3,8 (TDD)? | --> | PRACH Preamble | 1,2 | P |
| 4 | Check: does the UE transmit a preamble on PRACH, in frame number X+2, X+3 or X+4, subframe number 2, 5, 8 (FDD)/ 2,3,8 (TDD)? | --> | PRACH Preamble | 1,2 | P |
| 5 | The SS transmits a Random Access Response with not-matching RA-Id, including T-CRNTI and not including Back off Indicator sub header. | <-- | Random Access Response | - | - |
| 6 | Check: does the UE transmit a preamble on PRACH in frame number X+4, X+5 or X+6, subframe number 2, 5, 8 (FDD)/ 2,3,8 (TDD)? | --> | PRACH Preamble | 1,2 | P |
| 7 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 6, including T-CRNTI and UL grant and not including Back off Indicator sub header. The UL delay bit in the UL grant field is set to 0 | <-- | Random Access Response | - | - |
| 8 | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |
| 9 | The SS ignores the RRCConnectionRequest message and does not send any response. | - | - | - | - |
| 10 | UE waits for mac-ContentResolutionTimer expire. | - | - | - | - |
| 11 | Check: does the UE transmit preamble on PRACH using a preamble in subframe number 2,5,8 for FDD and subframe number 2,3 or 8 for TDD? | --> | PRACH Preamble | 3 | P |
| 12 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 11, including T-CRNTI and not including Back off Indicator sub header. | <-- | Random Access Response | - | - |
| 13 | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |
| 14 | The SS Transmits a valid MAC PDU containing *RRCConnectionSetup*, and including 'UE Contention Resolution Identity' MAC control element with matching 'Contention Resolution Identity' | <-- | MAC PDU | - | - |
| 15 | The UE transmits an *RRCConnectionSetupComplete* message. | --> | - | - | - |
| 16-19 | Steps 6 to 9 of the generic radio bearer establishment procedure (TS 36.508 4.5.3.3-1) are executed to successfully complete the service request procedure. | - | - | - | - |

#### 7.1.2.4.3.3 Specific message contents

**Table 7.1.2.4.3.3-1: SystemInformationBlockType2 (all steps, table 7.1.2.4.3.2-1)**

| Derivation path: 36.508 table 4.4.3.3.-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| ra-SupervisionInformation SEQUENCE { | | | |
| mac-ContentionResolutionTimer | Sf48 | Timer for contention resolution is 48 subframes | |
| ra-ResponseWindowSize | sf10 | | |
| } | | | |
| } | | | |
| prach-Configuration SEQUENCE { | | | |
| prach-ConfigInfo SEQUENCE { | | | |
| prach-ConfigurationIndex | 10 | As per table 5.7.1-2 of 36.211, this results in PRACH preamble transmission start in any frame numbers and sub-frame number 2, 5, 8 | FDD |
| prach-ConfigurationIndex | 9 | As per table 5.7.1-4 of 36.211, this results in PRACH preamble transmission with frequency resource index=0; occurring in any radio frames; resource is located in sub frame number 2,3 ,8 Note 1 | TDD |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| Note 1: 36.508, Table 4.4.3.2-3 specifies tdd-Configuration-> subframeAssignment as sa1. | | | |

### 7.1.2.5 Random access procedure / MAC PDU containing multiple RARs

#### 7.1.2.5.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state and transmitted PRACH preamble }
ensure that {

  when { UE receives during TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END] MAC PDU containing multiple
RAR's but none of the subheaders contains a RAPID corresponding to the UE }
    then { UE transmits a random access preamble in the next available Random Access occasion }
           }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state and transmitted PRACH preamble }
ensure that {

  when { UE receives during TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END] MAC PDU containing multiple
RAR's and one of the subheaders contains a RAPID corresponding to the UE }
```

```
then { UE transmits MAC PDU containing RRCConnectionRequest }
        }
```

#### 7.1.2.5.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.1.3 and 5.1.4.

[TS 36.321, clause 5.1.3]

The random-access procedure shall be performed as follows:

- set PREAMBLE_RECEIVED_TARGET_POWER to *preambleInitialReceivedTargetPower* + DELTA_PREAMBLE + (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*;]
- instruct the physical layer to transmit a preamble using the selected PRACH resource, corresponding RA-RNTI, preamble index and PREAMBLE_RECEIVED_TARGET_POWER.

[TS 36.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the UE shall monitor the PDCCH for Random Access Response(s) identified by the RA-RNTI defined below, in the RA Response window which starts at the subframe that contains the end of the preamble transmission [7] plus three subframes and has length *ra-ResponseWindowSize* subframes. The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + t\_id + 10 * f\_id$$

Where t_id is the index of the first subframe of the specified PRACH ($0 \leq t\_id < 10$), and f_id is the index of the specified PRACH within that subframe, in ascending order of frequency domain ($0 \leq f\_id < 6$). The UE may stop monitoring for Random Access Response(s) after successful reception of a Random Access Response containing the Random Access Preamble identifiers that matches the transmitted Random Access Preamble.

- If a downlink assignment for this TTI has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded, the UE shall regardless of the possible occurrence of a measurement gap:
  - if the Random Access Response contains a Back off Indicator sub header:
    - set the back off parameter value in the UE as indicated by the BI field of the Back off Indicator sub header and Table 7.2-1.
  - else, set the back off parameter value in the UE to 0 ms.
  - if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble (see subclause 5.1.3), the UE shall:
    - consider this Random Access Response reception successful;
    - process the received Timing Advance Command (see subclause 5.2);
    - indicate the *preambleInitialReceivedTargetPower* and the amount of power ramping applied to the latest preamble transmission to lower layers (i.e., (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*);
    - process the received UL grant value and indicate it to the lower layers;
    - if *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC):
      - consider the Random Access procedure successfully completed.
    - else, if the Random Access Preamble was selected by UE MAC:
      - set the Temporary C-RNTI to the value received in the Random Access Response message no later than at the time of the first transmission corresponding to the UL grant provided in the Random Access Response message;

- if this is the first successfully received Random Access Response within this Random Access procedure:
  - if the transmission is not being made for the CCCH logical channel, indicate to the Multiplexing and assembly entity to include a C-RNTI MAC control element in the subsequent uplink transmission;
  - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity and store it in the Msg3 buffer.

NOTE: When an uplink transmission is required, e.g., for contention resolution, the eNB should not provide a grant smaller than 56 bits in the Random Access Response.

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

If no Random Access Response is received within the RA Response window, or if none of all received Random Access Responses contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, the Random Access Response reception is considered not successful and the UE shall:

- increment PREAMBLE_TRANSMISSION_COUNTER by 1;
- If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
  - indicate a Random Access problem to upper layers.

...

- proceed to the selection of a Random Access Resource (see subclause 5.1.2).

#### 7.1.2.5.3 Test description

##### 7.1.2.5.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode (state 2) according to [18].

#### 7.1.2.5.3.2 Test procedure sequence

**Table 7.1.2.5.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a Paging message including a matched identity. | <-- | - | - | - |
| 2 | Check: Does the UE transmit a preamble on PRACH? | --> | PRACH Preamble | 1 | P |
| 3 | The SS transmits a MAC PDU addressed to UE RA-RNTI, containing multiple RAR's but none of the MAC sub headers contains a matching RAPID | <-- | Random Access Response | - | - |
| - | EXCEPTION: In parallel with step 4, parallel behaviour defined in table 7.1.2.5.3.2-2 is executed | - | - | - | - |
| 4 | Check: Does the UE re-transmit a preamble on PRACH? | --> | PRACH Preamble | 1 | P |
| 5 | The SS transmits a MAC PDU addressed to UE RA-RNTI, containing multiple RAR's one of the MAC sub headers contains a matching RAPID | <-- | Random Access Response | - | - |
| 6 | Check: Does the UE transmit a MAC PDU containing RRCConnectionRequest message? | --> | MAC PDU (RRCConnectionRequest) | 2 | P |
| 7 | The SS sends a MAC PDU containing matching Contention Resolution Identity MAC control element | <-- | MAC Control PDU | - | - |
| 7A | SS transmit RRCConnectionSetup message | <-- | - | - | - |
| 8 | The UE transmit *RRCConnectionSetupComplete* message including SERVICE REQUEST message. | --> | - | - | - |
| 9-12 | Steps 6 to 9 of the generic radio bearer establishment procedure (TS 36.508 4.5.3.3-1) are executed to successfully complete the service request procedure. | - | - | - | - |

**Table 7.1.2.5.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | Check: Does the UE transmit an RRCConnectionRequest message. | --> | MAC PDU (*RRCConnectionRequest*) | 1 | F |

#### 7.1.2.5.3.3 Specific message contents

None.

### 7.1.2.6 Maintenance of uplink time alignment

#### 7.1.2.6.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state and having initiated a random access procedure }

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}
        }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
```

```
  when { Timing Advanced Command MAC control element is received and UE has pending data during the
period the timeAlignmentTimer is running }
    then { UE does not send any Random Access Preamble, but Scheduling Requests to request
transmission of data while timeAlignmentTimer is running }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when{ timeAlignmentTimer has expired or is not running and UL transmission is required}
    then { UE triggers a RA Procedure }
            }
```

#### 7.1.2.6.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.2.

[TS 36.321 clause 5.2]

The UE has a configurable timer *timeAlignmentTimer* which is used to control how long the UE is considered uplink time aligned.

The UE shall:

- when a Timing Advance Command MAC control element is received:
  - apply the Timing Advance Command;
  - start or restart *timeAlignmentTimer*.
- when a Timing Advance Command is received in a Random Access Response message:
  - if the Random Access Preamble was not selected by UE MAC:
    - apply the Timing Advance Command;
    - start or restart *timeAlignmentTimer*.
  - else, if the *timeAlignmentTimer* is not running:
    - apply the Timing Advance  Command;
    - start *timeAlignmentTimer*;
    - when the contention resolution is considered not successful as described in subclause 5.1.5, stop *timeAlignmentTimer*.
  - else:
    - ignore the received Timing Advance Command.
- when *timeAlignmentTimer* expires:
  - flush all HARQ buffers;
  - notify RRC to release PUCCH/SRS;
  - clear any configured downlink assignments and uplink grants.

#### 7.1.2.6.3 Test description

##### 7.1.2.6.3.1 Pre-test condition

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The generic procedure to get UE in state Registered, Idle mode, UE Test Mode Activated (State 2a) according to TS 36.508 clause 4.5 is executed.

7.1.2.6.3.2 Test procedure sequence

**Table 7.1.2.6.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| 1 | SS pages the UE | <-- | - | - | - |
| 2 | SS respond to UE Random Access request by a Random Access Response with TA field within message set to 600(FDD) or 160(TDD) (Note 2). | <-- | MAC PDU(Random Access Response (TA=600)) | - | - |
| 3 | Check: Does UE send an *RRCConnectionRequest* message in the first scheduled UL transmission using the Timing Advance value sent by the SS in step 2? | --> | MAC PDU (*RRCConnectionRequest*) | 1 | P |
| 4 | The SS transmits a valid MAC PDU containing “UE Contention Resolution Identity” MAC control element with matching “Contention Resolution Identity” and RA Procedure considered a success. | <-- | MAC PDU (UE Contention Resolution Identity) | - | - |
| 5 | The SS sends an *RRCConnectionSetup* message. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit an *RRCConnectionSetupComplete*? | --> | MAC PDU (*RRCConnectionSetupComplete*) | 1 | P |
| 7 | The generic procedure to get UE in test state Loopback Activated (State 4) according to TS 36.508 clause 4.5 is executed with UL SDU size set to ‘0’ (no data returned in uplink) using parameters as specified in Table 7.1.2.6.3.3-1 | - | - | - | - |
| 8 | SS transmits Timing Advance command. SS does not send any subsequent alignments. | <-- | MAC PDU (Timing Advance Command MAC Control Element) | - | - |
| 9 | After 600ms (0.8 * *timeAlignmentTimer*) SS sends a MAC PDU containing a RLC PDU with SN=0 and poll bit set to trigger UE to transmit a status report in uplink. SS does not respond to any scheduling requests or Random Access Preambles from the UE. | <-- | MAC PDU | - | - |
| 10 | Check: For 0.2* *timeAlignmentTimer* does UE transmit Scheduling Requests, but no Random Access Preamble message? (Note 1) | --> | SR | 2 | P |
| 11 | Void | - | - | - | - |
| 12 | Check: Does the UE transmit a Random Access Preamble? | --> | Random Access Preamble | 3 | P |
| 13 | SS responds with a valid Random Access Response | <-- | MAC PDU (Random Access Response (Temporary C-RNTI)) | - | - |
| 14 | Check: Does the UE transmit a MAC PDU with C-RNTI containing RLC STATUS PDU for the acknowledgement of the DL Data with the Temporary C-RNTI set to the value received in the Random Access Response message?? | --> | MAC PDU(RLC STATUS PDU (ACK_SN =1)) | 3 | P |
| 15 | The SS Transmits a PDCCH transmission addressed to the C-RNTI stored in the UE and contains an UL grant for a new transmission | <-- | - | - | - |

Note 1 A conformant UE correctly applies Timing Advance Command MAC Control and restarts *timeAlignmentTimer*, causing the uplink to stay in sync for a period equal to the received Time Alignment Value.

Note 2 For FDD, $T_A$ value of 600 has been chosen arbitrarily in the middle of the range 0 to 1282 and corresponds to 0.3125 ms (timing advance in ms = 1000 x $N_{TA}$ x $T_s$ where $N_{TA} = T_A \times 16$ and $T_s = 1/(15000 \times 2048)$ seconds according to TS 36.213 and TS 36.211).
For TDD, TA value of 160 has been chosen and corresponds to 0.1036 ms (timing advance in ms = 1000 x (N_TA + N_TA_offset) x Ts where N_TA = TA x 16, N_TA_offset = 624Ts, and Ts = 1/(15000 x 2048) seconds according to TS 36.213 and TS 36.211).

#### 7.1.2.6.3.3 Specific Message Contents

**Table 7.1.2.6.3.3-1: SchedulingRequest-Configuration (RRCConnectionReconfiguration, step 7 table 7.1.2.6.3.2-1)**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Configuration ::= CHOICE { | | | |
| setup SEQUENCE { | | | |
| dsr-TransMax | n64 | Max value allowed | |
| } | | | |
| } | | | |

## 7.1.2.7 MAC contention resolution / Temporary C-RNTI

### 7.1.2.7.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
  when { SS does not send any MAC PDU including 'UE Contention Resolution Identity' MAC control
element before contention resolution timer expires }
    then { UE re-transmits RRCConnectionRequest }
            }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
  when { SS transmits a valid MAC PDU containing RRCConnectionSetup, but not including 'UE
Contention Resolution Identity' MAC control element }
    then { UE re-transmits RRCConnectionRequest }
            }
```

(3)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
  when { SS transmits a valid MAC PDU containing RRCConnectionSetup, including 'UE Contention
Resolution Identity' MAC control element but with un-matched 'Contention Resolution Identity' }
    then { UE re-transmits RRCConnectionRequest }
               }
```

(4)

```
with { UE in E-UTRA RRC_IDLE state and after transmitting a RRCConnectionRequest message }
ensure that {
  when { SS transmits a valid MAC PDU containing a RRCConnectionSetup, including 'UE Contention
Resolution Identity' MAC control element and matching 'Contention Resolution Identity' }
    then { UE transmits a RRCConnectionSetupComplete message }
            }
```

### 7.1.2.7.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.1.5.

[TS 36.321, clause 5.1.5]

Contention Resolution is based on either C-RNTI on PDCCH or UE Contention Resolution Identity on DL-SCH..

Once Msg3 is transmitted, the UE shall:

- start *mac-ContentionResolution*Timer and restart *mac-ContentionResolution*Timer at each HARQ retransmission;
- regardless of the possible occurrence of a measurement gap, monitor the PDCCH until *mac-ContentionResolution*Timer expires or is stopped;

- if notification of a reception of a PDCCH transmission is received from lower layers, the UE shall:

...

  - else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its Temporary C-RNTI:
    - if the MAC PDU is successfully decoded:
      - stop *mac-ContentionResolution*Timer;
      - if the MAC PDU contains a UE Contention Resolution Identity MAC control element; and
      - if the UE Contention Resolution Identity included in the MAC control element matches the CCCH SDU transmitted in Msg3:
        - consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;
        - set the C-RNTI to the value of the Temporary C-RNTI;
        - discard the Temporary C-RNTI;
        - consider this Random Access procedure successfully completed.
      - else
        - discard the Temporary C-RNTI;
        - consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.
- if *mac-ContentionResolution*Timer expires:
  - discard the Temporary C-RNTI;
  - consider the Contention Resolution not successful.
- if the Contention Resolution is considered not successful the UE shall:
  - flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;
      - increment PREAMBLE_TRANSMISSION_COUNTER by 1;
      - If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
        - indicate a Random Access problem to upper layers.
      - based on the back off parameter in the UE, select a random back off time according to a uniform distribution between 0 and the Back off Parameter Value;
      - delay the subsequent Random Access transmission by the back off time;
      - proceed to the selection of a Random Access Resource (see subclause 5.1.2).

#### 7.1.2.7.3 Test description

##### 7.1.2.7.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode (state 2) according to [18].

#### 7.1.2.7.3.2 Test procedure sequence

**Table 7.1.2.7.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a Paging message including a matched identity. | <-- | - | 1 | - |
| 2 | The UE transmits a MAC PDU containing an *RRCConnectionRequest* message. | --> | MAC PDU | 1 | - |
| 3 | Check: For time equal to 'Contention Resolution Timer', does UE send a PRACH preamble? | --> | PRACH preamble | 1 | F |
| 4 | Check: does the UE transmit a MAC PDU containing an *RRCConnectionRequest* message? | --> | MAC PDU (*RRCConnectionRequest)* | 1 | P |
| - | EXCEPTION: In parallel with steps 5 to 8, the parallel behaviour in table 7.1.2.7.3.2-2 is running. | - | - | - | - |
| 5 | The SS Transmits a valid MAC PDU containing *RRCConnectionSetup*, but not including 'UE Contention Resolution Identity' MAC control element | <-- | MAC PDU (*RRCConnectionSetup)* | 2 | - |
| 6 | Check: does the UE transmit a MAC PDU containing an *RRCConnectionRequest* message? | --> | MAC PDU (*RRCConnectionRequest)* | 2 | P |
| 7 | The SS Transmits a valid MAC PDU containing *RRCConnectionSetup*, and including 'UE Contention Resolution Identity' MAC control element but with un matched 'Contention Resolution Identity' | <-- | MAC PDU | 3 | - |
| 8 | Check: does the UE transmit a MAC PDU containing an *RRCConnectionRequest* message? | --> | MAC PDU | 3 | P |
| 9 | The SS Transmits a valid MAC PDU containing *RRCConnectionSetup*, and including 'UE Contention Resolution Identity' MAC control element with matching 'Contention Resolution Identity' | <-- | MAC PDU | 4 | - |
| 10 | Check: does the UE transmit a MAC PDU containing an *RRCConnectionSetupComplete* message including SERVICE REQUEST message? | --> | MAC PDU (*RRCConnectionSetupComplete)* | 4 | P |
| 11-14 | Steps 6 to 9 of the generic radio bearer establishment procedure (TS 36.508 4.5.3.3-1) are executed to successfully complete the service request procedure. | - | - | - | - |

**Table 7.1.2.7.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | Check: UE transmits a MAC PDU containing an *RRCConnectionSetupComplete* message indicating acceptance of *RRCConnectionSetup* message? | --> | MAC PDU (*RRCConnectionSetupComplete)* | 2,3 | F |

#### 7.1.2.7.3.3 Specific message contents

**7.1.2.7.3.3-1: *SystemInformationBlockType2* (all steps, table 7.1.2.7.3.2-1)**

| Derivation path: 36.508 table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| ra-SupervisionInformation SEQUENCE { | | | |
| preambleTransMax | N10 | Max value | |
| mac-ContentionResolutionTimer | sf64 | Max value | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.2.8 MAC contention resolution / C-RNTI

### 7.1.2.8.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state and after transmitting a
RRCConnectionReconfigurationComplete message for a handover 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 { The UE retransmits the RRCConnectionReconfigrationComplete message }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state and after transmitting a
RRCConnectionReconfigurationComplete message for a handover without dedicated preamble }
ensure that {
  when { UE receive PDCCH transmission addressed to its C-RNTI before Contention resolution timer
expiry }
    then { The UE does not retransmit the RRCConnectionReconfigrationComplete message }
            }
```

### 7.1.2.8.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.1.5.

[TS 36.321, clause 5.1.5]

Contention Resolution is based on either C-RNTI on PDCCH or UE Contention Resolution Identity on DL-SCH..

Once Msg3 is transmitted, the UE shall:

- start *mac-ContentionResolution*Timer and restart *mac-ContentionResolution*Timer at each HARQ retransmission;
- regardless of the possible occurrence of a measurement gap, monitor the PDCCH until *mac-ContentionResolution*Timer expires or is stopped;
- if notification of a reception of a PDCCH transmission is received from lower layers, the UE shall:
  - if the C-RNTI MAC control element was included in Msg3:
    - if the Random Access procedure was initiated by the MAC sublayer itself and the PDCCH transmission is addressed to the C-RNTI and contains an UL grant for a new transmission; or
    - if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI:
      - consider this Contention Resolution successful;

        - stop *mac-ContentionResolution*Timer;
        - discard the Temporary C-RNTI;
        - consider this Random Access procedure successfully completed.

...

        - else
            - discard the Temporary C-RNTI;
            - consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

- if *mac-ContentionResolution*Timer expires:
    - discard the Temporary C-RNTI;
    - consider the Contention Resolution not successful.
- if the Contention Resolution is considered not successful the UE shall:
    - flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;
        - increment PREAMBLE_TRANSMISSION_COUNTER by 1;
        - If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
            - indicate a Random Access problem to upper layers.
        - based on the back off parameter in the UE, select a random back off time according to a uniform distribution between 0 and the Back off Parameter Value;
        - delay the subsequent Random Access transmission by the back off time;
        - proceed to the selection of a Random Access Resource (see subclause 5.1.2).

#### 7.1.2.8.3 Test description

##### 7.1.2.8.3.1 Pre-test conditions

System Simulator:

- Cell 1 and Cell 2
- System information as in table 7.1.2.8.3.3-1.

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) according to [18] on cell 1.

##### 7.1.2.8.3.2 Test procedure sequence

Table 7.1.2.8.3.2-0 illustrates the downlink power levels and other changing parameters to be applied for the cells 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.

**Table 7.1.2.8.3.2-0: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 2 |
|---|---|---|---|---|
| **T1** | Cell-specific RS EPRE | dBm/15kHz | -85 | -79 |

**Table 7.1.2.8.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 0 | The SS changes Cell 1 and Cell 2 level according to the row "T1" in table 7.1.2.8.3.2-0 | - | - | - | - |
| 1 | The SS transmits a MAC PDU containing an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 2, not including explicit Random Access Preamble. | <-- | MAC PDU | - | - |
| 2 | The UE transmits on cell 2 a MAC PDU containing *RRCConnectionReconfigurationComplete*, including C-RNTI MAC control element. SS is configured to not transmit RLC ACK for this transmission. | --> | MAC PDU | - | - |
| 3 | SS Does not schedule any PDCCH transmission for UE C-RNTI | - | - | - | - |
| 4 | Check: does the UE transmit a PRACH preamble within time equal to 'Contention Resolution Timer'? | --> | (PRACH preamble) | 1 | F |
| 5 | Check: does the UE transmit on cell 2 a MAC PDU containing *RRCConnectionReconfigurationComplete with RLC SN 0*, including C-RNTI MAC control element? | --> | MAC PDU (*RLC SN = 0* ) | 1 | P |
| 6 | SS sends PDCCH transmission for UE C-RNTI | <-- | - | - | - |
| 7 | Check: does the UE transmit MAC PDU containing RRCConnectionReconfigurationComplete with RLC SN 0 within the next 2s? | --> | MAC PDU (RLC SN = 0 ) | 2 | F |
| 8 | Check: does the test result of CALL generic procedure indicate that the UE is in E-UTRA RRC_CONNECTED state on Cell 2? | - | - | 2 | - |

7.1.2.8.3.3 Specific message contents

**Table 7.1.2.8.3.3-1: *SystemInformationBlockType2* (all steps, Table 7.1.2.8.3.2-1)**

| Derivation path: 36.508 table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| ra-SupervisionInformation SEQUENCE { | | | |
| preambleTransMax | N10 | Max value | |
| mac-ContentionResolutionTimer | sf64 | Max value | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.2.8.3.3-2: *RRCConnectionReconfiguration* (step 1, Table 7.1.2.8.3.2-1)**

| Derivation path: 36.508 table 4.6.1-6, condition RBC-HO | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| mobilityControlInformation SEQUENCE { | MobilityControlInformation-HO | | |
| targetCellIdentity | PhysicalCellIdentity of Cell 2 (see 36.508 clause 4.4.4.2) | | |
| eutra-CarrierFreq | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.2.9 MAC back off indicator

### 7.1.2.9.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_IDLE state and having initiated a random access procedure }
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
}
            }
```

(2)

```
with { UE in E-UTRA RRC_IDLE state and having initiated a random access procedure }
ensure that {
  when { SS sends a Random Access Response containing Backoff Indicator and a Random Access Preamble
identifier with the same value as received from the UE }
    then { UE stores Backoff Indicator and sends a RRC connection request in the first scheduled UL
transmission }
            }
```

(3)

```
with { UE in E-UTRA RRC_IDLE state and having initiated a random access procedure }
ensure that {
  when { UE receives a Contention Resolution failure }
    then { UE triggers RA preamble after random time between 0 and the UE stored Backoff parameter }
            }
```

### 7.1.2.9.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clauses 5.1.4, 5.1.5 and 7.2.

[TS 36.321 clause 5.1.4]

- If a downlink assignment for this TTI has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded, the UE shall regardless of the possible occurrence of a measurement gap:
  - if the Random Access Response contains a Back off Indicator sub header:
    - set the back off parameter value in the UE as indicated by the BI field of the Back off Indicator sub header and Table 7.2-1.

- else, set the back off parameter value in the UE to 0 ms.

...

If no Random Access Response is received within the RA Response window, or if none of all received Random Access Responses contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, the Random Access Response reception is considered not successful and the UE shall:

...

- if in this Random Access procedure, the Random Access Preamble was selected by MAC:
  - based on the backoff parameter in the UE, select a random backoff time according to a uniform distribution between 0 and the Backoff Parameter Value;
  - delay the subsequent Random Access transmission by the backoff time;

[TS 36.321 clause 5.1.5]

- if the Contention Resolution is considered not successful the UE shall:
  - flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;
  - increment PREAMBLE_TRANSMISSION_COUNTER by 1;
  - If PREAMBLE_TRANSMISSION_COUNTER = *preambleTransMax* + 1:
  - indicate a Random Access problem to upper layers.
  - based on the backoff parameter in the UE, select a random backoff time according to a uniform distribution between 0 and the Backoff Parameter Value;
  - delay the subsequent Random Access transmission by the backoff time;
  - proceed to the selection of a Random Access Resource (see subclause 5.1.2).

[TS 36.321 clause 7.2]

Back off Parameter values are presented in Table 7.2-1.

**Table 7.2-1: Backoff Parameter values**

| Index | Backoff Parameter value (ms) |
|---|---|
| 0 | 0 |
| 1 | 10 |
| 2 | 20 |
| 3 | 30 |
| 4 | 40 |
| 5 | 60 |
| 6 | 80 |
| 7 | 120 |
| 8 | 160 |
| 9 | 240 |
| 10 | 320 |
| 11 | 480 |
| 12 | 960 |
| 13 | Reserved |
| 14 | Reserved |
| 15 | Reserved |

The reserved values of the backoff parameter if received by the current release version UEs shall be taken as 960 ms.

#### 7.1.2.9.3 Test description

##### 7.1.2.9.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Registered, Idle Mode (state 2) according to [18].

**Table 7.1.2.9.3.1-1: Void**

##### 7.1.2.9.3.2 Test procedure sequence

**Table 7.1.2.9.3.2-1: Back off Parameter values.**

| x: Index | y: Back off Parameter value (ms) |
|---|---|
| 1 | 10 |
| 2 | 20 |
| 3 | 30 |
| 4 | 40 |
| 5 | 60 |
| 6 | 80 |
| 7 | 120 |
| 8 | 160 |
| 9 | 240 |
| 10 | 320 |
| 11 | 480 |
| 12 | 960 |
| 13 | 960 |
| 14 | 960 |
| 15 | 960 |

**Table 7.1.2.9.3.2-2: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| - | EXCEPTION: Steps 1 to 5e are repeated for values of 'x' and 'y' according to table 7.1.2.9.3.2-1 | - | - | - | - |
| 1 | SS pages the UE | <-- | - | - | - |
| 2 | UE sends a Random Access Preamble | --> | Random Access Preamble | - | - |
| 3 | SS sends a Random Access Response with the back off parameter set to value Index field 'x' and with the Random Access Preamble identifier different from the value received from the UE in the Random Access Preamble.<br>The SS sets Timer_T1 to the Back off value 'y' associated with the Index value 'x' and starts Timer_T1. | <-- | Random Access Response(BI, RAPID) | - | - |
| 4 | Check: Does UE send a Random Access Preamble while Timer_T1 is running? | --> | Random Access Preamble | 1 | P |
| 5 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 4, including T-CRNTI and not including Back off Indicator sub header | <-- | Random Access Response | - | - |
| 5A | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |
| 5B | The SS Transmits a valid MAC PDU | <-- | MAC PDU | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | containing *RRCConnectionSetup*, and including 'UE Contention Resolution Identity' MAC control element with matching 'Contention Resolution Identity' | | (*RRCConnectionSetup*) | | |
| 5C | The UE transmits an *RRCConnectionSetupComplete* message. | --> | - | - | - |
| 5D | SS transmits SERVICE REJECT message with EMM cause "Congestion" to complete the procedure<br>Note: The EMM cause chosen is just for convenience, to ensure that UE will abort the procedure without side effects. | <-- | - | - | - |
| 5E | The SS transmits an *RRCConnectionRelease* message to release RRC connection and move to RRC_IDLE. | <-- | - | - | - |
| | EXCEPTION: Steps 6 to 20 are repeated for values of 'x' and 'y' according to table 7.1.2.9.3.2-1 | - | - | - | - |
| 6 | SS pages the UE | <-- | - | - | - |
| 7 | UE sends a Random Access Preamble | --> | Random Access Preamble | - | - |
| 8 | SS sends Random Access Response with a back off parameter set to value Index field 'x' and the Random Access Preamble identifier value set to the same value as received from the UE in the Random Access Preamble. | <-- | Random Access Response(BI, RAPID) | - | - |
| 9 | Check: Does UE sends an *RRCConnectionRequest* in the grant associated to the Random Access ´Response received in step 8? | --> | MAC PDU (*RRCConnectionRequest*) | 2 | P |
| 10 | The SS sends a Contention Resolution Failure. The SS sets Timer_T1 to the Back off value 'y' associated with the Index value 'x' and starts Timer_T1. | <-- | MAC Control PDU (Un matching UE Contention Resolution Identity) | - | - |
| 11 | Check: Does UE send a Random Access Preamble while Timer_T1 is running? | --> | Random Access Preamble | 3 | P |
| 12 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 11, including T-CRNTI and not including Back off Indicator sub header | <-- | Random Access Response | - | - |
| 13 | The UE transmits an *RRCConnectionRequest* message. | --> | - | - | - |
| 14 | The SS Transmits a valid MAC PDU containing *RRCConnectionSetup*, and including 'UE Contention Resolution Identity' MAC control element with matching 'Contention Resolution Identity' | <-- | MAC PDU (*RRCConnectionSetup*) | - | - |
| 15 | The UE transmits an *RRCConnectionSetupComplete* message. | --> | - | - | - |
| 16-19 | Steps 6 to 9 of the generic radio bearer establishment procedure (TS 36.508 4.5.3.3-1) are executed to successfully complete the service request procedure. | - | - | - | - |
| 20 | The SS transmits an *RRCConnectionRelease* message to release RRC connection and move to RRC_IDLE. | <-- | - | - | - |

#### 7.1.2.9.3.3 Specific Message Contents

None

## 7.1.3 DL-SCH data transfer

### 7.1.3.1 Correct handling of DL assignment / Dynamic case

#### 7.1.3.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA 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 subframe and UE performs HARQ operation }
    then { UE sends a HARQ feedback on the HARQ process }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives downlink assignment on the PDCCH with a C-RNTI unknown by the UE and data is
available in the associated subframe }
    then { UE does not send any HARQ feedback on the HARQ process }
            }
```

#### 7.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.321 clause 5.3.1

[TS 36.321, clause 5.3.1]

Downlink assignments transmitted on the PDCCH indicate if there is a transmission on the DL-SCH for a particular UE and provide the relevant HARQ information.

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI during which it monitors PDCCH:

- if a downlink assignment for this TTI has been received on the PDCCH for the UE's C-RNTI, or Temporary C-RNTI:
  - if this is the first downlink assignment for this Temporary C-RNTI:
    - consider the NDI to have been toggled.
  - if the downlink assignment is for UE'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 UE's Semi-Persistent Scheduling C-RNTI or a configured downlink assignment:
    - consider the NDI to have been toggled regardless of the value of the NDI.
  - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.

#### 7.1.3.1.3 Test description

##### 7.1.3.1.3.1 Pre-test conditions

System Simulator:

- Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.3.1.3.3-1

UE:

None.

Preamble:

- The generic procedure to get UE in test state Loopback Activated (State 4) according to TS 36.508 clause 4.5 is executed, with all the parameters as specified in the procedure except that the RLC SDU size is set to return no data in uplink.

#### 7.1.3.1.3.2 Test procedure sequence

**Table 7.1.3.1.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | SS transmits a downlink assignment including the C-RNTI assigned to the UE | <-- | (PDCCH (C-RNTI)) | - | - |
| 2 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU. | <-- | 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. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE send any HARQ ACK on PUCCH? | --> | HARQ ACK | 2 | F |

NOTE 1: For TDD, the timing of ACK/NACK is not constant as FDD, see Table 10.1-1 of TS 36.213.

#### 7.1.3.1.3.3 Specific Message Contents

**Table 7.1.3.1.3.3-1: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.1.3.3-2: Void**

**Table 7.1.3.1.3.3-3: Void**

### 7.1.3.2 Correct handling of DL assignment / Semi-persistent case

#### 7.1.3.2.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_Connected state with DRB established and sps-Configuration in DL is enabled
}
ensure that {
  when { UE receives a DL assignment addressed to its stored SPS-CRNTI in SF-Num y and with NDI set
as 0 }
    then { UE starts receiving DL MAC PDU in SF-Nums y+n*[semiPersistSchedIntervalDL] where ‘n’ is
positive integer starting at zero  }
            }
```

(2)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num y+n*[semiPersistSchedIntervalDL]  }
ensure that {

  when { UE receives a DL assignment addressed to its SPS-CRNTI in SF-Num p and with NDI set as 0, where p!= y+n*[semiPersistSchedIntervalDL] }
    then { UE starts receiving DL MAC PDU in SF-Nums p+n*[semiPersistSchedIntervalDL] and stops receiving DL MAC PDU at SF-Nums y+n*[semiPersistSchedIntervalDL]where 'n' is positive integer starting at zero }
            }
```

(3)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num p+n*[semiPersistSchedIntervalDL] }
ensure that {
  when { UE receives a DL assignment [for retransmission] addressed to its SPS-CRNTI in SF-Num z and with NDI set as 1, where z!= p+n*[semiPersistSchedIntervalDL] }
    then { UE receives MAC PDU in SF-Num z as per the new grant for SPS-CRNTI }
            }
```

(4)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num y+n*[semiPersistSchedIntervalDL]  }
ensure that {
  when { UE receives a DL assignment addressed to its CRNTI in SF-Num p, such that p!= y+n*[semiPersistSchedIntervalDL] }
    then { UE receives MAC PDU in SF-Num p as per assignment addressed to its C-RNTI }
            }
```

(5)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS grant to receive MAC PDU at SF-Num z+n*[semiPersistSchedIntervalDL] }
ensure that {
  when { UE receives a RRCConnectionReconfiguration including sps-Configuration with sps-ConfigurationDL set as 'disable' and hence resulting in DL SPS grant deactivation }
    then { UE deletes the stored sps-Configuration DL parameters and stops receiving DL MAC PDU's as per stored SPS assignment in SF-Num z+n*[semiPersistSchedIntervalDL] }
            }
```

(6)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num z+n*[semiPersistSchedIntervalDL] }
ensure that {
  when { UE receives a PDCCH [for DL SPS explicit release according to Table 9.2-1A in TS 36.213] addressed to its SPS C-RNTI in SF-Num p and with NDI set as 0, where p!= z+n*[semiPersistSchedIntervalDL] }
    then { UE sends an ACK to SS and releases the configured SPS assignment and stops receiving MAC PDU in SF-Num z+n*[semiPersistSchedIntervalDL] as per assignment addressed to its SPS C-RNTI }
            }
```

NOTE: SF-Num = [10*SFN + subframe] modulo 10240.

#### 7.1.3.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.3.1, 5.10 & 5.10.1, 36.331 clause 5.3.10.5, 36.300 clause 11.1.1 and 36.213 clause 9.2.

[TS 36.321, clause 5.3.1]

Downlink assignments transmitted on the PDCCH indicate if there is a transmission on the DL-SCH for a particular UE and provide the relevant HARQ information.

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI during which it monitors PDCCH:

- if a downlink assignment for this TTI has been received on the PDCCH for the UE's C-RNTI, or Temporary C-RNTI:
  - if this is the first downlink assignment for this Temporary C-RNTI:
    - consider the NDI to have been toggled.
  - if the downlink assignment is for UE'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 UE's Semi-Persistent Scheduling C-RNTI or a configured downlink assignment:
    - consider the NDI to have been toggled regardless of the value of the NDI.
  - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.
- else, if a downlink assignment for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:
  - if the NDI in the received HARQ information is 1:
    - consider the NDI not to have been toggled;
    - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.
  - else, if the NDI in the received HARQ information is 0:
    - if PDCCH contents indicate SPS release:
      - clear the configured downlink assignment (if any);
      - if *timeAlignmentTimer* is running:
      - instruct the physical layer to transmit a positive acknowledgement.
    - else:
      - store the downlink assignment and the associated HARQ information as configured downlink assignment;
      - initialise (if not active) or re-initialise (if already active) the configured downlink assignment to start in this TTI and to recur according to rules in subclause 5.10.1;
      - set the HARQ Process ID to the HARQ Process ID associated with this TTI;
      - consider the NDI bit to have been toggled;
      - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.
- else, if a downlink assignment for this TTI has been configured and there is no measurement gap in this TTI:
  - instruct the physical layer to receive, in this TTI, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;
  - set the HARQ Process ID to the HARQ Process ID associated with this TTI;
  - consider the NDI bit to have been toggled;
  - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.

For downlink assignments received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI and for configured downlink assignments, the HARQ Process ID associated with this TTI is derived from the following equation:

HARQ Process ID = [floor(CURRENT_TTI/(Downlink Semi-Persistent Scheduling Interval))] modulo Number of Configured SPS Processes,

where CURRENT_TTI=[(SFN * 10) + subframe number], Downlink Semi-Persistent Scheduling Interval is the periodicity of semi-persistent scheduling signalled via RRC and Number of Configured SPS Processes is the number of HARQ processes allocated for semi-persistent scheduling signalled via RRC.

[TS 36.321, clause 5.10]

When Semi-Persistent Scheduling is enabled by upper layer, the following information is provided:

- Semi-Persistent Scheduling C-RNTI;
- Uplink Semi-Persistent Scheduling Interval *semiPersistSchedIntervalUL* and number of empty transmissions before implicit release *implicitReleaseAfter*, if Semi-Persistent Scheduling is enabled for the uplink;
- Whether *twoIntervalsConfig* is enabled or disabled for uplink, only for TDD;
- Downlink Semi-Persistent Scheduling Interval *semiPersistSchedIntervalDL* and number of configured HARQ processes for Semi-Persistent Scheduling *numberOfConfSPS-Processes*, if Semi-Persistent Scheduling is enabled for the downlink;

When Semi-Persistent Scheduling for uplink or downlink is disabled by RRC, the corresponding configured grant or configured assignment shall be discarded.

[TS 36.321, clause 5.10.1]

After a Semi-Persistent downlink assignment is configured, the UE shall consider that the assignment recurs in each subframe for which:

- (10 * SFN + subframe) = [(10 * $SFN_{start\ time}$ + $subframe_{start\ time}$) + N * (Downlink Semi-Persistent Scheduling Interval)] modulo 10240, for all N>0.

Where $SFN_{start\ time}$ and $subframe_{start\ time}$ are the SFN and subframe, respectively, at the time the configured downlink assignment were (re-)initialised.

[TS 36.331, clause 5.3.10.5]

The UE shall:

1> reconfigure the semi-persistent scheduling in accordance with the received *sps-Config*:

[TS 36.300, clause 11.1.1]

In addition, E-UTRAN can allocate semi-persistent downlink resources for the first HARQ transmissions to UEs:

- RRC defines the periodicity of the semi-persistent downlink grant;
- PDCCH indicates whether the downlink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

When required, retransmissions are explicitly signalled via the PDCCH(s). In the sub-frames where the UE has semi-persistent downlink resource, if the UE cannot find its C-RNTI on the PDCCH(s), a downlink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI is assumed. Otherwise, in the sub-frames where the UE has semi-persistent downlink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the semi-persistent allocation for that TTI and the UE does not decode the semi-persistent resources.

[TS 36.213, clause 9.2]

A UE shall validate a Semi-Persistent Scheduling assignment PDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the PDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to ‘0’. In case of DCI formats 2 and 2A, the new data indicator field refers to the one for the enabled transport block.

Validation is achieved if all the fields for the respective used DCI format are set according to Table 9.2-1 or Table 9.2-1A.

If validation is achieved, the UE shall consider the received DCI information accordingly as a valid semi-persistent activation or release.

If validation is not achieved, the received DCI format shall be considered by the UE as having been received with a non-matching CRC.

**Table 9.2-1: Special fields for Semi-Persistent Scheduling Activation PDCCH Validation**

| | DCI format 0 | DCI format 1/1A | DCI format 2/2A |
|---|---|---|---|
| TPC command for scheduled PUSCH | set to ‘00’ | N/A | N/A |
| Cyclic shift DM RS | set to ‘000’ | N/A | N/A |
| Modulation and coding scheme and redundancy version | MSB is set to ‘0’ | N/A | N/A |
| HARQ process number | N/A | FDD: set to ‘000’<br>TDD: set to ‘0000’ | FDD: set to ‘000’<br>TDD: set to ‘0000’ |
| Modulation and coding scheme | N/A | MSB is set to ‘0’ | For the enabled transport block: MSB is set to ‘0’ |
| Redundancy version | N/A | set to ‘00’ | For the enabled transport block: set to ‘00’ |

**Table 9.2-1A: Special fields for Semi-Persistent Scheduling Release PDCCH Validation**

| | DCI format 0 | DCI format 1A |
|---|---|---|
| TPC command for scheduled PUSCH | set to ‘00’ | N/A |
| Cyclic shift DM RS | set to ‘000’ | N/A |
| Modulation and coding scheme and redundancy version | set to ‘11111’ | N/A |
| Resource block assignment and hopping resource allocation | Set to all ‘1’s | N/A |
| HARQ process number | N/A | FDD: set to ‘000’<br>TDD: set to ‘0000’ |
| Modulation and coding scheme | N/A | set to ‘11111’ |
| Redundancy version | N/A | set to ‘00’ |
| Resource block assignment | N/A | Set to all ‘1’s |

### 7.1. 3.2.3 Test description

#### 7.1.3.2.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(1,1) is used for step 8 in 4.5.3A.3 according to [18].
- The UL RLC SDU size is set to not return any data.

7.1.3.2.3.2 Test procedure sequence

**Table 7.1.3.2.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'Y', NDI=0 | <-- | (DL SPS Grant) | - | - |
| 2 | The SS transmits in SF-Num 'Y', a DL MAC PDU containing a RLC PDU (DL-SQN=0)on UM DRB | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 4 | The SS transmits in SF-Num 'Y+X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=1)on DRB | <-- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 6 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'P', NDI=0;<br>(Where Y+X<P< Y+2X) | <-- | (DL SPS Grant) | - | - |
| 7 | The SS transmits in SF-Num 'P', a DL MAC PDU containing a RLC PDU (DL-SQN=2)on UM DRB | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 9 | The SS transmits in SF-Num 'Y+2X', a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 2 | F |
| 10A | The SS Transmits a DL assignment using UE's C-RNTI in SF-Num 'P+X(semiPersistSchedIntervalDL)', NDI=0 | <-- | (DL Grant) | - | - |
| 11 | The SS transmits in SF-Num 'P+X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB; | <-- | MAC PDU | - | - |
| 12 | Void | - | - | - | - |
| 13 | Void | - | - | - | - |
| 14 | Void | - | - | - | - |
| 15 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 16 | The SS transmits in SF-Num 'P+2X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=4)on UM DRB | <-- | MAC PDU | - | - |
| 17 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 18 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num in SF-Num 'P+3X(semiPersistSchedIntervalDL)' . (Note 1a) | <-- | (DL SPS Grant) | - | - |
| 19 | The SS transmits in SF-Num 'P+3X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=5)on UM DRB;Note 1 | <-- | MAC PDU | - | - |
| 19A | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | | |
| | EXCEPTION: Step 19b and 19c shall be repeated until HARQ retransmission count = 3 is reached for MAC PDU at step 19 (Note 1b). | | | | |
| 19b | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'Z', NDI=1;<br>Where (P+3X < Z <P+4X); The DL HARQ process is same as in step 11 | <-- | (DL SPS Grant) | | |
| 19c | The SS re-transmits in SF-Num 'Z', a DL MAC | <-- | MAC PDU | | |

| | | | | | |
|---|---|---|---|---|---|
| | PDU containing a RLC PDU (DL-SQN=5)on UM DRB; (Note 1a) | | | | |
| | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 20 (Note 1b). | | | | |
| 20 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 3 | P |
| 21 | The SS Transmits a PDCCH [for DL SPS explicit release] using UE's SPS C-RNTI in SF-Num 'Q', NDI=0; Where (P+3X< Q <P+4X). | <-- | PDCCH [for DL SPS explicit release] | - | - |
| 22 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 6 | P |
| 23 | The SS transmits in SF-Num 'P+5X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=6)on UM DRB; | <-- | MAC PDU | - | - |
| 24 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 6 | F |
| 25 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'P+6X', NDI=0 | <-- | (DL SPS Grant) | - | - |
| 26 | The SS transmits in SF-Num 'P+6X', a DL MAC PDU containing a RLC PDU (DL-SQN=6)on UM DRB | <-- | MAC PDU | - | - |
| 27 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 28 | Void | - | - | - | - |
| 29 | Void | - | - | - | - |
| 30 | SS Transmits RRCConnectionReconfiguration to disable SPS-ConfigurationDL | - | - | - | - |
| 31 | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 32 | The SS transmits in SF-Num 'P+8X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=7) on UM DRB; | <-- | MAC PDU | - | - |
| 33 | Check: Dose the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 5 | F |

Note 1: The DL assignment for C-RNTI and hence the size of MAC PDU is different in size than stored SPS C-RNTI DL assignment in step 6. This assures UE is receiving DSCH data as per DL assignment for C-RNTI and not as per stored grant for SPS C-RNTI.

Note 1a: SS should transmit this PDU using $I_{TBS}$=6, $N_{PRB}$=1, see TS 36.213 Table 7.1.7.2.1-1. This will result in TBSize of 328 and having coding rate more than 1.

Note 1b: 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 2: For TDD, the subframe number for 'Y', 'P', 'Z' and 'Q' should be '0', '4', '5' and '9' respectively based on TDD configuration 1.

7.1.3.2.3.3 Specific message contents

**Table 7.1.3.2.3.3-1: *RRCConnectionReconfiguration.* RadioResourceConfigDedicated (Preamble)**

| Derivation path: 36.508 table 4.6.3-16 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated::= SEQUENCE { | | | |
| sps-Configuration ::= SEQUENCE { | | | |
| semiPersistSchedC-RNTI | 'FFF0'H | | |
| sps-ConfigurationDL::=CHOICE{ | | | |
| enable SEQUENCE { | | | |
| semiPersistSchedIntervalDL | sf40 | 40 Subframe | |
| numberOfConfSPS-Processes | 8 | | FDD |
| numberOfConfSPS-Processes | 7 | Max DL HARQ processes is 7 considering TDD configuration 1. | TDD |
| n1Pucch-AN-Persistent | 0 | | |
| } | | | |
| } | | | |
| sps-ConfigurationUL | Not Present | | |
| } | | | |
| } | | | |

**Table 7.1.3.2.3.3-2: *RRCConnectionReconfiguration.* RadioResourceConfigDedicated (step 30 of table 7.1.3.2.3.2-1)**

| Derivation path: 36.508 table 4.6.3-16 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated::= SEQUENCE { | | | |
| sps-Configuration ::= SEQUENCE { | | | |
| semiPersistSchedC-RNTI | Not Present | | |
| sps-ConfigurationDL::=CHOICE{ | | | |
| disable | NULL | | |
| } | | | |
| sps-ConfigurationUL | Not Present | | |
| } | | | |
| } | | | |

**Table 7.1.3.2.3.3-3: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| drx-Config CHOICE { | | | pc_FeatrGrp_5 AND DRX_S |
| setup SEQUENCE { | | | |
| onDurationTimer | psf40 | | |
| } | | | |
| } | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

| Condition | Explanation |
|---|---|
| DRX_S | Used for DRX configuration with small DRX cycle length |

### 7.1.3.3 MAC PDU header handling

#### 7.1.3.3.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives a MAC PDU containing an AMD PDU that is larger than 128 bytes with padding at
the end }
    then { UE successfully decodes the MAC PDU and forward to higher layer }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives a MAC PDU containing an AMD PDU that is smaller than 128 bytes with padding at
the end }
    then { UE successfully decodes the MAC PDU and forward to higher layer }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives a MAC PDU containing an single AMD PDU with no padding }
    then { UE successfully decodes the MAC PDU and forward to higher layer }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives a MAC PDU containing multiple MAC SDUs each containing an AMD PDU and no
padding }
    then { UE successfully decodes the MAC PDU and forwards the AMD PDUs to higher layer }
            }
```

#### 7.1.3.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.321 clauses 6.1.2 and 6.2.1.

[TS 36.321, clause 6.1.2]

A MAC PDU consists of a MAC header, zero or more MAC Service Data Units (MAC SDU), zero, or more MAC control elements, and optionally padding; as described in Figure 6.1.2-3.

Both the MAC header and the MAC SDUs are of variable sizes.

A MAC PDU header consists of one or more MAC PDU sub-headers; each sub header corresponding to either a MAC SDU, a MAC control element or padding.

A MAC PDU sub header consists of the six header fields R/R/E/LCID/F/L but for the last sub header in the MAC PDU and for fixed sized MAC control elements. The last sub header in the MAC PDU and sub-headers for fixed sized MAC control elements consist solely of the four header fields R/R/E/LCID. It follows that a MAC PDU sub header corresponding to padding consists of the four header fields R/R/E/LCID.

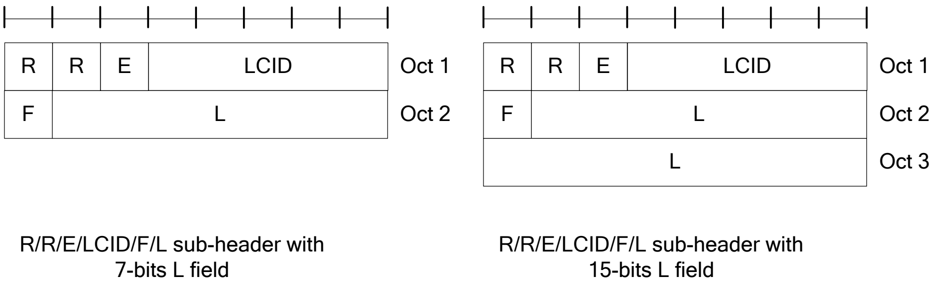


**Figure 6.1.2-1: R/R/E/LCID/F/L MAC sub header**

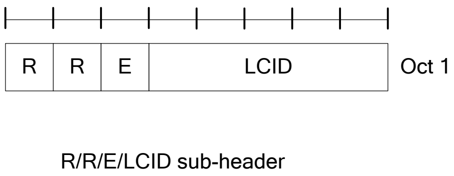


**Figure 6.1.2-2: R/R/E/LCID MAC sub header**

MAC PDU sub-headers have the same order as the corresponding MAC SDUs, MAC control elements and padding.

MAC control elements, are always placed before any MAC SDU.

Padding occurs at the end of the MAC PDU, except when single-byte or two-byte padding is required. Padding may have any value and the UE shall ignore it. When padding is performed at the end of the MAC PDU, zero or more padding bytes are allowed.

When single-byte or two-byte padding is required, one or two MAC PDU sub-headers corresponding to padding are placed at the beginning of the MAC PDU before any other MAC PDU subheader. A maximum of one MAC PDU can be transmitted per TB per UE.

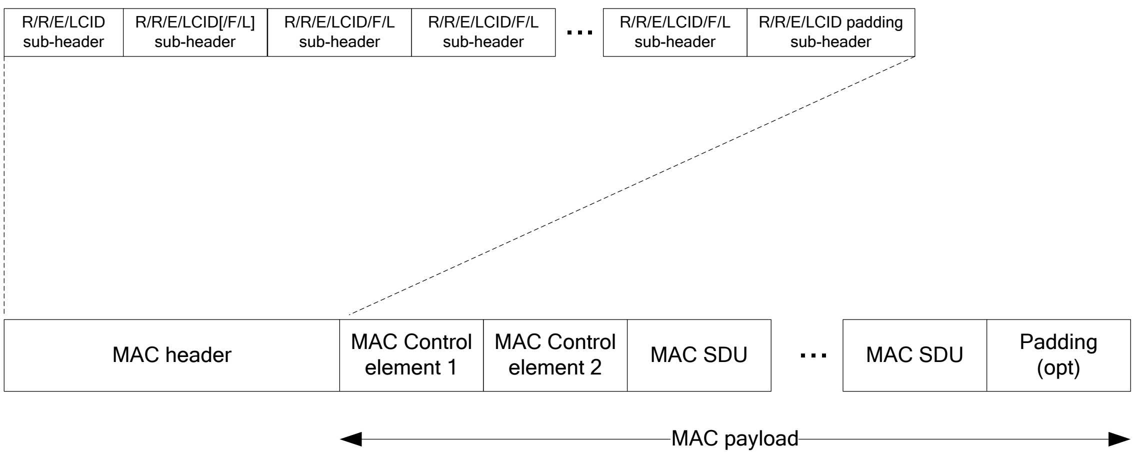


**Figure 6.1.2-3: Example of MAC PDU consisting of MAC header, MAC control elements, MAC SDUs and padding**

[TS 36.321, clause 6.2.1]

The MAC header is of variable size and consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC control element or padding as described in tables 6.2.1-1 and 6.2.1-2 for the DL and UL-SCH respectively. There is one LCID field for each MAC SDU, MAC control element or padding included in the MAC PDU. In addition to that, one or two additional LCID fields are included in the MAC PDU, when single-byte or two-byte padding is required but cannot be achieved by padding at the end of the MAC PDU. The LCID field size is 5 bits;

- L: The Length field indicates the length of the corresponding MAC SDU or MAC control element in bytes. There is one L field per MAC PDU sub header except for the last sub header and sub-headers corresponding to fixed-sized MAC control elements. The size of the L field is indicated by the F field;

- F: The Format field indicates the size of the Length field as indicated in table 6.2.1-3. There is one F field per MAC PDU sub header except for the last sub header and sub-headers corresponding to fixed-sized MAC control elements. The size of the F field is 1 bit. If the size of the MAC SDU or MAC control element is less than 128 bytes, the UE shall set the value of the F field to 0, otherwise the UE shall set it to 1;

- E: The Extension field is a flag indicating if more fields are present in the MAC header or not. The E field is set to "1" to indicate another set of at least R/R/E/LCID fields. The E field is set to "0" to indicate that either a MAC SDU, a MAC control element or padding starts at the next byte;

- R: Reserved bits, set to "0".

The MAC header and sub-headers are octet aligned.

**Table 6.2.1-1: Values of LCID for DL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11011 | Reserved |
| 11100 | UE Contention Resolution Identity |
| 11101 | Timing Advance Command |
| 11110 | DRX Command |
| 11111 | Padding |

**Table 6.2.1-2: Values of LCID for UL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11001 | Reserved |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

**Table 6.2.1-3: Values of F field:**

| Index | Size of Length field (in bits) |
|---|---|
| 0 | 7 |
| 1 | 15 |

#### 7.1.3.3.3 Test description

##### 7.1.3.3.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The UL RLC SDU size is set to not return any data.

#### 7.1.3.3.3.2 Test procedure sequence

**Table 7.1.3.3.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a MAC PDU containing a RLC SDU of 130 bytes in an AMD PDU (SN=0) with polling field 'P' set to '1' and 5 bytes of padding. The MAC header contains two MAC sub-headers where the first MAC sub-header is a 3-byte R/R/E/LCID/F/L MAC sub-header with 'E' field set to '1', the 'F' set to '1', the 'LCID' field set to '00011' and the 'L' field set to '132' bytes. The second MAC sub-header is a padding control 1byte R/R/E/LCID MAC sub-header with 'E' field set to '0' and 'LCID' field set to '11111'. | <-- | MAC PDU (R/R/E/LCID/F/L MAC sub-header (E='1', LCID='00011', F='1', L='132'), MAC R/R/E/LCID MAC sub-header (E='0', LCID='11111'), 132 bytes MAC SDU and 5 bytes padding) | - | - |
| 2 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 1? | --> | MAC PDU (RLC STATUS PDU (ACK_SN '1')) | 1 | P |
| 3 | The SS transmits a MAC PDU containing a RLC SDU of 40 bytes in an AMD PDU(SN=1) with polling field 'P' set to '1'and 4 bytes of padding. The MAC header contains two MAC sub-headers where the first MAC sub-header is a 2-byte R/R/E/LCID/F/L MAC sub-header with 'E' field set to '1', the 'F' set to '0', the 'LCID' field set to '00011' and the 'L' field set to '42' bytes. The second MAC sub-header is a padding control 1byte R/R/E/LCID MAC sub-header with 'E' field set to '0' and 'LCID' field set to '11111'. | <-- | MAC PDU (R/R/E/LCID/F/L MAC sub-header (E='1', LCID='00011', F='0', L='42'), R/R/E/LCID MAC sub-header (E='0', LCID='11111'), 42 bytes MAC SDU and 4 bytes padding) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 3? | --> | MAC PDU (RLC STATUS PDU (ACK_SN '2')) | 2 | P |
| 5 | The SS transmits a MAC PDU containing a MAC SDU with a RLC SDU of 130 bytes in an AMD PDU(SN=2) with polling field 'P' set to '1'. The MAC header contains one R/R/E/LCID MAC sub-header with 'E' field set to '0' and the 'LCID' field set to '00011'. | <-- | MAC PDU (R/R/E/LCID MAC sub-header (E='0', LCID='00011'), 132 bytes MAC SDU) | - | - |
| 6 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 5? | --> | MAC PDU (RLC STATUS PDU (ACK_SN '3')) | 3 | P |
| 7 | The SS transmits a MAC PDU containing one MAC SDU containing a RLC SDU of size 128 bytes in an AMD PDU (SN=3) and five MAC SDUs each containing a RLC SDU of 41 bytes in an AMD PDU (SN=4 to 8) in an AMD PDU with the polling field 'P' set to '1' in the last AMD PDU. The MAC header contains six MAC sub-headers where the first MAC sub-header contains a 3 byte R/R/E/LCID/F/L MAC sub-header with 'E' field set to '1' , 'LCID' field set to '00011', 'F' field set to '1' and the 'L' field set to '130'. The second to fifth MAC sub-header are two byte R/R/E/LCID/F/L MAC sub-headers with 'E' field set to '1' , 'LCID' field set to '00011', 'F' field set to '0' and the 'L' field set to '43' bytes. The sixth MAC sub-header is a one byte R/R/E/LCID MAC sub-header with 'E' field set to '0' and the 'LCID' field set to '00011'. | <-- | MAC PDU (R/R/E/LCID/L MAC sub-header (E='1', LCID='00011', F='1', L=' 130'), 4 x R/R/E/LCID/L MAC sub-header (E='1', LCID='00011', F='0', L='43'), R/R/E/LCID MAC sub-header (E='0', LCID='00011'), 130 bytes MAC SDU, 5 x 43 bytes MAC SDUs) | 4 | - |

| | | | | | |
|---|---|---|---|---|---|
| 8 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 7? | --> | MAC PDU (RLC STATUS PDU (ACK_SN '9')) | 4 | P |

#### 7.1.3.3.3.3 Specific Message Contents

**Table 7.1.2.9.3.3-1: SystemInformationBlockType2 (all steps, table 7.1.2.3.3.2-1)**

| Derivation path: 36.508 clause 4.4.3.3, Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| preambleInformation SEQUENCE { | | | |
| numberOfRA-Preambles | n64 | | |
| preamblesGroupAConfig := {SEQUENCE { | | | |
| sizeOfRA-PreamblesGroupA | n28 | | |
| messageSizeGroupA | b208 | | |
| messagePowerOffsetGroupB | minusinfinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| ue-TimersAndConstants SEQUENCE{ | | | |
| t300 | ms1500 | T300 | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.3.4 Correct HARQ process handling / DCCH and DTCH

#### 7.1.3.4.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established }
ensure that {
  when { the UE receives a MAC PDU for DRB and decode fails }
    then { the UE transmits a NACK for the corresponding HARQ process }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established }
ensure that {
  when { the UE receives a MAC PDU retransmission for DRB, and results in successful decode}
    then { the UE transmits an ACK for the corresponding HARQ process and delivers data to upper
layers }
            }
```

#### 7.1.3.4.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.3.2.1 & 5.3.2.2.

[TS 36.321, clause 5.3.2.1]

There is one HARQ entity at the UE 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 DL HARQ processes is specified in [2], clause 7.

When the physical layer is configured for spatial multiplexing [2], one or two TBs are expected per subframe and they are associated with the same HARQ process. Otherwise, one TB is expected per subframe.

The UE shall:

- If a downlink assignment has been indicated for this TTI:
  - allocate the TBs received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.
- If a downlink assignment has been indicated for the broadcast HARQ process:
  - allocate the received TB to the broadcast HARQ process.

NOTE: In case of BCCH a dedicated broadcast HARQ process is used.

[TS 36.321, clause 5.3.2.2]

For each subframe where a transmission takes place for the HARQ process, one or two (in case of 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:

- if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or
- if the HARQ process is equal to the broadcast process and if this is the first received transmission for the TB according to the system information schedule indicated by RRC; or
- if this is the very first received transmission for this TB(i.e. there is no previous NDI for this TB):
  - consider this transmission to be a new transmission.
- else:
  - consider this transmission to be a retransmission.

The UE then shall:

- if this is a new transmission
  - replace the data currently in the soft buffer for this TB with the received data.
- else if this is a retransmission:
  - if the data has not yet been successfully decoded:
    - combine the received data with the data currently in the soft buffer for this TB.
  - if the TB size is different from the last valid TB size signalled for this TB:
    - the UE may replace the data currently in the soft buffer for this TB with the received data.
- attempt to decode the data in the soft buffer for this TB;
- if the data in the soft buffer was successfully decoded for this TB:
  - if the HARQ process is equal to the broadcast process, deliver the decoded MAC PDU to upper layers.
  - else if this is the first successful decoding of the data in the soft buffer for this TB:

    -deliver the decoded MAC PDU to the disassembly and demultiplexing entity.
  - generate a positive acknowledgement (ACK) of the data in this TB.
- else:
  - generate a negative acknowledgement (NACK) of the data in this TB.

- if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not successful (see subclause 5.1.5); or

- if the HARQ process is equal to the broadcast process; or

- - if *timeAlignmentTimer* is stopped or expired:

  - do not indicate the generated positive or negative acknowledgement to the physical layer.

- else:

  - indicate the generated positive or negative acknowledgement for this TB to the physical layer.

The UE 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.

#### 7.1.3.4.3 Test description

##### 7.1.3.4.3.1 Pre-test conditions

System Simulator:

- Cell 1

- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.3.4.3.3-1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

7.1.3.4.3.2 Test procedure sequence

**Table 7.1.3.4.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| - | EXCEPTION: Steps 1 to 7 are run 8[FDD]/7[TDD] times using test parameter values as given for each iteration in table 7.1.3.4.3.2.-2. | - | - | - | - |
| 1 | The SS indicates a new transmission on PDCCH and transmits a MAC PDU (containing an RLC PDU), with content set so that UE could not successfully decode the data from its soft buffer. The AMD PDU contains a full RLC SDU. (Note 1) | <-- | MAC PDU | 1 | - |
| 2 | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | | P |
| | EXCEPTION: Step 3 shall be repeated till HARQ ACK is received at step 4 or until HARQ retransmission count = 4 is reached for MAC PDU at step 3 (Note 2). | | | | |
| 3 | The SS indicates a retransmission on PDCCH and transmits the same MAC PDU like step 1 (Note 1). | <-- | MAC PDU | - | - |
| | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 4 (Note 2). | | | | |
| 4 | Check: Does the UE send a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 5 | UE transmit a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 6 | The SS sends an UL grant suitable for the loop back PDU to transmitted | <-- | (UL Grant) | - | - |
| 7 | The UE transmit a MAC PDU containing the loop back PDU corresponding to step 1 and 3 | --> | MAC PDU | - | - |
| Note 1: SS should transmit this PDU using $I_{TBS}$=6, $N_{PRB}$=1, see TS 36.213 Table 7.1.7.2.1-1. This will result in TBSize of 328 and having coding rate more than 1.<br>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. | | | | | |

**Table 7.1.3.4.3.2-2: Test Parameters**

| Iteration | DL HARQ process (X) |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |
| 5 | 4 |
| 6 | 5 |
| 7 | 6 |
| 8 | 7[only for FDD] |
| Note: The maximum DL HARQ process is 7 for TDD configuration 1. | |

#### 7.1.3.4.3.3 Specific message contents

**Table 7.1.3.4.3.3-1: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.3.5 Correct HARQ process handling / CCCH

#### 7.1.3.5.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA 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 ACK/NACK for the corresponding HARQ process }
            }
```

(2)

```
with { UE in E-UTRA 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
matching the one included in the RRCConnectionRequest message }
    then { UE does not transmit a ACK/NACK for the corresponding HARQ process }
            }
```

(3)

```
with { UE in E-UTRA 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 transmits a NACK for the corresponding HARQ }
            }
```

(4)

```
with { UE in E-UTRA 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 matching
the one included in the RRCConnectionRequest message }
    then { UE transmits an ACK for the corresponding HARQ process and delivers data to upper layers
}
            }
```

#### 7.1.3.5.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.3.2.1 and 5.3.2.2.

[TS 36.321, clause 5.3.2.1]

There is one HARQ entity at the UE 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 DL HARQ processes is specified in [2], clause 7.

When the physical layer is configured for spatial multiplexing [2], one or two TBs are expected per subframe and they are associated with the same HARQ process. Otherwise, one TB is expected per subframe.

The UE shall:

- If a downlink assignment has been indicated for this TTI:
  - allocate the TBs received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.
- If a downlink assignment has been indicated for the broadcast HARQ process:
  - allocate the received TB to the broadcast HARQ process.

NOTE: In case of BCCH a dedicated broadcast HARQ process is used.

[TS 36.321, clause 5.3.2.2]

For each subframe where a transmission takes place for the HARQ process, one or two (in case of 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:

- if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or
- if the HARQ process is equal to the broadcast process and if this is the first received transmission for the TB according to the system information schedule indicated by RRC; or
- if this is the very first received transmission for this TB(i.e. there is no previous NDI for this TB):
  - consider this transmission to be a new transmission.
- else:
  - consider this transmission to be a retransmission.

The UE then shall:

- if this is a new transmission
  - replace the data currently in the soft buffer for this TB with the received data.
- if a retransmission is indicated for this TB:
  - if the data has not yet been successfully decoded:
    - combine the received data with the data currently in the soft buffer for this TB.
  - if the TB size is different from the last valid TB size signalled for this TB:
    - the UE may replace the data currently in the soft buffer for this TB with the received data.
- attempt to decode the data in the soft buffer for this TB;
- if the data in the soft buffer was successfully decoded for this TB:
  - if the HARQ process is equal to the broadcast process:
    - deliver the decoded MAC PDU to upper layers.
  - else if this is the first successful decoding of the data in the soft buffer for this TB:

        - deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

    - generate a positive acknowledgement (ACK) of the data in this TB.

- else:

    - generate a negative acknowledgement (NACK) of the data in this TB.

- if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and a UE the Contention Resolution Identity match is not indicated successful (see subclause 5.1.5); or

- if the HARQ process is equal to the broadcast process; or

- - if *timeAlignmentTimer* is stopped or expired:

    - do not indicate the generated positive or negative acknowledgement to the physical layer.

- else:

    - indicate the generated positive or negative acknowledgement for this TB to the physical layer.

The UE 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.

#### 7.1.3.5.3 Test description

##### 7.1.3.5.3.1 Pre-test conditions

System Simulator:

- Cell 1

- System information taking into account parameters in table 7.1.3.5.3.3-1

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode state (state 2) according to [18].

7.1.3.5.3.2 Test procedure sequence

**Table 7.1.3.5.3.2-1: 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-Id and including T-CRNTI. 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-Id and including T-CRNTI . 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 *RRCConnectionRequest* message. | --> | MAC PDU | - | - |
| 9 | The SS transmits a valid MAC PDU containing *RRCConnectionSetup*, 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-Id and including T-CRNTI. | <-- | Random Access Response | - | - |
| 13 | The UE transmits a MAC PDU containing an RRCConnectionRequest message. | --> | MAC PDU | - | - |
| 14 | The SS transmits a valid MAC PDU containing *RRCConnectionSetup*, 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 NACK? | --> | HARQ NACK | 3 | F |
| 16 | The UE transmits Preamble on PRACH | --> | PRACH Preamble | - | - |
| 17 | The SS transmits Random Access Response with matching RA-Id and including T-CRNTI. | <-- | Random Access Response | - | - |
| 18 | The UE transmits a MAC PDU containing an RRCConnectionRequest message. | --> | MAC PDU | - | - |
| 19 | The SS transmits the same MAC PDU like in step 14, but 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 *RRCConnectionSetupComplete* message including SERVICE REQUEST message indicating acceptance of *RRCConnectionSetup* message | --> | MAC PDU | - | - |
| 22-25 | Steps 6 to 9 of the generic radio bearer establishment procedure (TS 36.508 4.5.3.3-1) are executed to successfully complete the service request procedure. | - | - | - | - |

#### 7.1.3.5.3.3 Specific message contents

**Table 7.1.3.5.3.3-1: SystemInformationBlockType2 (all steps, table 7.1.3.5.3.2-1)**

| Derivation path: 36.508 table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| rach-Configuration SEQUENCE { | | | |
| ra-SupervisionInformation SEQUENCE { | | | |
| preambleTransMax | n8 | | |
| mac-ContentionResolutionTimer | sf64 | Max Value | |
| } | | | |
| } | | | |
| prach-Configuration SEQUENCE { | | | |
| prach-ConfigInfo SEQUENCE { | | | |
| prach-ConfigurationIndex | 1 | As per table 5.7.1-2 of 36.211, this results in PRACH preamble transmission start in even frame numbers and sub-frame number 4 | FDD |
| prach-ConfigurationIndex | 0 | As per table 5.7.1-4 of 36.211, this results in PRACH preamble transmission with frequency resource index=0; occurring in even radio frames; resource is located in first half frame and sub frame number 3 Note 1 | TDD |
| } | | | |
| } | | | |
| } | | | |
| ue-TimersAndConstants SEQUENCE{ | | | |
| t300 | ms2000 | T300 | |
| } | | | |
| } | | | |

## 7.1.3.6 Correct HARQ process handling / BCCH

#### 7.1.3.6.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives a MAC PDU addressed to SI-RNTI }
    then { UE does not send any ACK/NACK for the corresponding dedicated HARQ process }
        }
```

#### 7.1.3.6.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.3.2.1 & 5.3.2.2.

[TS 36.321, clause 5.3.2.1]

There is one HARQ entity at the UE 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 DL HARQ processes is specified in [2], clause 7.

When the physical layer is configured for spatial multiplexing [2], one or two TBs are expected per subframe and they are associated with the same HARQ process. Otherwise, one TB is expected per subframe.

The UE shall:

- If a downlink assignment has been indicated for this TTI:
  - allocate the TBs received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.
- If a downlink assignment has been indicated for the broadcast HARQ process:
  - allocate the received TB to the broadcast HARQ process.

NOTE: In case of BCCH a dedicated broadcast HARQ process is used.

[TS 36.321, clause 5.3.2.2]

For each subframe where a transmission takes place for the HARQ process, one or two (in case of 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:

- if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or
- if the HARQ process is equal to the broadcast process and if the physical layer indicates a new transmission for the TB according to the system information schedule indicated by RRC; or
- if this is the very first received transmission for this TB(i.e. there is no previous NDI for this TB):
  - consider this transmission to be a new transmission.
- else:
  - consider this transmission to be a retransmission.

The UE then shall:

- if this is a new transmission:
  - replace the data currently in the soft buffer for this TB with the received data.
- else if this is a retransmission:
  - if the data has not yet been successfully decoded:
    - combine the received data with the data currently in the soft buffer for this TB.
  - if the TB size is different from the last valid TB size signalled for this TB:
    - the UE may replace the data currently in the soft buffer for this TB with the received data.
- attempt to decode the data in the soft buffer for this TB;
- if the data in the soft buffer was successfully decoded for this TB:
  - if the HARQ process is equal to the broadcast process:
    - deliver the decoded MAC PDU to upper layers.
  - else if this is the first successful decoding of the data in the soft buffer for this TB:

- deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

- generate a positive acknowledgement (ACK) of the data in this TB.

- else:

  - generate a negative acknowledgement (NACK) of the data in this TB.

- 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

- if the HARQ process is equal to the broadcast process; or

- if *timeAlignmentTimer* is stopped or expired:

  - do not indicate the generated positive or negative acknowledgement to the physical layer.

- else:

  - indicate the generated positive or negative acknowledgement for this TB to the physical layer.

The UE 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.

#### 7.1.3.6.3 Test description

##### 7.1.3.6.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

- None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

- RRC Connection Reconfiguration (Preamble: Table 4.5.3.3-1) using parameters as specified in Table 7.1.3.6.3.3-4

7.1.3.6.3.2 Test procedure sequence

**Table 7.1.3.6.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| A | The SS transmits a *Paging* message including the *systemInfoModification*. (Note 1) | - | - | - | - |
| 1 | The SS transmits an updated system information with SI-RNTI addressed in L1/L2 header at the start of the modification period. CRC is calculated in such a way, it will result in CRC fail on UE side. Dedicated HARQ process for broadcast is used. | <-- | - | - | - |
| 2 | Check: Does the UE transmit a HARQ ACK/NACK? (Note 2 and 3) | --> | HARQ ACK/NACK | 1 | F |
| 3 | Void | - | - | - | - |
| 4 | Void | - | - | | |
| 5 | Void | - | - | - | - |
| 6 | After 100ms of step 2, the SS transmits an updated system information [contents same as in step 1] 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. | - | - | - | - |
| 7 | Check: Does the UE transmit an ACK/NACK? (Note 2 and 4) | -> | HARQ ACK/NACK | 1 | F |
| 8 | SS is configured to not allocate UL Grants on Scheduling Request | - | - | - | - |
| 9 | The SS Transmits MAC PDU containing a RLC PDU | <-- | MAC PDU | - | - |
| 10 | The UE transmits a HARQ ACK | --> | HARQ ACK | - | - |
| 11 | Check: Does the UE transmit PRACH Preamble, using PRACH resources as in new SI? | --> | PRACH Preamble | 1 | P |
| 12 | The SS transmits Random Access Response | <-- | Random Access Response | - | - |
| 13 | The UE transmits a MAC PDU with C-RNTI containing loop backed RLC PDU | --> | MAC PDU | - | - |
| 14 | SS sends PDCCH transmission for UE C-RNTI to complete contention resolution. | - | - | - | - |

Note 1: 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 36.213 section 10 for a normal HARQ process.

Note 3: For duration of 100ms, the SS should check HARQ 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 5020ms (5120 - 100), the SS should check HARQ ACK for all broadcast SIBs. 5120ms is the system information modification period calculated based on the default values of parameters specified in TS 36.508.( modification period = modificationPeriodCoeff * defaultPagingCycle,and in TS 36.508, modificationPeriodCoeff=4 and defaultPagingCycle=128radio frames).

7.1.3.6.3.3 Specific message contents

**Table 7.1.3.6.3.3-1: *SystemInformationBlockType2* (steps 1 and 6 of table 7.1.3.6.3.2-1)**

| Derivation path: 36.508 table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| prach-Config SEQUENCE { | | | |
| rootSequenceIndex | 20 (*u* = 2, Value different than default in TS 36.508) | | FDD |
| rootSequenceIndex | 2 (*u* = 2, Value different than default in TS 36.508) | rootSequenceIndex should take value from table of 5.7.2-5 in TS 36.211 since, the PRACH format 4 is used as default for testing for TDD. | TDD |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.6.3.3-2: *Paging* (step A, 5 of table 7.1.3.6.3.2-1)**

| Derivation path: 36.508 table 4.6.1-7 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| Paging ::= SEQUENCE { | | | |
| pagingRecordList | Not present | | |
| systemInfoModification | true | | |
| etws-Indication | Not present | | |
| nonCriticalExtension SEQUENCE {} | Not present | | |
| } | | | |

**Table 7.1.3.6.3.3-3: *SystemInformationBlockType1* (step 1 of table 7.1.3.6.3.2-1)**

| Derivation Path: 36.508 clause 4.4.3.2 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType1 ::= SEQUENCE { | | | |
| systemInfoValueTag | 1 | | |
| } | | | |

**Table 7.1.3.6.3.3-4: *RRCConnectionReconfiguration* (Preamble)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.3.7 MAC padding

#### 7.1.3.7.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
   when{ UE is receiving RLC PDUs in MAC PDUs with padding greater than 2 bytes }
    then { UE acknowledges reception of the RLC PDUs }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE is receiving RLC PDUs in MAC PDUs with padding equal to or less than 2 bytes }
    then { UE acknowledges reception of the RLC PDUs }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { SS is transmitting a MAC control Timing Advance PDU with padding equal to or less than 2
bytes and no Data MAC PDU sub-headers followed by transmitting a RLC PDU }
    then { UE acknowledges reception of the RLC PDU using the new Timing Advance }
            }
```

#### 7.1.3.7.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 6.1.2.

[TS 36.321 clause 6.1.2]

Padding occurs at the end of the MAC PDU, except when single-byte or two-byte padding is required. Padding may have any value and the UE shall ignore it. When padding is performed at the end of the MAC PDU, zero or more padding bytes are allowed.

When single-byte or two-byte padding is required, one or two MAC PDU subheaders corresponding to padding are placed at the beginning of the MAC PDU before any other MAC PDU subheader.

A maximum of one MAC PDU can be transmitted per TB per UE.

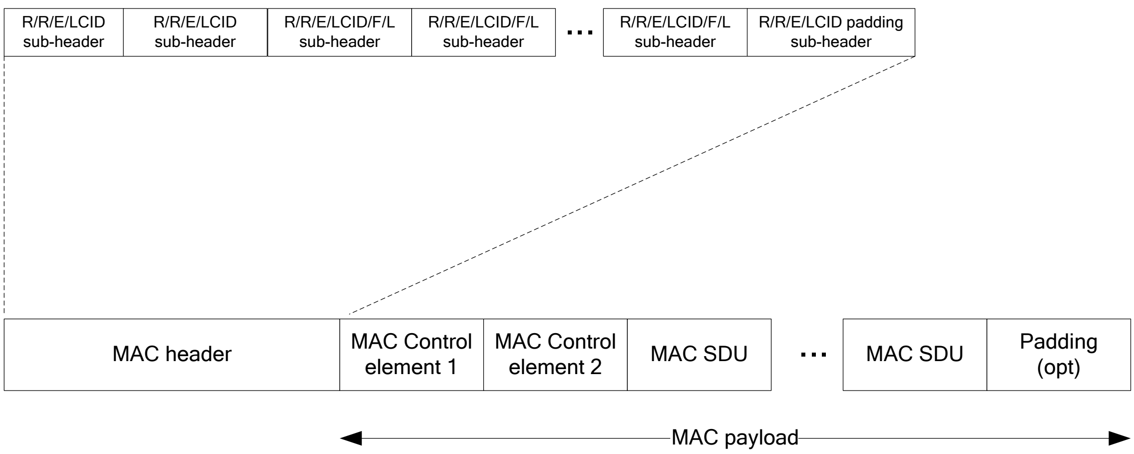


**Figure 6.1.2-3: Example of MAC PDU consisting of MAC header, MAC control elements, MAC SDUs and padding**

#### 7.1.3.7.3 Test description

##### 7.1.3.7.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The UL RLC SDU size is set to not return any data.

##### 7.1.3.7.3.2 Test procedure sequence

**Table 7.1.3.7.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a MAC PDU containing an RLC SDU in an AMD PDU with polling field 'P' set to '1'. The MAC SDU payload is set 8 bytes smaller than the TB size allocated in the DL Assignment minus AMD PDU and MAC headers. SS adds a 7-byte padding at the end of the MAC PDU and inserts a MAC padding sub-header after the MAC SDU sub-header. | <-- | MAC PDU(AMD PDU, 7-byte padding) | - | - |
| 2 | Check: Does the UE transmit an RLC STATUS PDU with ACK_SN field equal to 1? | --> | RLC STATUS PDU (ACK_SN '1') | 1 | P |
| 3 | The SS transmits a MAC PDU containing an RLC SDU in an AMD PDU with polling field 'P' set to '1'. The MAC SDU payload is set to 1-byte smaller than the TB size allocated in the DL Assignment minus AMD PDU and MAC headers. SS adds a 1 byte padding by inserting a MAC PDU sub-header before first Data MAC PDU sub-header. | <-- | MACPDU(AMD PDU, one byte padding) | - | - |
| 4 | Check: Does the UE transmit an RLC STATUS PDU with ACK_SN field equal to 2? | --> | MAC PDU(RLC STATUS PDU (ACK_SN =2) ) | 2 | P |
| 5 | The SS sets the downlink assignment for TBS of '16-bits' | - | - | - | - |
| 6 | The SS transmits a Timing Advance without any additional padding. Start Timer_1 = Time Alignment timer value. | <-- | MAC Control PDU(Timing Advance) | - | - |
| 7 | The SS sets the downlink assignment for TBS of '24-bits' | - | - | - | - |
| 8 | The SS waits a time period equal to 0.5 of Timer_1 value and configures a MAC PDU that consists of only a Control MAC PDU sub header (8-bits). Transmit another Timing Advance MAC PDU (8-bits) which leaves 1-byte padding. The SS does not transmit any subsequent timing alignment. Restart Timer_1 = Time Alignment timer value | <-- | MAC Control Element (Timing Advance) + 1-byte padding | - | - |
| 9 | The SS waits a time period equal to 0.7 of Timer_1. | - | - | - | - |
| 9A | SS transmits MAC PDU containing one RLC SDU in an AMD PDU with polling field 'P' set to '1'. | <-- | MAC PDU(AMD PDU (SN=2, P=1)) | - | - |
| 10 | Check: Does the UE transmit an RLC STATUS PDU acknowledging the reception of the RLC PDU in step 9 with new Timing Advance? | --> | MAC PDU(RLC STATUS PDU (ACK_SN =3)) | 3 | P |

#### 7.1.3.7.3.3 Specific Message Contents

None.

## 7.1.3.8 Void

## 7.1.3.9 MAC reset / DL

### 7.1.3.9.1 Test Purpose (TP)

(1)

```
with { UE  in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE MAC is reset, due to handover to a new cell }
    then { UE flushes DL HARQ buffer }
           }
```

(2)

```
with { UE  in E-UTRA RRC_CONNECTED state )
ensure that {
  when{ UE MAC is reset, due to handover to a new cell }
    then { UE considers the next transmission for each DL HARQ process as very first }
           }
```

### 7.1.3.9.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.9.

[TS 36.321 clause 5.9]

If a reset of the MAC entity is requested by upper layers, the UE shall:

- initialize Bj for each logical channel to zero;
- stop (if running) all timers;
- consider the *timeAlignmentTimer* as expired and perform the corresponding actions in subclause 5.2;
- set the NDIs for all uplink HARQ processes to the value 0;
- stop, if any, ongoing RACH procedure;
- discard explicitly signalled ra-PreambleIndex and ra-PRACH-MaskIndex, if any;
- flush Msg3 buffer;
- cancel, if any, triggered Scheduling Request procedure;
- cancel, if any, triggered Buffer Status Reporting procedure;
- cancel, if any, triggered Power Headroom Reporting procedure;
- flush the soft buffers for all DL HARQ processes;
- for each DL HARQ process, consider the next received transmission for a TB as the very first;
- release, if any, Temporary C-RNTI.

### 7.1.3.9.3 Test description

#### 7.1.3.9.3.1 Pre-test conditions

System Simulator:

- Cell 1 and Cell 2

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) in Cell 1 according to [18] using parameters as specified in Table 7.1.3.9.3.3-3.

#### 7.1.3.9.3.2 Test procedure sequence

Table 7.1.3.9.3.2-1 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, 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 7.1.3.9.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 2 | Remark |
|---|---|---|---|---|---|
| **T0** | Cell-specific RS EPRE | dBm/15Khz | -85 | Off | |
| **T1** | Cell-specific RS EPRE | dBm/15Khz | -85 | -79 | |

Table 7.1.3.9.3.3-2 illustrates the specific message content of RRC Connection Reconfiguration message during preamble.

**Table 7.1.3.9.3.2-2: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS changes Cell 2 power level according to the row "T1" in table 7.1.3.9.3.2-1 | - | - | - | - |
| 2 | The SS transmits a MAC PDU containing one RLC SDU on DRB, but the CRC is calculated in such a way that it will result in CRC error on UE side. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 3 | The UE transmit a HARQ NACK | --> | HARQ NACK | - | - |
| 4 | Void | - | - | - | - |
| 5 | The SS transmits an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 2 | <-- | - | - | - |
| 6 | The UE transmits on Cell 2, *RRCConnectionReconfigurationComplete* | --> | - | - | - |
| 7 | Check: For 100 ms, does the UE transmit any HARQ NACK? | --> | HARQ NACK | 1 | F |
| 8 | The SS transmits a MAC PDU containing RLC SDU on DRB. The HARQ Process and NDI on PDCCH is same as in step 2. The SS shall ensure that the HARQ process used at step 2 will not be used in between steps 4 and 7. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 9 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 2 | P |
| 10 | The SS allocates UL Grant sufficient for one RLC SDU to be loop backed in a TTI, and NDI indicates new transmission | <-- | Uplink Grant | - | - |
| 11 | The UE transmits a MAC PDU including one RLC SDU | --> | MAC PDU | - | - |

7.1.3.9.3.3 Specific Message Contents

**Table 7.1.3.9.3.3-1: *RRCConnectionReconfiguration* (step 5, table 7.1.3.9.3.2-2)**

| Derivation Path: 36.508, Table 4.6.1-8, condition HO | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| mobilityControlInfo SEQUENCE { | MobilityControlInfo-HO | | |
| targetPhysCellId | PhysicalCellIdentity of Cell 2 (see 36.508 clause 4.6.5) | | |
| carrierFreq | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.9.3.3-2: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.9.3.3-3: RLC-Config-DRB-AM {*RRCConnectionReconfiguration (*preamble: Table 4.5.3.3-1, step 8)}**

| Derivation path: 36.508 clause 4.8.2.1.3.2, Table 4.8.2.1.3.2-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RLC-Config-DRB-AM ::= CHOICE { | | | |
| am SEQUENCE { | | | |
| ul-AM-RLC SEQUENCE { | | | |
| t-PollRetransmit | ms250 | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.3.10

### 7.1.3.11 CA / Correct HARQ process handling / DCCH and DTCH / Pcell and Scell

#### 7.1.3.11.1 CA / Correct HARQ process handling / DCCH and DTCH / Pcell and Scell / Intra-band Contiguous CA

##### 7.1.3.11.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell activated }
ensure that {
  when { the UE receives a MAC PDU for DRB and decode fails }
    then { the UE transmits a NACK for the corresponding HARQ process within HARQ entity }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell activated }
ensure that {
  when { the UE receives a MAC PDU retransmission for DRB, and results in successful decode }
    then { the UE transmits an ACK for the corresponding HARQ process within HARQ entity and
delivers data to upper layers }
            }
```

##### 7.1.3.11.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.3.2.1.

[TS 36.321, clause 5.3.2.1]

There is one HARQ entity at the UE 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 DL HARQ processes per HARQ entity is specified in [2], clause 7.

When the physical layer is configured for downlink spatial multiplexing [2], one or two TBs are expected per subframe and they are associated with the same HARQ process. Otherwise, one TB is expected per subframe.

The UE shall:

- If a downlink assignment has been indicated for this TTI:
  - allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.
- If a downlink assignment has been indicated for the broadcast HARQ process:
  - allocate the received TB to the broadcast HARQ process.

NOTE: In case of BCCH a dedicated broadcast HARQ process is used.

##### 7.1.3.11.1.3 Test description

##### 7.1.3.11.1.3.1 Pre-test conditions

System Simulator:

- Cell 1 (PCell) and Cell 3(SCell)
- Cell 3 is an Active SCell according to [18] cl. 6.3.4
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.3.11.1.3.3-1 and 7.1.3.11.1.3.3-2.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) on Cell 1 according to [18].

7.1.3.11.1.3.2 Test procedure sequence

**Table 7.1.3.11.1.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 3 |
|---|---|---|---|---|
| T0 | Cell-specific RS EPRE | dBm/15k Hz | -85 | -85 |

**Table 7.1.3.11.1.3.2-2: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits an *RRCConnectionReconfiguration* message containing a *sCellToAddModList* on Cell 1 with SCell (Cell 3) addition. | <-- | *RRCConnectionReconfiguration* | - | - |
| 2 | The UE transmit an *RRCConnectionReconfigurationComplete* message. | --> | *RRCConnectionReconfigurationComplete* | - | - |
| 3 | The SS transmits Activation MAC control element to activate Scell (Cell 3). | <-- | MAC PDU (Activation ($C_1$=1)) | - | - |
| 4 | The SS indicates a new transmission on PDCCH of $CC_1$ and transmits a MAC PDU (containing an RLC PDU with SN=0), with content set so that UE could not successfully decode the data from its soft buffer. (Note 1) | <-- | MAC PDU ($CC_1$) | - | - |
| 5 | Check: Does the UE transmit a HARQ NACK for the DL data corresponding DL $CC_1$? | --> | HARQ NACK ($CC_1$) | 1 | P |
| - | EXCEPTION: Step 6 shall be repeated till HARQ ACK is received at step 7 or until HARQ retransmission count = 4 is reached for MAC PDU at step 7 (Note 2). | - | - | - | - |
| 6 | The SS indicates a retransmission on PDCCH of $CC_1$ and transmits the same MAC PDU like step 4 (Note 1). | <-- | MAC PDU ($CC_1$) | - | - |
| | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 7 (Note 2). | - | - | - | |
| 7 | Check: Does the UE send a HARQ ACK for the DL data corresponding to DL $CC_1$? | --> | HARQ ACK ($CC_1$) | 2 | P |
| 8 | The UE transmit a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 9 | The SS sends an UL grant suitable for transmitting loop back PDU on Cell 1. | <-- | (UL Grant) | - | - |
| 10 | The UE transmit a MAC PDU containing the loop back PDU corresponding to step 4 and 6 | --> | MAC PDU | - | - |
| 10a | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 10 | <-- | MAC PDU ($CC_1$) | - | - |
| 11 | The SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing an RLC PDU with SN=1), with content set so that UE could not successfully decode the data from its soft buffer. (Note 1) | <-- | MAC PDU ($CC_2$) | - | - |
| 12 | Check: Does the UE transmit a HARQ NACK for the DL data corresponding to DL $CC_2$? | --> | HARQ NACK ($CC_2$) | 1 | P |
| - | EXCEPTION: Step 13 shall be repeated till HARQ ACK is received at step 14 or until HARQ retransmission count = 4 is reached for MAC PDU at step 14 (Note 2). | - | - | - | - |
| 13 | The SS indicates a retransmission on PDCCH of $CC_2$ and transmits the same MAC PDU like step 11 (Note 1). | <-- | MAC PDU ($CC_2$) | - | - |
| | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 14 (Note 2). | - | - | - | - |
| 14 | Check: Does the UE send a HARQ ACK for the DL data corresponding to DL $CC_2$? | --> | HARQ ACK ($CC_2$) | 2 | P |
| 15 | UE transmit a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 16 | The SS sends an UL grant suitable for transmitting loop back PDU on Cell 1. | <-- | (UL Grant) | - | - |
| 17 | The UE transmit a MAC PDU containing the loop back PDU corresponding to step 11 and 13 | --> | MAC PDU | - | - |
| 17a | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 17 | <-- | MAC PDU ($CC_1$) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| - | EXCEPTION: Steps 18 to 21 are run 8 [FDD]/7 [TDD] times using test parameter values as given for each iteration in table 7.1.3.11. 1.3.2-4. (Note 6). | - | - | - | - |
| 18 | The SS indicates new transmissions on PDCCHs of $CC_1$ and $CC_2$ and transmits a MAC PDU (containing an RLC PDU) on both CCs respectively with contents set so that UE could not successfully decode the data from its soft buffers. (Note 1) (Note 6). | <-- | MAC PDU ($CC_1$) and MAC PDU ($CC_2$) | - | - |
| 19 | Check: Does the UE transmit HARQ NACK for the DL data corresponding to DL $CC_1$ and $CC_2$ respectively? | --> | HARQ NACK ($CC_1$ and $CC_2$) | 1 | P |
| - | EXCEPTION: In parallel with steps 20 to 21, the parallel behaviour in table 7.1.3.11.1.3.2-3 is running. | - | - | - | - |
| - | EXCEPTION: Step 20 shall be repeated till HARQ ACK is received at step 21 for the data corresponding both DL $CC_1$ and DL $CC_2$ or until HARQ retransmission count = 4 is reached for MAC PDUs at step 21 (Note 2). | - | - | - | - |
| 20 | The SS indicates retransmissions on PDCCHs of $CC_1$ and $CC_2$ and transmits the same MAC PDUs like step 18 (Note 1)(Note 3). | <-- | MAC PDU ($CC_1$) and MAC PDU($CC_2$) | - | - |
| - | EXCEPTION: Up to 3 HARQ NACK per CC from the UE should be allowed at step 21 (Note 2). | - | - | - | - |
| 21 | Check: Does the UE send a HARQ ACKs for the DL data corresponding to DL $CC_1$ and DL $CC_2$ (Note 7)? | --> | HARQ ACK ($CC_1$) and HARQ ACK ($CC_2$) | 2 | P |

Note 1: SS should transmit this PDU using $I_{TBS}$=6, $N_{PRB}$=1, see TS 36.213 Table 7.1.7.2.1-1. This will result in TBSize of 328 and having coding rate more than 1.
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: Retransmission is done only for the DL CCs, for which HARQ NACK was received.
Note 4: Void.
Note 5: $CC_1$ corresponds to Pcell (Cell 1) and $CC_2$ corresponds to Scell (Cell 3).
Note 6: At each iteration RLC PDU SN is incremented by 1 such that RLC PDUs with SN = 2, 4, 6, 8, 10 (and 12) are being transmitted on $CC_1$ whereas RLC PDUs with SN = 3, 5, 7, 9, 11 (and 13) on $CC_2$.
Note 7: HARQ ACKs are expected only for those CCs for which retransmission was done in step 20.

**Table 7.1.3.11.1.3.2-3: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| 1 | The UE transmit a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 2 | Wait for 30ms to ensure HARQ processes for both CCs are finished. | - | - | - | - |
| 3 | The SS allocates UL Grant sufficient for two RLC SDU to be loop backed on Cell 1. | <-- | (UL Grant) | - | - |
| 4 | The UE transmits a MAC PDU including two RLC SDU corresponding to step 18 in table 7.1.3.11.1.3.2-2. | --> | MAC PDU | - | - |
| 5 | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDUs in step 4 | <-- | MAC PDU ($CC_1$) | - | - |

**Table 7.1.3.11.1.3.2-4: Test Parameters**

| Iteration | DL HARQ process (X) |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |
| 5 | 4 |
| 6 | 5 |
| 7 | 6 |
| 8 | 7[only for FDD] |
| Note: The maximum DL HARQ process is 7 for TDD configuration 1. | |

#### 7.1.3.11.1.3.3 Specific message contents

**Table 7.1.3.11.1.3.3-1: *RRCConnectionReconfiguration* (preamble)**

| Derivation path: 36.508 Table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig SEQUENCE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.11.1.3.3-2: SchedulingRequest-Configuration (preamble)**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Configuration ::= CHOICE { | | | |
| setup SEQUENCE { | | | |
| dsr-TransMax | n8 | | |
| } | | | |
| } | | | |

**Table 7.1.3.11.1.3.3-3: *RRCConnectionReconfiguration* (step 2, Table 7.1.3.11. 1.3.2-2)**

| Derivation Path: 36.508 Table 4.6.1-8, condition SCell_AddMod |
|---|

**Table 7.1.3.11.1.3.3-4: *SCellToAddMod-r10* (Table 7.1.3.11.3.3-3)**

| Derivation Path: 36.508, Table 4.6.3-19D | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SCellToAddMod-r10 ::= SEQUENCE { | | | |
| sCellIndex-r10 | 1 | | |
| cellIdentification-r10 SEQUENCE { | | | |
| physCellId-r10 | PhysicalCellIdentity of Cell 3 | | |
| dl-CarrierFreq-r10 | Same downlink EARFCN as used for Cell 3 | | |
| } | | | |
| } | | | |

### 7.1.3.11.2 CA / Correct HARQ process handling / DCCH and DTCH / Pcell and Scell / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.3.11.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA
- Cells configuration: Cell 10 replaces Cell 3

- Cell 10 is an Active SCell according to [18] cl. 6.3.4.

## 7.1.3.12 TDD additional special subframe configuration / Special subframe pattern 9/7 / CRS based transmission scheme

### 7.1.3.12.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA TDD RRC_CONNECTED state }
ensure that {
  when { UE is configured with tdd-Config-v1130 equalling to ssp9 for normal cyclic prefix which is
configured in UL-CyclicPrefixLength equalling to len1, network schedules and transmits PDSCH data in
DwPTS }
    then { UE sends ACK to the network after successfully receive and decode the data }
            }
```

(2)

```
with { UE in E-UTRA TDD RRC_CONNECTED state }
ensure that {
  when { UE is configured with tdd-Config-v1130 equalling to ssp7 for extended cyclic prefix which
is configured in UL-CyclicPrefixLength equalling to len2, network schedules and transmits PDSCH data
in DwPTS }
    then { UE sends ACK to the network after successfully receive and decode the data }
            }
```

### 7.1.3.12.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 36.211 clause 4.2, TS 36.213 clause 7.1.7, TS 36.306 clause 4.3.4.21 and TS 36.331 clause 6.3.2.

[TS 36.211, clause 4.2]

Frame structure type 2 is applicable to TDD. Each radio frame of length $T_{\mathrm{f}} = 307200 \cdot T_{\mathrm{s}} = 10\,\mathrm{ms}$ consists of two half-frames of length $153600 \cdot T_{\mathrm{s}} = 5\,\mathrm{ms}$ each. Each half-frame consists of five subframes of length $30720 \cdot T_{\mathrm{s}} = 1\,\mathrm{ms}$. The supported uplink-downlink configurations are listed in Table 4.2-2 where, for each subframe in a radio frame, "D" denotes the subframe is reserved for downlink transmissions, "U" denotes the subframe is reserved for uplink transmissions and "S" denotes a special subframe with the three fields DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is given by Table 4.2-1 subject to the total length of DwPTS, GP and UpPTS being equal to $30720 \cdot T_{\mathrm{s}} = 1\,\mathrm{ms}$. Each subframe $i$ is defined as two slots, $2i$ and $2i+1$ of length $T_{\mathrm{slot}} = 15360 \cdot T_{\mathrm{s}} = 0.5\,\mathrm{ms}$ in each subframe.

Uplink-downlink configurations with both 5 ms and 10 ms downlink-to-uplink switch-point periodicity are supported.

In case of 5 ms downlink-to-uplink switch-point periodicity, the special subframe exists in both half-frames.

In case of 10 ms downlink-to-uplink switch-point periodicity, the special subframe exists in the first half-frame only.

Subframes 0 and 5 and DwPTS are always reserved for downlink transmission. UpPTS and the subframe immediately following the special subframe are always reserved for uplink transmission.

In case multiple cells are aggregated, the UE may assume that the guard period of the special subframe in the different cells have an overlap of at least $1456 \cdot T_s$.

In case multiple cells with different uplink-downlink configurations are aggregated and the UE is not capable of simultaneous reception and transmission in the aggregated cells, the following constraints apply:

- if the subframe in the primary cell is a downlink subframe, the UE shall not transmit any signal or channel on a secondary cell in the same subframe
- if the subframe in the primary cell is an uplink subframe, the UE is not expected to receive any downlink transmissions on a secondary cell in the same subframe

- if the subframe in the primary cell is a special subframe and the same subframe in a secondary cell is a downlink subframe, the UE is not expected to receive PDSCH/ EPDCCH/PMCH/PRS transmissions in the secondary cell in the same subframe, and the UE is not expected to receive any other signals on the secondary cell in OFDM symbols that overlaps with the guard period or UpPTS in the primary cell.

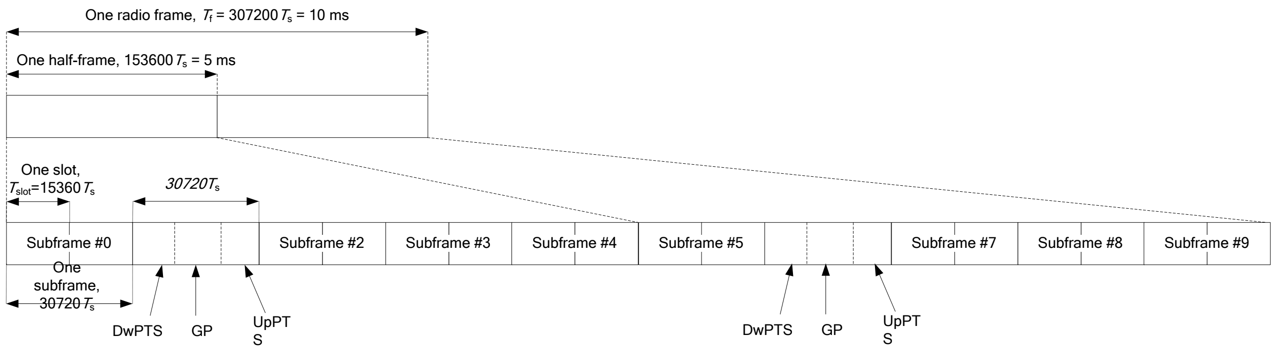


**Figure 4.2-1: Frame structure type 2 (for 5 ms switch-point periodicity)**

**Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS)**

<table>
<tr><th rowspan="3">Special subframe configuration</th><th colspan="3">Normal cyclic prefix in downlink</th><th colspan="3">Extended cyclic prefix in downlink</th></tr>
<tr><th>DwPTS</th><th colspan="2">UpPTS</th><th>DwPTS</th><th colspan="2">UpPTS</th></tr>
<tr><th></th><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th><th></th><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th></tr>
<tr><td>0</td><td>$6592 \cdot T_s$</td><td rowspan="5">$2192 \cdot T_s$</td><td rowspan="5">$2560 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$2192 \cdot T_s$</td><td rowspan="4">$2560 \cdot T_s$</td></tr>
<tr><td>1</td><td>$19760 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>2</td><td>$21952 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>3</td><td>$24144 \cdot T_s$</td><td>$25600 \cdot T_s$</td></tr>
<tr><td>4</td><td>$26336 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$4384 \cdot T_s$</td><td rowspan="4">$5120 \cdot T_s$</td></tr>
<tr><td>5</td><td>$6592 \cdot T_s$</td><td rowspan="5">$4384 \cdot T_s$</td><td rowspan="5">$5120 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>6</td><td>$19760 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>7</td><td>$21952 \cdot T_s$</td><td>$12800 \cdot T_s$</td></tr>
<tr><td>8</td><td>$24144 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>$13168 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
</table>

[TS 36.213, clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - set the Table 7.1.7.2.1-1 column indicator $N_{\mathrm{PRB}}$ to $N_{\mathrm{PRB}}^{1\mathrm{A}}$ from Section 5.3.3.1.3 in [4]
- for DCI format 1C:
  - use Table 7.1.7.2.3-1 for determining its transport block size.

else

- set $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

  - for special subframe configuration 9 with normal cyclic prefix or special subframe configuration 7 with extended cyclic prefix:
    - set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{\left\lfloor N'_{\mathrm{PRB}} \times 0.375 \right\rfloor, \quad 1\right\}$,
  - for other special subframe configurations:
    - set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{\left\lfloor N'_{\mathrm{PRB}} \times 0.75 \right\rfloor, \quad 1\right\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal downlink CP or configurations 0 and 4 with extended downlink CP, shown in Table 4.2-1 of [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.306, clause 4.3.4.21]

This field defines whether the UE supports TDD special subframe as specified in [TS 36.211]. It is mandatory for UEs of this release of the specification.

[TS 36.331, clause 6.3.2]

The IE *TDD-Config* is used to specify the TDD specific physical channel configuration.

***TDD-Config* information element**

```
-- ASN1START

TDD-Config ::=                      SEQUENCE {
    subframeAssignment                  ENUMERATED {
                                            sa0, sa1, sa2, sa3, sa4, sa5, sa6},
    specialSubframePatterns             ENUMERATED {
                                            ssp0, ssp1, ssp2, ssp3, ssp4,ssp5, ssp6, ssp7,
                                            ssp8}
}

TDD-Config-v1130 ::=                SEQUENCE {
    specialSubframePatterns-v1130       ENUMERATED {ssp7,ssp9}
}
```

```
-- ASN1STOP
```

| *TDD-Config* field descriptions |
|---|
| ***specialSubframePatterns***<br>Indicates Configuration as in TS 36.211 [21, table 4.2-1] where *ssp0* points to Configuration 0, *ssp1* to Configuration 1 etc. Value *ssp7* points to Configuration 7 for extended cyclic prefix and value *ssp9* points to Configuration 9 for normal cyclic prefix. E-UTRAN signals *ssp7* only when setting *specialSubframePatterns* (without suffix i.e. the version defined in REL-8) to *ssp4*. E-UTRAN signals value *ssp9* only when setting *specialSubframePatterns* (without suffix) to *ssp5*. If *specialSubframePatterns-v1130* is present, the UE shall ignore *specialSubframePatterns* (without suffix). |
| ***subframeAssignment***<br>Indicates DL/UL subframe configuration where sa0 point to Configuration 0, sa1 to Configuration 1 etc. as specified in TS 36.211 [21, table 4.2-2]. E-UTRAN configures the same value for serving cells residing on same frequency band. |

### 7.1.3.12.3 Test description

#### 7.1.3.12.3.1 Pre-test conditions

System Simulator:

- Cell 1 and Cell 2

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) in Cell 1 according to [18] using parameters as specified in section 7.1.3.12.3.3.

#### 7.1.3.12.3.2 Test procedure sequence

Table 7.1.3.12.3.2-1 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, 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 7.1.3.12.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 2 | Remark |
|---|---|---|---|---|---|
| **T0** | Cell-specific RS EPRE | dBm/15Khz | -85 | -91 | |
| **T1** | Cell-specific RS EPRE | dBm/15Khz | -85 | -79 | |

**Table 7.1.3.12.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS indicates a new transmission on PDCCH and transmits a MAC PDU in SF-Num 1 or 6 where the DwPTS belongs to. | <-- | MAC PDU | - | - |
| 2 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 3 | The UE transmits a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 4 | The SS sends an UL grant suitable for the loop back PDU to be transmitted | <-- | (UL Grant) | - | - |
| 5 | The UE transmits a MAC PDU containing the loop back PDU corresponding to step 1 | --> | MAC PDU | - | - |
| 6 | The SS changes Cell 2 power level according to the row "T1" in table 7.1.3.12.3.2-1 | - | - | - | - |
| 7 | The SS transmits an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 2 with special subframe pattern 7 for extended CP configured. | <-- | - | - | - |
| 8 | The UE transmits on Cell 2, *RRCConnectionReconfigurationComplete* | --> | - | - | - |
| 9 | The SS indicates a new transmission on PDCCH and transmits a MAC PDU in SF-Num 1 or 6 where the DwPTS belongs to. | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 11 | The UE transmits a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 12 | The SS sends an UL grant suitable for the loop back PDU to be transmitted | <-- | (UL Grant) | - | - |
| 13 | The UE transmits a MAC PDU containing the loop back PDU corresponding to step 9 | --> | MAC PDU | - | - |

#### 7.1.3.12.3.3 Specific message contents

**Table 7.1.3.12.3.3-1: SystemInformationBlockType1 for Cell 1 (preamble, Table 7.1.3.12.3.2-1)**

| Derivation Path: 36.508 clause 4.4.3.2, Table 4.4.3.2-3 | | | |
|---|---|---|---|
| Information Element | Value/remark | Comment | Condition |
| SystemInformationBlockType1 ::= SEQUENCE { | | | |
| tdd-Config SEQUENCE { | | | TDD |
| subframeAssignment | sa1 | | |
| specialSubframePatterns | ssp5 | | |
| } | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| tdd-Config-v1130 SEQUENCE { | | | |
| specialSubframePatterns-v1130 | ssp9 | | |
| } | | | |
| nonCriticalExtension | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.12.3.3-2: SystemInformationBlockType2 for Cell 1 (preamble, table 7.1.3.12.3.2-1)**

| Derivation path: 36.508 clause 4.4.3.3, Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| ul-CyclicPrefixLength | len1 | | |
| } | | | |
| } | | | |

**Table 7.1.3.12.3.3-3: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.12.3.3-4: SystemInformationBlockType1 for Cell 2 (from step6, Table 7.1.3.12.3.2-1)**

| Derivation Path: 36.508 clause 4.4.3.2, Table 4.4.3.2-3 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType1 ::= SEQUENCE { | | | |
| tdd-Config SEQUENCE { | | | TDD |
| subframeAssignment | sa1 | | |
| specialSubframePatterns | ssp4 | | |
| } | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| tdd-Config-v1130 SEQUENCE { | | | |
| specialSubframePatterns-v1130 | ssp7 | | |
| } | | | |
| nonCriticalExtension | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.12.3.3-5: SystemInformationBlockType2 for Cell 2 (from step6, table 7.1.3.12.3.2-1)**

| Derivation path: 36.508 clause 4.4.3.3, Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| ul-CyclicPrefixLength | len2 | | |
| } | | | |
| } | | | |

**Table 7.1.3.12.3.3-6: *RRCConnectionReconfiguration* (step 7, table 7.1.3.12.3.2-1)**

| |
|---|
| Derivation Path: 36.508, Table 4.6.1-8, condition HO |

**Table 7.1.3.12.3.3-7: *MobilityControlInfo* (Table 7.1.3.12.3.3-6)**

| Derivation Path: 36.331 clause 4.6.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| MobilityControlInfo ::= SEQUENCE { | | | |
| targetPhysCellId | PhysicalCellIdentity of Cell 2 | | |
| carrierFreq SEQUENCE { | | | |
| dl-CarrierFreq | Same downlink EARFCN as used for Cell 2 | | |
| ul-CarrierFreq | Not present | | TDD |
| } | | | |
| carrierBandwidth SEQUENCE { | | | |
| dl-Bandwidth | Same downlink system bandwidth as used for Cell 2 | | |
| ul-Bandwidth | Not present | | TDD |
| } | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| antennaInfoCommon SEQUENCE { | | | |
| antennaPortsCount | an1 | | |
| } | | | |
| tdd-Config SEQUENCE { | | | |
| subframeAssignment | sa1 | | |
| specialSubframePatterns | ssp4 | | |
| } | | | |
| ul-CyclicPrefixLength | len2 | | |
| tdd-Config-v1130 SEQUENCE { | | | |
| specialSubframePatterns-v1130 | ssp7 | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.3.13 TDD additional special subframe configuration / Special subframe pattern 9/7 / UE-specific reference signals based transmission scheme

### 7.1.3.13.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA TDD RRC_CONNECTED state }
ensure that {
  when { UE is configured with tdd-Config-v1130 equalling to ssp9 for normal cyclic prefix which is configured in UL-CyclicPrefixLength equalling to len1 under tm8 transmission mode, network uses DCI format 2B for PDSCH scheduling and transmits PDSCH data in DwPTS }
    then { UE sends ACK to the network after UE successfully receives and decodes the data }
            }
```

(2)

```
with { UE in E-UTRA TDD RRC_CONNECTED state }
ensure that {
  when { UE is configured with tdd-Config-v1130 equalling to ssp7 for extended cyclic prefix which is configured in UL-CyclicPrefixLength equalling to len2 under tm7 transmission mode, network uses DCI format 1 for PDSCH scheduling and transmits PDSCH data in DwPTS }
    then { UE sends ACK to the network after UE successfully receives and decodes the data }
            }
```

### 7.1.3.13.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 36.211 clause 4.2, TS 36.213 clause 6.10.3.2 and clause 7.1.7, TS 36.306 clause 4.3.4.21 and TS 36.331 clause 6.3.2.

[TS 36.211, clause 4.2]

Frame structure type 2 is applicable to TDD. Each radio frame of length $T_\mathrm{f} = 307200 \cdot T_\mathrm{s} = 10\,\mathrm{ms}$ consists of two half-frames of length $153600 \cdot T_\mathrm{s} = 5\,\mathrm{ms}$ each. Each half-frame consists of five subframes of length $30720 \cdot T_\mathrm{s} = 1\,\mathrm{ms}$. The supported uplink-downlink configurations are listed in Table 4.2-2 where, for each subframe in a radio frame, "D" denotes the subframe is reserved for downlink transmissions, "U" denotes the subframe is reserved for uplink transmissions and "S" denotes a special subframe with the three fields DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is given by Table 4.2-1 subject to the total length of DwPTS, GP and UpPTS being equal to $30720 \cdot T_\mathrm{s} = 1\,\mathrm{ms}$. Each subframe $i$ is defined as two slots, $2i$ and $2i+1$ of length $T_\mathrm{slot} = 15360 \cdot T_\mathrm{s} = 0.5\,\mathrm{ms}$ in each subframe.

Uplink-downlink configurations with both 5 ms and 10 ms downlink-to-uplink switch-point periodicity are supported.

In case of 5 ms downlink-to-uplink switch-point periodicity, the special subframe exists in both half-frames.

In case of 10 ms downlink-to-uplink switch-point periodicity, the special subframe exists in the first half-frame only.

Subframes 0 and 5 and DwPTS are always reserved for downlink transmission. UpPTS and the subframe immediately following the special subframe are always reserved for uplink transmission.

In case multiple cells are aggregated, the UE may assume that the guard period of the special subframe in the different cells have an overlap of at least $1456 \cdot T_\mathrm{s}$.

In case multiple cells with different uplink-downlink configurations are aggregated and the UE is not capable of simultaneous reception and transmission in the aggregated cells, the following constraints apply:

- if the subframe in the primary cell is a downlink subframe, the UE shall not transmit any signal or channel on a secondary cell in the same subframe
- if the subframe in the primary cell is an uplink subframe, the UE is not expected to receive any downlink transmissions on a secondary cell in the same subframe

- if the subframe in the primary cell is a special subframe and the same subframe in a secondary cell is a downlink subframe, the UE is not expected to receive PDSCH/EPDCCH/PMCH/PRS transmissions in the secondary cell in the same subframe, and the UE is not expected to receive any other signals on the secondary cell in OFDM symbols that overlaps with the guard period or UpPTS in the primary cell.

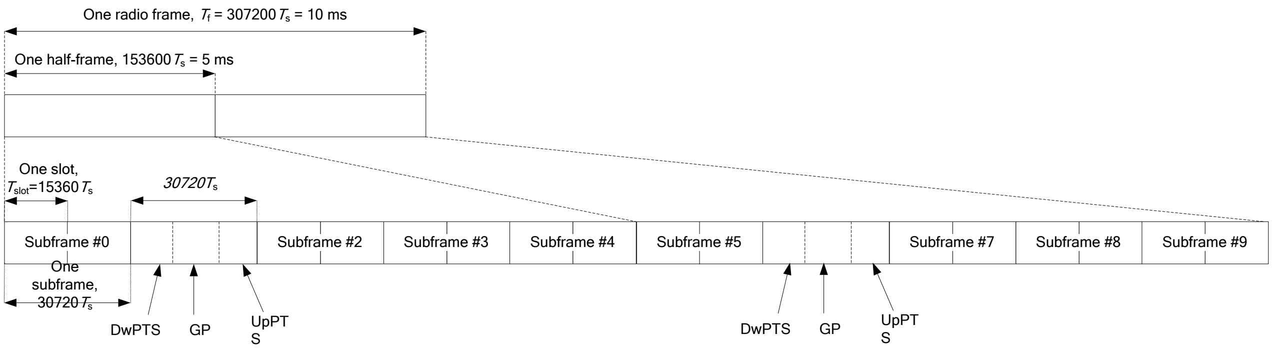


**Figure 4.2-1: Frame structure type 2 (for 5 ms switch-point periodicity)**

**Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS).**

| Special subframe configuration | Normal cyclic prefix in downlink | | | Extended cyclic prefix in downlink | | |
|---|---|---|---|---|---|---|
| | DwPTS | UpPTS | | DwPTS | UpPTS | |
| | | Normal cyclic prefix in uplink | Extended cyclic prefix in uplink | | Normal cyclic prefix in uplink | Extended cyclic prefix in uplink |
| 0 | $6592 \cdot T_s$ | $2192 \cdot T_s$ | $2560 \cdot T_s$ | $7680 \cdot T_s$ | $2192 \cdot T_s$ | $2560 \cdot T_s$ |
| 1 | $19760 \cdot T_s$ | | | $20480 \cdot T_s$ | | |
| 2 | $21952 \cdot T_s$ | | | $23040 \cdot T_s$ | | |
| 3 | $24144 \cdot T_s$ | | | $25600 \cdot T_s$ | | |
| 4 | $26336 \cdot T_s$ | | | $7680 \cdot T_s$ | $4384 \cdot T_s$ | $5120 \cdot T_s$ |
| 5 | $6592 \cdot T_s$ | $4384 \cdot T_s$ | $5120 \cdot T_s$ | $20480 \cdot T_s$ | | |
| 6 | $19760 \cdot T_s$ | | | $23040 \cdot T_s$ | | |
| 7 | $21952 \cdot T_s$ | | | $12800 \cdot T_s$ | | |
| 8 | $24144 \cdot T_s$ | | | - | - | - |
| 9 | $13168 \cdot T_s$ | | | - | - | - |

[TS 36.213, clause 6.10.3.2]

…

For antenna ports $p=7$, $p=8$ or $p=7,8,\ldots,\upsilon+6$, in a physical resource block with frequency-domain index $n_{\text{PRB}}$ assigned for the corresponding PDSCH transmission, a part of the reference signal sequence $r(m)$ shall be mapped to complex-valued modulation symbols $a_{k,l}^{(p)}$ in a subframe according to

Normal cyclic prefix:

$$a_{k,l}^{(p)} = w_p(l') \cdot r(3 \cdot l' \cdot N_{\text{RB}}^{\max,\text{DL}} + 3 \cdot n_{\text{PRB}} + m')$$

where

$$w_p(i) = \begin{cases} \overline{w}_p(i) & (m'+n_{\text{PRB}}) \bmod 2 = 0 \\ \overline{w}_p(3-i) & (m'+n_{\text{PRB}}) \bmod 2 = 1 \end{cases}$$

$$k = 5m' + N_{\text{sc}}^{\text{RB}} n_{\text{PRB}} + k'$$

$$k' = \begin{cases} 1 & p \in \{7,8,11,13\} \\ 0 & p \in \{9,10,12,14\} \end{cases}$$

$$l = \begin{cases} l' \bmod 2 + 2 & \text{if in a special subframe with configuration 3, 4, 8 or 9 (see Table 4.2-1)} \\ l' \bmod 2 + 2 + 3\lfloor l'/2 \rfloor & \text{if in a special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \\ l' \bmod 2 + 5 & \text{if not in a special subframe} \end{cases}$$

$$l' = \begin{cases} 0,1,2,3 & \text{if } n_s \bmod 2 = 0 \text{ and in a special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \\ 0,1 & \text{if } n_s \bmod 2 = 0 \text{ and not in special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \\ 2,3 & \text{if } n_s \bmod 2 = 1 \text{ and not in special subframe with configuration 1, 2, 6, or 7 (see Table 4.2-1)} \end{cases}$$

$$m' = 0,1,2$$

The sequence $\overline{w}_p(i)$ is given by Table 6.10.3.2-1.

**Table 6.10.3.2-1: The sequence $\overline{w}_p(i)$ for normal cyclic prefix.**

| Antenna port $p$ | $\left[\overline{w}_p(0) \quad \overline{w}_p(1) \quad \overline{w}_p(2) \quad \overline{w}_p(3)\right]$ |
|---|---|
| 7 | $\left[+1 \quad +1 \quad +1 \quad +1\right]$ |
| 8 | $\left[+1 \quad -1 \quad +1 \quad -1\right]$ |
| 9 | $\left[+1 \quad +1 \quad +1 \quad +1\right]$ |
| 10 | $\left[+1 \quad -1 \quad +1 \quad -1\right]$ |
| 11 | $\left[+1 \quad +1 \quad -1 \quad -1\right]$ |
| 12 | $\left[-1 \quad -1 \quad +1 \quad +1\right]$ |
| 13 | $\left[+1 \quad -1 \quad -1 \quad +1\right]$ |
| 14 | $\left[-1 \quad +1 \quad +1 \quad -1\right]$ |

Extended cyclic prefix:

$$a_{k,l}^{(p)} = w_p(l' \bmod 2) \cdot r(4 \cdot l' \cdot N_{\mathrm{RB}}^{\max,\mathrm{DL}} + 4 \cdot n_{\mathrm{PRB}} + m')$$

where

$$w_p(i) = \begin{cases} \overline{w}_p(i) & m' \bmod 2 = 0 \\ \overline{w}_p(1-i) & m' \bmod 2 = 1 \end{cases}$$

$$k = 3m' + N_{\mathrm{sc}}^{\mathrm{RB}} n_{\mathrm{PRB}} + k'$$

$$k' = \begin{cases} 1 & \text{if } n_{\mathrm{s}} \bmod 2 = 0 \text{ and } p \in \{7,8\} \\ 2 & \text{if } n_{\mathrm{s}} \bmod 2 = 1 \text{ and } p \in \{7,8\} \end{cases}$$

$$l = l' \bmod 2 + 4$$

$$l' = \begin{cases} 0,1 & \text{if } n_{\mathrm{s}} \bmod 2 = 0 \text{ and in a special subframe with configuration 1, 2, 3, 5 or 6 (see Table 4.2-1)} \\ 0,1 & \text{if } n_{\mathrm{s}} \bmod 2 = 0 \text{ and not in a special subframe} \\ 2,3 & \text{if } n_{\mathrm{s}} \bmod 2 = 1 \text{ and not in a special subframe} \end{cases}$$

$$m' = 0,1,2,3$$

The sequence $\overline{w}_p(i)$ is given by Table 6.10.3.2-2.

**Table 6.10.3.2-2: The sequence $\overline{w}_p(i)$ for extended cyclic prefix.**

| Antenna port $p$ | $\left[\overline{w}_p(0) \quad \overline{w}_p(1)\right]$ |
|---|---|
| 7 | $\left[+1 \quad +1\right]$ |
| 8 | $\left[-1 \quad +1\right]$ |

For extended cyclic prefix, UE-specific reference signals are not supported on antenna ports 9 to 14.

Resource elements $(k,l)$ used for transmission of UE-specific reference signals to one UE on any of the antenna ports in the set $S$, where $S = \{7,8,11,13\}$ or $S = \{9,10,12,14\}$ shall

- not be used for transmission of PDSCH on any antenna port in the same slot, and
- not be used for UE-specific reference signals to the same UE on any antenna port other than those in $S$ in the same slot.

Figure 6.10.3.2-3 illustrates the resource elements used for UE-specific reference signals for normal cyclic prefix for antenna ports 7, 8, 9 and 10. Figure 6.10.3.2-4 illustrates the resource elements used for UE-specific reference signals for extended cyclic prefix for antenna ports 7, 8.

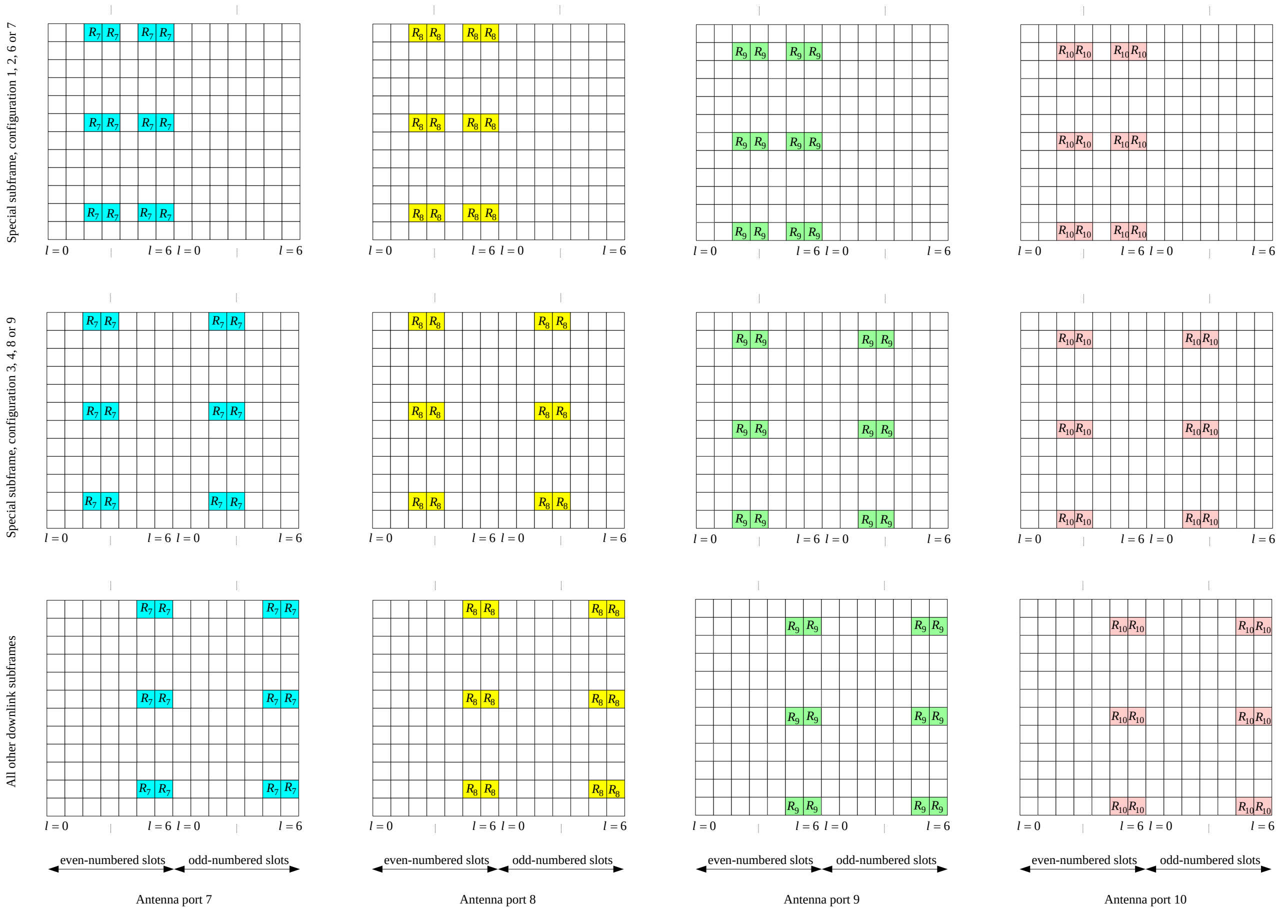


**Figure 6.10.3.2-3: Mapping of UE-specific reference signals, antenna ports 7, 8, 9 and 10 (normal cyclic prefix)**

[TS 36.213, clause 7.1]

…

For frame structure type 2,

- the UE is not expected to receive PDSCH resource blocks transmitted on antenna port 5 in any subframe in which the number of OFDM symbols for PDCCH with normal CP is equal to four;

- the UE is not expected to receive PDSCH resource blocks transmitted on antenna port 5 in the two PRBs to which a pair of VRBs is mapped if either one of the two PRBs overlaps in frequency with a transmission of PBCH in the same subframe;

- the UE is not expected to receive PDSCH resource blocks transmitted on antenna port 7, 8, 9, 10, 11, 12, 13 or 14 in the two PRBs to which a pair of VRBs is mapped if either one of the two PRBs overlaps in frequency with a transmission of primary or secondary synchronisation signals in the same subframe;

- with normal CP configuration, the UE is not expected to receive PDSCH on antenna port 5 for which distributed VRB resource allocation is assigned in the special subframe with configuration #1 or #6;

- the UE is not expected to receive PDSCH on antenna port 7 for which distributed VRB resource allocation is assigned;

- with normal cyclic prefix, the UE is not expected to receive PDSCH resource blocks transmitted on antenna port 5 in DwPTS when the UE is configured with special subframe configuration 9.

- The UE may skip decoding the transport block(s) if it does not receive all assigned PDSCH resource blocks. If the UE skips decoding, the physical layer indicates to higher layer that the transport block(s) are not successfully decoded.

If a UE is configured by higher layers to decode PDCCH with CRC scrambled by the C-RNTI, the UE shall decode the PDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-5. The scrambling initialization of PDSCH corresponding to these PDCCHs is by C-RNTI.

If a UE is configured by higher layers to decode EPDCCH with CRC scrambled by the C-RNTI, the UE shall decode the EPDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-5A. The scrambling initialization of PDSCH corresponding to these EPDCCHs is by C-RNTI.

If the UE is configured with the carrier indicator field for a given serving cell and, if the UE is configured by higher layers to decode PDCCH/EPDCCH with CRC scrambled by the C-RNTI, then the UE shall decode PDSCH of the serving cell indicated by the carrier indicator field value in the decoded PDCCH/EPDCCH.

When a UE configured in transmission mode 3, 4, 8, 9 or 10 receives a DCI Format 1A assignment, it shall assume that the PDSCH transmission is associated with transport block 1 and that transport block 2 is disabled.

When a UE is configured in transmission mode 7, scrambling initialization of UE-specific reference signals corresponding to these PDCCHs/EPDCCHs is by C-RNTI.

The UE does not support transmission mode 8 if extended cyclic prefix is used in the downlink.

When a UE is configured in transmission mode 9 or 10, in the subframes indicated by the higher layer parameter *mbsfn-SubframeConfigList* except in subframes for the serving cell

- indicated by higher layers to decode PMCH or,

- configured by higher layers to be part of a positioning reference signal occasion and the positioning reference signal occasion is only configured within MBSFN subframes and the cyclic prefix length used in subframe #0 is normal cyclic prefix,

the UE shall upon detection of a PDCCH with CRC scrambled by the C-RNTI with DCI format 1A/2C/2D intended for the UE or, upon detection of an EPDCCH with CRC scrambled by the C-RNTI with DCI format 1A/2C/2D intended for the UE, decode the corresponding PDSCH in the same subframe.

A UE configured in transmission mode 10 can be configured with scrambling identities, $n_{\mathrm{ID}}^{\mathrm{DMRS},i}$ , $i = 0,1$ by higher layers for UE-specific reference signal generation as defined in Section 6.10.3.1 of [3] to decode PDSCH according to a detected PDCCH/EPDCCH with CRC scrambled by the C-RNTI with DCI format 2D intended for the UE.

**Table 7.1-5: PDCCH and PDSCH configured by C-RNTI**

| Transmission mode | DCI format | Search Space | Transmission scheme of PDSCH corresponding to PDCCH |
|---|---|---|---|
| Mode 1 | DCI format 1A | Common and<br>UE specific by C-RNTI | Single-antenna port, port 0 (see subclause 7.1.1) |
| | DCI format 1 | UE specific by C-RNTI | Single-antenna port, port 0 (see subclause 7.1.1) |
| Mode 2 | DCI format 1A | Common and<br>UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1 | UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| Mode 3 | DCI format 1A | Common and<br>UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 2A | UE specific by C-RNTI | Large delay CDD (see subclause 7.1.3) or Transmit diversity (see subclause 7.1.2) |
| Mode 4 | DCI format 1A | Common and<br>UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 2 | UE specific by C-RNTI | Closed-loop spatial multiplexing (see subclause 7.1.4)or Transmit diversity (see subclause 7.1.2) |
| Mode 5 | DCI format 1A | Common and<br>UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1D | UE specific by C-RNTI | Multi-user MIMO (see subclause 7.1.5) |
| Mode 6 | DCI format 1A | Common and<br>UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1B | UE specific by C-RNTI | Closed-loop spatial multiplexing (see subclause 7.1.4) using a single transmission layer |
| Mode 7 | DCI format 1A | Common and<br>UE specific by C-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see subclause 7.1.1), otherwise Transmit diversity (see subclause 7.1.2) |
| | DCI format 1 | UE specific by C-RNTI | Single-antenna port, port 5 (see subclause 7.1.1) |
| Mode 8 | DCI format 1A | Common and<br>UE specific by C-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see subclause 7.1.1), otherwise Transmit diversity (see subclause 7.1.2) |
| | DCI format 2B | UE specific by C-RNTI | Dual layer transmission, port 7 and 8 (see subclause 7.1.5A) or single-antenna port, port 7 or 8 (see subclause 7.1.1) |
| Mode 9 | DCI format 1A | Common and<br>UE specific by C-RNTI | Non-MBSFN subframe: If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see subclause 7.1.1), otherwise Transmit diversity (see subclause 7.1.2)<br>MBSFN subframe: Single-antenna port, port 7 (see subclause 7.1.1) |
| | DCI format 2C | UE specific by C-RNTI | Up to 8 layer transmission, ports 7-14 (see subclause 7.1.5B) or single-antenna port, port 7 or 8 (see subclause 7.1.1) |
| Mode 10 | DCI format 1A | Common and<br>UE specific by C-RNTI | Non-MBSFN subframe: If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see subclause 7.1.1), otherwise Transmit diversity (see subclause 7.1.2)<br>MBSFN subframe: Single-antenna port, port 7 (see subclause 7.1.1) |
| | DCI format 2D | UE specific by C-RNTI | Up to 8 layer transmission, ports 7-14 (see subclause 7.1.5B) or single-antenna port, port 7 or 8 (see subclause 7.1.1) |

[TS 36.306, clause 4.3.4.21]

This field defines whether the UE supports TDD special subframe as specified in [TS 36.211]. It is mandatory for UEs of this release of the specification.

[TS 36.331, clause 6.3.2]

The IE *TDD-Config* is used to specify the TDD specific physical channel configuration.

**_TDD-Config_ information element**

```
-- ASN1START

TDD-Config ::=                      SEQUENCE {
    subframeAssignment                  ENUMERATED {
                                            sa0, sa1, sa2, sa3, sa4, sa5, sa6},
    specialSubframePatterns             ENUMERATED {
                                            ssp0, ssp1, ssp2, ssp3, ssp4,ssp5, ssp6, ssp7,
                                            ssp8}
}

TDD-Config-v1130 ::=                SEQUENCE {
    specialSubframePatterns-v1130       ENUMERATED {ssp7,ssp9}
}

-- ASN1STOP
```

| ***TDD-Config* field descriptions** |
|---|
| ***specialSubframePatterns***<br>Indicates Configuration as in TS 36.211 [21, table 4.2-1] where *ssp0* points to Configuration 0, *ssp1* to Configuration 1 etc. Value *ssp7* points to Configuration 7 for extended cyclic prefix and value *ssp9* points to Configuration 9 for normal cyclic prefix. E-UTRAN signals *ssp7* only when setting *specialSubframePatterns* (without suffix i.e. the version defined in REL-8) to *ssp4*. E-UTRAN signals value *ssp9* only when setting *specialSubframePatterns* (without suffix) to *ssp5*. If *specialSubframePatterns-v1130* is present, the UE shall ignore *specialSubframePatterns* (without suffix). |
| ***subframeAssignment***<br>Indicates DL/UL subframe configuration where sa0 point to Configuration 0, sa1 to Configuration 1 etc. as specified in TS 36.211 [21, table 4.2-2]. E-UTRAN configures the same value for serving cells residing on same frequency band. |

### 7.1.3.13.3 Test description

#### 7.1.3.13.3.1 Pre-test conditions

System Simulator:

- Cell 1 and Cell 2

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) in Cell 1 according to [18] using parameters as specified in section 7.1.3.13.3.3.

#### 7.1.3.13.3.2 Test procedure sequence

Table 7.1.3.13.3.2-1 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, 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 7.1.3.13.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 2 | Remark |
|---|---|---|---|---|---|
| **T0** | Cell-specific RS EPRE | dBm/15Khz | -85 | -91 | |
| **T1** | Cell-specific RS EPRE | dBm/15Khz | -85 | -79 | |

**Table 7.1.3.13.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS indicates a new transmission on PDCCH by using DCI format 2B and transmits a MAC PDU in SF-Num 1 or 6 where the DwPTS belongs to. | <-- | MAC PDU | - | - |
| 2 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 3 | The UE transmits a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 4 | The SS sends an UL grant suitable for the loop back PDU to be transmitted | <-- | (UL Grant) | - | - |
| 5 | The UE transmits a MAC PDU containing the loop back PDU corresponding to step 1 | --> | MAC PDU | - | - |
| 6 | The SS changes Cell 2 power level according to the row "T1" in table 7.1.3.13.3.2-1 | - | - | - | - |
| 7 | The SS transmits an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 2 with special subframe pattern 7 for extended CP and tm7 configured. | <-- | - | - | - |
| 8 | The UE transmits on Cell 2, *RRCConnectionReconfigurationComplete* | --> | - | - | - |
| 9 | The SS indicates a new transmission on PDCCH by using DCI format 1 and transmits a MAC PDU in SF-Num 1 or 6 where the DwPTS belongs to. | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 11 | The UE transmits a Scheduling Request on PUCCH | --> | (SR) | - | - |
| 12 | The SS sends an UL grant suitable for the loop back PDU to be transmitted | <-- | (UL Grant) | - | - |
| 13 | The UE transmits a MAC PDU containing the loop back PDU corresponding to step 1 and 6 | --> | MAC PDU | - | - |

#### 7.1.3.13.3.3 Specific message contents

**Table 7.1.3.13.3.3-1: SystemInformationBlockType1 for Cell 1 (preamble, Table 7.1.3.13.3.2-1)**

| Derivation Path: 36.508 clause 4.4.3.2, Table 4.4.3.2-3 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType1 ::= SEQUENCE { | | | |
| tdd-Config SEQUENCE { | | | TDD |
| subframeAssignment | sa1 | | |
| specialSubframePatterns | ssp5 | | |
| } | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| tdd-Config-v1130 SEQUENCE { | | | |
| specialSubframePatterns-v1130 | ssp9 | | |
| } | | | |
| nonCriticalExtension | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-2: SystemInformationBlockType2 for Cell 1 (preamble, table 7.1.3.13.3.2-1)**

| Derivation path: 36.508 clause 4.4.3.3, Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| ul-CyclicPrefixLength | len1 | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-3: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE { | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-4: PhysicalConfigDedicated-DEFAULT (preamble: Table 4.5.3.3-1, step 8)**

| Derivation Path: 36.331 clause 6.3.2 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PhysicalConfigDedicated-DEFAULT ::= SEQUENCE { | | | |
| antennaInfo CHOICE { | | | |
| explicitValue SEQUENCE { | | | 2TX |
| transmissionMode | tm8-v920 | | |
| ue-TransmitAntennaSelection CHOICE { | | | |
| Release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-5: SystemInformationBlockType1 for Cell 2 (from step6, Table 7.1.3.13.3.2-1)**

| Derivation Path: 36.508 clause 4.4.3.2, Table 4.4.3.2-3 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType1 ::= SEQUENCE { | | | |
| tdd-Config SEQUENCE { | | | TDD |
| subframeAssignment | sa1 | | |
| specialSubframePatterns | ssp4 | | |
| } | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| nonCriticalExtension SEQUENCE { | | | |
| tdd-Config-v1130 SEQUENCE { | | | |
| specialSubframePatterns-v1130 | ssp7 | | |
| } | | | |
| nonCriticalExtension | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-6: SystemInformationBlockType2 for Cell 2 (from step6, table 7.1.3.13.3.2-1)**

| Derivation path: 36.508 clause 4.4.3.3, Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| ul-CyclicPrefixLength | len2 | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-7: *RRCConnectionReconfiguration* (step 7, table 7.1.3.13.3.2-1)**

| Derivation Path: 36.508, Table 4.6.1-8, condition HO |
|---|

**Table 7.1.3.13.3.3-8: *MobilityControlInfo* (Table 7.1.3.13.3.3-7)**

| Derivation Path: 36.331 clause 4.6.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| MobilityControlInfo ::= SEQUENCE { | | | |
| targetPhysCellId | PhysicalCellIdentity of Cell 2 | | |
| carrierFreq SEQUENCE { | | | |
| dl-CarrierFreq | Same downlink EARFCN as used for Cell 2 | | |
| ul-CarrierFreq | Not present | | TDD |
| } | | | |
| carrierBandwidth SEQUENCE { | | | |
| dl-Bandwidth | Same downlink system bandwidth as used for Cell 2 | | |
| ul-Bandwidth | Not present | | TDD |
| } | | | |
| radioResourceConfigCommon SEQUENCE { | | | |
| tdd-Config SEQUENCE { | | | |
| subframeAssignment | sa1 | | |
| specialSubframePatterns | ssp4 | | |
| } | | | |
| ul-CyclicPrefixLength | len2 | | |
| tdd-Config-v1130 SEQUENCE { | | | |
| specialSubframePatterns-v1130 | ssp7 | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.13.3.3-9: PhysicalConfigDedicated-DEFAULT (Table 7.1.3.13.3.3-7)**

| Derivation Path: 36.508 clause 4.8.2.1, Table 4.8.2.1.6-1, condition RBC-HO | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PhysicalConfigDedicated-DEFAULT ::= SEQUENCE { | | | |
| antennaInfo CHOICE { | | | |
| explicitValue SEQUENCE { | | | 2TX |
| transmissionMode | tm7 | | |
| ue-TransmitAntennaSelection CHOICE { | | | |
| Release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.3.14 Correct handling of DL assignment / Dynamic case / EPDCCH

### 7.1.3.14.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with EPDCCH in localized transmission type }
ensure that {
  when { UE receives downlink assignment on the EPDCCH for the UE's C-RNTI and receives data in the
associated subframe and UE performs HARQ operation }
    then { UE sends a HARQ feedback on the HARQ process }
          }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state and EPDCCH in localized transmission type }
ensure that {
  when { UE receives downlink assignment on the EPDCCH with a C-RNTI unknown by the UE and data is
available in the associated subframe }
    then { UE does not send any HARQ feedback on the HARQ process }
          }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives downlink assignment
on the EPDCCH for the UE's C-RNTI and receives data in the associated subframe and UE performs HARQ
operation }
    then { UE sends a HARQ feedback on the HARQ process }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives downlink assignment
on the EPDCCH with a C-RNTI unknown by the UE and data is available in the associated subframe }
    then { UE does not send any HARQ feedback on the HARQ process }
            }
```

#### 7.1.3.14.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.321 clauses 3.1 and 5.3.1. Unless otherwise stated these are Rel-11 requirements.

[36.321, clause 3.1]

**PDCCH:** Refers to the PDCCH [7], EPDCCH (in subframes when configured) or, for an RN with R-PDCCH configured and not suspended, to the R-PDCCH.

[TS 36.321, clause 5.3.1]

Downlink assignments transmitted on the PDCCH indicate if there is a transmission on the DL-SCH for a particular UE and provide the relevant HARQ information.

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI during which it monitors PDCCH:

- if a downlink assignment for this TTI has been received on the PDCCH for the UE's C-RNTI, or Temporary C-RNTI:
  - if this is the first downlink assignment for this Temporary C-RNTI:
    - consider the NDI to have been toggled.
  - if the downlink assignment is for UE'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 UE's Semi-Persistent Scheduling C-RNTI or a configured downlink assignment:
    - consider the NDI to have been toggled regardless of the value of the NDI.
  - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.

#### 7.1.3.14.3 Test description

##### 7.1.3.14.3.1 Pre-test conditions

System Simulator:

- Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.3.1.3.3-1

UE:

None.

Preamble:

- The generic procedure to get UE in test state Loopback Activated (State 4) according to TS 36.508 clause 4.5 is executed, with all the parameters as specified in the procedure except that the RLC SDU size is set to return no data in uplink.

#### 7.1.3.14.3.2 Test procedure sequence

**Table 7.1.3.14.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | SS transmits a downlink assignment including the C-RNTI assigned to the UE | <-- | (EPDCCH (C-RNTI)) | - | - |
| 2 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU. | <-- | 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 | <-- | (EPDCCH (unknown C-RNTI)) | - | - |
| 5 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE send any HARQ ACK/ NACK on PUCCH? | --> | HARQ ACK/ NACK | 2 | F |
| 7 | SS sends RRCConnectionReconfiguration to configure EPDCCH in distributed transmission mode | - | - | - | - |
| 8 | SS transmits a downlink assignment including the C-RNTI assigned to the UE | <-- | (EPDCCH (C-RNTI)) | - | - |
| 9 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU. | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 3 | P |
| 11 | SS transmits a downlink assignment to including a C-RNTI different from the assigned to the UE | <-- | (EPDCCH (unknown C-RNTI)) | - | - |
| 12 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU. | <-- | MAC PDU | - | - |
| 13 | Check: Does the UE send any HARQ ACK/ NACK on PUCCH? | --> | HARQ ACK/ NACK | 4 | F |

NOTE 1: For TDD, the timing of ACK/NACK is not constant as FDD, see Table 10.1-1 of TS 36.213.

#### 7.1.3.14.3.3 Specific Message Contents

**Table 7.1.3.14.3.3-1: *MAC-MainConfig-RBC* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| MAC-MainConfig-RBC ::= SEQUENCE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |

**Table 7.1.3.14.3.3-2: *PhysicalConfigDedicated* (Preamble and step 7)**

| Derivation Path: 36.508 clause 4.8.2.1.6, Table 4.8.2.1.6-1 with condition ePDCCH |
|---|

**Table 7.1.3.14.3.3-3: *EPDCCH-Config-r11* (Preamble)**

| Derivation Path: 36.508 clause 4.6.3, Table 4.6.3-2B | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| EPDCCH-Config-r11 ::= SEQUENCE{ | | | |
| config-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePatternConfig-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePattern-r11 CHOICE { | | | |
| subframePatternFDD-r10 | FFS | | FDD |
| subframePatternTDD-r10 CHOICE { | | | TDD |
| subframeConfig1-5-r10 | FFS | | |
| subframeConfig0-r10 | FFS | | |
| subframeConfig6-r10 | FFS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| startSymbol-r11 | 3 | | |
| setConfigToAddModList-r11 SEQUENCE (SIZE(1..maxEPDCCH-Set-r11)) OF SEQUENCE { | 1 entry | | |
| setConfigId-r11[1] | 0 | | |
| transmissionType-r11[1] | localised | | |
| resourceBlockAssignment-r11[1] SEQUENCE{ | | | |
| numberPRB-Pairs-r11 | n8 | | |
| resourceBlockAssignment-r11 | FFS | | |
| } | | | |
| dmrs-ScramblingSequenceInt-r11[1] | FFS | | |
| pucch-ResourceStartOffset-r11[1] | FFS | | |
| re-MappingQCL-ConfigListId-r11[1] | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.14.3.3-4: *EPDCCH-Config-r11* (Table 7.1.3.14.3.2-1, step 7)**

| Derivation Path: 36.508 clause 4.6.3, Table 4.6.3-2B | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| EPDCCH-Config-r11 ::= SEQUENCE{ | | | |
| config-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePatternConfig-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePattern-r11 CHOICE { | | | |
| subframePatternFDD-r10 | FFS | | FDD |
| subframePatternTDD-r10 CHOICE { | | | TDD |
| subframeConfig1-5-r10 | FFS | | |
| subframeConfig0-r10 | FFS | | |
| subframeConfig6-r10 | FFS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| startSymbol-r11 | Not present | PCFICH indicate | |
| setConfigToAddModList-r11 SEQUENCE (SIZE(1..maxEPDCCH-Set-r11)) OF SEQUENCE { | 2 entries | 2 non-overlapping distributed sets | |
| setConfigId-r11[1] | 0 | | |
| transmissionType-r11[1] | distributed | | |
| resourceBlockAssignment-r11[1] SEQUENCE{ | | | |
| numberPRB-Pairs-r11 | n4 | | |
| resourceBlockAssignment-r11 | FFS | | |
| } | | | |
| dmrs-ScramblingSequenceInt-r11[1] | FFS | | |
| pucch-ResourceStartOffset-r11[1] | FFS | | |
| re-MappingQCL-ConfigListId-r11[1] | Not present | | |
| setConfigId-r11[2] | 1 | | |
| transmissionType-r11[2] | distributed | | |
| resourceBlockAssignment-r11[2] SEQUENCE{ | | | |
| numberPRB-Pairs-r11 | n8 | | |
| resourceBlockAssignment-r11 | FFS | | |
| } | | | |
| dmrs-ScramblingSequenceInt-r11[2] | FFS | | |
| pucch-ResourceStartOffset-r11[2] | FFS | | |
| re-MappingQCL-ConfigListId-r11[2] | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.3.15 Correct handling of DL assignment / Semi-persistent case / EPDCCH

### 7.1.3.15.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_Connected state with DRB established and sps-Configuration in DL is enabled
and EPDCCH in localized transmission mode }
ensure that {
  when { UE receives a DL assignment addressed to its stored SPS-CRNTI in SF-Num y and with NDI set
as 0 }
    then { UE starts receiving DL MAC PDU in SF-Nums y+n*[semiPersistSchedIntervalDL] where 'n' is
positive integer starting at zero  }
            }
```

(2)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive
MAC PDU at SF-Num y+n*[semiPersistSchedIntervalDL] and EPDCCH in localized transmission mode }
ensure that {
  when { UE receives a DL assignment addressed to its SPS-CRNTI in SF-Num p and with NDI set as 0,
where p!= y+n*[semiPersistSchedIntervalDL] }
```

```
    then { UE starts receiving DL MAC PDU in SF-Nums p+n*[semiPersistSchedIntervalDL] and stops
receiving DL MAC PDU at SF-Nums y+n*[semiPersistSchedIntervalDL]where 'n' is positive integer
starting at zero }
            }
```

(3)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive
MAC PDU at SF-Num p+n*[semiPersistSchedIntervalDL] and EPDCCH in localized transmission mode }
ensure that {
  when { UE receives a DL assignment [for retransmission] addressed to its SPS-CRNTI in SF-Num z and
with NDI set as 1, where z!= p+n*[semiPersistSchedIntervalDL] }
    then { UE receives MAC PDU in SF-Num z as per the new grant for SPS-CRNTI }
            }
```

(4)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive
MAC PDU at SF-Num y+n*[semiPersistSchedIntervalDL] and EPDCCH in localized transmission mode }
ensure that {
  when { UE receives a DL assignment addressed to its CRNTI in SF-Num p, such that p!=
y+n*[semiPersistSchedIntervalDL] }
    then { UE receives MAC PDU in SF-Num p as per assignment addressed to its C-RNTI }
            }
```

(5)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS grant to receive MAC
PDU at SF-Num z+n*[semiPersistSchedIntervalDL] and EPDCCH in localized transmission mode }
ensure that {
  when { UE receives a RRCConnectionReconfiguration including sps-Configuration with sps-
ConfigurationDL set as 'disable' and hence resulting in DL SPS grant deactivation }
    then { UE deletes the stored sps-Configuration DL parameters and stops receiving DL MAC PDU's as
per stored SPS assignment in SF-Num z+n*[semiPersistSchedIntervalDL] }
            }
```

(6)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive
MAC PDU at SF-Num z+n*[semiPersistSchedIntervalDL] and EPDCCH in localized transmission mode }
ensure that {
  when { UE receives a EPDCCH [for DL SPS explicit release according to Table 9.2-1A in TS 36.213]
addressed to its SPS C-RNTI in SF-Num p and with NDI set as 0, where p!=
z+n*[semiPersistSchedIntervalDL] }
    then { UE sends an ACK to SS and releases the configured SPS assignment and stops receiving MAC
PDU in SF-Num z+n*[semiPersistSchedIntervalDL] as per assignment addressed to its SPS C-RNTI }
            }
```

(7)

```
with { UE in E-UTRA RRC_Connected state with DRB established and sps-Configuration in DL is enabled
}
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives a DL assignment
addressed to its stored SPS-CRNTI in SF-Num y and with NDI set as 0 }
    then { UE starts receiving DL MAC PDU in SF-Nums y+n*[semiPersistSchedIntervalDL] where 'n' is
positive integer starting at zero  }
            }
```

(8)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive
MAC PDU at SF-Num y+n*[semiPersistSchedIntervalDL]  }
ensure that {

  when { EPDCCH is configured with distributed transmission type and UE receives a DL assignment
addressed to its SPS-CRNTI in SF-Num p and with NDI set as 0, where p!=
y+n*[semiPersistSchedIntervalDL] }
    then { UE starts receiving DL MAC PDU in SF-Nums p+n*[semiPersistSchedIntervalDL] and stops
receiving DL MAC PDU at SF-Nums y+n*[semiPersistSchedIntervalDL]where 'n' is positive integer
starting at zero }
            }
```

(9)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num p+n*[semiPersistSchedIntervalDL] }
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives a DL assignment [for retransmission] addressed to its SPS-CRNTI in SF-Num z and with NDI set as 1, where z!= p+n*[semiPersistSchedIntervalDL] }
    then { UE receives MAC PDU in SF-Num z as per the new grant for SPS-CRNTI }
            }
```

(10)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num y+n*[semiPersistSchedIntervalDL]  }
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives a DL assignment addressed to its CRNTI in SF-Num p, such that p!= y+n*[semiPersistSchedIntervalDL] }
    then { UE receives MAC PDU in SF-Num p as per assignment addressed to its C-RNTI }
            }
```

(11)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS grant to receive MAC PDU at SF-Num z+n*[semiPersistSchedIntervalDL] }
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives a RRCConnectionReconfiguration including sps-Configuration with sps-ConfigurationDL set as 'disable' and hence resulting in DL SPS grant deactivation }
    then { UE deletes the stored sps-Configuration DL parameters and stops receiving DL MAC PDU's as per stored SPS assignment in SF-Num z+n*[semiPersistSchedIntervalDL] }
            }
```

(12)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at SF-Num z+n*[semiPersistSchedIntervalDL] }
ensure that {
  when { EPDCCH is configured with distributed transmission type and UE receives a ePDCCH [for DL SPS explicit release according to Table 9.2-1A in TS 36.213] addressed to its SPS C-RNTI in SF-Num p and with NDI set as 0, where p!= z+n*[semiPersistSchedIntervalDL] }
    then { UE sends an ACK to SS and releases the configured SPS assignment and stops receiving MAC PDU in SF-Num z+n*[semiPersistSchedIntervalDL] as per assignment addressed to its SPS C-RNTI }
            }
```

NOTE: SF-Num = [10*SFN + subframe] modulo 10240.

### 7.1.3.15.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.3.1 , 5.10 & 5.10.1, 36.331 clause 5.3.10.5, 36.300 clause 11.1.1 and 36.213 clause 9.2. Unless otherwise stated these are Rel-11 requirements.

[TS 36.321, clause 5.3.1]

Downlink assignments transmitted on the PDCCH indicate if there is a transmission on the DL-SCH for a particular UE and provide the relevant HARQ information.

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI during which it monitors PDCCH:

- if a downlink assignment for this TTI has been received on the PDCCH for the UE's C-RNTI, or Temporary C-RNTI:
  - if this is the first downlink assignment for this Temporary C-RNTI:
    - consider the NDI to have been toggled.
  - if the downlink assignment is for UE'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 UE's Semi-Persistent Scheduling C-RNTI or a configured downlink assignment:

        - consider the NDI to have been toggled regardless of the value of the NDI.

    - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.

- else, if a downlink assignment for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:

    - if the NDI in the received HARQ information is 1:

        - consider the NDI not to have been toggled;

        - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.

    - else, if the NDI in the received HARQ information is 0:

        - if PDCCH contents indicate SPS release:

            - clear the configured downlink assignment (if any);

            - if *timeAlignmentTimer* is running:

            - instruct the physical layer to transmit a positive acknowledgement.

        - else:

            - store the downlink assignment and the associated HARQ information as configured downlink assignment;

            - initialise (if not active) or re-initialise (if already active) the configured downlink assignment to start in this TTI and to recur according to rules in subclause 5.10.1;

            - set the HARQ Process ID to the HARQ Process ID associated with this TTI;

            - consider the NDI bit to have been toggled;

            - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.

- else, if a downlink assignment for this TTI has been configured and there is no measurement gap in this TTI:

    - instruct the physical layer to receive, in this TTI, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

    - set the HARQ Process ID to the HARQ Process ID associated with this TTI;

    - consider the NDI bit to have been toggled;

    - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.

For downlink assignments received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI and for configured downlink assignments, the HARQ Process ID associated with this TTI is derived from the following equation:

HARQ Process ID = [floor(CURRENT_TTI/(Downlink Semi-Persistent Scheduling Interval))] modulo Number of Configured SPS Processes,

where CURRENT_TTI=[(SFN * 10) + subframe number], Downlink Semi-Persistent Scheduling Interval is the periodicity of semi-persistent scheduling signalled via RRC and Number of Configured SPS Processes is the number of HARQ processes allocated for semi-persistent scheduling signalled via RRC.

[TS 36.321, clause 5.10]

When Semi-Persistent Scheduling is enabled by upper layer, the following information is provided:

- Semi-Persistent Scheduling C-RNTI;

- Uplink Semi-Persistent Scheduling Interval *semiPersistSchedIntervalUL* and number of empty transmissions before implicit release *implicitReleaseAfter*, if Semi-Persistent Scheduling is enabled for the uplink;
- Whether *twoIntervalsConfig* is enabled or disabled for uplink, only for TDD;
- Downlink Semi-Persistent Scheduling Interval *semiPersistSchedIntervalDL* and number of configured HARQ processes for Semi-Persistent Scheduling *numberOfConfSPS-Processes*, if Semi-Persistent Scheduling is enabled for the downlink;

When Semi-Persistent Scheduling for uplink or downlink is disabled by RRC, the corresponding configured grant or configured assignment shall be discarded.

[TS 36.321, clause 5.10.1]

After a Semi-Persistent downlink assignment is configured, the UE shall consider that the assignment recurs in each subframe for which:

- (10 * SFN + subframe) = [(10 * $SFN_{start\ time}$ + $subframe_{start\ time}$) + N * (Downlink Semi-Persistent Scheduling Interval)] modulo 10240, for all N>0.

Where $SFN_{start\ time}$ and $subframe_{start\ time}$ are the SFN and subframe, respectively, at the time the configured downlink assignment were (re-)initialised.

[TS 36.331, clause 5.3.10.5]

The UE shall:

1> reconfigure the semi-persistent scheduling in accordance with the received *sps-Config*:

[TS 36.300, clause 11.1.1]

In addition, E-UTRAN can allocate semi-persistent downlink resources for the first HARQ transmissions to UEs:

- RRC defines the periodicity of the semi-persistent downlink grant;
- PDCCH indicates whether the downlink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

When required, retransmissions are explicitly signalled via the PDCCH(s). In the sub-frames where the UE has semi-persistent downlink resource, if the UE cannot find its C-RNTI on the PDCCH(s), a downlink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI is assumed. Otherwise, in the sub-frames where the UE has semi-persistent downlink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the semi-persistent allocation for that TTI and the UE does not decode the semi-persistent resources.

[TS 36.213, clause 9.2]

A UE shall validate a Semi-Persistent Scheduling assignment PDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the PDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2, 2A, 2B, 2C and 2D, the new data indicator field refers to the one for the enabled transport block.

A UE shall validate a Semi-Persistent Scheduling assignment EPDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the EPDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2, 2A, 2B, 2C and 2D, the new data indicator field refers to the one for the enabled transport block.

Validation is achieved if all the fields for the respective used DCI format are set according to Table 9.2-1 or Table 9.2-1A.

If validation is achieved, the UE shall consider the received DCI information accordingly as a valid semi-persistent activation or release.

If validation is not achieved, the received DCI format shall be considered by the UE as having been received with a non-matching CRC.

**Table 9.2-1: Special fields for Semi-Persistent Scheduling Activation PDCCH/EPDCCH Validation**

| | DCI format 0 | DCI format 1/1A | DCI format 2/2A/2B/2C/2D |
|---|---|---|---|
| TPC command for scheduled PUSCH | set to '00' | N/A | N/A |
| Cyclic shift DM RS | set to '000' | N/A | N/A |
| Modulation and coding scheme and redundancy version | MSB is set to '0' | N/A | N/A |
| HARQ process number | N/A | FDD: set to '000'<br>TDD: set to '0000' | FDD: set to '000'<br>TDD: set to '0000' |
| Modulation and coding scheme | N/A | MSB is set to '0' | For the enabled transport block: MSB is set to '0' |
| Redundancy version | N/A | set to '00' | For the enabled transport block: set to '00' |

**Table 9.2-1A: Special fields for Semi-Persistent Scheduling Release PDCCH/EPDCCH Validation**

| | DCI format 0 | DCI format 1A |
|---|---|---|
| TPC command for scheduled PUSCH | set to '00' | N/A |
| Cyclic shift DM RS | set to '000' | N/A |
| Modulation and coding scheme and redundancy version | set to '11111' | N/A |
| Resource block assignment and hopping resource allocation | Set to all '1's | N/A |
| HARQ process number | N/A | FDD: set to '000'<br>TDD: set to '0000' |
| Modulation and coding scheme | N/A | set to '11111' |
| Redundancy version | N/A | set to '00' |
| Resource block assignment | N/A | Set to all '1's |

#### 7.1. 3.15.3 Test description

##### 7.1.3.15.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(1,1) is used for step 8 in 4.5.3A.3 according to [18].
- The UL RLC SDU size is set to not return any data.

7.1.3.15.3.2 Test procedure sequence

**Table 7.1.3.15.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'Y', NDI=0 | <-- | (DL SPS Grant) | - | - |
| 2 | The SS transmits in SF-Num 'Y', a DL MAC PDU containing a RLC PDU (DL-SQN=0)on UM DRB | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 4 | The SS transmits in SF-Num 'Y+X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=1)on DRB | <-- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 6 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'P', NDI=0; (Where Y+X<P< Y+2X) | <-- | (DL SPS Grant) | - | - |
| 7 | The SS transmits in SF-Num 'P', a DL MAC PDU containing a RLC PDU (DL-SQN=2)on UM DRB | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 9 | The SS transmits in SF-Num 'Y+2X', a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 2 | F |
| 10A | The SS Transmits a DL assignment using UE's C-RNTI in SF-Num 'P+X(semiPersistSchedIntervalDL)', NDI=0 | <-- | (DL Grant) | - | - |
| 11 | The SS transmits in SF-Num 'P+X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB; | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 13 | The SS transmits in SF-Num 'P+2X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=4)on UM DRB | <-- | MAC PDU | - | - |
| 14 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 15 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num in SF-Num 'P+3X(semiPersistSchedIntervalDL)' . (Note 1a) | <-- | (DL SPS Grant) | - | - |
| 16 | The SS transmits in SF-Num 'P+3X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=5)on UM DRB; Note 1 | <-- | MAC PDU | - | - |
| 16A | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | | |
| | EXCEPTION: Step 19b and 19c shall be repeated until HARQ retransmission count = 3 is reached for MAC PDU at step 19 (Note 1b). | | | | |
| 16b | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'Z', NDI=1; Where (P+3X < Z <P+4X); The DL HARQ process is same as in step 11 | <-- | (DL SPS Grant) | | |
| 16c | The SS re-transmits in SF-Num 'Z', a DL MAC PDU containing a RLC PDU (DL-SQN=5)on UM DRB; (Note 1a) | <-- | MAC PDU | | |
| | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 20 (Note 1b). | | | | |
| 17 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 3 | P |
| 18 | The SS Transmits a EPDCCH [for DL SPS | <-- | EPDCCH [for DL SPS explicit | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | explicit release] using UE's SPS C-RNTI in SF-Num 'Q', NDI=0; Where (P+3X< Q <P+4X). | | release] | | |
| 19 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 6 | P |
| 20 | The SS transmits in SF-Num 'P+5X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=6)on UM DRB; | <-- | MAC PDU | - | - |
| 21 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 6 | F |
| 22 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'P+6X', NDI=0 | <-- | (DL SPS Grant) | - | - |
| 23 | The SS transmits in SF-Num 'P+6X', a DL MAC PDU containing a RLC PDU (DL-SQN=6)on UM DRB | <-- | MAC PDU | - | - |
| 24 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 25 | SS Transmits RRCConnectionReconfiguration to disable SPS-ConfigurationDL | - | - | - | - |
| 26 | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 27 | The SS transmits in SF-Num 'P+8X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=7) on UM DRB | <-- | MAC PDU | - | - |
| 28 | Check: Dose the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 5 | F |
| 29 | SS sends RRCConnectionReconfiguration to configure EPDCCH in distributed transmission mode | - | - | - | - |
| 30 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'Y', NDI=0 | <-- | (DL SPS Grant) | - | - |
| 31 | The SS transmits in SF-Num 'Y', a DL MAC PDU containing a RLC PDU (DL-SQN=0)on UM DRB | <-- | MAC PDU | - | - |
| 32 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 7 | P |
| 33 | The SS transmits in SF-Num 'Y+X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=1)on DRB | <-- | MAC PDU | - | - |
| 34 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 7 | P |
| 35 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'P', NDI=0;<br>(Where Y+X<P< Y+2X) | <-- | (DL SPS Grant) | - | - |
| 36 | The SS transmits in SF-Num 'P', a DL MAC PDU containing a RLC PDU (DL-SQN=2)on UM DRB | <-- | MAC PDU | - | - |
| 37 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 8 | P |
| 38 | The SS transmits in SF-Num 'Y+2X', a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB | <-- | MAC PDU | - | - |
| 39 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 8 | F |
| 39A | The SS Transmits a DL assignment using UE's C-RNTI in SF-Num 'P+X(semiPersistSchedIntervalDL)', NDI=0 | <-- | (DL Grant) | - | - |
| 40 | The SS transmits in SF-Num 'P+X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB; | <-- | MAC PDU | - | - |
| 41 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 10 | P |
| 42 | The SS transmits in SF-Num 'P+2X(semiPersistSchedIntervalDL)', a DL MAC PDU containing a RLC PDU (DL-SQN=4)on UM DRB | <-- | MAC PDU | - | - |
| 43 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 7 | P |
| 44 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num in SF-Num 'P+3X(semiPersistSchedIntervalDL)' . (Note | <-- | (DL SPS Grant) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | 1a) | | | | |
| 45 | The SS transmits in SF-Num 'P+3X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=5)on UM DRB; Note 1 | <-- | MAC PDU | - | - |
| 45A | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | | |
| | EXCEPTION: Step 19b and 19c shall be repeated until HARQ retransmission count = 3 is reached for MAC PDU at step 19 (Note 1b). | | | | |
| 45b | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'Z', NDI=1; Where (P+3X < Z <P+4X); The DL HARQ process is same as in step 11 | <-- | (DL SPS Grant) | | |
| 45c | The SS re-transmits in SF-Num 'Z', a DL MAC PDU containing a RLC PDU (DL-SQN=5)on UM DRB; (Note 1a) | <-- | MAC PDU | | |
| | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 20 (Note 1b). | | | | |
| 46 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 9 | P |
| 47 | The SS Transmits a EPDCCH [for DL SPS explicit release] using UE's SPS C-RNTI in SF-Num 'Q', NDI=0; Where (P+3X< Q <P+4X). | <-- | EPDCCH [for DL SPS explicit release] | - | - |
| 48 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 12 | P |
| 49 | The SS transmits in SF-Num 'P+5X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=6)on UM DRB | <-- | MAC PDU | - | - |
| 50 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 12 | F |
| 51 | The SS Transmits a DL assignment using UE's SPS C-RNTI in SF-Num 'P+6X', NDI=0 | <-- | (DL SPS Grant) | - | - |
| 52 | The SS transmits in SF-Num 'P+6X', a DL MAC PDU containing a RLC PDU (DL-SQN=6)on UM DRB | <-- | MAC PDU | - | - |
| 53 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 7 | P |
| 54 | SS Transmits RRCConnectionReconfiguration to disable SPS-ConfigurationDL | - | - | - | - |
| 55 | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 56 | The SS transmits in SF-Num 'P+8X(semiPersistSchedIntervalDL)', a DL MAC PDU containing 1 RLC PDU's (DL-SQN=7) on UM DRB | <-- | MAC PDU | - | - |
| 57 | Check: Dose the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 11 | F |

Note 1: The DL assignment for C-RNTI and hence the size of MAC PDU is different in size than stored SPS C-RNTI DL assignment in step 6. This assures UE is receiving DSCH data as per DL assignment for C-RNTI and not as per stored grant for SPS C-RNTI.

Note 1a: SS should transmit this PDU using $I_{TBS}$=6, $N_{PRB}$=1, see TS 36.213 Table 7.1.7.2.1-1. This will result in TBSize of 328 and having coding rate more than 1.

Note 1b: 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 2: For TDD, the subframe number for 'Y', 'P', 'Z' and 'Q' should be '0', '4', '5' and '9' respectively based on TDD configuration 1.

7.1.3.15.3.3 Specific message contents

**Table 7.1.3.15.3.3-1: RadioResourceConfigDedicated (Preamble)**

| Derivation path: 36.508 table 4.6.3-16 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated::= SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE{ | | | |
| drx-Config CHOICE { | | | pc_FeatrGrp_5 AND DRX_S |
| setup SEQUENCE { | | | |
| onDurationTimer | psf40 | | |
| } | | | |
| } | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| sps-Config ::= SEQUENCE { | | | |
| semiPersistSchedC-RNTI | 'FFF0'H | | |
| sps-ConfigurationDL::=CHOICE{ | | | |
| enable SEQUENCE { | | | |
| semiPersistSchedIntervalDL | sf40 | 40 Subframe | |
| numberOfConfSPS-Processes | 8 | | FDD |
| numberOfConfSPS-Processes | 7 | Max DL HARQ processes is 7 considering TDD configuration 1. | TDD |
| n1Pucch-AN-Persistent | 0 | | |
| } | | | |
| } | | | |
| sps-ConfigurationUL | Not Present | | |
| } | | | |
| } | | | |

| Condition | Explanation |
|---|---|
| DRX_S | Used for DRX configuration with small DRX cycle length |

**Table 7.1.3.15.3.3-2: PhysicalConfigDedicated (Preamble in Table 4.5.3.3-1 step 8, and step 29 in Table 7.1.3.15.3.2-1)**

| Derivation Path: 36.508 clause 4.8.2.1.6, Table 4.8.2.1.6-1 with condition ePDCCH |
|---|

**Table 7.1.3.15.3.3-3: RadioResourceConfigDedicated (step 25 and 54 of table 7.1.3.15.3.2-1)**

| Derivation path: 36.508 table 4.6.3-16 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated::= SEQUENCE { | | | |
| sps-Configuration ::= SEQUENCE { | | | |
| semiPersistSchedC-RNTI | Not Present | | |
| sps-ConfigurationDL::=CHOICE{ | | | |
| disable | NULL | | |
| } | | | |
| sps-ConfigurationUL | Not Present | | |
| } | | | |
| } | | | |

**Table 7.1.3.15.3.3-4: EPDCCH-SetConfig-r11 (preamble: Table 4.5.3.3-1, step 8)**

| Derivation Path: 36.508 clause 4.6.3, Table 4.6.3-2B | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| EPDCCH-Config-r11 ::= SEQUENCE{ | | | |
| config-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePatternConfig-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePattern-r11 CHOICE { | | | |
| subframePatternFDD-r10 | FFS | | FDD |
| subframePatternTDD-r10 CHOICE { | | | TDD |
| subframeConfig1-5-r10 | FFS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| startSymbol-r11 | 3 | | |
| setConfigToAddModList-r11 SEQUENCE (SIZE(1..maxEPDCCH-Set-r11)) OF SEQUENCE { | 1 entry | | |
| setConfigId-r11[1] | 0 | | |
| transmissionType-r11[1] | localised | | |
| resourceBlockAssignment-r11[1] SEQUENCE{ | | | |
| numberPRB-Pairs-r11 | n8 | | |
| resourceBlockAssignment-r11 | FFS | | |
| } | | | |
| dmrs-ScramblingSequenceInt-r11[1] | FFS | | |
| pucch-ResourceStartOffset-r11[1] | FFS | | |
| re-MappingQCL-ConfigListId-r11[1] | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.3.15.3.3-5: *EPDCCH-Config-r11* (Table 7.1.3.15.3.2-1, step 29)**

| Derivation Path: 36.508 clause 4.6.3, Table 4.6.3-2B | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| EPDCCH-Config-r11 ::= SEQUENCE{ | | | |
| config-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePatternConfig-r11 CHOICE { | | | |
| setup SEQUENCE { | | | |
| subframePattern-r11 CHOICE { | | | |
| subframePatternFDD-r10 | FFS | | FDD |
| subframePatternTDD-r10 CHOICE { | | | TDD |
| subframeConfig1-5-r10 | FFS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| startSymbol-r11 | Not present | PCFICH indicate | |
| setConfigToAddModList-r11 SEQUENCE (SIZE(1..maxEPDCCH-Set-r11)) OF SEQUENCE { | 2 entries | 2 non-overlapping distributed sets | |
| setConfigId-r11[1] | 0 | | |
| transmissionType-r11[1] | distributed | | |
| resourceBlockAssignment-r11[1] SEQUENCE{ | | | |
| numberPRB-Pairs-r11 | n4 | | |
| resourceBlockAssignment-r11 | FFS | | |
| } | | | |
| dmrs-ScramblingSequenceInt-r11[1] | FFS | | |
| pucch-ResourceStartOffset-r11[1] | FFS | | |
| re-MappingQCL-ConfigListId-r11[1] | Not present | | |
| setConfigId-r11[2] | 1 | | |
| transmissionType-r11[2] | distributed | | |
| resourceBlockAssignment-r11[2] SEQUENCE{ | | | |
| numberPRB-Pairs-r11 | n8 | | |
| resourceBlockAssignment-r11 | FFS | | |
| } | | | |
| dmrs-ScramblingSequenceInt-r11[2] | FFS | | |
| pucch-ResourceStartOffset-r11[2] | FFS | | |
| re-MappingQCL-ConfigListId-r11[2] | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.4 UL-SCH data transfer

### 7.1.4.1 Correct handling of UL assignment / Dynamic case

#### 7.1.4.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE receives for a TTI an uplink grant with valid C-RNTI }
    then { UE transmits data and associated HARQ information to the HARQ entity for this TTI }
}
```

#### 7.1.4.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.321 clause 5.4.1.

[TS 36.321, clause 5.4.1]

In order to transmit on the UL-SCH the UE must have a valid uplink grant (except for non-adaptive HARQ retransmissions) which it may receive dynamically on the PDCCH or in a Random Access Response or which may be configured semi-persistently. To perform requested transmissions, the MAC layer receives HARQ information from lower layers.

When *timeAlignmentTimer* is running and the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI :

- if an uplink grant for this TTI has been received in a Random Access Response:
  - set NDI to the value 0 and consider the NDI to have been toggled.
    - if an uplink grant for this TTI has been received on the PDCCH for the UE's C-RNTI or Temporary C-RNTI; or
- if an uplink grant for this TTI has been received in a Random Access Response:
  - if the uplink grant is for UE'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 UE's Semi-Persistent Scheduling C-RNTI or a configured uplink grant:
- consider the NDI to have been toggled regardless of the value of the NDI.
  - deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if an uplink grant for this TTI has been received on the PDCCH for the UE's Semi-Persistent C-RNTI:
  - if the NDI in the received HARQ information is 1:
    - consider the NDI not to have been toggled;
    - indicate a valid uplink grant and the associated HARQ information to the HARQ entity for this TTI.

...

NOTE 1: The period of configured uplink grants is expressed in TTIs.

NOTE 2: If the UE receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions in the same UL subframe, the UE may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or Semi persistent scheduling C-RNTI.

NOTE 3: When a configured uplink grant is indicated during a measurement gap and indicates an UL-SCH transmission during a measurement gap, the UE processes the grant but does not transmit on UL-SCH.

#### 7.1.4.1.3 Test description

##### 7.1.4.1.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

#### 7.1.4.1.3.2 Test procedure sequence

**Table 7.1.4.1.3.2-1: 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 | 1 | - |
| 3 | Void | --> | - | - | - |
| - | EXCEPTION: Step 4 runs in parallel with behaviour in table 7.1.4.1.3.2-2 | - | - | - | - |
| 4 | The SS is configured for Uplink Grant Allocation Type 2. For 400 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. Note 1. | <-- | (UL Grant (unknown C-RNTI)) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4? | --> | MAC PDU | 1 | F |
| 6 | The SS is configured for Uplink Grant Allocation Type 2. 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)) | - | - |
| 7 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 6? | --> | MAC PDU | 1 | P |
| Note 1: Note 400 ms corresponding to 40 frames is selected to be sufficiently large than loop back delay and small than the time needed for Scheduling Request to be repeated dsr-TransMax times( {64-1}* 20 milliseconds). | | | | | |

**Table 7.1.4.1.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | UE transmits a Scheduling Request. | --> | (SR) | - | - |

#### 7.1.4.1.3.3 Specific message contents.

**Table 7.1.4.1.3.3-1: SchedulingRequest-Configuration to be used in RRCConnectionReconfiguration in preamble**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Configuration ::= CHOICE { | | | |
| setup SEQUENCE { | | | |
| dsr-TransMax | n64 | Max value allowed | |
| } | | | |
| } | | | |

**Table 7.1.4.1.3.3-2: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.4.2 Correct handling of UL assignment / Semi-persistent case

### 7.1.4.2.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_Connected state with DRB established and sps-Configuration in UL is enabled
}
ensure that {
  when { UE receives a UL grant addressed to its stored SPS-CRNTI in SF-Num y and with NDI set as 0
}
    then { UE starts transmitting UL MAC PDU in SF-Num F1 }
          }
```

(2)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored UL SPS grant to transmit MAC
PDU at SF-Num F1 }
ensure that {
  when { UE receives a UL grant addressed to its SPS-CRNTI in SF-Num-frame p and with NDI set as 0,
where p+4!=F1(FDD) or p+k(p)!=F1(TDD) }
    then { UE starts transmitting UL MAC PDU in SF-Num F2 and stops transmitting UL MAC PDU at SF-
Num F1 }
            }
```

(3)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored UL SPS grant to transmit MAC
PDU at SF-Num F1 }
ensure that {
  when { UE receives a UL grant [for retransmission] addressed to its SPS-CRNTI in SF-Num z and with
NDI set as 1, for the corresponding HARQ Process, where z+4!=F1(FDD) or z+k(z)!=F1(TDD) }
    then { UE re-transmits MAC PDU in SF-Num z+4(FDD) or z+k(z)(TDD) as per the new grant for SPS-
CRNTI }
            }
```

(4)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored UL SPS grant to transmit MAC
PDU at SF-Num F3 }
ensure that {
  when { UE receives a UL grant addressed to its CRNTI in SF-Num p, such that in SF-Num p+4=F3(FDD)
or p+k(p)=F3(TDD) }
    then { UE transmits MAC PDU in SF-Num p+4(FDD) or p+k(p)(TDD) as per grant addressed to its C-
RNTI }
            }
```

(5)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored UL SPS grant to transmit MAC
PDU at SF-Num F3 }
```

```
ensure that {
  when { UE receives a RRCConnectionReconfiguration including sps-Configuration with sps-
ConfigurationUL set as 'disable' and hence resulting in UL SPS grant deactivation }
    then { UE deletes the stored sps-Configuration UL parameters and stops transmitting UL MAC PDU's
as per stored SPS grant in SF-Num F3 }
            }
```

(6)

```
with { UE in E-UTRA RRC_Connected state with DRB established and configured UL SPS grant }
ensure that {
  when { UE transmits 'implicitReleaseAfter' MAC PDU's on SPS-Grant containing zero MAC SDU }
    then { UE clears configured SPS grant }
            }
```

(7)

```
with { UE in E-UTRA RRC_Connected state with DRB established and stored UL SPS grant to transmit MAC
PDU at SF-Num F3 }
ensure that {
  when { UE receives a PDCCH [for UL SPS explicit release according to Table 9.2-1A in TS 36.213]
addressed to its SPS C-RNTI in SF-Num p and with NDI set as 0, where p+4!=F3(FDD) or p+k(p)!=F3(TDD)
}
    then { UE releases the configured SPS grant and stops transmitting UL MAC PDU in SF-Num F3 as
per grant addressed to its SPS C-RNTI }
            }
```

NOTE: SF-Num = [10*SFN + subframe] modulo 10240.

NOTE 2: The value of the k(y), k(p), k(z) is k value determined according to the table 8-2 in the TS 36.213, given that UL grant is in subframe y, p, z.

NOTE 3: The Subframe_Offset(y+k(y)), Subframe_Offset(p+k(p)), Subframe_Offset(z+k(z)) is subframe_offset value determined according to the clause 5.10.2 in the TS36.321, given the position of initial Semi-Persistent grant on subframe y+k(y), p+k(p), z+k(z).

NOTE 4: To simply the TP description, following abbreviations are defined:

For FDD:

F1 = y+4+n*[semiPersistSchedIntervalUL]

F2 = p+4+n*[semiPersistSchedIntervalUL]

F3 = z+4+n*[semiPersistSchedIntervalUL]

For TDD:

F1 = y+k(y)+n*[semiPersistSchedIntervalUL]+ Subframe_Offset(y+k(y))*(n modulo 2)

F2 = p+k(p)+n*[semiPersistSchedIntervalUL]+ Subframe_Offset(p+k(p))*(n modulo 2)

F3 = z+k(z)+n*[semiPersistSchedIntervalUL]+ Subframe_Offset(z+k(z))*(n modulo 2)

n >= 0

#### 7.1.4.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.4.1, 5.10, 5.10.2, 7.4, 36.331 clause 5.3.10.5, 36.213 clause 8, 9.2 and 36.300 clause 11.1.2.

[TS 36.321, clause 5.4.1]

In order to transmit on the UL-SCH the UE must have a valid uplink grant (except for non-adaptive HARQ retransmissions) which it may receive dynamically on the PDCCH or in a Random Access Response or which may be configured semi-persistently. To perform requested transmissions, the MAC layer receives HARQ information from lower layers.

When *timeAlignmentTimer* is running and the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI:

- if an uplink grant for this TTI has been received in a Random Access Response:
    - set NDI to the value 0 and consider the NDI to have been toggled.
- if an uplink grant for this TTI has been received on the PDCCH for the UE's C-RNTI or Temporary C-RNTI; or
- if an uplink grant for this TTI has been received in a Random Access Response:
    - if the uplink grant is for UE's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was the uplink grant is for UE'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 UE's Semi-Persistent Scheduling C-RNTI or a configured uplink grant:
        - consider the NDI to have been toggled regardless of the value of the NDI.
    - deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if an uplink grant for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:
    - if the NDI in the received HARQ information is 1:
        - consider the NDI not to have been toggled;
        - deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
    - else if the NDI in the received HARQ information is 0:
        - if PDCCH contents indicate SPS release:
            - clear the configured uplink grant (if any).
        - else:
            - store the uplink grant and the associated HARQ information as configured uplink grant;
            - initialise (if not active) or re-initialise (if already active) the configured uplink grant to start in this TTI and to recur according to rules in subclause 5.10.2;
            - consider the NDI bit to have been toggled;
            - deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if an uplink grant for this TTI has been configured:
    - consider the NDI bit to have been toggled;
    - deliver the configured uplink grant, and the associated HARQ information to the HARQ entity for this TTI.

NOTE 1: The period of configured uplink grants is expressed in TTIs.

NOTE 2: If the UE receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions in the same UL subframe, the UE may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or Semi persistent scheduling C-RNTI.

NOTE 3: When a configured uplink grant is indicated during a measurement gap and indicates an UL-SCH transmission during a measurement gap, the UE processes the grant but does not transmit on UL-SCH.

[TS 36.321, clause 5.10]

When Semi-Persistent Scheduling is enabled by RRC, the following information is provided:

- Semi-Persistent Scheduling C-RNTI;
- Uplink Semi-Persistent Scheduling Interval *semiPersistSchedIntervalUL* and number of empty transmissions before implicit release *implicitReleaseAfter*, if Semi-Persistent Scheduling is enabled for the uplink;

- Whether *twoIntervalsConfig* is enabled or disabled for uplink, only for TDD;

- Downlink Semi-Persistent Scheduling Interval *semiPersistSchedIntervalDL* and number of configured HARQ processes for Semi-Persistent Scheduling *numberOfConfSPS-Processes*, if Semi-Persistent Scheduling is enabled for the downlink;

When Semi-Persistent Scheduling for uplink or downlink is disabled by RRC, the corresponding configured grant or configured assignment shall be discarded.

[TS 36.321, clause 5.10.2]

After a Semi-Persistent Scheduling uplink grant is configured, the UE shall:

- if *twoIntervalsConfig* is enabled by upper layer;
  - set the Subframe_Offset according to Table 7.4-1.
- else:
  - set Subframe_Offset to 0.
- consider that the grant recurs in each subframe for which:
  - (10 * SFN + subframe) = [(10 * $SFN_{start\ time}$ + $subframe_{start\ time}$) + N * *semiPersistSchedIntervalUL* + Subframe_Offset * (N modulo 2)] modulo 10240, for all N>0.

Where $SFN_{start\ time}$ and $subframe_{start\ time}$ are the SFN and subframe, respectively, at the time the configured uplink grant were (re-)initialised.

The UE shall clear the configured uplink grant immediately after *implicitRelease after* number of consecutive new MAC PDUs each containing zero MAC SDUs have been provided by the Multiplexing and Assembly entity, on the Semi-Persistent Scheduling resource.

NOTE 4: Retransmissions for Semi-Persistent Scheduling can continue after clearing the configured uplink grant.

[TS 36.321, clause 7.4]

Subframe_Offset values are presented in Table 7.4-1.

**Table 7.4-1: Subframe_Offset values**

| TDD UL/DL configuration | Position of initial Semi-Persistent grant | Subframe_Offset value (ms) |
|---|---|---|
| 0 | N/A | 0 |
| 1 | Subframes 2 and 7 | 1 |
| | Subframes 3 and 8 | -1 |
| 2 | Subframe 2 | 5 |
| | Subframe 7 | -5 |
| 3 | Subframes 2 and 3 | 1 |
| | Subframe 4 | -2 |
| 4 | Subframe 2 | 1 |
| | Subframe 3 | -1 |
| 5 | N/A | 0 |
| 6 | N/A | 0 |

[TS 36.331, clause 5.3.10.5]

The UE shall:

1> reconfigure the semi-persistent scheduling in accordance with the received *sps-Config*:

[TS 36.213, clause 8]

…

For TDD UL/DL configurations 1 and 6 and subframe bundling operation, the UE shall upon detection of a PDCCH with DCI format 0 in subframe *n* intended for the UE, and/or a PHICH transmission intended for the UE in subframe *n-l* with $l$ given in Table 8-2a, adjust the corresponding first PUSCH transmission in the bundle in subframe $n+k$, with $k$ given in Table 8-2, according to the PDCCH and PHICH information.

…

**Table 8-2 *k* for TDD configurations 0-6**

| TDD UL/DL Configuration | DL subframe number *n* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| 0 | 4 | 6 | | | | 4 | 6 | | | |
| 1 | | 6 | | | 4 | | 6 | | | 4 |
| 2 | | | | 4 | | | | | 4 | |
| 3 | 4 | | | | | | | | 4 | 4 |
| 4 | | | | | | | | | 4 | 4 |
| 5 | | | | | | | | | 4 | |
| 6 | 7 | 7 | | | | 7 | 7 | | | 5 |

…

[TS 36.213, clause 9.2]

A UE shall validate a Semi-Persistent Scheduling assignment PDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the PDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2 and 2A, the new data indicator field refers to the one for the enabled transport block.

Validation is achieved if all the fields for the respective used DCI format are set according to Table 9.2-1 or Table 9.2-1A.

If validation is achieved, the UE shall consider the received DCI information accordingly as a valid semi-persistent activation or release.

If validation is not achieved, the received DCI format shall be considered by the UE as having been received with a non-matching CRC.

**Table 9.2-1: Special fields for Semi-Persistent Scheduling Activation PDCCH Validation**

| | DCI format 0 | DCI format 1/1A | DCI format 2/2A |
|---|---|---|---|
| TPC command for scheduled PUSCH | set to '00' | N/A | N/A |
| Cyclic shift DM RS | set to '000' | N/A | N/A |
| Modulation and coding scheme and redundancy version | MSB is set to '0' | N/A | N/A |
| HARQ process number | N/A | FDD: set to '000'<br>TDD: set to '0000' | FDD: set to '000'<br>TDD: set to '0000' |
| Modulation and coding scheme | N/A | MSB is set to '0' | For the enabled transport block: MSB is set to '0' |
| Redundancy version | N/A | set to '00' | For the enabled transport block: set to '00' |

**Table 9.2-1A: Special fields for Semi-Persistent Scheduling Release PDCCH Validation**

| | DCI format 0 | DCI format 1A |
|---|---|---|
| TPC command for scheduled PUSCH | set to '00' | N/A |
| Cyclic shift DM RS | set to '000' | N/A |
| Modulation and coding scheme and redundancy version | set to '11111' | N/A |
| Resource block assignment and hopping resource allocation | Set to all '1's | N/A |
| HARQ process number | N/A | FDD: set to '000'<br>TDD: set to '0000' |
| Modulation and coding scheme | N/A | set to '11111' |
| Redundancy version | N/A | set to '00' |
| Resource block assignment | N/A | Set to all '1's |

[TS 36.300, clause 11.1.2]

In addition, E-UTRAN can allocate a semi-persistent uplink resource for the first HARQ transmissions and potentially retransmissions to UEs:

- RRC defines the periodicity of the semi-persistent uplink grant;
- PDCCH indicates whether the uplink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

In the sub-frames where the UE has semi-persistent uplink resource, if the UE cannot find its C-RNTI on the PDCCH(s), an uplink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI can be made. The network performs decoding of the pre-defined PRBs according to the pre-defined MCS. Otherwise, in the sub-frames where the UE has semi-persistent uplink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the persistent allocation for that TTI and the UE's transmission follows the PDCCH allocation, not the semi-persistent allocation. Retransmissions are either implicitly allocated in which case the UE uses the semi-persistent uplink allocation, or explicitly allocated via PDCCH(s) in which case the UE does not follow the semi-persistent allocation.

#### 7.1.4.2.3 Test description

##### 7.1.4.2.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(1,1) is used for step 8 in 4.5.3A.3 according to [18].
- The loop back size is set in such a way that one RLC SDU in DL shall result in 1 RLC SDU's in UL of same size.

7.1.4.2.3.2 Test procedure sequence

**Table 7.1.4.2.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 0A | SS transmits RRCConnectionReconfiguration to configure UL SPS | <-- | - | - | - |
| 0B | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 1 | The SS transmits a DL MAC PDU containing 10 RLC SDU's on UM DRB. | <-- | MAC PDU | - | - |
| 2 | The UE transmits a Scheduling Request, indicating that loop back PDUs are ready for transmission in UL RLC | --> | (SR) | - | - |
| 3 | The SS transmits an UL Grant using UE's SPS C-RNTI in SF-Num '4', NDI=0, allowing the UE to transmit one loop back PDU per MAC PDU. | <-- | (UL SPS Grant) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU in SF-Num '8' as per grant in step 3? | --> | MAC PDU | 1 | P |
| 5 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 6 | Check: Does the UE transmit a MAC PDU in SF-Num '**4**8(FDD)/**4**7(TDD)' as per grant in step 3? | --> | MAC PDU | 1 | P |
| 7 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 8 | The SS Transmits an UL Grant using UE's SPS C-RNTI in SF-Num '**6**4', NDI=0 and allowing the UE to transmit two loop back PDUs per MAC PDU. | <-- | (UL SPS Grant) | - | - |
| 9 | Check: Does the UE transmit a MAC PDU in SF-Num '68' as per grant in step 8? | --> | MAC PDU | 2 | P |
| 10 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 11 | Check: Does the UE transmit a MAC PDU in SF-Num '88' as per grant in step 3? | --> | MAC PDU | 2 | F |
| 12 | Check: Does the UE transmit a MAC PDU in SF-Num '108(FDD)/107(TDD)' as per grant in step 8? | --> | MAC PDU | 2 | P |
| 13 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 14 | The SS Transmits an UL Grant using UE's SPS C-RNTI in SF-Num '120 (FDD)/124(TDD)', NDI=1; the UL HARQ process is the same as in step 12 | <-- | (UL SPS Grant) | - | - |
| 15 | Check: Does the UE transmit in SF-Num '124 (FDD)/128 (TDD)' a MAC PDU as in step 12? | --> | MAC PDU | 3 | P |
| 16 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 17 | Check: Does the UE transmit a MAC PDU in SF-Num '148' as per grant in step 8? | --> | MAC PDU | 1 | P |
| 18 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 19 | The SS Transmits an UL Grant using UE's C-RNTI in SF-Num '164(FDD)/161(TDD)'; allowing UE to transmit a MAC PDU containing two RLC SDU's | <-- | (UL Grant) | - | - |
| 20 | Check: Does the UE transmit a MAC PDU in SF-Num '168(FDD)/167(TDD)' as per grant in step 19? | --> | MAC PDU | 4 | P |
| 21 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 22 | The SS transmits a PDCCH [for UL SPS explicit release] using UE's SPS C-RNTI in SF-Num '180' with NDI=0. | <-- | PDCCH [for UL SPS explicit release] | - | - |
| 23 | Check: Does the UE transmit a MAC PDU in SF-Num '188' as per grant in step 8 containing zero MAC SDU? | --> | MAC PDU | 7 | F |
| 24 | The SS transmits an UL Grant using UE's SPS C-RNTI in SF-Num '399', NDI=0, transmit one loop back PDU per MAC PDU | <-- | (UL SPS Grant) | - | - |
| 25 | Check: Does the UE transmit a MAC PDU in SF-Num '403' as per grant in step 24 | --> | MAC PDU | 1 | P |

| | | | | | |
|---|---|---|---|---|---|
| | containing zero MAC SDU? | | | | |
| 26 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 27 | Check: Does the UE transmit a MAC PDU in SF-Num '443 (FDD)/442 (TDD)' as per grant in step 24 containing zero MAC SDU? | --> | MAC PDU | 1 | P |
| 28 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 29 | Check: Does the UE transmit a MAC PDU in SF-Num '483' as per grant in step 24? | --> | MAC PDU | 6 | F |
| 30 | The SS Transmits an UL Grant using UE's SPS C-RNTI in SF-Num '604', NDI=0, transmit one loop back PDU per MAC PDU. | <-- | (UL SPS Grant) | - | - |
| 31 | Check: Does the UE transmit a MAC PDU in SF-Num '608' as per grant in step 30 containing zero MAC SDU? | --> | MAC PDU | 1 | P |
| 32 | The SS transmits a HARQ ACK | <-- | HARQ ACK | - | - |
| 33 | SS Transmits *RRCConnectionReconfiguration* to disable SPS-ConfigurationUL. | <-- | - | - | - |
| 34 | The UE transmits *RRCConnectionReconfigurationComplete* | --> | - | - | - |
| 35 | The SS transmits a DL MAC PDU containing 1 RLC SDU | <-- | MAC PDU | - | - |
| 36 | Void | - | - | - | - |
| 37 | Check: Does the UE transmit a MAC PDU in SF-Num '648 (FDD)/647 (TDD)' as per grant in step 30? | --> | MAC PDU | 5 | F |

#### 7.1.4.2.3.3 Specific message contents

**Table 7.1.4.2.3.3-1: *RRCConnectionReconfiguration.* RadioResourceConfigDedicated (Step 0A)**

| Derivation path: 36.508 table 4.6.3-16 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated::= SEQUENCE { | | | |
| sps-Configuration ::= SEQUENCE { | | | |
| semiPersistSchedC-RNTI | 'FFF0'H | | |
| sps-ConfigurationDL | Not Present | | |
| sps-ConfigurationUL::=CHOICE{ | | | |
| enable SEQUENCE { | | | |
| semiPersistSchedIntervalUL | sf40 | 40 Subframe | |
| implicitReleaseAfter | e2 | | |
| p0-Persistent | Not Present | | |
| twoIntervalConfig | Not Present | | FDD |
| twoIntervalConfig | true | | TDD |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.2.3.3-2: *RRCConnectionReconfiguration.* RadioResourceConfigDedicated (step 33 of table 7.1.4.2.3.2-1)**

| Derivation path: 36.508 table 4.6.3-16 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated::= SEQUENCE { | | | |
| sps-Configuration ::= SEQUENCE { | | | |
| semiPersistSchedC-RNTI | Not Present | | |
| sps-ConfigurationDL | Not Present | | |
| sps-ConfigurationUL::=CHOICE{ | | | |
| disable | NULL | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.2.3.3-3: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| drx-Config CHOICE { | | | pc_FeatrGrp_5 AND DRX_S |
| setup SEQUENCE { | | | |
| onDurationTimer | psf40 | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

| Condition | Explanation |
|---|---|
| DRX_S | Used for DRX configuration with small DRX cycle length |

## 7.1.4.3 Logical channel prioritization handling

### 7.1.4.3.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { sending data on the uplink }
    then { UE serves the logical channels according to their priority and configured PBR }
        }
```

### 7.1.4.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.321 clauses 5.4.3.1.

[TS 36.321, clause 5.4.3.1]

The Logical Channel Prioritization procedure is applied when a new transmission is performed.

RRC controls the scheduling of uplink data by signalling for each logical channel: *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).

The UE shall maintain a variable Bj for each logical channel j. Bj shall be initialized to zero when the related logical channel is established, and incremented by the product PBR × TTI duration for each TTI, where PBR is Prioritized Bit Rate of logical channel j. However, the value of Bj can never exceed the bucket size and if the value of Bj is larger than the bucket size of logical channel j, it shall be set to the bucket size. The bucket size of a logical channel is equal to PBR × BSD, where PBR and BSD are configured by upper layers.

The UE shall perform the following Logical Channel Prioritization procedure when a new transmission is performed:

- The UE shall allocate resources to the logical channels in the following steps:
  - Step 1: All the logical channels with Bj > 0 are allocated resources in a decreasing priority order. If the PBR of a radio bearer is set to “infinity”, the UE shall allocate resources for all the data that is available for transmission on the radio bearer before meeting the PBR of the lower priority radio bearer(s);
  - Step 2: the UE shall decrement Bj by the total size of MAC SDUs served to logical channel j in Step 1

NOTE: The value of Bj can be negative.

  - Step 3: if any resources remain, all the logical channels 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;
  - if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant as much as possible;
  - UE should maximise the transmission of data.

The UE shall not transmit data for a logical channel corresponding to a radio bearer that is suspended (the conditions for when a radio bearer is considered suspended are defined in [8]).

For the Logical Channel Prioritization procedure, the UE shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR;
- data from any Logical Channel, except data from UL-CCCH;
- MAC control element for BSR included for padding.

#### 7.1.4.3.3 Test description

##### 7.1.4.3.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18] with the exceptions listed in table 7.1.4.3.3.1-2 applicable for the configured UM DRBs and table 7.1.4.3.3.1-3 for SR configuration.
- The condition SRB2-DRB(1,3) is used for step 8 in 4.5.3A.3 according to [18].
- The 3 UM DRBs are configured according to table 7.1.4.3.3.1-1.

**Table 7.1.4.3.3.1-1: 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 7.1.4.3.3.1-2: PDCP Settings**

| Parameter | Value |
|---|---|
| Discard_Timer | ms1500 |

**Table 7.1.4.3.3.1-3: SchedulingRequest-Config**

| Derivation Path: 36.508 Table 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| dsr-TransMax | n16 | | |

#### 7.1.4.3.3.2 Test procedure sequence

**Table 7.1.4.3.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| - | EXCEPTION: Steps 0 to 4 are run 4 times using the parameters specified for each run in table 7.1.4.3.3.2-3. | - | - | - | - |
| 0 | Void | - | - | - | - |
| 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 7.1.4.3.3.2-2 shall take place. | - | - | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2. 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?<br><br>- the total number of octets received for DRB1 is D1 octets +/- 10%<br>- the total number of octets received for DRB2 is D2 octets +/- 10%<br>- the total number of octets received for DRB3 is D3 octets +/- 10% | - | - | 1 | P |
| 4 | The SS re-establishes the RLC for each RB at the UE by sending an RRCConnectionReconfiguration for intra-cell handover with SR configuration set as per Table 7.1.4.3.3.1-3. | - | - | - | - |
| 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. | | | | | |

**Table 7.1.4.3.3.2-2: 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 7.1.4.3.3.2-3: 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) | 1143 | 573 | 1143 | 1143 |
| T1 (ms) | 20 | 20 | 20 | 10 |
| T2 (ms) | 500 | 700 | 500 | 500 |
| D1 (octets) | 4160 | 4160 | 2240 | 33000 (Note 1) |
| D2 (octets) | 8000 | 8000 | 10260 (Note 1) | 8000 |
| D3 (octets) | 16000 | 7790 (Note 1) | 16000 | 16000 |
| Note 1: It is calculated from the following equation for the case of the least header size.<br>(D1 + D2 + D3) = (D - 3) * T2 / T1 | | | | |

NOTE: the numbers above and the test procedure assume that the UE has a loopback buffer of at least 57280 octets.

#### 7.1.4.3.3.3 Specific message contents

**Table 7.1.4.3.3.3-1: *RRCConnectionReconfiguration* (step 4, table 7.1.4.3.3.2-1)**

| Derivation Path: 36.508 table 4.6.1-8: RRCConnectionReconfiguration, condition HO | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| mobilityControlInfo SEQUENCE { | | | |
| targetPhysCellId | Set to the physical cell identity of cell 1 | | |
| carrierFreq | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.4.4 Correct handling of MAC control information / Scheduling requests and PUCCH

#### 7.1.4.4.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }

ensure that {
  when { PUCCH is configured and UE has UL data available for transmission and UE has no UL-SCH
resources available and SR_COUNTER is less than dsr-TransMax }
    then { the UE transmits a SR on every available PUCCH until resources are granted }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state and has pending SR(s) }
ensure that {
  when { UE receives an UL grant for a new transmission }
    then { UE cancels all pending SR(s) }
            }
```

#### 7.1.4.4.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.4.

[TS 36.321, clause 5.4.4]

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

When an SR is triggered, it shall be considered as pending until it is cancelled.

If an SR is triggered and there is no other SR pending, the UE shall set the SR_COUNTER to 0.

As long as one SR is pending, the UE shall for each TTI:

- if no UL-SCH resources are available for a transmission in this TTI:
  - if the UE has no valid PUCCH resource for SR configured in any TTI: initiate a Random Access procedure (see subclause 5.1) and cancel all pending SRs;
  - else if the UE has a valid PUCCH resource for SR configured for this TTI and if this TTI is not part of a measurement gap:
    - if SR_COUNTER < *dsr-TransMax*:
      - increment SR_COUNTER by 1;
      - instruct the physical layer to signal the SR on PUCCH;
    - else:
      - notify RRC to release PUCCH/SRS;
      - clear any configured downlink assignments and uplink grants;
      - initiate a Random Access procedure (see subclause 5.1) and cancel all pending SRs.
- else if UL-SCH resources for new transmission are granted in this TTI, cancel all pending SR(s).7.1.4.4.3 Test description

#### 7.1.4.4.3.1 Pre-test conditions

System Simulator:

- - Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.4.4.3.3-1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

**Table 7.1.4.4.3.1-1: RLC settings**

| Parameter | Value |
|---|---|
| t-PollRetransmit | 250 ms |

7.1.4.4.3.2 Test procedure sequence

**Table 7.1.4.4.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits a MAC PDU containing 10 MAC SDUs each containing a RLC SDU | <-- | MAC PDU (containing 10 MAC SDUs) | - | - |
| - | EXCEPTION: Step 2 runs in parallel with behaviour in table 7.1.4.4.3.2-2. | - | - | - | - |
| 2 | Check: Does the UE transmit 6 Scheduling Requests separately on 6 consecutively available PUCCHs? (Note 1) | --> | (SR) | 1 | P |
| 3 | The SS is configured for Uplink Grant Allocation Type 3. The SS transmits an UL grant to allocate UL-SCH resources that are enough to transmit MAC PDU containing 10 MAC SDUs | <-- | (UL Grant ) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU containing 10 RLC PDUs? | --> | MAC PDU (containing 10 MAC SDUs) | 1 | P |
| 5 | Check: 1 second does the UE transmit a Scheduling Request in the next 100ms? | --> | (SR) | 1,2 | F |
| 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 6 Scheduling Requests as sr-ConfigIndex = 30. | | | | | |

**Table 7.1.4.4.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | Check: Does the UE transmit a MAC PDU? | --> | MAC PDU | 1 | F |

7.1.4.4.3.3 Specific Message Contents

**Table 7.1.4.4.3.3-1: SchedulingRequest-Configuration to be used in RRCConnectionReconfiguration in preamble**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Configuration::= CHOICE { | | | |
| enable SEQUENCE { | | | |
| dsr-TransMax | n64 | | |
| } | | | |
| } | | | |

7.1.4.4.3.3 Specific Message Contents

None.

## 7.1.4.5 Correct handling of MAC control information / Scheduling requests and random access procedure

### 7.1.4.5.1 Test Purpose (TP)

(1)

```
with { The UE is in E-UTRA RRC_CONNECTED state and no PUCCH resource for SR is configured }
ensure that {
    when { UE has UL data available for transmission, UE has no UL-SCH resources available and time
alignment timer expires }
    then { the UE initiates the random access procedure }
          }
```

(2)

```
with { The  UE in E-UTRA RRC_CONNECTED state )
ensure that {
  when { PUCCH Configured and UE has UL data available for transmission and UE has no UL-SCH
resources available and SR_COUNTER becomes equal to dsr-TransMax  }
    then { the UE transmits a PRACH Preamble to initiate a Random Access procedure }


        :}
```

#### 7.1.4.5.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 , clause 5.4.4.

[TS 36.321 clause 5.4.4]

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

When an SR is triggered, it shall be considered as pending until it is cancelled.

If an SR is triggered and there is no other SR pending, the UE shall set the SR_COUNTER to 0.

As long as one SR is pending, the UE shall for each TTI:

- if no UL-SCH resources are available for a transmission in this TTI:
  - if the UE has no valid PUCCH resource for SR configured in any TTI: initiate a Random Access procedure (see subclause 5.1) and cancel all pending SRs;
  - else if the UE has a valid PUCCH resource for SR configured for this TTI and if this TTI is not part of a measurement gap:
    - if SR_COUNTER < *dsr-TransMax*:
      - increment SR_COUNTER by 1;
      - instruct the physical layer to signal the SR on PUCCH;
    - else:
      - notify RRC to release PUCCH/SRS;
      - clear any configured downlink assignments and uplink grants;
- initiate a Random Access procedure (see subclause 5.1) and cancel all pending SRs.-else if UL-SCH resources for new transmission are granted in this TTI, cancel all pending SR(s).

#### 7.1.4.5.3 Test description

##### 7.1.4.5.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

7.1.4.5.3.2 Test procedure sequence

**Table 7.1.4.5.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | 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) | - | - |
| 1A | The SS transmits a MAC PDU containing a MAC SDU | <-- | MAC PDU (MAC SDU) | - | - |
| - | EXCEPTION: Step 2B is repeated less than 64 times (dsr-TransMax) | - | - | - | - |
| 2B | The UE may transmit Scheduling Requests before time alignment timer expires. The SS shall not respond to the Scheduling Requests in this step. (Note 5) | --> | (SR) | - | - |
| 2 | Check: does the UE transmit a preamble on PRACH? (Note 1) | --> | (PRACH Preamble) | 1 | P |
| 3 | 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 1A. | <-- | Random Access Response | - | - |
| 4 | The UE transmit a MAC PDU including a C-RNTI MAC Control Element and a MAC SDU. (Note 2) | --> | MAC PDU (C-RNTI control element, MAC SDU) | - | - |
| 5 | The SS sends PDCCH transmission for UE C-RNTI | <-- | - | - | - |
| 5A | The SS transmits RRCConnectionReconfiguration containing a *radioResourceConfiguration* with a physical channel reconfiguration | <-- | | - | - |
| - | EXCEPTION: Steps 5A1 to 5A4 are optionally executed. (Note 6) | - | | - | - |
| 5A1 | The UE transmits a preamble on PRACH. (Note 6) | --> | (PRACH Preamble) | - | - |
| 5A2 | The SS transmits a Random Access Response including an UL grant of 7 bytes. (Note 7) | <-- | Random Access Response | - | - |
| 5A3 | The UE transmit a MAC PDU including a C-RNTI MAC Control Element | --> | - | - | - |
| 5A4 | The SS sends PDCCH transmission for UE C-RNTI of 5 bytes (Note 9) | <-- | - | - | - |
| 5B | The UE transmits a Scheduling Request on PUCCH. (Note 8) | --> | (SR) | - | - |
| 5C | The SS transmits an UL grant to enable UE to transmit the *RRCConnectionReconfigurationComplete* message. (Note 10) | <-- | (UL Grant) | - | - |
| 5D | The UE transmits *RRCConnectionReconfigurationComplete* message. | --> | - | - | - |
| 5E | Void | - | - | - | - |
| 6 | The SS ignores any Scheduling Requests from the UE. | - | - | - | - |
| 7 | The SS transmits a MAC PDU containing one MAC SDU containing a RLC SDU | <-- | MAC PDU MAC SDU) | - | - |
| - | EXCEPTION: Step 8 shall be repeated 8 times. | - | - | - | - |
| 8 | The UE transmits a Scheduling Request on PUCCH (Note 3) | --> | (SR) | - | - |
| 9 | Check: does the UE transmit a preamble on PRACH? (Note 4) | --> | (PRACH Preamble) | 2 | P |
| 10 | 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 7. | <-- | Random Access Response | - | - |

| | | | | | |
|---|---|---|---|---|---|
| 11 | The UE transmit a MAC PDU including a C-RNTI MAC Control Element and a MAC SDU. (Note 2) | --> | MAC PDU (C-RNTI control element, MAC SDU) | - | - |
| 12 | The SS sends PDCCH transmission for UE C-RNTI | <-- | - | - | - |

Note 1: When UL time alignment timer expires in the UE then "UL synchronization" is lost and the UE initiates a Random Access Procedure.
Note 2: The UE transmission of the MAC PDU ensures that the random access procedure was successful.
Note 3: The UE repeats the scheduling requests as long as SR_COUNTER < *dsr-TransMax* and there is data in the transmission buffer and there are no resources available to transmit it.
Note 4: Reception of PRACH Preamble by the SS verifies that UE has initiated a Random Access procedure triggered by SR_COUNTER having reached *dsr-TransMax*.
Note 5: In step 2B, SR repetition of 63 times (*dsr-TransMax* (64)) will take at least 63*20 = 1260 ms which is much larger than TA timer 750ms.
Note 6: RLC status PDU may trigger the UE to transmit PRACH Preamble.
Note 7: UL grant of 56 bits (ITBS=4, NPRB=1, see TS 36.213 Table 7.1.7.2.1-1) is chosen to allow the UE to transmit C-RNTI MAC Control Element but not allowing the UE to transmit RRCConnectionReconfiguration Complete. 7 bytes allow transmission of C-RNTI + Short BSR or C-RNTI + STATUS PDU.
Note 8: If RRCConnectionReconfigurationComplete was not ready for transmission in step 5A3 then SR is triggered when RRC message arrives in the transmission buffer. Otherwise (RRCConnectionReconfigurationComplete was ready for the transmission in step 5A3) the SR is triggered because expiry of the retxBSR-Timer.
Note 9: 5 bytes are assigned so that STATUS PDU can be included if it was not transmitted by the UE in step 5A3 (see Note 7) (5 bytes assignment allow transmission of Short BSR + STATUS PDU)
Note 10: STATUS PDU is included if optional test steps 5A1 to 5A4 were not executed.

#### 7.1.4.5.3.3 Specific Message Contents

**Table 7.1.4.5.3.3-1: SchedulingRequest-Config to be used in RRCConnectionReconfiguration ( preamble, Table 7.1.4.5.3.2-1)**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Config-DEFAULT::= CHOICE { | | | |
| setup SEQUENCE { | | | |
| dsr-TransMax | n64 | | |
| } | | | |
| } | | | |

**Table 7.1.4.5.3.3-2: RRCConnectionReconfiguration (step 5A, Table 7.1.4.5.3.2-1)**

| Derivation Path: 36.331 clause 6.2.2 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| rrc-TransactionIdentifier | RRC-TransactionIdentifier-DL | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| measConfig | Not present | | |
| mobilityControlInfo | Not present | | |
| dedicatedInfoNASList | Not present | | |
| radioResourceConfigDedicated | RadioResourceConfigDedicated-Step5a | | |
| securityConfigHO | Not present | | |
| nonCriticalExtension SEQUENCE {} | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.5.3.3-3: RadioResourceConfigDedicated-Step5A (Table 7.1.4.5.3.3-2)**

| Derivation Path: 36.331 clause 6.3.2 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigDedicated-HO ::= SEQUENCE { | | | |
| srb-ToAddModList | Not present | | |
| drb-ToAddModList | Not present | | |
| drb-ToReleaseList | Not present | | |
| mac-MainConfig | Not present | | |
| sps-Config | Not present | | |
| physicalConfigDedicated | PhysicalConfigDedicated-Step5a | | |
| } | | | |

**Table 7.1.4.5.3.3-4: PhysicalConfigDedicated-Step5A (Table 7.1.4.5.3.3-3)**

| Derivation Path: 36.331 clause 6.3.2 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PhysicalConfigDedicated-DEFAULT ::= SEQUENCE { | | | |
| pdsch-ConfigDedicated | Not present | | |
| pucch-ConfigDedicated | Not present | | |
| pusch-ConfigDedicated | Not present | | |
| uplinkPowerControlDedicated | Not present | | |
| tpc-PDCCH-ConfigPUCCH | Not present | | |
| tpc-PDCCH-ConfigPUSCH | Not present | | |
| cqi-ReportConfig | CQI-ReportConfig-DEFAULT using condition CQI_PERIODIC | See subclause 4.6.3 of 36.508 | |
| soundingRS-LU-ConfigDedicated | SoundingRS-ULI-ConfigDedicated-DEFAULT | See subclause 4.6.3 of 36.508 | |
| antennaInfo | Not present | | |
| schedulingRequestConfig | SchedulingRequest-Config- Config-Step5a | | |
| } | | | |

**Table 7.1.4.5.3.3-5: SchedulingRequest-Config-Step5A (Table 7.1.4.5.3.3-4)**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Config::= CHOICE { | | | |
| enable SEQUENCE { | | | |
| dsr-TransMax | n8 | | |
| } | | | |
| } | | | |

**Table 7.1.4.5.3.3-6: MAC-MainConfig-RBC in *RRCConnectionReconfiguration* (preamble)**

| Derivation Path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| MAC-MainConfigRBC- ::= SEQUENCE { | | | |
| ul-SCH-Configuration SEQUENCE { | | | |
| retxBSR-Timer | sf320 | | |
| } | | | |
| } | | | |

### 7.1.4.6 Correct handling of MAC control information / Buffer status / UL data arrive in the UE Tx buffer and retransmission of BSR / Regular BSR

#### 7.1.4.6.1 Test Purpose (TP)

(1)

```
with ( UE in E-UTRA 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 E-UTRA 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 E-UTRA 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 E-UTRA RRC_CONNECTED state )
ensure t hat {
   when{RETX_BSR_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 E-UTRA RRC_CONNECTED stat e)
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)

```
with (UE in E-UTRA 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 only UL resources to send all pending data available for transmission, but
UL grant is not sufficient to additionally accommodate the BSR MAC control element}
     then { UE cancels the triggered BSR report and transmits the UL data}
       }
```

(8)

```
with (UE in E-UTRA 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}
       }
```

#### 7.1.4.6.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.3.1, 5.4.5, 6.1.2, 6.1.3.1 and 6.2.1 and in TS 36.323 clause 4.5.

[TS 36.321 clause 5.4.3.1]

For the Logical Channel Prioritization procedure, the UE shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR;
- data from any Logical Channel, except data from UL-CCCH;

- MAC control element for BSR included for padding.

[TS 36.321 clause 5.4.4]

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

[TS 36.321 clause 5.4.5]

The Buffer Status reporting procedure is used to provide the serving eNB with information about the amount of data available for transmission in the UL buffers of the UE. RRC controls BSR reporting by configuring the two timers *periodicBSR-Timer* and *retxBSR-Timer* and by, for each logical channel, optionally signalling *logicalChannelGroup* which allocates the logical channel to an LCG [8].

For the Buffer Status reporting procedure, the UE shall consider all radio bearers which are not suspended and may consider radio bearers which are suspended.

A Buffer Status Report (BSR) shall be triggered if any of the following events occur:

- UL data, for a logical channel which belongs to a LCG, becomes available for transmission in the RLC entity or in the PDCP entity (the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively) and either the data belongs to a logical channel with higher priority than the priorities of the logical channels which belong to any LCG and for which data is already available for transmission, or there is no data available for transmission for any of the logical channels which belong to a LCG, 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 control element plus its subheader, in which case the BSR is referred below to as "Padding BSR";
- *retxBSR-Timer* expires and the UE has data available for transmission for any of the logical channels which belong to a LCG, 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 and Periodic BSR:

- if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Long BSR;
- else report Short BSR.

For Padding BSR:

- 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:
  - if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Truncated BSR of the LCG with the highest priority logical channel with data available for transmission;
  - else report Short BSR.
- else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader, report Long BSR.

If the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

- if the UE has UL resources allocated for new transmission for this TTI:
  - instruct the Multiplexing and Assembly procedure to generate a BSR MAC control element;
  - start or restart *periodicBSR-Timer* except when the BSR is a Truncated BSR;
  - start or restart *retxBSR-Timer*.
- else if a Regular BSR has been triggered:
  - a Scheduling Request shall be triggered.

A MAC PDU shall contain at most one MAC BSR control element, even when multiple events trigger a BSR by the time a BSR can be transmitted in which case the Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The UE shall restart *retxBSR-Timer* upon indication of a grant for transmission of new data on UL-SCH.

All triggered BSRs shall be cancelled in case the UL grant 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.

[TS 36.321 clause 6.1.2]

MAC control elements are always placed before any MAC SDU.

[TS 36.321 clause 6.1.3.1]

Buffer Status Report (BSR) MAC control elements consist of either:

- Short BSR and Truncated BSR format: one LCG ID field and one corresponding Buffer Size field (figure 6.1.3.1-1); or
- Long BSR format: four Buffer Size fields, corresponding to LCG IDs #0 through #3 (figure 6.1.3.1-2).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in table 6.2.1.-1.

The fields LCG ID and Buffer Size are defined as follow:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) which buffer status is being reported. The length of the field is 2 bits;
- Buffer Size: The Buffer Size field identifies the total amount of data available across all logical channels of a logical channel group after the MAC PDU has been built. The amount of data is indicated in number of bytes. It shall include all data that is available for transmission in the RLC layer and in the PDCP layer; the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field is 6 bits. The values taken by the Buffer Size field are shown in Table 6.1.3.1-1.

| | | |
|---|---|---|
| LCG ID | Buffer Size | Oct 1 |

**Figure 6.1.3.1-1: Short BSR and Truncated BSR MAC control element**

<table>
<tr><td colspan="6">Buffer Size #0</td><td colspan="2">Buffer Size #1</td><td>Oct 1</td></tr>
<tr><td colspan="4">Buffer Size #1</td><td colspan="4">Buffer Size #2</td><td>Oct 2</td></tr>
<tr><td colspan="2">Buffer Size #2</td><td colspan="6">Buffer Size #3</td><td>Oct 3</td></tr>
</table>

**Figure 6.1.3.1-2: Long BSR MAC control element**

**Table 6.1.3.1-1: Buffer size levels for BSR**

| Index | Buffer Size (BS) value [bytes] | Index | Buffer Size (BS) value [bytes] |
|---|---|---|---|
| 0 | BS = 0 | 32 | 1132 < BS <= 1326 |
| 1 | 0 < BS <= 10 | 33 | 1326 < BS <= 1552 |
| 2 | 10 < BS <= 12 | 34 | 1552 < BS <= 1817 |
| 3 | 12 < BS <= 14 | 35 | 1817 < BS <= 2127 |
| 4 | 14 < BS <= 17 | 36 | 2127 < BS <= 2490 |
| 5 | 17 < BS <= 19 | 37 | 2490 < BS <= 2915 |
| 6 | 19 < BS <= 22 | 38 | 2915 < BS <= 3413 |
| 7 | 22 < BS <= 26 | 39 | 3413 < BS <= 3995 |
| 8 | 26 < BS <= 31 | 40 | 3995 < BS <= 4677 |
| 9 | 31 < BS <= 36 | 41 | 4677 < BS <= 5476 |
| 10 | 36 < BS <= 42 | 42 | 5476 < BS <= 6411 |
| 11 | 42 < BS <= 49 | 43 | 6411 < BS <= 7505 |
| 12 | 49 < BS <= 57 | 44 | 7505 < BS <= 8787 |
| 13 | 57 < BS <= 67 | 45 | 8787 < BS <= 10287 |
| 14 | 67 < BS <= 78 | 46 | 10287 < BS <= 12043 |
| 15 | 78 < BS <= 91 | 47 | 12043 < BS <= 14099 |
| 16 | 91 < BS <= 107 | 48 | 14099 < BS <= 16507 |
| 17 | 107 < BS <= 125 | 49 | 16507 < BS <= 19325 |
| 18 | 125 < BS <= 146 | 50 | 19325 < BS <= 22624 |
| 19 | 146 < BS <= 171 | 51 | 22624 < BS <= 26487 |
| 20 | 171 < BS <= 200 | 52 | 26487 < BS <= 31009 |
| 21 | 200 < BS <= 234 | 53 | 31009 < BS <= 36304 |
| 22 | 234 < BS <= 274 | 54 | 36304 < BS <= 42502 |
| 23 | 274 < BS <= 321 | 55 | 42502 < BS <= 49759 |
| 24 | 321 < BS <= 376 | 56 | 49759 < BS <= 58255 |
| 25 | 376 < BS <= 440 | 57 | 58255 < BS <= 68201 |
| 26 | 440 < BS <= 515 | 58 | 68201 < BS <= 79846 |
| 27 | 515 < BS <= 603 | 59 | 79846 < BS <= 93479 |
| 28 | 603 < BS <= 706 | 60 | 93479 < BS <= 109439 |
| 29 | 706 < BS <= 826 | 61 | 109439 < BS <= 128125 |
| 30 | 826 < BS <= 967 | 62 | 128125 < BS <= 150000 |
| 31 | 967 < BS <= 1132 | 63 | BS > 150000 |

[TS 36.321 clause 6.2.1]

**Table 6.2.1-2: Values of LCID for UL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11001 | Reserved |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

[TS 36.323 clause 4.5]

For the purpose of MAC buffer status reporting, the UE shall consider the following as data available for transmission in the PDCP layer:

For SDUs for which no PDU has been submitted to lower layers:

- the SDU itself, if the SDU has not yet been processed by PDCP, or
- the PDU (control or data) if the SDU has been processed by PDCP.

#### 7.1.4.6.3 Test description

##### 7.1.4.6.3.1 Pre-test conditions

System Simulator :

- Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.4.6.3.3-1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(3,0) is used for step 8 in 4.5.3A.3 according to [18].
- 3 AM DRBS are configured with the following parameters:

**Table 7.1.4.6.3.1-1: Logical Channel Configuration Settings**

| Parameter | Value DRB1 | Value DRB2 | Value DRB3 |
|---|---|---|---|
| LogicalChannel-Identity | 3 | 4 | 5 |
| 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) |

#### 7.1.4.6.3.2 Test procedure sequence

**Table 7.1.4.6.3.2-1: 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 two RLC SDUs of size 10 bytes on LC 3 | <-- | MAC PDU (2 RLC SDUs on LC 3) | - | - |
| 3 | SS allocates an UL Grant of 32 bits. (Note 1) | <-- | (UL Grant, 32 bits) | - | - |
| 4 | Check: Does the UE transmit a Short BSR with 'LCG ID' field set to '2' and 'Buffer size' field set to value '6' or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID='2', Buffer Size='6' 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 respond to the scheduling request in step 6 by an UL Grant of 32 bits. (Note 1) | <-- | (UL Grant, 32 bits) | - | - |
| 8 | Check: Does the UE transmit a Short BSR with 'LCG ID' field set to '2' and 'Buffer size' field set to value '6' or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID='2', Buffer Size='6' or bigger)) | 4,5 | P |
| 9 | The SS transmits a MAC PDU containing one RLC SDUs of size 10 bytes on LC 4 | <-- | MAC PDU (1 RLC SDUs on LC 4) | - | - |
| 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 32 bits. (Note 1) | <-- | (UL Grant, 32 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 '8' or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID='2', Buffer Size='8' or bigger)) | 3,5 | P |
| 13 | The SS transmits a MAC PDU containing two RLC SDUs of size 4 bytes on LC 5 | <-- | MAC PDU (2 RLC SDUs on LC 5) | - | - |
| 14 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 15 | The SS respond to the scheduling request in step 14 by one UL Grant of 32 bits. (Note 1) | <-- | (UL Grant, 32 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 '8' or bigger? (Note 3) | --> | MAC PDU (MAC Long BSR (Buffer size#1='1' or bigger, Buffer size#2='8' 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 424 bits. (Note 4) | <-- | (UL Grant, 424 bits) | - | - |
| 20 | Check: Does the UE transmit a MAC PDU including five RLC SDUs and not including any BSR? (Note 5) | --> | MAC PDU (SDU subheader, AMD PDU header and 2 RLC SDUs on LC 3, SDU subheader, AMD PDU header and 1 RLC SDUs on LC 4, SDU subheader, AMD PDU header and 2 RLC SDUs on LC 5) | 7 | P |
| 21 | The SS transmits a MAC PDU containing two MAC SDUs, the first containing a 8 byte RLC SDU with LCID set to '00011' and the second containing a 7 byte RLC SDU with LCID set to '00101'. | <-- | MAC PDU (MAC sub-header (E='1', LCID='00011', F='0', L='10'), MAC sub-header (E='0', LCID='00101',), AMD PDU, AMD PDU) | - | - |
| 22 | The UE sends Scheduling Request | --> | (SR) | - | - |
| 23 | The SS transmits an uplink grant of size 256 bits. (Note 6) | <-- | (UL grant) | - | - |
| 24 | Check: Does the UE return a MAC PDU of length 256 bits including 2 RLC SDUs, Padding and Short BSR or LongBSR with Buffer size(s) set to '0'? (Note 5) (Note 7) | --> | MAC PDU (Short BSR MAC sub-header (E='1', LCID='11101', MAC sub-header (E='1', F='0'), MAC sub-header (E='1', F='0'), F='0'), padding MAC sub-header (E='0', LCID='11111'), Short BSR ( Buffer Size='0'), AMD PDU, AMD PDU, padding) | 8 | P |

| | | | | | |
|---|---|---|---|---|---|
| | | | Or<br>MAC PDU (Long BSR MAC sub-header (E='1', LCID='11101', MAC sub-header (E='1', F='0'), MAC sub-header (E='1', F='0'), F='0'), padding MAC sub-header (E='0', LCID='11111'), LongBSR ( Buffer Size='0'), AMD PDU, AMD PDU, padding) | | |
| 25 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID='00011') | <-- | RLC STATUS PDU (ACK_SN=1) | | |
| 26 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID='00101') | <-- | RLC STATUS PDU (ACK_SN=1) | | |

Note 1: 32 bits enables UE to transmit a MAC PDU with a MAC BSR header and a Short BSR (1 bytes) or a Long BSR (3 byte).

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: The UE has 38 bytes of user data (received in steps 2, 9 and 13) in the transmission buffer. 424 bits enables UE to transmit user data in MAC PDU with 2 bytes SDU subheader for LC 3, 2 bytes SDU subheader for LC 4 and 1 byte SDU subheader for LC 5, 24 bytes MAC SDU for LC 3 (2 RLC SDUs, 10 bytes each and 4 bytes AMD PDU header), 12 bytes MAC SDU for LC 4 (1 RLC SDU, 10 bytes and 2 bytes AMD PDU header, 12 bytes MAC SDU for LC 5 (2 RLC SDUs, 4 bytes each and 4 bytes AMD PDU header)) equals to 424 bits (53 bytes).

Note 5 The MAC SDUs for the different logical channels may be in any order in the MAC PDU.

Note 6: UL grant of 256 bits ($I_{TBS}$=6, $N_{PRB}$=3, TS 36.213 Table 7.1.7.2.1-1) 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 + 7 bytes RLC SDU+ 2 bytes AMD PDU header) + 1 byte Short BSR+6 byte padding + one byte BSR header+ 2 x 2 bytes MAC sub-header (7 bit LI) + one byte padding MAC sub-header (R/R/E/LCID) = 32bytes = 256 bits) or UL grant of 256 bits ($I_{TBS}$=6, $N_{PRB}$=3, TS 36.213 Table 7.1.7.2.1-1) 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 + 7 bytes RLC SDU+ 2 bytes AMD PDU header) + 3 byte LongBSR + 4 byte padding + one byte BSR header+ 2 x 2 bytes MAC sub-header (7 bit LI) + one byte padding MAC sub-header (R/R/E/LCID) = 32bytes = 256 bits).

Note 7: It is left up to UE implementation whether ShortBSR or LongBSR is reported.

#### 7.1.4.6.3.3 Specific Message Contents

**Table 7.1.4.6.3.3-1: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| Explicit SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n5 | | |
| periodicBSR-Timer | Infinity | | |
| retxBSR-Timer | sf320 | | |
| ttiBundling | FALSE | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.7 Correct handling of MAC control information / Buffer Status / UL resources are allocated / Padding BSR

#### 7.1.4.7.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA 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 more than one LCG in the TTI where the BSR is transmitted }
    then { UE reports a Truncated 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 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 form only one LCG in the TTI where the BSR is transmitted }
    then { UE reports a Short BSR }
            }
```

(3)

```
with { UE in E-UTRA 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 }
            }
```

#### 7.1.4.7.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.3.1, 5.4.5, 6.1.2, 6.1.3.1 and 6.2.1 and in TS 36.323, clause 4.5.

[TS 36.321 clause 5.4.3.1]

For the Logical Channel Prioritization procedure, the UE shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR;
- data from any Logical Channel, except data from UL-CCCH;
- MAC control element for BSR included for padding.

[TS 36.321 clause 5.4.5]

The Buffer Status reporting procedure is used to provide the serving eNB with information about the amount of data available for transmission in the UL buffers of the UE. RRC controls BSR reporting by configuring the two timers *periodicBSR-Timer* and *retxBSR-Timer* and by, for each logical channel, optionally signalling *logicalChannelGroup* which allocates the logical channel to an LCG [8].

For the Buffer Status reporting procedure, the UE shall consider all radio bearers which are not suspended and may consider radio bearers which are suspended.

A Buffer Status Report (BSR) shall be triggered if any of the following events occur:

...

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC control element plus its subheader, in which case the BSR is referred below to as "Padding BSR";

...

For padding BSR:

- if the number of padding bits is equal to or larger than the size of the Short BSR plus its sub header but smaller than the size of the Long BSR plus its subheader:
  - if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Truncated BSR of the LCG with the highest priority logical channel with data available for transmission;
  - else report Short BSR.
- else if the number of padding bits is equal to or larger than the size of the Long BSR plus its sub header, report Long BSR.

If the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

- if the UE has UL resources allocated for new transmission for this TTI:
  - instruct the Multiplexing and Assembly procedure to generate a BSR MAC control element;
  - start or restart the *periodicBSR-Timer* except when the BSR is a Truncated BSR;
  - start or restart *retxBSR-Timer*.
- else if a Regular BSR has been triggered:
  - a Scheduling Request shall be triggered.

A MAC PDU shall contain at most one MAC BSR control element, even when multiple events trigger a BSR by the time a BSR can be transmitted in which case the Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The UE shall restart *retxBSR-Timer* upon indication of a grant for transmission of new data on UL-SCH.

All triggered BSRs shall be cancelled in case the UL grant 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.

[TS 36.321 clause 6.1.2]

MAC control elements are always placed before any MAC SDU.

[TS 36.321 clause 6.1.3.1]

Buffer Status Report (BSR) MAC control elements consist of either:

- Short BSR and Truncated BSR format: one LCG ID field and one corresponding Buffer Size field (figure 6.1.3.1-1); or
- Long BSR format: four Buffer Size fields, corresponding to LCG IDs #0 through #3 (figure 6.1.3.1-2).

The BSR formats are identified by MAC PDU sub headers with LCIDs as specified in table 6.2.1.-2.

The fields LCG ID and Buffer Size are defined as follow:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) which buffer status is being reported. The length of the field is 2 bits;
- Buffer Size: The Buffer Size field identifies the total amount of data available across all logical channels of a logical channel group after the MAC PDU has been built. The amount of data is indicated in number of bytes. It shall include all data that is available for transmission in the RLC layer and in the PDCP layer; the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field is 6 bits. The values taken by the Buffer Size field are shown in Table 6.1.3.1-1.

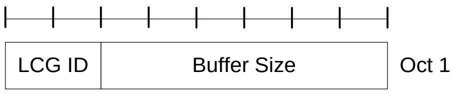


**Figure 6.1.3.1-1: Short BSR and Truncated BSR MAC control element**

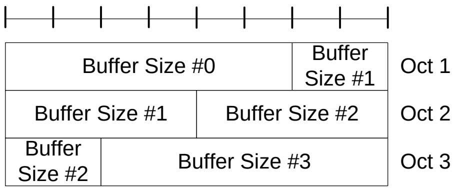


**Figure 6.1.3.1-2: Long BSR MAC control element**

[TS 36.321 clause 6.2.1]

**Table 6.2.1-2: Values of LCID for UL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11001 | Reserved |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

[TS 36.323 clause 4.5]

For the purpose of MAC buffer status reporting, the UE shall consider PDCP Control PDUs, as well as the following as data available for transmission in the PDCP layer:

For SDUs for which no PDU has been submitted to lower layers:

- the SDU itself, if the SDU has not yet been processed by PDCP, or
- the PDU (control or data) if the SDU has been processed by PDCP.

#### 7.1.4.7.3 Test description

##### 7.1.4.7.3.1 Pre-test conditions

System Simulator:

- Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.4.7.3.3-1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(2,0) is used for step 8 in 4.5.3A.3 according to [18].
- 2 AM DRBS are configured with the parameters specified in table 7.1.4.7.1-1.

**Table 7.1.4.7.1-1: Logical Channel Configuration Settings**

| Parameter | DRB1 | DRB2 |
|---|---|---|
| LogicalChannel-Identity | 3 | 4 |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

#### 7.1.4.7.3.2 Test procedure sequence

**Table 7.1.4.7.3.2-1: 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 2 times | - | - | - | - |
| 2 | The SS transmits a MAC PDU including an RLC SDU of size 12 bytes on logical channel 4. | <-- | MAC PDU (RLC SDU on LC 4) | - | |
| 3 | The SS transmits a MAC PDU including an RLC SDU of size 12 bytes on logical channel 3. | <-- | MAC PDU (RLC SDU on LC 3) | - | - |
| 4 | UE transmits a Scheduling Request on PUCCH. | --> | (SR) | - | - |
| 5 | The SS sends an uplink grant of size 32 bits. (Note 1) | <-- | (UL grant) | - | - |
| 6 | The UE transmit a Long BSR report | --> | MAC PDU (Long BSR header (LCID='11110'), Long BSR) | - | - |
| 7 | The SS is configured for Uplink Grant Allocation Type 3. 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 Truncated BSR indicating pending data ('Buffer size' field > '0') for logicalChannelGroup 1 ('LCG ID' field set to '01')? | --> | MAC PDU (Truncated BSR header (LCID='11100'), Truncated BSR(LCG ID ='01', Buffer size>'0'), RLC SDU) | 1 | P |
| 9 | Void | - | - | - | - |
| 10 | The SS is configured for Uplink Grant Allocation Type 3. The SS sends an uplink grant of size 136 bits (Note 2) | <-- | (UL grant) | - | - |
| 11 | 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 (Short BSR header(LCID='11101'), Short BSR(LCG ID ='10',Buffer size>'0'), RLC SDU) | 2 | P |
| 12 | Void | - | - | - | - |
| 13 | Void | - | - | - | - |
| 14 | The SS is configured for Uplink Grant Allocation Type 3. The SS sends an uplink grant of size 152 bits. (Note 3) | <-- | (UL grant) | - | - |
| 15 | Check: Does UE transmit a MAC PDU containing a RLC SDU and a Long BSR? | --> | MAC PDU (Long BSR header (LCID='11110'), Long BSR), RLC SDU) | 3 | P |

Note 1: SS transmit an UL grant of 32 bits ($I_{TBS}$=0, $N_{PRB}$=2, TS 36.213 Table 7.1.7.2.1-1) to allow UE to transmit a Regular BSR triggered by the new data received logicalChannelGroup 1 and 2 in steps 2 and 3. This to enable testing of Padding BSR which has lower priority than Regular BSR.

Note 2: UL grant of 136 bits ($I_{TBS}$=9, $N_{PRB}$=1, TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding bits will be equal to or larger than the size of Short/Truncated BSR and smaller than Long BSR. RLC SDU size is 12 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 2 bytes (1 byte for MAC SDU sub-header using R/R/E/LCID for last sub header and 1 byte for BSR sub-header) and size of Short BSR/Truncated BSR is one byte, i.e. setting UL grant to 17 bytes (136 bits) enable UE to include Short/Truncated BSR.

Note 3: UL grant of 152 bits ($I_{TBS}$=0, $N_{PRB}$=6, TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding bits will be equal to or larger than the size of Long BSR. RLC SDU size is 12 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 2 bytes (1 byte for MAC SDU sub-header using R/R/E/LCID for last sub header and 1 byte for BSR sub-header) and size of Long BSR is 3 bytes, i.e. setting UL grant to 19 bytes (152 bits) enable UE to include padding Long BSR.

#### 7.1.4.7.3.3 Specific Message Contents

None

## 7.1.4.7a Correct handling of MAC control information / Buffer Status / UL resources are allocated / Cancellation of Padding BSR

### 7.1.4.7a.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE has transmitted a MAC PDU with a Regular BSR and padding such that a padding BSR is
triggered AND UE has remaining data causing continuous data transmission while periodicBSR-Timer is
running without causing any Regular BSR or padding BSR to be triggered }
    then { UE reports a Periodic BSR }
            }
```

### 7.1.4.7a.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.3.1, 5.4.5, 6.1.2, 6.1.3.1 and 6.2.1 and in TS 36.323, clause 4.5.

[TS 36.321 clause 5.4.3.1]

For the Logical Channel Prioritization procedure, the UE shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR;
- data from any Logical Channel, except data from UL-CCCH;
- MAC control element for BSR included for padding.

[TS 36.321 clause 5.4.5]

The Buffer Status reporting procedure is used to provide the serving eNB with information about the amount of data available for transmission in the UL buffers of the UE. RRC controls BSR reporting by configuring the two timers *periodicBSR-Timer* and *retxBSR-Timer* and by, for each logical channel, optionally signalling *logicalChannelGroup* which allocates the logical channel to an LCG [8].

For the Buffer Status reporting procedure, the UE shall consider all radio bearers which are not suspended and may consider radio bearers which are suspended.

A Buffer Status Report (BSR) shall be triggered if any of the following events occur:

- UL data, for a logical channel which belongs to a LCG, becomes available for transmission in the RLC entity or in the PDCP entity (the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively) and either the data belongs to a logical channel with higher priority than the priorities of the logical channels which belong to any LCG and for which data is already available for transmission, or there is no data available for transmission for any of the logical channels which belong to a LCG, 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 control element plus its subheader, in which case the BSR is referred below to as "Padding BSR";
- *retxBSR-Timer* expires and the UE has data available for transmission for any of the logical channels which belong to a LCG, 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 and Periodic BSR:

- if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Long BSR;

- else report Short BSR.

For padding BSR:

- if the number of padding bits is equal to or larger than the size of the Short BSR plus its sub header but smaller than the size of the Long BSR plus its subheader:
  - if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Truncated BSR of the LCG with the highest priority logical channel with data available for transmission;
  - else report Short BSR.
- else if the number of padding bits is equal to or larger than the size of the Long BSR plus its sub header, report Long BSR.

If the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

- if the UE has UL resources allocated for new transmission for this TTI:
  - instruct the Multiplexing and Assembly procedure to generate a BSR MAC control element;
  - start or restart the *periodicBSR-Timer* except when the BSR is a Truncated BSR;
  - start or restart *retxBSR-Timer*.
- else if a Regular BSR has been triggered:
  - a Scheduling Request shall be triggered.

A MAC PDU shall contain at most one MAC BSR control element, even when multiple events trigger a BSR by the time a BSR can be transmitted in which case the Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The UE shall restart *retxBSR-Timer* upon indication of a grant for transmission of new data on UL-SCH.

All triggered BSRs shall be cancelled in case the UL grant 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.

[TS 36.321 clause 6.1.2]

MAC control elements are always placed before any MAC SDU.

[TS 36.321 clause 6.1.3.1]

Buffer Status Report (BSR) MAC control elements consist of either:

- Short BSR and Truncated BSR format: one LCG ID field and one corresponding Buffer Size field (figure 6.1.3.1-1); or
- Long BSR format: four Buffer Size fields, corresponding to LCG IDs #0 through #3 (figure 6.1.3.1-2).

The BSR formats are identified by MAC PDU sub headers with LCIDs as specified in table 6.2.1.-2.

The fields LCG ID and Buffer Size are defined as follow:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) which buffer status is being reported. The length of the field is 2 bits;
- Buffer Size: The Buffer Size field identifies the total amount of data available across all logical channels of a logical channel group after the MAC PDU has been built. The amount of data is indicated in number of bytes. It shall include all data that is available for transmission in the RLC layer and in the PDCP layer; the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field is 6 bits. The values taken by the Buffer Size field are shown in Table 6.1.3.1-1.

| | | |
|---|---|---|
| LCG ID | Buffer Size | Oct 1 |

**Figure 6.1.3.1-1: Short BSR and Truncated BSR MAC control element**

<table>
<tr><td colspan="2">Buffer Size #0</td><td>Buffer Size #1</td><td>Oct 1</td></tr>
<tr><td colspan="2">Buffer Size #1</td><td>Buffer Size #2</td><td>Oct 2</td></tr>
<tr><td>Buffer Size #2</td><td colspan="2">Buffer Size #3</td><td>Oct 3</td></tr>
</table>

**Figure 6.1.3.1-2: Long BSR MAC control element**

[TS 36.321 clause 6.2.1]

**Table 6.2.1-2: Values of LCID for UL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11001 | Reserved |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

[TS 36.323 clause 4.5]

For the purpose of MAC buffer status reporting, the UE shall consider PDCP Control PDUs, as well as the following as data available for transmission in the PDCP layer:

For SDUs for which no PDU has been submitted to lower layers:

- the SDU itself, if the SDU has not yet been processed by PDCP, or
- the PDU (control or data) if the SDU has been processed by PDCP.

#### 7.1.4.7a.3 Test description

##### 7.1.4.7a.3.1 Pre-test conditions

System Simulator:

- Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Tables 7.1.4.7a.3.3-1-3.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(3,0) is used for step 8 in 4.5.3A.3 according to [18].
- 3 AM DRBS are configured with the parameters specified in table 7.1.4.7a.1-1.

**Table 7.1.4.7a.1-1: Logical Channel Configuration Settings**

| Parameter | Value DRB1 | Value DRB2 | Value DRB3 |
|---|---|---|---|
| LogicalChannel-Identity | 3 | 4 | 5 |
| Priority | 8 | 7 | 6 |
| prioritizedBitRate | 0 kB/s | 0 kB/s | 0 kB/s |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) | 1 (LCG ID#1) |

7.1.4.7a.3.2 Test procedure sequence

**Table 7.1.4.7a.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 including an RLC SDU of size 11 bytes on logical channel 5. | <-- | MAC PDU (RLC SDU on LC 5) | - | |
| - | EXCEPTION: Step 3 shall be repeated 4 times | - | - | - | - |
| 3 | The SS transmits a MAC PDU including an RLC SDU of size 10 bytes on logical channel 4. | <-- | MAC PDU (RLC SDU on LC 4) | - | - |
| - | EXCEPTION: Step 4 shall be repeated 5 times | - | - | - | - |
| 4 | The SS transmits a MAC PDU including an RLC SDU of size 10 bytes on logical channel 3. | <-- | MAC PDU (RLC SDU on LC 3) | - | - |
| 5 | Void | - | - | - | - |
| 6 | 60 ms after step 4, t he SS sends an uplink grant of size 176 bits. (Note 1) | <-- | (UL grant) | - | - |
| 7 | The UE transmits a longBSR triggered by a Regular BSR report | --> | MAC PDU (Long BSR header (LCID='11110'), MAC SDU header, Long BSR, RLC SDU, padding) | - | - |
| 8 | 20 ms after step 4, the SS sends an uplink grant of 104 bits for every 5th uplink TTI 10 times. (Note 2) | - | - | - | - |
| - | EXCEPTION: In parallel with step 9, the parallel behaviour in table 7.1.4.7a.3.2-2 is running until the periodic BSR is received in step 9. | - | - | - | - |
| 9 | Check: Does UE transmit a MAC PDU containing a periodic BSR?<br>(Note 3 and Note 4) | --> | MAC PDU (*Long BSR header, ,MAC SDU header, Long BSR RLC SDU segment)*<br>*or*<br>MAC PDU (*Short BSR header, ,MAC SDU header, Short BSR RLC SDU segment)* | 1 | P |
| - | EXCEPTION: In parallel with step 10, the parallel behaviour in table 7.1.4.7a.3.2-3 is running. Step 10 shall occur at least once. (Note 4) | - | - | - | - |
| 10 | CHECK: Does UE transmit a MAC PDU containing a MAC SDU | --> | MAC PDU (RLC SDU segments) | 1 | P |

Note 1: UL grant of 176 bits ($I_{TBS}$=3, $N_{PRB}$=3, TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding bits (padding header + padding payload) will be equal to or larger to trigger a padding BSR (Short BSR), i.e. 2 bytes or more (one byte for BSR sub-header and 1 bytes for a Short BSR). RLC SDU size is 11 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 4 bytes (1 byte for BSR sub header, 2 byte for MAC SDU sub-header using R/R/E/LCID/F/L and 1 byte for R/R/E padding sub header) and size of Long BSR (Regular BSR) is 3 bytes and padding is 2 bytes, i.e. setting UL grant to 22 bytes (176 bits). The remaining 3 bytes would have enabled the UE to segment a second RLC SDU if the RLC SDU belongs to the same logical channel. However, as there is only one RLC SDU available for transmission for LC5 (highest priority) then would the UE have to add a second MAC SDU to transmit a segment of an additional RLC SDU from LC4. This would require 4 bytes or more and the UE will instead add 3 bytes of padding, which will trigger a padding BSR.

Note 2: UL grant of 104 bits ($I_{TBS}$=3, $N_{PRB}$=2, TS 36.213 Table 7.1.7.2.1-1) is chosen such that UE is able to transmit a MAC PDU that fits exactly a PDCP SDU to enable periodic BSR to be triggered when periodicBSR-Timer expires. RLC SDU size is 10 bytes, size of AMD PDU header is 2 bytes and size of MAC header is 1 byte (1 byte for MAC SDU sub-header using R/R/E/LCID for last sub header), i.e. setting UL grant to 13 bytes (104 bits). The UL grant is sent by the SS 10 times (every 5th TTI) to enable UE to transmit the remaining 9 RLC SDUs and at least one periodic BSR,

Note 3: The Periodic BSR is triggered by the expiry of the periodiBSR-Timer (32 sub-frames, see Table 7.1.4.7a.3.3-1) and verifies that the triggered padding BSR in step 7 in Table 7.1.4.7a.3.2-1 is cancelled by the UE. If the UE would not have cancelled the triggered padding BSR then would the UE reset the periodicBSR-Timer after each transmission causing the timer to not expire.

Note 4: If UE has cancelled the triggered padding BSR in step 7 in Table 7.1.4.7a.3.2-1 then the *periodicBSR-*

| |
|---|
| *Timer* will expire before all data in the transmission buffer has been sent by the UE. This verifies that the received BSR report in step 9 is triggered by a periodic BSR report and not due to a regular or padding BSR. |

**Table 7.1.4.7a.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | UE transmits a MAC PDU containing an RLC SDU | --> | MAC PDU (RLC SDU) | - | - |

**Table 7.1.4.7a.3.2-3: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | UE transmits a MAC PDU containing an RLC SDU | --> | MAC PDU (*Long BSR header, ,MAC SDU header, Long BSR RLC SDU segment)*<br>*or*<br>MAC PDU (*Short BSR header, ,MAC SDU header, Short BSR RLC SDU segment)* | - | - |

### 7.1.4.7a.3.3 Specific Message Contents

**Table 7.1.4.7a.3.3-1: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| Explicit SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n5 | | |
| periodicBSR-Timer | Sf32 | 32 subframes | |
| retxBSR-Timer | sf320 | | |
| ttiBundling | FALSE | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.7a.3.3-2: SchedulingRequest-Configuration (preamble: Table 4.5.3.3-1, step 8)**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Configuration ::= CHOICE { | | | |
| setup SEQUENCE { | | | |
| dsr-TransMax | n64 | Max value allowed | |
| } | | | |
| } | | | |

**Table 7.1.4.7a.3.3-3: RLC-Config-DRB-AM (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 clause 4.8.2.1.3.2, Table 4.8.2.1.3.2-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RLC-Config-DRB-AM ::= CHOICE { | | | |
| am SEQUENCE { | | | |
| ul-AM-RLC SEQUENCE { | | | |
| t-PollRetransmit | ms500 | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.4.8 Correct handling of MAC control information / Buffer status / Periodic BSR timer expires

### 7.1.4.8.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { periodicBSR-Timer expires and more than one LCG has buffered data in a TTI }
    then { UE triggers a Periodic BSR and reports Long BSR }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { periodicBSR-Timer expires and one LCG has buffered data in a TTI }
    then { UE triggers a Periodic BSR and reports Short BSR and restarts the periodicBSR-Timer}
          }
```

### 7.1.4.8.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.5, 6.1.2, 6.1.3.1 and 6.2.1; TS 36.323 clause 4.5.

[TS 36.321 clause 5.4.5]

The Buffer Status reporting procedure is used to provide the serving eNB with information about the amount of data available for transmission in the UL buffers of the UE. RRC controls BSR reporting by configuring the two timers *periodicBSR-Timer* and *retxBSR-Timer* and by, for each logical channel, optionally signalling *logicalChannelGroup* which allocates the logical channel to an LCG [8].

For the Buffer Status reporting procedure, the UE shall consider all radio bearers which are not suspended and may consider radio bearers which are suspended.

A Buffer Status Report (BSR) shall be triggered if any of the following events occur:

...

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as "Periodic BSR".

For Regular and Periodic BSR:

- if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Long BSR;

- else report Short BSR.

...

If the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

- if the UE has UL resources allocated for new transmission for this TTI:

  - instruct the Multiplexing and Assembly procedure to generate a BSR MAC control element;

  - start or restart the *periodicBSR-Timer* except when the BSR is a Truncated BSR;

  - start or restart *retxBSR-Timer*.

A MAC PDU shall contain at most one MAC BSR control element, even when multiple events trigger a BSR by the time a BSR can be transmitted in which case the Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The UE shall restart *retxBSR-Timer* upon indication of a grant for transmission of new data on UL-SCH.

All triggered BSRs shall be cancelled in case the UL grant 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.

[TS 36.321 clause 6.1.2]

MAC control elements are always placed before any MAC SDU.

[TS 36.321 clause 6.1.3.1]

Buffer Status Report (BSR) MAC control elements consist of either:

- Short BSR and Truncated BSR format: one LCG ID field and one corresponding Buffer Size field (figure 6.1.3.1-1); or

- Long BSR format: four Buffer Size fields, corresponding to LCG IDs #0 through #3 (figure 6.1.3.1-2).

The BSR formats are identified by MAC PDU sub headers with LCIDs as specified in table 6.2.1.-2.

The fields LCG ID and Buffer Size are defined as follow:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) which buffer status is being reported. The length of the field is 2 bits;

- Buffer Size: The Buffer Size field identifies the total amount of data available across all logical channels of a logical channel group after the MAC PDU has been built. The amount of data is indicated in number of bytes. It shall include all data that is available for transmission in the RLC layer and in the PDCP layer; the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field is 6 bits. The values taken by the Buffer Size field are shown in Table 6.1.3.1-1.

| | | |
|---|---|---|
| LCG ID | Buffer Size | Oct 1 |

**Figure 6.1.3.1-1: Short BSR and Truncated BSR MAC control element**

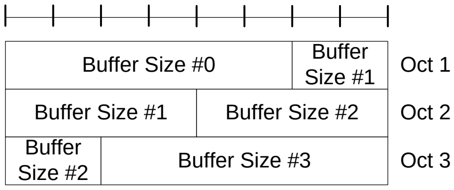


**Figure 6.1.3.1-2: Long BSR MAC control element**

[TS 36.321 clause 6.2.1]

**Table: 6.2.1-2 Values of LCID for UL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11001 | Reserved |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

[TS 36.323 clause 4.5]

For the purpose of MAC buffer status reporting, the UE shall consider PDCP Control PDUs, as well as the following as data available for transmission :

For SDUs for which no PDU has been submitted to lower layers:

- the SDU itself, if the SDU has not yet been processed by PDCP, or
- the PDU if the SDU has been processed by PDCP.

##### 7.1.4.8.3 Test description

###### 7.1.4.8.3.1 Pre-test conditions

System Simulator:

- Cell 1
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.4.8.3.3-1

UE:

None.

Preamble;

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(2,0) is used for step 8 in 4.5.3A.3 according to [18].
- 2 AM DRBS are configured with the parameters specified in table 7.1.4.8.1-1.

**Table 7.1.4.8.1-1: Logical Channel Configuration Settings**

| Parameter | DRB1 | DRB2 |
|---|---|---|
| LogicalChannel-Identity | 3 | 4 |
| priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 | 1 |

7.1.4.8.3.2 Test procedure sequence

**Table 7.1.4.8.3.2-1: 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 logical channel 4 (LCG ID 1), which contains 1 RLC SDU of size 14 bytes. | <-- | MAC PDU (RLC PDU) | | |
| 3 | The SS is configured for Uplink Grant Allocation Type 2. The SS sends an uplink grant of size 32 bits. (Note 2) | <-- | (UL grant) | - | - |
| 4 | The UE transmits a short BSR report. (Note 6) | --> | MAC PDU ((LCID='11101', LCG ID='01', Buffer size index > 0) | - | - |
| - | EXCEPTION: Steps 5 to 6 shall be repeated two times (Note 4) | - | - | - | - |
| 5 | Wait for periodicBSR-Timer expiry. | - | - | - | - |
| 5A | The SS sends an uplink grant of size 32 bits | - | - | - | - |
| 6 | Check: Does UE transmit a MAC PDU containing a Short BSR with 'LCG ID' field set to '01' (logicalChannelGroup 1) and Buffer Size Index > 0? | --> | MAC PDU (LCID='11101', LCG ID='01', Buffer Size index > 0) | 2 | P |
| 7 | Void | | | | |
| 8 | The SS transmits a MAC PDU containing an RLC PDU on logical channel 3 (LCG ID 2), which contains 1 RLC SDU of size 14 bytes. | <-- | MAC PDU (RLC PDU) | - | - |
| 8A | The SS sends an uplink grant of size 32 bits (Note 3) | <-- | (UL grant) | - | - |
| 8B | 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') | - | - |
| 9 | Void | | | | |
| - | EXCEPTION: Step 9A to 10 shall be repeated twice. (Note 5) | - | - | - | - |
| 10 | 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 |
| 10A | The SS is configured for Uplink Grant Allocation Type 3. The SS transmits 1 UL grant of size 328 bits to enable the UE to loopback RLC SDU on LCG ID = 1 and LCG = 2. (Note 7) | | | - | - |
| 11 | The UE transmits MAC PDU containing the remaining RLC SDUs as sent by the SS in steps 2 and 8. | --> | MAC PDU | - | - |

Note 1: Void

Note 2: SS transmits an UL grant of 32 bits ($I_{TBS}$=0, $N_{PRB}$=2, TS 36.213 Table 7.1.7.2.1-1) to allow UE to transmit a Regular BSR triggered by the new data received logicalChannelGroup 1 in step 2.

Note 3: SS transmits an UL grant of 32 bits ($I_{TBS}$=0, $N_{PRB}$=2, TS 36.213 Table 7.1.7.2.1-1) to allow UE to transmit a Regular BSR triggered by the new data received logicalChannelGroup 2 in step 8.

Note 4: One short BSR due to first expiry of *periodicBSR-Timer* and one short BSR due to second expire of *periodicBSR-Timer*.

Note 5: One long BSR due to expire of *periodicBSR-Timer* and one long BSR due to second expiry of *periodicBSR-Timer.*

Note 6: The UE starts periodicBSR-Timer.

Note 7: SS transmits an UL grant of 328 bits ($I_{TBS}$=7, $N_{PRB}$=3, TS 36.213 Table 7.1.7.2.1-1) to allow UE to transmit RLC SDU on LCG =1 (14 bytes) and LCG = 2 (14 bytes) and a minimum MAC header of 3 bytes.

#### 7.1.4.8.3.3 Specific Message Contents

**Table 7.1.4.8.3.3-1: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicit SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n5 | | |
| periodicBSR-Timer | sf10 | | |
| retxBSR-Timer | sf10240 | | |
| ttiBundling | FALSE | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.9 Void

### 7.1.4.10 MAC padding

#### 7.1.4.10.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE is to transmit a MAC PDU with padding exceeding 2 bytes }
    then { Padding goes to the end of the MAC PDU }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE is to transmit a MAC PDU with single-byte padding and there is a data MAC PDU sub-header
present }
    then { UE is inserting padding MAC PDU subheader before any other MAC PDU sub-header }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE is to transmit a MAC PDU with two-byte padding and there is a data MAC PDU sub-header }
    then { UE is inserting two padding MAC PDU subheaders before any other MAC PDU sub-header or one
padding MAC PDU subheader as a last MAC PDU subheader }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE is to transmit a MAC PDU with single-byte padding and there is no data MAC PDU sub-
header but a MAC Control element is present }
    then { UE is inserting a padding MAC PDU subheader before any other MAC PDU sub-header }
            }
```

(5)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE is to transmit a MAC PDU with two-byte padding and there is no data MAC PDU sub-header
but a MAC Control element is present}
    then { UE is inserting two padding MAC PDU subheaders before any other MAC PDU sub-header or one
padding MAC PDU subheader as a last MAC PDU subheader and one byte padding at the end of the MAC PDU
            }
}
```

#### 7.1.4.10.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in TS 36.321, clause 6.1.2.

[TS 36.321 clause 6.1.2]

Padding occurs at the end of the MAC PDU, except when single-byte or two-byte padding is required. Padding may have any value and the UE shall ignore it. When padding is performed at the end of the MAC PDU, zero or more padding bytes are allowed.

When single-byte or two-byte padding is required, one or two MAC PDU subheaders corresponding to padding are placed at the beginning of the MAC PDU before any other MAC PDU subheader.

A maximum of one MAC PDU can be transmitted per TB per UE.

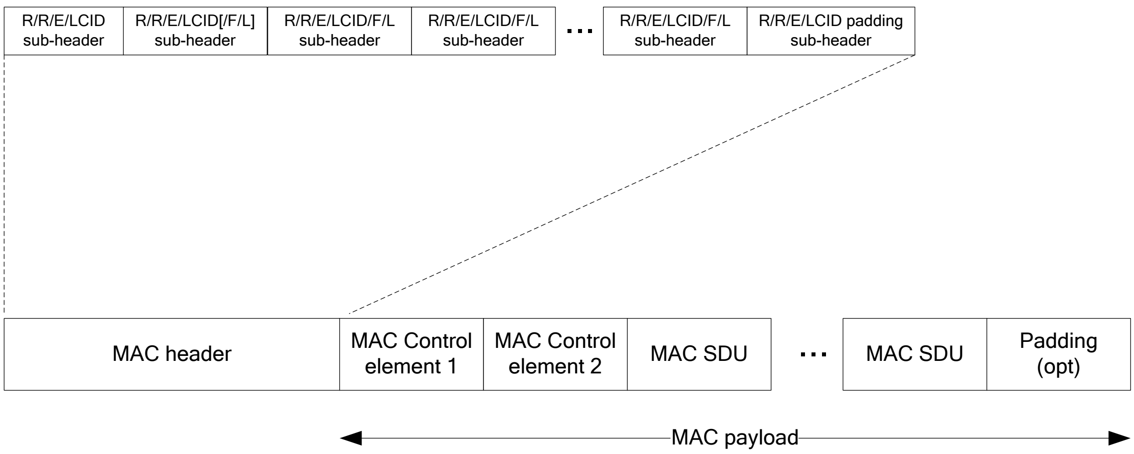


**Figure 6.1.2-3: Example of MAC PDU consisting of MAC header, MAC control elements, MAC SDUs and padding**

#### 7.1.4.10.3 Test description

##### 7.1.4.10.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

#### 7.1.4.10.3.2 Test procedure sequence

**Table 7.1.4.10.3.3.2-1: 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 with 10 bytes MAC SDU. | <-- | MAC PDU(AMD PDU) | - | - |
| 3 | The UE transmits a Scheduling Request on PUCCH. | - | (SR) | - | - |
| 4 | The SS transmits an uplink grant of size 176 bits. (Note 1) | <-- | (UL grant) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU with a MAC SDU of length 10 bytes and where the last MAC sub-header has the Extension field 'E' set to '0' and the Logical Channel ID field 'LCID' set to '11111'? | --> | MAC PDU (BSR sub-header, MAC SDU sub-header, Padding MAC sub-header (E='0', LCID='11111'),Short BSR, MAC SDU, padding) | 1 | P |
| 6 | The SS transmits a MAC PDU with 13 bytes MAC SDU. | <-- | MAC PDU(AMD PDU) | - | - |
| 7 | The UE transmits a Scheduling Request on PUCCH. | - | (SR) | - | - |
| 8 | The SS transmits an uplink grant of size 120 bits. (Note 2) | <-- | (UL grant) | - | - |
| 9 | Check: Does the UE transmit a MAC PDU with a MAC SDU of length 13 bytes and with a padding MAC sub-header, with Extension field 'E' is set to '1' and the Logical Channel ID field 'LCID' is set to '11111', inserted before the MAC SDU sub-header? | --> | MAC PDU (Padding MAC-sub-header (E='1', LCID='11111'), MAC SDU sub-header, MAC SDU) | 2 | P |
| 10 | The SS transmits a MAC PDU with 10 bytes MAC SDU. | <-- | MAC PDU (AMD PDU) | - | - |
| 11 | The UE transmits a Scheduling Request on PUCCH. | - | (SR) | - | - |
| 12 | The SS transmits an uplink grant of size 120 bits. (Note 3) | <-- | (UL grant) | - | - |
| 13 | Check: Does the UE transmit a MAC PDU with two padding MAC sub-headers, with Extension field 'E' is set to '1' and the Logical Channel ID field 'LCID' is set to '11111', inserted before the BSR sub-header and the MAC SDU sub-header Or a MAC PDU with BSR sub-header with Extension field 'E' is set to '1' and MAC SDU sub-header (R/R/E/LCID/F/L) inserted before the Padding MAC sub-header? | --> | MAC PDU (Padding MAC-sub-header#1 (E='1', LCID='11111'), Padding MAC-sub-header#2 (E='1', LCID='11111'), BSR sub-header, MAC SDU sub-header, Short BSR, MAC-SDU)<br>Or<br>MAC PDU(BSR sub-header, MAC SDU sub-header, Padding MAC-sub-header(E='0', LCID='11111'), Short BSR, MAC-SDU) | 3 | P |
| 14 | The SS transmits a Timing Advance command and does not send any subsequent timing alignments. Start Timer_T1 = Time Alignment timer value on SS. | <-- | MAC PDU<br>(Timing Advance Command) | - | - |
| 15 | 40 to 50 TTI before Timer_T1 expires the SS transmits a MAC PDU containing an RLC AMD PDU. | <-- | MAC PDU (AMD PDU) | - | - |
| 16 | The SS ignores scheduling requests and waits until the UE transmits a preamble on PRACH. | --> | (PRACH preamble) | - | - |
| 17 | The SS transmits a Random Access Response, with an UL Grant of 56-bits. (Note 4) | <-- | Random Access Response | - | - |
| 18 | Check: Does the UE transmit a MAC PDU with a BSR sub-header (8-bits), a Control sub-header (8-bits) , a short BSR (8-bits) and a C-RNTI MAC Control Element (16-bits) ? (Note 6) | --> | MAC PDU (BSR sub-header, MAC Control sub-header, Padding MAC sub-header (E='0', LCID='11111'), Short BSR, C-RNTI control element, padding)<br>Or<br>MAC PDU (<br>Padding MAC-sub-header#1 | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | | | (E='1', LCID='11111'), Padding MAC-sub-header#2 (E='1', LCID='11111'), BSR sub-header, MAC Control sub-header, Short BSR, C-RNTI control element) | | |
| 19 | The SS transmits an UL grant of 24 bits. (Note 5) | <-- | (UL grant) | - | - |
| 19 A | Check: Does the UE transmit a MAC PDU with a padding MAC sub header with Extension field 'E' is set to '1' and 'LCID' field set to '11111' (8-bits) inserted before a BSR sub-header (8bits) and a short BSR (8 bits)? | --> | MAC PDU (Padding MAC-sub-header (E='1', LCID='11111'), BSR sub-header, Short BSR) | 4 | P |
| 20 | The SS transmits an uplink grant enabling UE to transmit loop back PDU. | <-- | (UL grant) | - | - |
| 21 | The UE transmits Loop back PDU. | --> | MAC PDU(AMD PDU) | - | - |

Note 1: UL grant of 176 bits ($I_{TBS}$=3, $N_{PRB}$=3, see TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding will be larger than 2 bytes. RLC SDU size is 8 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 4 bytes (2 bytes for MAC SDU sub-header using 7-bit LI, 1 byte for BSR sub-header and 1 byte for padding MAC sub-header) and size of Short BSR is 1 byte, equals to 120 bits (15 bytes) and resulting into 56 bits padding.

Note 2: UL grant of 120 bits ($I_{TBS}$=0, $N_{PRB}$=5, see TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding will be a single byte. RLC SDU size is 11 bytes, size of AMD PDU header is 2 bytes and size of MAC header is 1 byte for MAC SDU sub-header, equals to 112 bits (14 bytes) and resulting into 1 single byte padding.

Note 3: UL grant of 120 bits ($I_{TBS}$=0, $N_{PRB}$=5, see TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding will be equal to 2 bytes. RLC SDU size is 8 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 4 bytes (1 bytes for MAC SDU sub-header, 1 byte for Short BSR sub-header and 2 bytes for padding MAC sub-header) and size of Short BSR is 1 byte, equals to 120 bits (15 bytes) and resulting no padding at the end of the MAC PDU.

Note 4: UL grant of 56 bits ($I_{TBS}$=0, $N_{PRB}$=3, see TS 36.213 Table 7.1.7.2.1-1) is as 36.321 clause 5.1.4 states that the eNB should not provide a grant smaller than 56 bits in the Random Access Response.

Note 5: UL grant of 24 bits (ITBS=1, NPRB=1, see TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding will be equal to a single byte.

Note 6: The order of short BSR and C-RNTI control element is not restricted, i.e. the short BSR can be placed before the C-RNTI control element and vice versa. The same applies for the related sub-headers.

#### 7.1.4.10.3.3 Specific Message Contents

None.

### 7.1.4.11 Correct HARQ process handling

#### 7.1.4.11.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established }
ensure that {
  when { UE receives an UL Grant with toggled NDI and has data available for transmission }
    then { UE transmits a new MAC PDU using redundancy version 0 }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU less
than maxHARQ-Tx times }
ensure that {
  when { UE receives a NACK and no uplink grant is included for the next TTI corresponding to the
HARQ process }
    then { UE performs non-adaptive retransmission of the MAC PDU with redundancy version toggled by
one of the last (re)transmission [0,2,3,1 order] }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU less than maxHARQ-Tx times }
ensure that {
  when { UE receives an uplink grant on PDCCH for the next TTI corresponding to the HARQ process with old NDI [not toggled], irrespective of ACK/NACK is received for previous (re)transmission }
    then { UE performs an adaptive retransmission of the MAC PDU with redundancy version as received on PDCCH }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU less than maxHARQ-Tx times }
ensure that {
  when { UE receives an ACK and no uplink grant is included for the next TTI corresponding to the HARQ process }
    then { UE does not retransmit the MAC PDU }
            }
```

(5)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU maxHARQ-Tx times }
ensure that {
  when { UE receives an uplink grant on PDCCH for the next TTI corresponding to the HARQ process with not toggled NDI }
    then { UE does not retransmit the MAC PDU  but transmit a MAC Padding PDU}
            }
```

(6)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU less than maxHARQ-Tx times }
ensure that {
  when { UE receives an uplink grant on PDCCH for the next TTI corresponding to the HARQ process with toggled NDI, and data are not available for transmission }
    then { UE transmits any MAC Padding PDU }
            }
```

(7)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU maxHARQ-Tx times }
ensure that {
  when { UE receives a NACK and no uplink grant is included for the next TTI corresponding to the HARQ process }
    then { UE does not transmit any MAC PDU }
            }
```

### 7.1.4.11.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.2.1 & 5.4.2.2.

[TS 36.321, clause 5.4.2.1]

There is one HARQ entity at the UE, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for the feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes is specified in [2], clause 8.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. It also routes the received feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process.

If TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. TTI 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 non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The feedback for a bundle is only received for the last TTI of the bundle (i.e. the TTI corresponding to TTI_BUNDLE_SIZE ), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle.

For transmission of Msg3 during Random Access (see section 5.1.5) TTI bundling does not apply. For each TTI, the HARQ entity shall:

- identify the HARQ process associated with this TTI;
- if an uplink grant has been indicated for this TTI:
  - if the received grant was not addressed to a Temporary C-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or
  - if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or- if the uplink grant was received in a Random Access Response:
    - if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:
      - obtain the MAC PDU to transmit from the Msg3 buffer.
    - else:
    - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
  - deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;
  - instruct the identified HARQ process to trigger a new transmission.
- else:
  - deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;
  - instruct the identified HARQ process to generate an adaptive retransmission.
- else, if the HARQ buffer of the HARQ process corresponding to this TTI is not empty:
- instruct the identified HARQ process to generate a non-adaptive retransmission.

When determining if NDI has been toggled compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 36.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

Each HARQ process shall maintain a state variable CURRENT_TX_NB, which indicates the number of transmissions that have taken place for the MAC PDU currently in the buffer, and a state variable HARQ_FEEDBACK, which indicates the HARQ feedback for the MAC PDU currently in the buffer. When the HARQ process is established, CURRENT_TX_NB shall be initialized to 0.

The sequence of redundancy versions is 0, 2, 3, 1. The variable CURRENT_IRV is an index into the sequence of redundancy versions. This variable is up-dated modulo 4.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or Random Access Response. Adaptive retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH. Non-adaptive retransmission is performed on the same resource and with the same MCS as was used for the last made transmission attempt,

The UE is configured with a Maximum number of HARQ transmissions and a Maximum number of Msg3 HARQ transmissions by RRC: *maxHARQ-Tx* and *maxHARQ-Msg3Tx* respectively. For transmissions on all HARQ processes and all logical channels except for transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Tx*. For transmission of a MAC PDU stored in the Msg3 buffer, maximum number of transmissions shall be set to *maxHARQ-Msg3Tx*.

When the HARQ feedback is received for this TB, the HARQ process shall:

- set HARQ_FEEDBACK to the received value.

If the HARQ entity requests a new transmission, the HARQ process shall:

- set CURRENT_TX_NB to 0;
- set CURRENT_IRV to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- set HARQ_FEEDBACK to NACK;
  - generate a transmission as described below.

If the HARQ entity requests a retransmission, the HARQ process shall:

- increment CURRENT_TX_NB by 1;
  - if the HARQ entity requests an adaptive retransmission:
    - store the uplink grant received from the HARQ entity;
    - set CURRENT_IRV to the index corresponding to the redundancy version value provided in the HARQ information;
  - set HARQ_FEEDBACK to NACK;
    - generate a transmission as described below.
  - else if the HARQ entity requests a non-adaptive retransmission:
    - if HARQ_FEEDBACK = NACK:
      - generate a transmission as described below.

NOTE: When receiving a HARQ ACK alone, the UE keeps the data in the HARQ buffer.

NOTE: When no UL-SCH transmission can be made due to the occurrence of a measurement gap, no HARQ feedback can be received and a non-adaptive retransmission follows.

To generate a transmission, the HARQ process shall:

- 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:
- instruct the physical layer to generate a transmission according to the stored uplink grant with the redundancy version corresponding to the CURRENT_IRV value;
- increment CURRENT_IRV by 1;
  - if there is a measurement gap at the time of the HARQ feedback reception for this transmission and if the MAC PDU was not obtained from the Msg3 buffer:
    - set HARQ_FEEDBACK to ACK at the time of the HARQ feedback reception for this transmission.

After performing above actions, the HARQ process then shall:

- if CURRENT_TX_NB = maximum number of transmissions - 1:
  - flush the HARQ buffer.

#### 7.1.4.11.3 Test description

##### 7.1.4.11.3.1 Pre-test conditions

System Simulator:

- Cell 1
- System information takes into account the parameters in table 7.1.2.11.3.1-1.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18] using parameters as specified in Table 7.1.4.11.3.3-1 and 7.1.4.11.3.3-2.
- The loop back size is set in such a way that one RLC SDU in DL shall result in 1 RLC SDU's in UL.
- No UL Grant is allocated; PUCCH is in synchronised state for sending Scheduling Requests.

7.1.4.11.3.2 Test procedure sequence

**Table 7.1.4.11.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS Transmits a valid MAC PDU containing RLC PDU | <-- | MAC PDU | - | - |
| 2 | Void | - | - | - | - |
| 3 | The SS is configured for Uplink Grant Allocation Type 3. The SS allocates an UL Grant for one HARQ process X, sufficient for one RLC SDU to be loop backed in a TTI, and NDI indicates new transmission | <-- | Uplink Grant | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process X, redundancy version 0?<br>(Note 1) | --> | MAC PDU | 1 | P |
| 5 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 6 | Check: Does the UE retransmit the MAC PDU for HARQ process X, redundancy version 2?<br>(Note 1) | --> | MAC PDU | 2 | P |
| 7 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 8 | Check: Does the UE retransmit the MAC PDU for HARQ process X, redundancy version 3?<br>(Note 1) | --> | MAC PDU | 2 | P |
| 9 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 10 | Check: Does the UE retransmit the MAC PDU for HARQ process X, redundancy version 1?<br>(Note 1) | --> | MAC PDU | 2 | P |
| 11 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 12 | Check: Does the UE retransmit the MAC PDU for HARQ process X, redundancy version 0?<br>(Note 1) | --> | MAC PDU | 2 | P |
| 13 | Void | - | - | - | - |
| 14 | Void | - | - | - | - |
| 15 | The SS transmits an ACK | <-- | HARQ ACK | - | - |
| 16 | Check: Does the UE retransmit the MAC PDU for HARQ process X? | --> | MAC PDU | 4 | F |
| 17 | The SS transmits an UL grant corresponding to TTI for HARQ process X, with NDI not toggled and redundancy version to be used as '1' | <-- | Uplink Grant | - | - |
| 18 | Check: Does the UE retransmit the MAC PDU in for HARQ process X, using redundancy version 1?<br>(Note 1) | --> | MAC PDU | 3 | P |
| 19 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 20 | The SS transmits an UL grant corresponding to next TTI for HARQ process X, with NDI not toggled and redundancy version to be used as '3' | <-- | Uplink Grant | - | - |
| 21 | Check: Does the UE retransmit the MAC PDU for HARQ process X, using next redundancy version 3?<br>(Note 1) | --> | MAC PDU | 3 | P |
| 22 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 23 | Check: Does the UE retransmit the MAC PDU in the next TTIs corresponding to HARQ process X? | --> | MAC PDU | 7 | F |
| 24 | The SS transmits an UL grant corresponding to TTI for HARQ process X, with NDI not toggled | <-- | Uplink Grant | - | - |
| | EXCEPTION: In parallel with step 25, UE executes parallel behaviour defined in table 7.1.4.11.3.2-2 | - | - | - | - |
| 25 | Check: Does the UE retransmit the MAC PDU | --> | MAC PDU | 5 | F |

| | | | | | |
|---|---|---|---|---|---|
| | in the next TTIs corresponding to HARQ process X? | | | | |
| 25A | The SS transmits an RLC STATUS PDU to the UE | <-- | RLC STATUS PDU (ACK_SN=1) | - | - |
| 26 | The SS transmits a valid MAC PDU containing RLC PDU | <-- | MAC PDU | - | - |
| 27 | Void | - | - | - | - |
| 28 | The SS is configured for Uplink Grant Allocation Type 3. The SS allocates UL Grant for one HARQ process Y, sufficient for one RLC SDU to be loop backed in a TTI, and NDI indicates new transmission | <-- | Uplink Grant | - | - |
| 29 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process Y, redundancy version 0?<br>(Note 1) | --> | MAC PDU | 1 | P |
| 30 | The SS is configured for Uplink Grant Allocation Type 3. The SS allocates UL Grant for one HARQ process Y, sufficient for one RLC SDU to be loop backed in a TTI, and NDI indicates new transmission | <-- | Uplink Grant | - | - |
| | EXCEPTION: In parallel with step 31, UE executes parallel behaviour defined in table 7.1.4.11.3.2-2. | - | - | - | - |
| 31 | Check: Does the UE retransmit the MAC PDU in the next TTIs corresponding to HARQ process Y? | --> | MAC PDU | 6 | F |
| 32 | The SS transmits an RLC STATUS PDU to the UE | <-- | RLC STATUS PDU (ACK_SN=2) | - | - |
| Note 1: Transmission of a UL MAC PDU with a specific redundancy version by the UE is implicitly tested by receiving the UL MAC PDU correctly at SS. | | | | | |

**Table 7.1.4.11.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The UE transmits a MAC Padding PDU | --> | MAC PDU | - | - |

#### 7.1.4.11.3.3 Specific message contents

**Table 7.1.4.11.3.3-1: MAC-MainConfig {*RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)}**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| MAC-MainConfig-RBC ::= SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n8 | | |
| } | | | |
| } | | | |

**Table 7.1.4.11.3.3-2: RLC-Config-DRB-AM {*RRCConnectionReconfiguration (*preamble: Table 4.5.3.3-1, step 8)}**

| Derivation path: 36.508 clause 4.8.2.1.3.2, Table 4.8.2.1.3.2-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RLC-Config-DRB-AM ::= CHOICE { | | | |
| am SEQUENCE { | | | |
| ul-AM-RLC SEQUENCE { | | | |
| t-PollRetransmit | ms250 | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.4.12 MAC reset / UL

### 7.1.4.12.1 Test Purpose (TP)

(1)

```
with(UE  in E-UTRA RRC_CONNECTED state, with Scheduling Request procedure triggered)
ensure that {
  when{ UE MAC is reset, due to handover to a new cell }
    then { UE cancels Scheduling Request procedure }
            }
```

(2)

```
with ( UE  in E-UTRA RRC_CONNECTED state )
ensure that {
  when{ UE MAC is reset, due to handover to a new cell }
    then { UE flushes UL HARQ buffer }
            }
```

(3)

```
with (UE  in E-UTRA RRC_CONNECTED state )
ensure that {
  when{ UE MAC is reset, due to handover to a new cell }
    then { UE Considers the next transmission for each UL HARQ process as very first }
            }
```

### 7.1.4.12.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.9.

[TS 36.321 clause 5.9]

If a reset of the MAC entity is requested by upper layers, the UE shall:

- initialize Bj for each logical channel to zero;
- stop (if running) all timers;
- consider *timeAlignment*Timer as expired and perform the corresponding actions in subclause 5.2;
- stop, if any, ongoing RACH procedure;
- discard explicitly signalled *ra-PreambleIndex* and *ra-PRACH-MaskIndex*, if any;
- flush Msg3 buffer;
- cancel, if any, triggered Scheduling Request procedure;
- cancel, if any, triggered Buffer Status Reporting procedure;
- cancel, if any, triggered Power Headroom Reporting procedure;
- flush the soft buffers for all DL HARQ processes;

- for each DL HARQ process, consider the next received transmission for a TB as the very first transmission;
- release, if any, Temporary C-RNTI.

#### 7.1.4.12.3 Test description

##### 7.1.4.12.3.1 Pre-test conditions

System Simulator:

- Cell 1 and Cell 2

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) in Cell 1 according to [18].
- The condition SRB2-DRB(1,1) is used for step 8 in 4.5.3A.3 according to [18].

##### 7.1.4.12.3.2 Test procedure sequence

Table 7.1.4.12.3.2-1 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, 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 7.1.4.12.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 2 | Remark |
|---|---|---|---|---|---|
| **T0** | Cell-specific RS EPRE | dBm/15Khz | -85 | Off | |
| **T1** | Cell-specific RS EPRE | dBm/15Khz | -91 | -85 | |
| **T2** | Cell-specific RS EPRE | dBm/15Khz | -85 | -91 | |

**Table 7.1.4.12.3.2-2: 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 one RLC SDU on LC 4 | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 3 | The UE transmit a scheduling request | --> | (SR) | - | - |
| 4 | Wait for 50ms [Discard timer] to expire at UE. | - | - | - | - |
| 5 | The SS changes power level according to the row "T1" in table 7.1.4.12.3.2-1 | - | - | - | - |
| 6 | The SS transmits an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 2. | <-- | - | - | - |
| 7 | The UE transmits on cell 2, *RRCConnectionReconfigurationComplete* | --> | - | - | - |
| 8 | Check: For 2 seconds, if UE transmits a scheduling request? | --> | (SR) | 1 | F |
| 9 | The SS transmits a MAC PDU containing RLC SDU on LC 4 | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 10 | The UE transmit a scheduling request | --> | (SR) | - | - |
| 11 | The SS allocate UL Grant sufficient for one RLC SDU to be loop backed in a TTI, and NDI indicates new transmission | <-- | Uplink Grant | - | - |
| 12 | The UE transmit a MAC PDU including one RLC SDU | --> | MAC PDU | - | - |
| 13 | The SS transmits a NACK | <-- | HARQ NACK | - | - |
| 13 A | The SS changes power level according to the row "T2" in table 7.1.4.12.3.2-1 | - | - | - | - |
| 14 | The SS transmits an *RRCConnectionReconfiguration* message to order the UE to perform intra frequency handover to Cell 1 | <-- | - | - | - |
| 15 | The UE transmits on cell 1, *RRCConnectionReconfigurationComplete* | --> | - | - | - |
| 16 | Check: For 2 seconds, does UE transmit MAC PDU containing Loop Back PDU? | --> | MAC PDU (1 RLC SDU of 40 bytes on DRB) | 2 | F |
| 17 | The SS transmits a MAC PDU containing RLC SDU on LC 4 | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 18 | The UE transmit a scheduling request | --> | (SR) | - | - |
| 19 | The SS allocate UL Grant sufficient for one RLC SDU to be loop backed in a TTI, and NDI indicates new transmission | <-- | Uplink Grant | - | - |
| 20 | Check: Does UE transmit a MAC PDU including one RLC SDU? | --> | MAC PDU | 3 | P |

### 7.1.4.12.3.3 Specific Message Contents

**Table 7.1. 4.12.3.3-1: MAC-MainConfiguration {RRCConnectionReconfiguration (preamble)}**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| Information Element | Value/remark | Comment | Condition |
| MAC-MainConfiguration-RBC ::= SEQUENCE { | | | |
| ul-SCH-Configuration SEQUENCE { | | | |
| maxHARQ-Tx | n28 | | |
| } | | | |
| } | | | |

**Table 7.1. 4.12.3.3-2: PDCP-Configuration-DRB-UM {RRCConnectionReconfiguration (preamble)}**

| Derivation Path: 36.508 clause 4.8.2.1.2.1-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PDCP-Configuration-DRB-UM ::= SEQUENCE { | | | |
| discardTimer | ms50 | Lowest value | |
| } | | | |

**Table 7.1.4.12.3.3-3: SchedulingRequest-Configuration {RRCConnectionReconfiguration (preamble)}**

| Derivation Path: 36.508 clause 4.6.3-20 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequest-Configuration::= CHOICE { | | | |
| enable SEQUENCE { | | | |
| dsr-TransMax | n64 | Max value allowed | |
| } | | | |
| } | | | |

**Table 7.1.4.12.3.3-4: *RRCConnectionReconfiguration* (step 6, table 7.1.4.12.3.2-2)**

| Derivation Path: 36.508, Table 4.6.1-6, condition RBC-HO | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| mobilityControlInformation SEQUENCE { | MobilityControlInformation-HO | | |
| targetCellIdentity | PhysicalCellIdentity of Cell 2 (see 36.508 clause 4.4.4.2) | | |
| eutra-CarrierFreq | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.12.3.3-5: *RRCConnectionReconfiguration* (step 14, table 7.1.4.12.3.2-2)**

| Derivation Path: 36.508, Table 4.6.1-6, condition RBC-HO | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| mobilityControlInformation SEQUENCE { | MobilityControlInformation-HO | | |
| targetCellIdentity | PhysicalCellIdentity of Cell 1 (see 36.508 clause 4.4.4.2) | | |
| eutra-CarrierFreq | Not present | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.13 MAC PDU header handling

#### 7.1.4.13.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE has a MAC SDU to be transmitted that is less smaller 128 bytes }
    then { UE sets F field to 0 }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE has a MAC SDU to be transmitted that is larger than 128 bytes }
    then { UE sets F field to 1 }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE inserts a R/R/E/LCID field in the MAC header and there is a subsequent R/R/E/LCID field
to be inserted }
    then { UE sets E field to 1 }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE inserts a R/R/E/LCID field in the MAC header and a MAC SDU or a MAC control element
starts at the next byte }
    then { UE sets E field to 0 }
            }
```

(5)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE inserts the last MAC sub-header in the MAC PDU }
    then { UE inserts a MAC sub-header consist solely of the four header fields R/R/E/LCID }
            }
```

(6)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { UE inserts padding at the end of a MAC PDU }
    then { UE inserts the last MAC sub-header as a padding MAC subheader consisting solely of the
four header fields R/R/E/LCID with LCID set to Padding }
      }
```

#### 7.1.4.13.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.321 clause 6.1.2 and 6.2.1.

[TS 36.321, clause 6.1.2]

A MAC PDU consists of a MAC header, zero or more MAC Service Data Units (MAC SDU), zero, or more MAC control elements, and optionally padding; as described in Figure 6.1.2-3.

Both the MAC header and the MAC SDUs are of variable sizes.

A MAC PDU header consists of one or more MAC PDU sub-headers; each sub header corresponding to either a MAC SDU, a MAC control element or padding.

A MAC PDU sub header consists of the six header fields R/R/E/LCID/F/L but for the last sub header in the MAC PDU and for fixed sized MAC control elements. The last sub header in the MAC PDU and sub-headers for fixed sized MAC control elements consist solely of the four header fields R/R/E/LCID. A MAC PDU subheader corresponding to padding consists of the four header fields R/R/E/LCID.

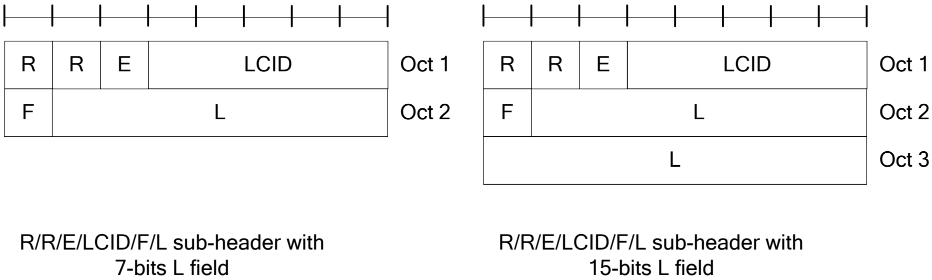


**Figure 6.1.2-1: R/R/E/LCID/F/L MAC sub header**

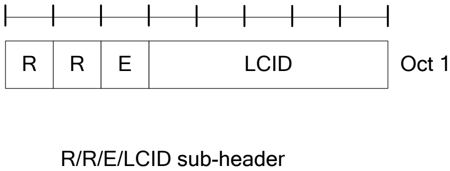


**Figure 6.1.2-2: R/R/E/LCID MAC sub header**

MAC PDU sub-headers have the same order as the corresponding MAC SDUs, MAC control elements and padding.

MAC control elements are always placed before any MAC SDU.

Padding occurs at the end of the MAC PDU, except when single-byte or two-byte padding is required. Padding may have any value and the UE shall ignore it. When padding is performed at the end of the MAC PDU, zero or more padding bytes are allowed.

When single-byte or two-byte padding is required, one or two MAC PDU subheaders corresponding to padding are placed at the beginning of the MAC PDU before any other MAC PDU subheader.

A maximum of one MAC PDU can be transmitted per TB per UE.

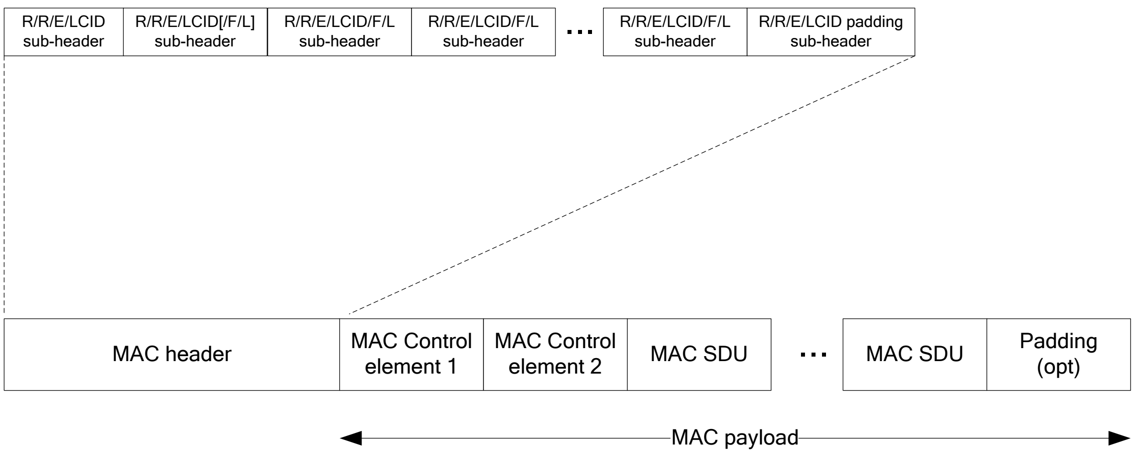


**Figure 6.1.2-3: Example of MAC PDU consisting of MAC header, MAC control elements, MAC SDUs and padding**

[TS 36.321, clause 6.2.1]

The MAC header is of variable size and consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC control element or padding as described in tables 6.2.1-1 and 6.2.1-2 for the DL and UL-SCH respectively. There is one LCID field for each MAC SDU, MAC control element or padding included in the MAC PDU. In addition to that, one or two additional LCID fields are included in the MAC PDU, when single-byte or two-byte padding is required but cannot be achieved by padding at the end of the MAC PDU. The LCID field size is 5 bits;
- L: The Length field indicates the length of the corresponding MAC SDU or MAC control element in bytes. There is one L field per MAC PDU sub header except for the last sub header and sub-headers corresponding to fixed-sized MAC control elements. The size of the L field is indicated by the F field;
- F: The Format field indicates the size of the Length field as indicated in table 6.2.1-3. There is one F field per MAC PDU sub header except for the last sub header and sub-headers corresponding to fixed-sized MAC control elements. The size of the F field is 1 bit. If the size of the MAC SDU or MAC control element is less than 128 bytes, the UE shall set the value of the F field to 0, otherwise the UE shall set it to 1;
- E: The Extension field is a flag indicating if more fields are present in the MAC header or not. The E field is set to "1" to indicate another set of at least R/R/E/LCID fields. The E field is set to "0" to indicate that either a MAC SDU, a MAC control element or padding starts at the next byte;
- R: Reserved bits, set to "0".

The MAC header and sub-headers are octet aligned.

...

**Table 6.2.1-2: Values of LCID for UL-SCH**

| Index | LCID values |
|---|---|
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-11001 | Reserved |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

…

**Table 6.2.1-3: Values of F field:**

| Index | Size of Length field (in bits) |
|---|---|
| 0 | 7 |
| 1 | 15 |

#### 7.1.4.13.3 Test description

##### 7.1.4.13.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(2,0) is used for step 8 in 4.5.3A.3 according to [18].

- 2 AM DRBs are configured with the parameters specified in table 7.1.4.13.3.1-1.

**Table 7.1.4.13.3.1-1: Logical Channel Configuration Settings**

| Parameter | DRB1 | DRB2 |
|---|---|---|
| LogicalChannel-Identity | 3 | 4 |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 | 1 |

7.1.4.13.3.2 Test procedure sequence

**Table 7.1.4.13.3.2-1: 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 a MAC SDU of size 127 bytes (RLC SDU of size 125 bytes + AMD PDU header 2 bytes ) with the Logical Channel ID field 'LCID' set to '00011', and 1 Byte Padding in the associated MAC SDU sub-header. | <-- | MAC PDU (MAC sub-header ( LCID='00011'), AMD PDU) | - | - |
| 3 | The UE sends Scheduling Request | --> | (SR) | - | - |
| 4 | The SS transmits an uplink grant of size 1096 bits. (Note 1) | <-- | (UL grant) | - | - |
| 5 | Check: does the UE transmit a MAC PDU with a MAC SDU sub-header with Logical Channel ID field 'LCID' set to '00011', Format field 'F' set to '0' and Length field 'L' set to '127'? (Note 6) | --> | MAC PDU (MAC sub-header ( LCID='00011', F='0', L='127' bytes), AMD PDU) | 1 | P |
| 5a | The SS transmits an RLC STATUS PDU to acknowledge correctly received data | <-- | RLC STATUS PDU (ACK_SN=1) | - | - |
| 6 | The SS transmits a MAC PDU containing a MAC SDU of size 128 bytes (RLC SDU of 126 bytes + AMD PDU header 2 bytes) with the Logical Channel ID field 'LCID' set to '00011'. | <-- | MAC PDU (MAC sub-header (LCID='00011'), AMD PDU) | - | - |
| 7 | The UE send Scheduling Request | --> | (SR) | - | - |
| 8 | The SS transmits an uplink grant of size 1096 bits. (Note 2) | <-- | (UL grant) | - | - |
| 9 | Check: Does the UE transmit a MAC PDU with a MAC SDU sub-header with Format field 'F' set to '1' and Logical Channel ID field 'LCID' set to '00011'? (Note 6) | --> | MAC PDU (MAC sub-header (LCID='00011', F='1', L=128), AMD PDU) | 2 | P |
| 10 | The SS transmits an RLC STATUS PDU to acknowledge correctly received data | <-- | RLC STATUS PDU (ACK_SN=2) | - | - |
| 11 | The SS transmits a MAC PDU containing two MAC SDUs, the first containing a 9 byte RLC SDU with LCID set to '00011' and the second containing s 6 byte RLC SDU with LCID set to '00100'. | <-- | MAC PDU (MAC sub-header (E='1', LCID='00011', F='0', L='11'), MAC sub-header (E='0', LCID='00100'), AMD PDU, AMD PDU) | - | - |
| 12 | The UE sends Scheduling Request | --> | (SR) | - | - |
| 13 | The SS transmits an uplink grant of size 176 bits. (Note 3) | <-- | (UL grant) | - | - |
| 14 | Check: Does the UE return a MAC PDU of length 176 bits containing two MAC sub-headers where the first MAC sub-header have the Expansion bit 'E' set to '1' and the second MAC sub-header has the Expansion bit 'E' set to '0' and no length field? (Note 5) | --> | MAC PDU (MAC sub-header (E='1', (LCID='00011', L='11) or (LCID='00100',L='8), MAC sub-header (E='0', no Length field present), AMD PDU, AMD PDU) | 3,4, 5 | P |
| 15 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID='00011') | <-- | RLC STATUS PDU (ACK_SN=3) | - | - |
| 16 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID='00100') | <-- | RLC STATUS PDU (ACK_SN=1) | | |
| 17 | The SS transmits a MAC PDU containing two MAC SDUs, the first containing a 8 byte RLC SDU with LCID set to '00011' and the second containing a 7 byte RLC SDU with LCID set to '00100'. | <-- | MAC PDU (MAC sub-header (E='1', LCID='00011', F='0', L='10'), MAC sub-header (E='0', LCID='00100',), AMD PDU, AMD PDU) | - | - |
| 18 | The UE sends Scheduling Request | --> | (SR) | - | - |
| 19 | The SS transmits an uplink grant of size 256 bits. (Note 4) | <-- | (UL grant) | - | - |
| 20 | Check: Does the UE return a MAC PDU of length 256 bits containing four MAC sub- | --> | MAC PDU (Long BSR MAC sub-header (E='1', LCID='11110', | 3,4, 6 | P |

| | | | | | |
|---|---|---|---|---|---|
| | headers where the first three MAC sub-header have the Expansion bit 'E' set to '1' and the last MAC sub-header has the Expansion bit 'E' set to '0' and the LCID field set to '11111'? (Note 5) (Note 7) | | MAC sub-header (E='1', F='0'), MAC sub-header (E='1', F='0'), F='0'), padding MAC sub-header (E='0', LCID='11111'), Long BSR, AMD PDU, AMD PDU, padding)<br>Or<br>MAC PDU (Short BSR MAC sub-header (E='1', LCID='11101', MAC sub-header (E='1', F='0'), MAC sub-header (E='1', F='0'), F='0'), padding MAC sub-header (E='0', LCID='11111'), Short BSR, AMD PDU, AMD PDU, padding) | | |
| 21 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID='00011') | <-- | RLC STATUS PDU (ACK_SN=4) | | |
| 22 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID='00100') | <-- | RLC STATUS PDU (ACK_SN=2) | | |

Note 1: UL grant of 1096 bits ($I_{TBS}$=8, $N_{PRB}$=8, TS 36.213 Table 7.1.7.2.1-1) is chosen to enable UE to transmit a MAC SDU of size 127 bytes in a MAC PDU (125 bytes RLC SDU size + 2 bytes AMD PDU header + 2 bytes MAC header (7 bit LI) = 129 bytes = 1032 bits < 1096 bits.
Note 2: UL grant of 1096 bits ($I_{TBS}$=8, $N_{PRB}$=8, TS 36.213 Table 7.1.7.2.1-1) is chosen to enable UE to transmit a MAC SDU of size 128 bytes in a MAC PDU (126 bytes RLC SDU size + 2 bytes AMD PDU header + 3 bytes MAC header (15 bit LI) = 131 bytes = 1048 bits < 1096 bits.
Note 3: UL grant of 176 bits ($I_{TBS}$=1, $N_{PRB}$=5, TS 36.213 Table 7.1.7.2.1-1) is chosen to enable UE to transmit two MAC SDUs, one of size 11 and one of size 8 bytes, in a MAC PDU (9 bytes RLC SDU + 2 bytes AMD PDU header + 6 bytes RLC SDU +2 bytes AMD PDU header + 2 bytes MAC sub-header (7 bit LI) + one byte MAC sub-header (R/R/E/LCID) = 22 bytes = 176 bits)
Note 4: UL grant of 256 bits ($I_{TBS}$=6, $N_{PRB}$=3, TS 36.213 Table 7.1.7.2.1-1) 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 + 7 bytes RLC SDU+ 2 bytes AMD PDU header) + 3 byte Long BSR+4 byte padding + one byte BSR header+ 2 x 2 bytes MAC sub-header (7 bit LI) + one byte padding MAC sub-header (R/R/E/LCID) = 32bytes = 256 bits) or (8 bytes RLC SDU + 2 bytes AMD PDU header + 7 bytes RLC SDU+ 2 bytes AMD PDU header) + 1 byte Short BSR+6 byte padding + one byte BSR header+ 2 x 2 bytes MAC sub-header (7 bit LI) + one byte padding MAC sub-header (R/R/E/LCID) = 32bytes = 256 bits))
Note 5: MAC SDU for LCID 3 and 4 can come in any order
Note 6: At this step UE shall include a BSR and report it on any of the configured Logical Channel Groups: 0 (SRB2), 1 (DRB2) and 2 (DRB1),
Note 7: It is left up to UE implementation whether ShortBSR or LongBSR is reported.

#### 7.1.4.13.3.3 Specific Message Contents

None.

### 7.1.4.14 Correct HARQ process handling / TTI bundling

#### 7.1.4.14.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and TTI bundling configured }
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 non-adaptive retransmissions for 3 additional consecutive UL subframes }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established, TTI bundling configured and having transmitted a MAC PDU less than maxHARQ-Tx times }
ensure that {
  when { UE receives a NACK and no uplink grant is included for the next TTI corresponding to the bundled HARQ process }
    then { UE performs non-adaptive retransmissions of the MAC PDU for 4 consecutive UL subframes }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established, TTI bundling configured and having
transmitted a MAC PDU less than maxHARQ-Tx times }
ensure that {
  when { UE receives an uplink grant on PDCCH for the next TTI corresponding to the HARQ process
with old NDI, irrespective of ACK/NACK is received for previous (re)transmission }
    then { UE performs an adaptive retransmission of the MAC PDU with redundancy version as received
on PDCCH in first UL subframe and non-adaptive retransmissions in 3 additional consecutive UL
subframes }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted a MAC PDU less
than maxHARQ-Tx times }
ensure that {
  when { UE receives an ACK and no uplink grant is included for the next TTI corresponding to the
HARQ process }
    then { UE does not retransmit the TTI Bundle }
            }
```

#### 7.1.4.14.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.2.1, 5.4.2.2 & 7.5, TS 36.213 clause 8, 8.3, 8.6.1 & 9.1.2.

[TS 36.321, clause 5.4.2.1]

There is one HARQ entity at the UE, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for HARQ the feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes is specified in [2], clause 8.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. It also routes the received HARQ feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process.

When TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. TTI 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 non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The HARQ feedback of a bundle is only received for the last TTI of the bundle (i.e. the TTI corresponding to TTI_BUNDLE_SIZE), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle.

For transmission of Msg3 during Random Access (see section 5.1.5) TTI bundling does not apply.

For each TTI, the HARQ entity shall:

- identify the HARQ process associated with this TTI;
- if an uplink grant has been indicated for this TTI:
  - if the received grant was not addressed to a Temporary C-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or
  - if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or
  - if the uplink grant was received in a Random Access Response:
    - if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:
      - obtain the MAC PDU to transmit from the Msg3 buffer.

- else:
  - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
- deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;
- instruct the identified HARQ process to trigger a new transmission.

- else:
  - deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;
  - instruct the identified HARQ process to generate an adaptive retransmission.

- else, if the HARQ buffer of the HARQ process corresponding to this TTI is not empty:
  - instruct the identified HARQ process to generate a non-adaptive retransmission.

When determining if NDI has been toggled compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 36.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

Each HARQ process shall maintain a state variable CURRENT_TX_NB, which indicates the number of transmissions that have taken place for the MAC PDU currently in the buffer, and a state variable HARQ_FEEDBACK, which indicates the HARQ feedback for the MAC PDU currently in the buffer. When the HARQ process is established, CURRENT_TX_NB shall be initialized to 0.

The sequence of redundancy versions is 0, 2, 3, 1. The variable CURRENT_IRV is an index into the sequence of redundancy versions. This variable is up-dated modulo 4.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or Random Access Response. Adaptive retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH. Non-adaptive retransmission is performed on the same resource and with the same MCS as was used for the last made transmission attempt.

The UE is configured with a Maximum number of HARQ transmissions and a Maximum number of Msg3 HARQ transmissions by RRC: *maxHARQ-Tx* and *maxHARQ-Msg3Tx* respectively. For transmissions on all HARQ processes and all logical channels except for transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Tx*. For transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Msg3Tx*.

When the HARQ feedback is received for this TB, the HARQ process shall:

- set HARQ_FEEDBACK to the received value.

If the HARQ entity requests a new transmission, the HARQ process shall:

- set CURRENT_TX_NB to 0;
- set CURRENT_IRV to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- set HARQ_FEEDBACK to NACK;
- generate a transmission as described below.

If the HARQ entity requests a retransmission, the HARQ process shall:

- increment CURRENT_TX_NB by 1;
- if the HARQ entity requests an adaptive retransmission:

- store the uplink grant received from the HARQ entity;
- set CURRENT_IRV to the index corresponding to the redundancy version value provided in the HARQ information;
- set HARQ_FEEDBACK to NACK;
- generate a transmission as described below.

- else if the HARQ entity requests a non-adaptive retransmission:
  - if HARQ_FEEDBACK = NACK:
    - generate a transmission as described below.

NOTE 1: When receiving a HARQ ACK alone, the UE keeps the data in the HARQ buffer.

NOTE 2: When no UL-SCH transmission can be made due to the occurrence of a measurement gap, no HARQ feedback can be received and a non-adaptive retransmission follows.

To generate a transmission, the HARQ process shall:

- if the MAC PDU was obtained from the Msg3 buffer; or
- 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 in this TTI:
  - instruct the physical layer to generate a transmission according to the stored uplink grant with the redundancy version corresponding to the CURRENT_IRV value;
  - increment CURRENT_IRV by 1;
  - if there is a measurement gap at the time of the HARQ feedback reception for this transmission and if the MAC PDU was not obtained from the Msg3 buffer:
    - set HARQ_FEEDBACK to ACK at the time of the HARQ feedback reception for this transmission.

After performing above actions, the HARQ process then shall:

- if CURRENT_TX_NB = maximum number of transmissions – 1:
  - flush the HARQ buffer;

[TS 36.321, clause 7.5]

The parameter TTI_BUNDLE_SIZE is 4.

[TS 36.213, clause 8]

For FDD, there shall be 8 HARQ processes in the uplink for non-subframe bundling operation, i.e. normal HARQ operation, and 4 HARQ processes in the uplink for subframe bundling operation. The subframe bundling operation is configured by the parameter *ttiBundling* provided by higher layers.

In case higher layers configure the use of subframe bundling for FDD and TDD, the subframe bundling operation is only applied to UL-SCH, such that four consecutive uplink subframes are used.

…

For FDD and subframe bundling operation, the UE shall upon detection of a PDCCH with DCI format 0 in subframe $n$ intended for the UE, and/or a PHICH transmission in subframe $n$-5 intended for the UE, adjust the corresponding first PUSCH transmission in the bundle in subframe $n+4$ according to the PDCCH and PHICH information.

…

For TDD UL/DL configurations 1 and 6 and subframe bundling operation, the UE shall upon detection of a PDCCH with DCI format 0 in subframe $n$ intended for the UE, and/or a PHICH transmission intended for the UE in subframe $n-l$ with $l$ given in Table 8-2a, adjust the corresponding first PUSCH transmission in the bundle in subframe $n+k$, with $k$ given in Table 8-2, according to the PDCCH and PHICH information.

…

**Table 8-2: *k* for TDD configurations 0-6**

| TDD UL/DL Configuration | DL subframe number *n* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 4 | 6 | | | | 4 | 6 | | | |
| 1 | | 6 | | | 4 | | 6 | | | 4 |
| 2 | | | | 4 | | | | | 4 | |
| 3 | 4 | | | | | | | | 4 | 4 |
| 4 | | | | | | | | | 4 | 4 |
| 5 | | | | | | | | | 4 | |
| 6 | 7 | 7 | | | | 7 | 7 | | | 5 |

**Table 8-2a: *l* for TDD configurations 0, 1 and 6**

| TDD UL/DL Configuration | DL subframe number *n* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 9 | 6 | | | | 9 | 6 | | | |
| 1 | | 2 | | | 3 | | 2 | | | 3 |
| 6 | 5 | 5 | | | | 6 | 6 | | | 8 |

[TS 36.213, clause 8.3]

For Frame Structure type 1, an ACK/NACK received on the PHICH assigned to a UE in subframe $i$ is associated with the PUSCH transmission in subframe $i$-4.

For Frame Structure type 2 UL/DL configuration 1-6, an ACK/NACK received on the PHICH assigned to a UE in subframe $i$ is associated with the PUSCH transmission in the subframe $i$-$k$ as indicated by the following table 8.3-1.

…

**Table 8.3-1 *k* for TDD configurations 0-6**

| TDD UL/DL Configuration | DL subframe number *i* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0 | 7 | 4 | | | | 7 | 4 | | | |
| 1 | | 4 | | | 6 | | 4 | | | 6 |
| 2 | | | | 6 | | | | | 6 | |
| 3 | 6 | | | | | | | | 6 | 6 |
| 4 | | | | | | | | | 6 | 6 |
| 5 | | | | | | | | | 6 | |
| 6 | 6 | 4 | | | | 7 | 4 | | | 6 |

[TS 36.213, clause 8.6.1]

For $0 \le I_{\mathrm{MCS}} \le 28$, the modulation order ( $Q_m$ ) is determined as follows:

…

- If the parameter *ttiBundling* provided by higher layers is set to *TRUE*, then the resource allocation size is restricted to $N_{\mathrm{PRB}} \le 3$ and the modulation order is set to $Q_m = 2$ .

[TS 36.213, clause 9.1.2]

For scheduled PUSCH transmissions in subframe $n$, a UE shall determine the corresponding PHICH resource in subframe $n+k_{PHICH}$, where $k_{PHICH}$ is always 4 for FDD and is given in table 9.1.2-1 for TDD. For subframe bundling operation, the corresponding PHICH resource is associated with the last subframe in the bundle.

**Table 9.1.2-1: $k_{PHICH}$ for TDD**

| TDD UL/DL | UL subframe index *n* |
|---|---|

| Configuration | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | 4 | 7 | 6 | | | 4 | 7 | 6 |
| 1 | | | 4 | 6 | | | | 4 | 6 | |
| 2 | | | 6 | | | | | 6 | | |
| 3 | | | 6 | 6 | 6 | | | | | |
| 4 | | | 6 | 6 | | | | | | |
| 5 | | | 6 | | | | | | | |
| 6 | | | 4 | 6 | 6 | | | 4 | 7 | |

#### 7.1.4.14.3 Test description

##### 7.1.4.14.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(1,1) is used for step 8 in 4.5.3A.3 according to [18].
- No UL Grant is allocated; PUCCH is in synchronised state for sending Scheduling Requests.

7.1.4.14.3.2 Test procedure sequence

**Table 7.1.4.14.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 0A | SS Transmits RRCConnectionReconfiguration to configure TTI bundling | <-- | - | - | - |
| 0B | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 1 | The SS Transmits a valid MAC PDU containing RLC PDU of size 312 bits on UM Bearer. | <-- | MAC PDU | - | - |
| 2 | The UE transmits a Scheduling Request | --> | Scheduling Request | - | - |
| 3 | The SS allocates an UL Grant of 328 bits with NDI indicating new transmission (i.e. Nprb=3 and Imcs=7)(Note 1) | <-- | Uplink Grant | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including one RLC SDU, with redundancy version 0, 'k' subframes after step 3? (Note 3) | --> | MAC PDU | 1 | P |
| 5 | Check: Does UE repeat non-adaptive retransmission of MAC PDU in step 4, for 3 consecutive UL subframes with redundancy version 2, 3 and 1 respectively? (Note 3) | --> | MAC PDU | 1 | P |
| 6 | The SS transmits a NACK, 'kk' subframes after last transmission in step 5. | <-- | HARQ NACK | - | - |
| 7 | Check: Does the UE make non-adaptive retransmissions of the MAC PDU 'm' subframes after NACK in step 6, for 4 consecutive UL subframes with redundancy version 0, 2, 3 and 1 respectively? (Note 3) | --> | MAC PDU | 2 | P |
| 8 | The SS transmits an ACK, 'kk' subframes after last transmission in step 7. | <-- | HARQ ACK | - | - |
| 9 | The SS allocates an UL Grant with NDI indicating retransmission, start redundancy version =2[i.e. Nprb=3 and Imcs=30], 'l' subframes after ACK in step 8. | <-- | Uplink Grant | - | - |
| 10 | Check: Does the UE perform an adaptive retransmission of the MAC PDU 'k' subframes after grant in step 9, using redundancy version 2? (Note 3) | --> | MAC PDU | 3 | P |
| 11 | Check: Does UE repeat non-adaptive retransmission of MAC PDU in step 10, for 3 consecutive UL sub-frames with redundancy version 3, 1 and 0 respectively? (Note 3) | --> | MAC PDU | 3 | P |
| 12 | The SS transmits an ACK, 'kk' subframes after last transmission in step 11. | <-- | HARQ ACK | - | - |
| 13 | Check: Does the UE make any retransmissions of the MAC PDU 'm' subframes after ACK in step 12, for 4 consecutive UL subframes? | --> | MAC PDU | 4 | F |

Note 1: In step3, for TDD, the subframe number of allocating UL grant should be selected from {'1', '4', '6', '9'} based on TDD default UL/DL configuration 1.

Note 2: For FDD value of 'k', 'kk' is 4, 'l' is 5 and 'm' is 9.
For TDD UL/DL configuration 1, values of 'k', 'l', 'm' and 'kk' are given in table 7.1.4.14.3.2-2.

Note 3: Transmission of a UL MAC PDU with a specific redundancy version by the UE is implicitly tested by receiving the UL MAC PDU correctly at SS.

**Table 7.1.4.14.3.2-2: Values for parameter ‘k’, ‘l’, ‘m’ and ‘kk’ in Main behaviour.**

| Parameter | DL sub-frame number *n* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| k | | 6 | | | 4 | | 6 | | | 4 |
| l | | 3 | | | 2 | | 3 | | | 2 |
| m | | 7 | | | 8 | | 7 | | | 8 |
| kk | | | 4 | 6 | | | | 4 | 6 | |

#### 7.1.4.14.3.3 Specific message contents

**Table 7.1.4.14.3.3-1: MAC-MainConfig-RBC in *RRCConnectionReconfiguration(*Step 0A)**

| Derivation Path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| MAC-MainConfigRBC- ::= SEQUENCE { | | | |
| ul-SCH-Configuration SEQUENCE { | | | |
| maxHARQ-Tx | n28 | Max value allowed | |
| periodicBSR-Timer | Infinity | | |
| retxBSR-Timer | sf10240 | | |
| ttiBundling | TRUE | | |
| } | | | |
| } | | | |

## 7.1.4.15 UE power headroom reporting / Periodic reporting

### 7.1.4.15.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established, periodic power headroom reporting
configured }
ensure that {
  when { periodicPHR-Timer is configured in RRCConnectionReconfiguration procedure }
    then { UE transmits a MAC PDU containing Power Headroom MAC Control Element }
          }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established, periodic power headroom reporting
configured }
ensure that {
  when { periodicPHR-Timer expires and UL resources allocated for new transmission }
    then { UE transmits a MAC PDU containing Power Headroom MAC Control Element }
          }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established }
ensure that {
  when { power headroom reporting is disabled }
    then { UE stops transmitting Power Headroom MAC Control Element }
          }
```

### 7.1.4.15.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.4.6 and 6.1.3.6, 36.331.

[TS 36.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving eNB with information about the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission. The reporting period, delay and mapping of Power Headroom are defined in subclause 9.1.8 of 3GPP TS 36.133 [9]. RRC controls Power Headroom reporting by configuring the two timers *periodicPHR-Timer* and *prohibitPHR-Timer*, and by signalling *dl-PathlossChange* which sets the change in measured downlink pathloss to trigger a PHR [8].

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- the *prohibitPHR-Timer* expires or has expired and the path loss has changed more than *dl-PathlossChange* dB since the transmission of a PHR when UE has UL resources for new transmission;
- *periodicPHR-Timer* expires;
- upon configuration and reconfiguration of the power headroom reporting functionality by upper layers [8], which is not used to disable the function.

If the UE has UL resources allocated for new transmission for this TTI:

- if it is the first UL resource allocated for a new transmission since the last MAC reset, start *periodicPHR-Timer*.
- if the Power Headroom reporting procedure determines that at least one PHR has been triggered since the last transmission of a PHR r this is the first time that a PHR is triggered, and;
- if the allocated UL resources can accommodate a PHR MAC control element plus its subheader as a result of logical channel prioritization:
  - obtain the value of the power headroom from the physical layer;
  - instruct the Multiplexing and Assembly procedure to generate and transmit a PHR MAC control element based on the value reported by the physical layer;
  - start or restart *periodicPHR-Timer*;
  - start or restart *prohibitPHR-Timer*;
  - cancel all triggered PHR(s).

[TS 36.321, clause 6.1.3.6]

The Power Headroom MAC control element is identified by a MAC PDU sub header with LCID as specified in table 6.2.1-2. It has a fixed size and consists of a single octet defined as follows (figure 6.1.3.6-1):

- 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 6.1.3.6-1 below (the corresponding measured values in dB can be found in subclause 9.1.8.4 of [19])

| | | | |
|---|---|---|---|
| R | R | Power Headroom | Oct 1 |

**Figure 6.1.3.6-1: Power Headroom MAC control element**

**Table 6.1.3.6-1: 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 |

#### 7.1. 4.15.3 Test description

##### 7.1.4.15.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) on Cell 1 according to [18].

##### 7.1.4.15.3.2 Test procedure sequence

**Table 7.1.4.15.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS is configured for Uplink Grant Allocation Type 2. The SS transmits UL grant for the UE at every TTI for FDD and every 5ms in a DL subframe for TDD. | --> | - | - | - |
| 2 | The SS transmits an *RRCConnectionReconfiguration* message to provide Power Headroom parameters | <-- | - | - | - |
| 3 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 1 | P |
| 4 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm the setup of Power Headroom parameters. | --> | - | - | - |
| 5 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element 200ms after step 3? | --> | MAC PDU | 2 | P |
| 6 | The SS transmits an *RRCConnectionReconfiguration* message to disable Power Headroom reporting | <-- | - | - | - |
| 7 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm the disabling of Power Headroom parameters | --> | - | - | - |
| 8 | Check: for 2 seconds, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 3 | F |
| Note: Steps 3 and 4 can happen in 2 MAC PDU's, or may be combined in one MAC PDU. | | | | | |

#### 7.1.4.15.3.3 Specific message contents

**Table 7.1.4.15.3.3-1: RRCConnectionReconfiguration (step 2, Table 7.1.4.15.3.2-1)**

| Derivation path: 36.508 table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE { | | | |
| phr-Confign CHOICE { | | | |
| setup SEQUENCE { | | | |
| periodicPHR-Timer | sf200 | | |
| prohibitPHR-Timer | sf1000 | | |
| dl-PathlossChange | infinity | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.15.3.3-2: RRCConnectionReconfiguration (step 6, Table 7.1.4.15.3.2-1)**

| Derivation path: 36.508 table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE { | | | |
| phr-Config CHOICE { | | | |
| release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.16 UE power headroom reporting / DL pathloss change reporting

#### 7.1.4.16.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_Connected state with DRB established, Power headroom reporting for *dl-PathlossChange* configured }
**ensure that** {
  **when** { the DL Pathloss has changed more than *dl-PathlossChange* dB **and** *prohibitPHR-Timer* is running }
    **then** { UE does not transmit a MAC PDU containing Power Headroom MAC Control Element }
      }

(2)

```
with { UE in E-UTRA RRC_Connected state with DRB established, Power headroom reporting for dl-
PathlossChange configured }
ensure that {
  when { prohibitPHR-Timer expires and power headroom report is triggered due to DL Pathloss change
}
    then { UE transmits a MAC PDU containing Power Headroom MAC Control Element }
           }
```

### 7.1.4.16.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.4.6 and 6.1.3.6

[TS 36.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving eNB with information about the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission. The reporting period, delay and mapping of Power Headroom are defined in subclause 9.1.8 of [9]. RRC controls Power Headroom reporting by configuring the two timers *periodicPHR-Timer* and *prohibitPHR-Timer*, and by signalling *dl-PathlossChange* which sets the change in measured downlink pathloss to trigger a PHR [8].

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *prohibitPHR-Timer* expires or has expired and the path loss has changed more than *dl-PathlossChange* dB since the transmission of a PHR when UE has UL resources for new transmission;
- *periodicPHR-Timer* expires;
- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers [8], which is not used to disable the function.

If the UE has UL resources allocated for new transmission for this TTI:

- if it is the first UL resource allocated for a new transmission since the last MAC reset, start *periodicPHR-Timer*;
- if the Power Headroom reporting procedure determines that at least one PHR has been triggered since the last transmission of a PHR or this is the first time that a PHR is triggered, and;
- if the allocated UL resources can accommodate a PHR MAC control element plus its subheader as a result of logical channel prioritization:
  - obtain the value of the power headroom from the physical layer;
  - instruct the Multiplexing and Assembly procedure to generate and transmit a PHR MAC control element based on the value reported by the physical layer;
  - start or restart *periodicPHR-Timer*;
  - start or restart *prohibitPHR-Timer*;
  - cancel all triggered PHR(s).

[TS 36.321, clause 6.1.3.6]

The Power Headroom MAC control element is identified by a MAC PDU sub header with LCID as specified in table 6.2.1-1. It has a fixed size and consists of a single octet defined as follows (figure 6.1.3.6-1):

- 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 6.1.3.6.1-1 below (the corresponding measured values in dB can be found in subclause 9.1.8.4 of [17]).

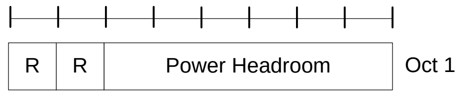


**Figure 6.1.3.6-1: Power Headroom MAC control element**

**Table 6.1.3.6-1: 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 |

### 7.1.4.16.3 Test description

#### 7.1.4.16.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) on Cell 1 according to [18].

7.1.4.16.3.2 Test procedure sequence

**Table 7.1.4.16.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS is configured for Uplink Grant Allocation Type 2. SS is configured to transmit UL grant for UE at every TTI for FDD, and every 5ms in a DL subframe for TDD. | - | - | - | - |
| 2 | The SS transmits an *RRCConnectionReconfiguration* message to provide Power Headroom parameters | <-- | *RRCConnectionReconfiguration* | - | - |
| 3 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm the setup of Power Headroom parameters. | --> | - | - | - |
| 4 | Wait for T1= 10% of *prohibitPHR-Timer*. | - | - | - | - |
| 5 | Reduce SS power level so as to cause a DL_Pathloss change at UE by 5dB. | - | - | - | - |
| 6 | Check: for 80% of *prohibitPHR-Timer* since step 3, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 1 | F |
| 7 | Check: after *prohibitPHR-Timer* after step 3, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 2 | P |
| 8 | Increase SS power level so as to cause a DL_Pathloss change at UE by 5dB. | - | - | - | - |
| 9 | Check: for 80% of *prohibitPHR-Timer* since step 7, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 1 | F |
| 10 | Check: after *prohibitPHR-Timer* after step 7, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 2 | P |
| Note: Steps 3 in main behaviour and step 1 in parallel behaviour can happen in 2 MAC PDU's, or may be combined in one MAC PDU. | | | | | |

**Table 7.1.4.16.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The UE transmits a MAC PDU containing Power Headroom MAC Control Element. | --> | MAC PDU | - | - |

#### 7.1.4.16.3.3 Specific message contents

**Table 7.1.4.16.3.3-1: RRCConnectionReconfiguration (step 2, Table 7.1.4.16.3.2-1)**

| Derivation path: 36.508 table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE { | | | |
| phr-Config CHOICE { | | | |
| setup SEQUENCE { | | | |
| periodicPHR-Timer | infinity | | |
| prohibitPHR-Timer | sf1000 | | |
| dl-PathlossChange | dB3 | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.17

### 7.1.4.18 CA / Correct handling of MAC control information / Buffer Status / UL data arrive in the UE Tx buffer / Extended buffer size

#### 7.1.4.18.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established, and ExtendedBSR-Sizes is configured in
RRCConnectionReconfiguration procedure }
ensure that {
  when { UL data arrives in the UE transmission buffer}
    then { UE transmits a MAC PDU containing 'Buffer Status Report' MAC control element with
Extended Buffer size }
            }
```

#### 7.1.4.18.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS36.321, clause 5.4.3 ,5.4.5 and 6.1.3.1.

[36.321, clause 5.4.3.1]

…

For the Logical Channel Prioritization procedure, the UE shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR or Extended PHR;
- data from any Logical Channel, except data from UL-CCCH;

- MAC control element for BSR included for padding.

…

[36.321, clause 5.4.5]

…

A MAC PDU shall contain at most one MAC BSR control element, even when multiple events trigger a BSR by the time a BSR can be transmitted in which case the Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The UE shall restart *retxBSR-Timer* upon indication of a grant for transmission of new data on any UL-SCH.

All triggered BSRs shall be cancelled in case the UL grant(s) in this subframe 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 UE shall transmit at most one Regular/Periodic BSR in a TTI. If the UE is requested to transmit multiple MAC PDUs in a TTI, it may include a padding BSR in any of the MAC PDUs which do not contain a Regular/Periodic BSR.

All BSRs transmitted in a TTI always reflect the buffer status after all MAC PDUs have been built for this TTI. Each LCG shall report at the most one buffer status value per TTI and this value shall be reported in all BSRs reporting buffer status for this LCG.

NOTE: A Padding BSR is not allowed to cancel a triggered Regular/Periodic BSR. A Padding BSR is triggered for a specific MAC PDU only and the trigger is cancelled when this MAC PDU has been built.

[36.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC control elements consist of either:

- Short BSR and Truncated BSR format: one LCG ID field and one corresponding Buffer Size field (figure 6.1.3.1-1); or
- Long BSR format: four Buffer Size fields, corresponding to LCG IDs #0 through #3 (figure 6.1.3.1-2).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in table 6.2.1-2.

The fields LCG ID and Buffer Size are defined as follow:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) which buffer status is being reported. The length of the field is 2 bits;
- Buffer Size: The Buffer Size field identifies the total amount of data available across all logical channels of a logical channel group after all MAC PDUs for the TTI have been built. The amount of data is indicated in number of bytes. It shall include all data that is available for transmission in the RLC layer and in the PDCP layer; the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field is 6 bits. If *extendedBSR-Sizes* is not configured, the values taken by the Buffer Size field are shown in Table 6.1.3.1-1. If *extendedBSR-Sizes* is configured, the values taken by the Buffer Size field are shown in Table 6.1.3.1-2.

…

**Table 6.1.3.1-2: Extended Buffer size levels for BSR**

| Index | Buffer Size (BS) value [bytes] | Index | Buffer Size (BS) value [bytes] |
|---|---|---|---|
| 0 | BS = 0 | 32 | 4940 < BS <= 6074 |
| 1 | 0 < BS <= 10 | 33 | 6074 < BS <= 7469 |
| 2 | 10 < BS <= 13 | 34 | 7469 < BS <= 9185 |
| 3 | 13 < BS <= 16 | 35 | 9185 < BS <= 11294 |
| 4 | 16 < BS <= 19 | 36 | 11294 < BS <= 13888 |
| 5 | 19 < BS <= 23 | 37 | 13888 < BS <= 17077 |
| 6 | 23 < BS <= 29 | 38 | 17077 < BS <= 20999 |
| 7 | 29 < BS <= 35 | 39 | 20999 < BS <= 25822 |
| 8 | 35 < BS <= 43 | 40 | 25822 < BS <= 31752 |
| 9 | 43 < BS <= 53 | 41 | 31752 < BS <= 39045 |
| 10 | 53 < BS <= 65 | 42 | 39045 < BS <= 48012 |
| 11 | 65 < BS <= 80 | 43 | 48012 < BS <= 59039 |
| 12 | 80 < BS <= 98 | 44 | 59039 < BS <= 72598 |
| 13 | 98 < BS <= 120 | 45 | 72598 < BS <= 89272 |
| 14 | 120 < BS <= 147 | 46 | 89272 < BS <= 109774 |
| 15 | 147 < BS <= 181 | 47 | 109774 < BS <= 134986 |
| 16 | 181 < BS <= 223 | 48 | 134986 < BS <= 165989 |
| 17 | 223 < BS <= 274 | 49 | 165989 < BS <= 204111 |
| 18 | 274 < BS <= 337 | 50 | 204111 < BS <= 250990 |
| 19 | 337 < BS <= 414 | 51 | 250990 < BS <= 308634 |
| 20 | 414 < BS <= 509 | 52 | 308634 < BS <= 379519 |
| 21 | 509 < BS <= 625 | 53 | 379519 < BS <= 466683 |
| 22 | 625 < BS <= 769 | 54 | 466683 < BS <= 573866 |
| 23 | 769 < BS <= 945 | 55 | 573866 < BS <= 705666 |
| 24 | 945 < BS <= 1162 | 56 | 705666 < BS <= 867737 |
| 25 | 1162 < BS <= 1429 | 57 | 867737 < BS <= 1067031 |
| 26 | 1429 < BS <= 1757 | 58 | 1067031 < BS <= 1312097 |
| 27 | 1757 < BS <= 2161 | 59 | 1312097 < BS <= 1613447 |
| 28 | 2161 < BS <= 2657 | 60 | 1613447 < BS <= 1984009 |
| 29 | 2657 < BS <= 3267 | 61 | 1984009 < BS <= 2439678 |
| 30 | 3267 < BS <= 4017 | 62 | 2439678 < BS <= 3000000 |
| 31 | 4017 < BS <=4940 | 63 | BS > 3000000 |

## 7.1.4.18.3 Test description

### 7.1.4.18.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB (1, 0) is used for step 8 in 4.5.3A.3 according to [18].

#### 7.1.4.18.3.2 Definition of system information messages

**Table 7.1.4.18.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | Void | - | - | - | - |
| 2 | Void | - | - | - | - |
| 3 | The SS transmits a MAC PDU containing an RLC SDU of size 60 bytes. | <-- | MAC PDU(RLC SDU) | - | - |
| 4 | The UE transmit a scheduling request. | --> | (SR) | - | - |
| 5 | The SS respond to the scheduling request in step 4 by an UL Grant of 32 bits. | <-- | (UL Grant, 32 bits) | - | - |
| 6 | Check: Does The UE transmit a short BSR with 'Buffer size' field set to '10'? | --> | MAC PDU (MAC Short BSR (Buffer Size='10')) | 1 | P |
| 7 | The SS is configured for Uplink Grant Allocation Type 3. The SS sends an uplink grant of size 520 bits. | <-- | (UL grant) | - | - |
| 8 | UE transmits a MAC PDU containing a RLC SDU. | --> | MAC PDU(RLC SDU) | - | - |

#### 7.1.4.18.3.3 Specific message contents

**Table 7.1.4.18.3.3-1: RRCConnectionReconfiguration (Preamble)**

| Derivation path: 36.508 table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig-v1020 CHOICE { | | | |
| extendedBSR-Sizes-r10 | Setup | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.4.19 CA / UE power headroom reporting / SCell activation and DL pathloss change reporting / Extended PHR

### 7.1.4.19.1 CA / UE power headroom reporting / SCell activation and DL pathloss change reporting / Extended PHR / Intra-band Contiguous CA

#### 7.1.4.19.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_Connected state with DRB established, Extended Power headroom reporting and
an SCell with uplink addition configured }
ensure that {
  when { UE receives an Activation MAC Control Element activating the SCell }
    then { UE transmits a MAC PDU containing Extended Power Headroom MAC Control Element }
        }
```

(2)

```
with { UE in E-UTRA RRC_Connected state with DRB established, Extended Power headroom reporting for
DL_Pathloss change configured }
ensure that {
  when { the DL Pathloss changes and prohibitPHR-Timer is running }
    then { UE does not transmit a MAC PDU containing Extended Power Headroom MAC Control Element }
        }
```

(3)

```
with { UE in E-UTRA RRC_Connected state with DRB established, Extended Power headroom reporting for
DL_Pathloss change configured }
ensure that {
  when { prohibitPHR-Timer expires and extended power headroom report is triggered due to DL
Pathloss change }
    then { UE transmits a MAC PDU containing Extended Power Headroom MAC Control Element }
            }
```

#### 7.1.4.19.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.4.6 and 6.1.3.6a

[TS 36.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving eNB with information about the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell and also with information about the difference between the nominal UE maximum power and the estimated power for UL-SCH and PUCCH transmission on PCell.

The reporting period, delay and mapping of Power Headroom are defined in subclause 9.1.8 of [9]. RRC controls Power Headroom reporting by configuring the two timers *periodicPHR-Timer* and *prohibitPHR-Timer*, and by signalling *dl-PathlossChange* which sets the change in measured downlink pathloss and the required power backoff due to power management (as allowed by P-MPRc [10]) to trigger a PHR [8].

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *prohibitPHR-Timer* expires or has expired and the path loss has changed more than *dl-PathlossChange* dB for at least one activated Serving Cell which is used as a pathloss reference since the last transmission of a PHR when the UE has UL resources for new transmission;
- *periodicPHR-Timer* expires;
- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers [8], which is not used to disable the function;
- activation of an SCell with configured uplink.
- *prohibitPHR-Timer* expires or has expired, when the UE has UL resources for new transmission, and the following is true in this TTI for any of the active Serving Cells 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-MPR$_c$ [10]) for this cell has changed more than *dl-PathlossChange* dB since the last transmission of a PHR when the UE had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE: The UE 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 $P_{CMAX,c}$/PH when a PHR is triggered by other triggering conditions.

If the UE has UL resources allocated for new transmission for this TTI:

- if it is the first UL resource allocated for a new transmission since the last MAC reset, start *periodicPHR-Timer*;
- if the Power Headroom reporting procedure determines that at least one PHR has been triggered since the last transmission of a PHR or this is the first time that a PHR is triggered, and;
- if the allocated UL resources can accommodate a PHR MAC control element plus its subheader if *extendedPHR* is not configured, or the Extended PHR MAC control element plus its subheader if *extendedPHR* is configured, as a result of logical channel prioritization:
  - if *extendedPHR* is configured:
    - for each activated Serving Cell with configured uplink:

        - obtain the value of the Type 1 power headroom;

        - if the UE has UL resources allocated for transmission on this Serving Cell for this TTI:

            - obtain the value for the corresponding $P_{CMAX,c}$ field from the physical layer;

    - if *simultaneousPUCCH-PUSCH* is configured:

        - obtain the value of the Type 2 power headroom for the PCell;

        - if the UE has a PUCCH transmission in this TTI:

            - obtain the value for the corresponding $P_{CMAX,c}$ field from the physical layer;

    - instruct the Multiplexing and Assembly procedure to generate and transmit an Extended PHR MAC control element as defined in subclause 6.1.3.6a based on the values reported by the physical layer;

- else:

    - obtain the value of the Type 1 power headroom from the physical layer;

    - instruct the Multiplexing and Assembly procedure to generate and transmit a PHR MAC control element as defined in subclause 6.1.3.6 based on the value reported by the physical layer;

- start or restart *periodicPHR-Timer*;

- start or restart *prohibitPHR-Timer*;

- cancel all triggered PHR(s).

[TS 36.321, clause 6.1.3.6a]

The Extended Power Headroom MAC control element is identified by a MAC PDU subheader with LCID as specified in table 6.2.1-2. It has a variable size and is defined in Figure 6.1.3.6a-2. When Type 2 PH is reported, the octet containing the Type 2 PH field is included first after the octet indicating the presence of PH per SCell and followed by an octet containing the associated $P_{CMAX,c}$ field (if reported). Then follows in ascending order based on the *ServCellIndex [8]* an octet with the Type 1 PH field and an octet with the associated $P_{CMAX,c}$ field (if reported), for the PCell and for each SCell indicated in the bitmap.

The Extended Power Headroom MAC Control Element is defined as follows:

- $C_i$: this field indicates the presence of a PH field for the SCell with *SCellIndex* i as specified in [8]. The $C_i$ field set to "1" indicates that a PH field for the SCell with *SCellIndex* i is reported. The $C_i$ field set to "0" indicates that a PH field for the SCell with *SCellIndex* 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, V=0 indicates real transmission on PUSCH and V=1 indicates that a PUSCH reference format is used. For Type 2 PH, V=0 indicates real transmission on PUCCH and V=1 indicates that a PUCCH reference format is used. Furthermore, for both Type 1 and Type 2 PH, V=0 indicates the presence of the associated $P_{CMAX,c}$ field, and V=1 indicates that the associated $P_{CMAX,c}$ 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 6.1.3.6-1 (the corresponding measured values in dB can be found in subclause 9.1.8.4 of [9]);

- P: this field indicates whether the UE applies power backoff due to power management (as allowed by P-MPR [10]). The UE shall set P=1 if the corresponding $P_{CMAX,c}$ field would have had a different value if no power backoff due to power management had been applied;

- $P_{CMAX,c}$: if present, this field indicates the $P_{CMAX,c}$ or $\tilde{P}_{CMAX,c}$ [2] used for calculation of the preceding PH field. The reported $P_{CMAX,c}$ and the corresponding nominal UE transmit power levels are shown in Table 6.1.3.6a-1 (the corresponding measured values in dBm can be found in subclause 9.6.1 of [9]).

**Figure 6.1.3.6a-1: Void**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $C_7$ | $C_6$ | $C_5$ | $C_4$ | $C_3$ | $C_2$ | $C_1$ | R |
| P | V | PH (Type 2, PCell) | | | | | |
| R | R | $P_{CMAX,c}$ 1 | | | | | |
| P | V | PH (Type 1, PCell) | | | | | |
| R | R | $P_{CMAX,c}$ 2 | | | | | |
| P | V | PH (Type 1, SCell 1) | | | | | |
| R | R | $P_{CMAX,c}$ 3 | | | | | |
| ... | | | | | | | |
| P | V | PH (Type 1, SCell n) | | | | | |
| R | R | $P_{CMAX,c}$ m | | | | | |

**Figure 6.1.3.6a-2: Extended Power Headroom MAC Control Element**

**Table 6.1.3.6a-1: Nominal UE transmit power level for Extended PHR**

| $P_{CMAX,c}$ | 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 |

#### 7.1.4.19.1.3 Test description

##### 7.1.4.19.1.3.1 Pre-test conditions

System Simulator:

- Cell 1 is the PCell, Cell 3 is the SCell to be added
- Cell 3 is an Active SCell according to [18] cl. 6.3.4

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) on Cell 1 according to [18].

7.1.4.19.1.3.2 Test procedure sequence

**Table 7.1.4.19.1.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits an *RRCConnectionReconfiguration* message with SCell (Cell 3) addition | <-- | *RRCConnectionReconfiguration* | - | - |
| 2 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm SCell (Cell 3) addition. | --> | *RRCConnectionReconfigurationComplete* | - | - |
| 3 | The SS is configured for Uplink Grant Allocation Type 2. SS is configured to transmit UL grant for UE at every TTI for FDD, and every 5ms in a DL subframe for TDD. | - | - | - | - |
| 4 | The SS transmits an *RRCConnectionReconfiguration* message to provide Extended Power Headroom parameters | <-- | *RRCConnectionReconfiguration* | - | - |
| | EXCEPTION: In parallel with step 5, UE executes parallel behaviour defined in table 7.1.4.19.1.3.2-2 | - | - | - | - |
| 5 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm the setup of Extended Power Headroom parameters | --> | *RRCConnectionReconfigurationComplete* | - | - |
| 6 | The SS transmits an Activation MAC control element to activate SCell (Cell 3). | <-- | MAC PDU (Activation ($C_1$=1)) | - | - |
| 7 | Check: Does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 1 | P |
| 8 | Wait for T1= 10% of *prohibitPHR-Timer*. | - | - | - | - |
| 9 | Reduce the PCell (Cell 1) power level so as to cause a DL_Pathloss change at UE by 5dB. | - | - | - | - |
| 10 | Check: for 80% of *prohibitPHR-Timer* since step 7, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 2 | F |
| 11 | Check: after *prohibitPHR-Timer* after step 7, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 3 | P |
| 12 | Increase the PCell (Cell 1) power level so as to cause a DL_Pathloss change at UE by 5dB. | - | - | - | - |
| 13 | Check: for 80% of *prohibitPHR-Timer* since step 11, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 2 | F |
| 14 | Check: after *prohibitPHR-Timer* after step 11, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 3 | P |
| 15 | Reduce the SCell (Cell 3) power level so as to cause a DL_Pathloss change at UE by 5dB. | - | - | - | - |
| 16 | Check: for 80% of *prohibitPHR-Timer* since step 14, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 2 | F |
| 17 | Check: after *prohibitPHR-Timer* after step 14, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 3 | P |
| 18 | Increase the SCell (Cell 3) power level so as to cause a DL_Pathloss change at UE by 5dB. | - | - | - | - |
| 19 | Check: for 80% of *prohibitPHR-Timer* since step 17, does the UE transmit a MAC PDU | --> | MAC PDU | 2 | F |

| | | | | | |
|---|---|---|---|---|---|
| | containing Extended Power Headroom MAC Control Element? | | | | |
| 20 | Check: after *prohibitPHR-Timer* after step 17, does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 3 | P |

**Table 7.1.4.19.1.3.2-2: Parallel behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The UE transmits a MAC PDU containing Extended Power Headroom MAC Control Element. | --> | MAC PDU | - | - |

#### 7.1.4.19.1.3.3 Specific message contents

**Table 7.1.4.19.1.3.3-1: RRCConnectionReconfiguration (step 4, Table 7.1.4.19.1.3.2-1)**

| Derivation path: 36.508 table 4.6.1-8 condition SCell_AddMod | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE { | | | |
| phr-Config CHOICE { | | | |
| setup SEQUENCE { | | | |
| periodicPHR-Timer | infinity | | |
| prohibitPHR-Timer | sf1000 | | |
| dl-PathlossChange | dB3 | | |
| } | | | |
| } | | | |
| mac-MainConfig-v1020 SEQUENCE { | | | |
| extendedPHR-r10 | setup | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.19.2 CA / UE power headroom reporting / SCell activation and DL pathloss change reporting / Extended PHR / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.4.19.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA
- Cells configuration: Cell 10 replaces Cell 3

- Cell 10 is an Active SCell according to [18] cl. 6.3.4.

### 7.1.4.20 CA / Correct handling of MAC control information / Buffer status

#### 7.1.4.20.1 CA / Correct handling of MAC control information / Buffer status / Intra-band Contiguous CA

##### 7.1.4.20.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell configured and activated }
ensure that {
  when { UL data arrives in the UE transmission buffer and UE is scheduled to transmit on both PCell
and SCell in a TTI }
    then { UE transmits two MAC PDUs in a TTI, and one of the MAC PDU includes a Regular BSR,
another MAC PDU includes a padding BSR }
            }
```

(2)

```
with { UE in E-UTRA 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 }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell configured and activated }
ensure that {
  when { periodicBSR-Timer expires and UE is scheduled to transmit on both PCell and SCell in a TTI
}
    then { UE transmits two MAC PDUs in a TTI, and one of the MAC PDU includes a Periodic BSR,
another MAC PDU includes a padding BSR }
            }
```

##### 7.1.4.20.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.3.1 and 5.4.5.

[TS 36.321 clause 5.4.3.1]

For the Logical Channel Prioritization procedure, the UE shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR or Extended PHR;
- data from any Logical Channel, except data from UL-CCCH;
- MAC control element for BSR included for padding.

NOTE: When the UE is requested to transmit multiple MAC PDUs in one TTI, steps 1 to 3 and the associated rules may be applied either to each grant independently or to the sum of the capacities of the grants. Also the order in which the grants are processed is left up to UE implementation. It is up to the UE implementation to decide in which MAC PDU a MAC control element is included when UE is requested to transmit multiple MAC PDUs in one TTI.

[TS 36.321 clause 5.4.5]

The Buffer Status reporting procedure is used to provide the serving eNB with information about the amount of data available for transmission in the UL buffers of the UE. RRC controls BSR reporting by configuring the two timers *periodicBSR-Timer* and *retxBSR-Timer* and by, for each logical channel, optionally signalling *logicalChannelGroup* which allocates the logical channel to an LCG [8].

For the Buffer Status reporting procedure, the UE shall consider all radio bearers which are not suspended and may consider radio bearers which are suspended.

A Buffer Status Report (BSR) shall be triggered if any of the following events occur:

- UL data, for a logical channel which belongs to a LCG, becomes available for transmission in the RLC entity or in the PDCP entity (the definition of what data shall be considered as available for transmission is specified in [3] and [4] respectively) and either the data belongs to a logical channel with higher priority than the priorities of the logical channels which belong to any LCG and for which data is already available for transmission, or there is no data available for transmission for any of the logical channels which belong to a LCG, 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 control element plus its subheader, in which case the BSR is referred below to as "Padding BSR";
- *retxBSR-Timer* expires and the UE has data available for transmission for any of the logical channels which belong to a LCG, 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 and Periodic BSR:

- if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Long BSR;
- else report Short BSR.

For Padding BSR:

- 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:
  - if more than one LCG has data available for transmission in the TTI where the BSR is transmitted: report Truncated BSR of the LCG with the highest priority logical channel with data available for transmission;
  - else report Short BSR.
- else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader, report Long BSR.

If the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

- if the UE has UL resources allocated for new transmission for this TTI:
  - instruct the Multiplexing and Assembly procedure to generate the BSR MAC control element(s);
  - start or restart *periodicBSR-Timer* except when all the generated BSRs are Truncated BSRs;
  - start or restart *retxBSR-Timer*.
- else if a Regular BSR has been triggered:
  - if an uplink grant is not configured or the Regular BSR was not triggered due to data becoming available for transmission for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:
    - a Scheduling Request shall be triggered.

A MAC PDU shall contain at most one MAC BSR control element, even when multiple events trigger a BSR by the time a BSR can be transmitted in which case the Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The UE shall restart *retxBSR-Timer* upon indication of a grant for transmission of new data on any UL-SCH.

All triggered BSRs shall be cancelled in case the UL grant(s) in this subframe 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 UE shall transmit at most one Regular/Periodic BSR in a TTI. If the UE is requested to transmit multiple MAC PDUs in a TTI, it may include a padding BSR in any of the MAC PDUs which do not contain a Regular/Periodic BSR.

All BSRs transmitted in a TTI always reflect the buffer status after all MAC PDUs have been built for this TTI. Each LCG shall report at the most one buffer status value per TTI and this value shall be reported in all BSRs reporting buffer status for this LCG.

NOTE: A Padding BSR is not allowed to cancel a triggered Regular/Periodic BSR. A Padding BSR is triggered for a specific MAC PDU only and the trigger is cancelled when this MAC PDU has been built.

#### 7.1.4.20.1.3 Test description

##### 7.1.4.20.1.3.1 Pre-test conditions

System Simulator :

- Cell 1(PCell), Cell 3 (SCell)
- Cell 3 is an Active SCell according to [18] cl. 6.3.4.
- RRC Connection Reconfiguration (preamble: Table 4.5.3.3-1, step 8) using parameters as specified in Table 7.1.4.20.1.3.3-1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].
- The condition SRB2-DRB(2,0) is used for step 8 in 4.5.3A.3 according to [18].
- 2 AM DRBS are configured with the parameters specified in table 7.1.4.20.1-1.

**Table 7.1.4.20.1-1: Logical Channel Configuration Settings**

| Parameter | DRB1 | DRB2 |
|---|---|---|
| LogicalChannel-Identity | 3 | 4 |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.4.20.1.3.2 Test procedure sequence

**Table 7.1.4.20.1.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits an *RRCConnectionReconfiguration* message with SCell (Cell 3) addition | <-- | *RRCConnectionReconfiguration* | - | - |
| 2 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm SCell (Cell 3) addition. | --> | *RRCConnectionReconfigurationComplete* | - | - |
| 3 | The SS transmits an Activation MAC control element to activate SCell (Cell 3). | <-- | MAC PDU (Activation ($C_1$=1)) | - | - |
| - | EXCEPTION: Steps 4 and 5 shall be repeated for 2 times | - | - | - | - |
| 4 | The SS transmits a MAC PDU including an RLC SDU of size 12 bytes. | <-- | MAC PDU (RLC SDU on LC3) | - | |
| 5 | The SS transmits a MAC PDU including an RLC SDU of size 12 bytes. | <-- | MAC PDU (RLC SDU on LC4) | - | |
| 6 | UE transmits a Scheduling Request on PUCCH. | --> | (SR) | - | - |
| 7 | The SS sends two uplink grants with same size of 136 bits for Cell 1 and Cell 3 in the same TTI (Note2) | <-- | (UL grant) | - | - |
| 8 | Check: Does the UE transmit a MAC PDU containing an RLC SDU and a short BSR and another MAC PDU containing an RLC SDU and a padding BSR in a TTI? | --> | MAC PDU (Short BSR header (LCID='11101'), MAC sub-header (E='0', F='0'), Short BSR, AMD PDU),<br>MAC PDU (Short BSR header (LCID='11101'),MAC sub-header(E='0', F='0'),, Short BSR, AMD PDU) | 1 | P |
| 8a | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDUs in step 8 | <-- | MAC PDU | - | - |
| 9 | The SS sends two uplink grants with same size of 152 bits for both Cell 1 and Cell 3 in the same TTI (Note 3) | <-- | (UL grant) | - | - |
| 10 | Check: Does the UE transmit two MAC PDUs, both containing an RLC SDU and a long padding BSR in a TTI? | --> | MAC PDU (Long BSR header (LCID='11110'), MAC sub-header, Long BSR, RLC SDU)<br><br>MAC PDU (Long BSR header (LCID='11110'), Long BSR, RLC SDU) | 2 | P |
| 10a | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDUs in step 10 | <-- | MAC PDU | - | - |
| - | EXCEPTION: Steps 11 and 12 shall be repeated for 2 times | - | - | - | - |
| 11 | The SS transmits a MAC PDU including an RLC SDU of size 12 bytes. | <-- | MAC PDU (RLC SDU on LC3) | - | |
| 12 | The SS transmits a MAC PDU including an RLC SDU of size 12 bytes. | <-- | MAC PDU (RLC SDU on LC4) | - | |
| 13 | UE transmits a Scheduling Request on PUCCH. | --> | (SR) | - | - |
| 14 | The SS is configured for Uplink Grant Allocation Type 2. The SS sends an uplink grant of size 32 bits.(Note 1) | <-- | (UL grant) | - | - |
| 15 | 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') | - | - |
| 16 | Wait for periodicBSR-Timer expiry. | - | - | - | - |
| 17 | The SS sends two uplink grants with same size of 136 bits for Cell 1 and Cell 3 in the same TTI (Note2) | <-- | (UL grant) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| 18 | Check: Does UE transmit a MAC PDU containing a Short BSR with 'LCG ID' field set to '10' (logicalChannelGroup 1) and Buffer Size Index > 0 and another MAC PDU containing an RLC SDU and a padding BSR in a TTI? | --> | MAC PDU (Short BSR header (LCID='11101'),', Short BSR, (LCG ID= '10', Buffer Size index > 0), AMD PDU)<br><br>MAC PDU (Short BSR, (LCID='11101'),MAC sub-header, Short BSR,AMD PDU) | 3 | P |
| 18a | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDUs in step 18 | <-- | MAC PDU | - | - |
| 19 | The SS sends two uplink grants with same size of 152 bits for both Cell 1 and Cell 3 in the same TTI (Note 3) | <-- | (UL grant) | - | - |
| 20 | Check: Does the UE transmit two MAC PDUs, both containing an RLC SDU and a long padding BSR in a TTI?? | --> | MAC PDU (Long BSR header (LCID='11110'), Long BSR, RLC SDU)<br><br>MAC PDU (Long BSR header (LCID='11110'), Long BSR, RLC SDU) | 2 | P |
| 21 | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDUs in step 21 | <-- | MAC PDU | - | - |
| Note 1: SS transmit an UL grant of 32 bits ($I_{TBS}$=0, $N_{PRB}$=2, TS 36.213 Table 7.1.7.2.1-1) to allow UE to transmit a Regular BSR triggered by the new data received logicalChannelGroup 1 and 2 in steps 2 and 3. This to enable testing of Padding BSR which has lower priority than Regular BSR.<br>Note 2: UL grant of 136 bits ($I_{TBS}$=9, $N_{PRB}$=1, TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding bits will be equal to or larger than the size of Short/Truncated BSR and smaller than Long BSR. RLC SDU size is 12 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 2 bytes (1 byte for MAC SDU sub-header using R/R/E/LCID for last sub header and 1 byte for BSR sub-header) and size of Short BSR/Truncated BSR is one byte, i.e. setting UL grant to 17 bytes (136 bits) enable UE to include Short/Truncated BSR.<br>Note 3: UL grant of 152 bits ($I_{TBS}$=0, $N_{PRB}$=6, TS 36.213 Table 7.1.7.2.1-1) is chosen such that the MAC PDU padding bits will be equal to or larger than the size of Long BSR. RLC SDU size is 12 bytes, size of AMD PDU header is 2 bytes, size of MAC header is 2 bytes (1 byte for MAC SDU sub-header using R/R/E/LCID for last sub header and 1 byte for BSR sub-header) and size of Long BSR is 3 bytes, i.e. setting UL grant to 19 bytes (152 bits) enable UE to include padding Long BSR. | | | | | |

#### 7.1.4.20.1.3.3 Specific Message Contents

**Table 7.1.4.20.1.3.3-1: *RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicit SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n5 | | |
| periodicBSR-Timer | sf10 | | |
| retxBSR-Timer | sf10240 | | |
| ttiBundling | FALSE | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

#### 7.1.4.20.2 CA / Correct handling of MAC control information / Buffer status / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.4.20.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA
- Cells configuration: Cell 10 replaces Cell 3
- Cell 10 is an Active SCell according to [18] cl. 6.3.4

### 7.1.4.21 CA / UE power headroom reporting / Extended PHR

#### 7.1.4.21.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established Extended PHR reporting configured }
ensure that {
  when { periodicPHR-Timer is configured in RRCConnectionReconfiguration procedure }
    then { UE transmits a MAC PDU containing Extended Power Headroom MAC Control Element }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established, Extended PHR reporting configured }
ensure that {
  when { periodicPHR-Timer expires and UL resources allocated for new transmission }
    then { UE transmits a MAC PDU containing Extended Power Headroom MAC Control Element }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established }
ensure that {
  when { Extended power headroom reporting is disabled }
    then { UE stops transmitting Extended Power Headroom MAC Control Element }
            }
```

#### 7.1.4.21.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321 clause 5.4.6 and 6.1.3.6a.

[TS 36.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving eNB with information about the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell and also with information about the difference between the nominal UE maximum power and the estimated power for UL-SCH and PUCCH transmission on PCell.

The reporting period, delay and mapping of Power Headroom are defined in subclause 9.1.8 of [9]. RRC controls Power Headroom reporting by configuring the two timers *periodicPHR-Timer* and *prohibitPHR-Timer*, and by signalling *dl-PathlossChange* which sets the change in measured downlink pathloss and the required power backoff due to power management (as allowed by P-MPRc [10]) to trigger a PHR [8].

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *prohibitPHR-Timer* expires or has expired and the path loss has changed more than *dl-PathlossChange* dB for at least one activated Serving Cell which is used as a pathloss reference since the last transmission of a PHR when the UE has UL resources for new transmission;
- *periodicPHR-Timer* expires;
- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers [8], which is not used to disable the function;
- activation of an SCell with configured uplink.

- *prohibitPHR-Timer* expires or has expired, when the UE has UL resources for new transmission, and the following is true in this TTI for any of the active Serving Cells 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-MPR$_c$ [10]) for this cell has changed more than *dl-PathlossChange* dB since the last transmission of a PHR when the UE had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE: The UE 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 $P_{CMAX,c}$/PH when a PHR is triggered by other triggering conditions.

If the UE has UL resources allocated for new transmission for this TTI:

- if it is the first UL resource allocated for a new transmission since the last MAC reset, start *periodicPHR-Timer*;
- if the Power Headroom reporting procedure determines that at least one PHR has been triggered since the last transmission of a PHR or this is the first time that a PHR is triggered, and;
- if the allocated UL resources can accommodate a PHR MAC control element plus its subheader if *extendedPHR* is not configured, or the Extended PHR MAC control element plus its subheader if *extendedPHR* is configured, as a result of logical channel prioritization:
    - if *extendedPHR* is configured:
        - for each activated Serving Cell with configured uplink:
            - obtain the value of the Type 1 power headroom;
            - if the UE has UL resources allocated for transmission on this Serving Cell for this TTI:
                - obtain the value for the corresponding $P_{CMAX,c}$ field from the physical layer;
        - if simultaneousPUCCH-PUSCH is configured:
            - obtain the value of the Type 2 power headroom for the PCell;
            - if the UE has a PUCCH transmission in this TTI:
                - obtain the value for the corresponding $P_{CMAX,c}$ field from the physical layer;
        - instruct the Multiplexing and Assembly procedure to generate and transmit an Extended PHR MAC control element as defined in subclause 6.1.3.6a based on the values reported by the physical layer;
    - else:
        - obtain the value of the Type 1 power headroom from the physical layer;
        - instruct the Multiplexing and Assembly procedure to generate and transmit a PHR MAC control element as defined in subclause 6.1.3.6 based on the value reported by the physical layer;
    - start or restart *periodicPHR-Timer*;
    - start or restart *prohibitPHR-Timer*;
    - cancel all triggered PHR(s).

[TS 36.321, clause 6.1.3.6a]

The Extended Power Headroom MAC control element is identified by a MAC PDU subheader with LCID as specified in table 6.2.1-2. It has a variable size and is defined in Figure 6.1.3.6a-2. When Type 2 PH is reported, the octet containing the Type 2 PH field is included first after the octet indicating the presence of PH per SCell and followed by an octet containing the associated $P_{CMAX,c}$ field (if reported). Then follows in ascending order based on the *ServCellIndex [8]* an octet with the Type 1 PH field and an octet with the associated $P_{CMAX,c}$ field (if reported), for the PCell and for each SCell indicated in the bitmap.

The Extended Power Headroom MAC Control Element is defined as follows:

- $C_i$: this field indicates the presence of a PH field for the SCell with *SCellIndex* i as specified in [8]. The $C_i$ field set to "1" indicates that a PH field for the SCell with *SCellIndex* i is reported. The $C_i$ field set to "0" indicates that a PH field for the SCell with *SCellIndex* 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, V=0 indicates real transmission on PUSCH and V=1 indicates that a PUSCH reference format is used. For Type 2 PH, V=0 indicates real transmission on PUCCH and V=1 indicates that a PUCCH reference format is used. Furthermore, for both Type 1 and Type 2 PH, V=0 indicates the presence of the associated $P_{CMAX,c}$ field, and V=1 indicates that the associated $P_{CMAX,c}$ 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 6.1.3.6-1 (the corresponding measured values in dB can be found in subclause 9.1.8.4 of [9]);

- P: this field indicates whether the UE applies power backoff due to power management (as allowed by P-MPR [10]). The UE shall set P=1 if the corresponding $P_{CMAX,c}$ field would have had a different value if no power backoff due to power management had been applied;

- $P_{CMAX,c}$: if present, this field indicates the $P_{CMAX,c}$ or $\tilde{P}_{CMAX,c}$ [2] used for calculation of the preceding PH field. The reported $P_{CMAX,c}$ and the corresponding nominal UE transmit power levels are shown in Table 6.1.3.6a-1 (the corresponding measured values in dBm can be found in subclause 9.6.1 of [9]).

**Figure 6.1.3.6a-1: Void**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $C_7$ | $C_6$ | $C_5$ | $C_4$ | $C_3$ | $C_2$ | $C_1$ | R |
| P | V | PH (Type 2, PCell) | | | | | |
| R | R | $P_{CMAX,c}$ 1 | | | | | |
| P | V | PH (Type 1, PCell) | | | | | |
| R | R | $P_{CMAX,c}$ 2 | | | | | |
| P | V | PH (Type 1, SCell 1) | | | | | |
| R | R | $P_{CMAX,c}$ 3 | | | | | |

...

| | | |
|---|---|---|
| P | V | PH (Type 1, SCell n) |
| R | R | $P_{CMAX,c}$ m |

**Figure 6.1.3.6a-2: Extended Power Headroom MAC Control Element**

**Table 6.1.3.6a-1: Nominal UE transmit power level for Extended PHR**

| $P_{CMAX,c}$ | 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. 4.15.3 Test description

#### 7.1.4.21.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) on Cell 1 according to [18].

#### 7.1.4.21.3.2 Test procedure sequence

**Table 7.1.4.21.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS is configured for Uplink Grant Allocation Type 2. The SS transmits UL grant for the UE at every TTI for FDD and every 5ms in a DL subframe for TDD. | --> | - | - | - |
| 2 | The SS transmits an *RRCConnectionReconfiguration* message to provide Extended Power Headroom parameters | <-- | - | - | - |
| 3 | Check: does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element? | --> | MAC PDU | 1 | P |
| 4 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm the setup of Extended Power Headroom parameters. | --> | - | - | - |
| 5 | Check: does the UE transmit a MAC PDU containing Extended Power Headroom MAC Control Element 200ms after step 3? | --> | MAC PDU | 2 | P |
| 6 | The SS transmits an *RRCConnectionReconfiguration* message to disable Extended Power Headroom reporting | <-- | - | - | - |
| 7 | The UE transmits an *RRCConnectionReconfigurationComplete* message to confirm the disabling of Extended Power Headroom parameters | --> | - | - | - |
| 8 | Check: for 2 seconds, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? | --> | MAC PDU | 3 | F |
| Note: Steps 3 and 4 can happen in 2 MAC PDU's, or may be combined in one MAC PDU. | | | | | |

#### 7.1.4.21.3.3 Specific message contents

**Table 7.1.4.21.3.3-1: RRCConnectionReconfiguration (step 2, Table 7.1.4.21.3.2-1)**

| Derivation path: 36.508 table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE { | | | |
| phr-Confign CHOICE { | | | |
| setup SEQUENCE { | | | |
| periodicPHR-Timer | sf200 | | |
| prohibitPHR-Timer | sf1000 | | |
| dl-PathlossChange | infinity | | |
| } | | | |
| } | | | |
| mac-MainConfig-v1020 SEQUENCE { | | | |
| extendedPHR-r10 | setup | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.4.21.3.3-2: RRCConnectionReconfiguration (step 6, Table 7.1.4.21.3.2-1)**

| Derivation path: 36.508 table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue SEQUENCE { | | | |
| phr-Config CHOICE { | | | |
| release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.4.22 Correct HARQ process handling / UL MIMO

#### 7.1.4.22.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and UL MIMO configured }
ensure that {
  when { UE receives one uplink grant (DCI format 4) with toggled NDI and two transport blocks
enabled, and has data available for transmission }
    then { UE transmits two new MAC PDUs both using redundancy version 0 for two HARQ processes in a
TTI }
```

```
}
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted two MAC PDUs
less than maxHARQ-Tx times }
ensure that {
  when { UE receives NACKs for two HARQ processes and no uplink grant is included for the next TTI
corresponding to the two HARQ processes }
    then { UE performs non-adaptive retransmission of the two MAC PDUs with redundancy version
toggled by one of the last (re)transmission [0,2,3,1 order] }
}
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted two MAC PDUs
less than maxHARQ-Tx times }
ensure that {
  when { UE receives NACK for one of the HARQ process and ACK for another HARQ process and no uplink
grant is included for the next TTI corresponding to the HARQ processes }
    then { UE performs non-adaptive retransmission of the MAC PDU with redundancy version toggled by
one of the last (re)transmission [0,2,3,1 order] for the HARQ process that receives NACK and does
not retransmit any MAC PDUs for another HARQ process that receives ACK }
}
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted two MAC PDUs
less than maxHARQ-Tx times }
ensure that {
  when { UE receives an uplink grant on PDCCH for the next TTI corresponding to the two HARQ
processes with old NDI [not toggled] for one HARQ process and with toggled NDI for another HARQ
process, irrespective of ACK/NACK is received for previous (re)transmission }
    then { UE performs an adaptive retransmission of the MAC PDU with redundancy version as received
on PDCCH for HARQ process with old NDI and transmits a new MAC PDU for HARQ process with new NDI }
}
```

(5)

```
with { UE in E-UTRA RRC_CONNECTED state with DRB established and having transmitted two MAC PDU less
than maxHARQ-Tx times }
ensure that {
  when { UE receives ACKs and no uplink grant is included for the next TTI corresponding to the two
HARQ processes }
    then { UE does not retransmit any MAC PDUs for the two HARQ processes }
}
```

### 7.1.4.22.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.4.2.1 & 5.4.2.2; TS 36.212, clause 5.3.3.1.8.

[TS 36.321, clause 5.4.2.1]

There is one HARQ entity at the UE for each Serving Cell with configured uplink, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for the HARQ feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes per HARQ entity is specified in [2], clause 8.

When the physical layer is configured for uplink spatial multiplexing [2], there are two HARQ processes associated with a given TTI. Otherwise there is one HARQ process associated with a given TTI.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process(es) for which a transmission should take place. It also routes the received HARQ feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process(es).

When TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. TTI 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 non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The HARQ feedback of a bundle is only received for the last TTI of the bundle (i.e the TTI corresponding to TTI_BUNDLE_SIZE), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle. TTI bundling is not supported when the UE is configured with one or more SCells with configured uplink.

TTI bundling is not supported for RN communication with the E-UTRAN in combination with an RN subframe configuration.

For transmission of Msg3 during Random Access (see section 5.1.5) TTI bundling does not apply.

For each TTI, the HARQ entity shall:

- identify the HARQ process(es) associated with this TTI, and for each identified HARQ process:
    - if an uplink grant has been indicated for this process and this TTI:
        - if the received grant was not addressed to a Temporary C-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or
        - if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or
        - if the uplink grant was received in a Random Access Response:
            - if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:
                - obtain the MAC PDU to transmit from the Msg3 buffer.
            - else:
                - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
            - deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;
            - instruct the identified HARQ process to trigger a new transmission.
        - else:
            - deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;
            - instruct the identified HARQ process to generate an adaptive retransmission.
    - else, if the HARQ buffer of this HARQ process is not empty:
        - instruct the identified HARQ process to generate a non-adaptive retransmission.

When determining if NDI has been toggled compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 36.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

Each HARQ process shall maintain a state variable CURRENT_TX_NB, which indicates the number of transmissions that have taken place for the MAC PDU currently in the buffer, and a state variable HARQ_FEEDBACK, which indicates the HARQ feedback for the MAC PDU currently in the buffer. When the HARQ process is established, CURRENT_TX_NB shall be initialized to 0.

The sequence of redundancy versions is 0, 2, 3, 1. The variable CURRENT_IRV is an index into the sequence of redundancy versions. This variable is up-dated modulo 4.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or Random Access Response. Adaptive retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH. Non-adaptive retransmission is performed on the same resource and with the same MCS as was used for the last made transmission attempt.

The UE is configured with a Maximum number of HARQ transmissions and a Maximum number of Msg3 HARQ transmissions by RRC: *maxHARQ-Tx* and *maxHARQ-Msg3Tx* respectively. For transmissions on all HARQ processes and all logical channels except for transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Tx*. For transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Msg3Tx*.

When the HARQ feedback is received for this TB, the HARQ process shall:

- set HARQ_FEEDBACK to the received value.

If the HARQ entity requests a new transmission, the HARQ process shall:

- set CURRENT_TX_NB to 0;
- set CURRENT_IRV to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- set HARQ_FEEDBACK to NACK;
- generate a transmission as described below.

If the HARQ entity requests a retransmission, the HARQ process shall:

- increment CURRENT_TX_NB by 1;
- if the HARQ entity requests an adaptive retransmission:
  - store the uplink grant received from the HARQ entity;
  - set CURRENT_IRV to the index corresponding to the redundancy version value provided in the HARQ information;
  - set HARQ_FEEDBACK to NACK;
  - generate a transmission as described below.
- else if the HARQ entity requests a non-adaptive retransmission:
  - if HARQ_FEEDBACK = NACK:
    - generate a transmission as described below.

NOTE 1: When receiving a HARQ ACK alone, the UE keeps the data in the HARQ buffer.

NOTE 2: When no UL-SCH transmission can be made due to the occurrence of a measurement gap, no HARQ feedback can be received and a non-adaptive retransmission follows.

To generate a transmission, the HARQ process shall:

- if the MAC PDU was obtained from the Msg3 buffer; or
- 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 in this TTI:
  - instruct the physical layer to generate a transmission according to the stored uplink grant with the redundancy version corresponding to the CURRENT_IRV value;
  - increment CURRENT_IRV by 1;

- if there is a measurement gap at the time of the HARQ feedback reception for this transmission and if the MAC PDU was not obtained from the Msg3 buffer:
  - set HARQ_FEEDBACK to ACK at the time of the HARQ feedback reception for this transmission.

After performing above actions, the HARQ process then shall:

- if CURRENT_TX_NB = maximum number of transmissions – 1:
  - flush the HARQ buffer.

[TS 36.212, clause 5.3.3.1.8]

DCI format 4 is used for the scheduling of PUSCH in one UL cell with multi-antenna port transmission mode,

The following information is transmitted by means of the DCI format 4:

- Carrier indicator – 0 or 3 bits. The field is present according to the definitions in [3].
- Resource block assignment - $\max\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil, \left\lceil \log_2\left(\binom{\lceil N_{RB}^{UL}/P+1\rceil}{4}\right)\right\rceil\right)$ bits,
- where P is the UL RBG size as defined in section 8.1.2 of [3]
- For resource allocation type 0:
- The $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil\right)$ LSBs provide the resource allocation in the UL subframe as defined in section 8.1.1 of [3]
- For resource allocation type 1:
  - The $\left\lceil \log_2\left(\binom{\lceil N_{RB}^{UL}/P+1\rceil}{4}\right)\right\rceil$ LSBs provide the resource allocation in the UL subframe as defined in section 8.1.2 of [3]
- TPC command for scheduled PUSCH – 2 bits as defined in section 5.1.1.1 of [3]
- Cyclic shift for DM RS and OCC index – 3 bits as defined in section 5.5.2.1.1 of [2]
- UL index – 2 bits as defined in sections 5.1.1.1, 7.2.1, 8 and 8.4 of [3] (this field is present only for TDD operation with uplink-downlink configuration 0)
- Downlink Assignment Index (DAI) – 2 bits as defined in section 7.3 of [3] (this field is present only for TDD operation with uplink-downlink configurations 1-6)
- CSI request – 1 or 2 bits as defined in section 7.2.1 of [3]. The 2-bit field only applies to UEs that are configured with more than one DL cell.
- SRS request – 2 bits as defined in section 8.2 of [3]
- Resource allocation type – 1 bit as defined in section 8.1 of [3]

In addition, for transport block 1:

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit

In addition, for transport block 2:

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]

- New data indicator – 1 bit

Precoding information and number of layers: number of bits as specified in Table 5.3.3.1.8-1. Bit field as shown in Table 5.3.3.1.8-2 and Table 5.3.3.1.8- 3. Note that TPMI for 2 antenna ports indicates which codebook index is to be used in Table 5.3.3A.2-1 of [2], and TPMI for 4 antenna ports indicates which codebook index is to be used in Table 5.3.3A.2-2, Table 5.3.3A.2-3, Table 5.3.3A.2-4 and Table 5.3.3A.2-5 of [2]. If both transport blocks are enabled, transport block 1 is mapped to codeword 0; and transport block 2 is mapped to codeword 1. In case one of the transport blocks is disabled, the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2. For a single enabled codeword, indices 24 to 39 in Table 5.3.3.1.8-3 are only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two layers.

**Table 5.3.3.1.8-1: Number of bits for precoding information**

| Number of antenna ports at UE | Number of bits for precoding information |
|---|---|
| 2 | 3 |
| 4 | 6 |

**Table 5.3.3.1.8-2: Content of precoding information field for 2 antenna ports**

| One codeword:<br>Codeword 0 enabled<br>Codeword 1 disabled | | Two codewords:<br>Codeword 0 enabled<br>Codeword 1 enabled | |
|---|---|---|---|
| **Bit field mapped to index** | **Message** | **Bit field mapped to index** | **Message** |
| 0 | 1 layer: TPMI=0 | 0 | 2 layers: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1-7 | reserved |
| 2 | 1 layer: TPMI=2 | | |
| … | … | | |
| 5 | 1 layer: TPMI=5 | | |
| 6-7 | reserved | | |

**Table 5.3.3.1.8-3: Content of precoding information field for 4 antenna ports**

| One codeword:<br>Codeword 0 enabled<br>Codeword 1 disabled | | Two codewords:<br>Codeword 0 enabled<br>Codeword 1 enabled | |
|---|---|---|---|
| **Bit field mapped to index** | **Message** | **Bit field mapped to index** | **Message** |
| 0 | 1 layer: TPMI=0 | 0 | 2 layers: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 2 layers: TPMI=1 |
| … | … | … | … |
| 23 | 1 layer: TPMI=23 | 15 | 2 layers: TPMI=15 |
| 24 | 2 layers: TPMI=0 | 16 | 3 layers: TPMI=0 |
| 25 | 2 layers: TPMI=1 | 17 | 3 layers: TPMI=1 |
| … | … | … | … |
| 39 | 2 layers: TPMI=15 | 27 | 3 layers: TPMI=11 |
| 40-63 | reserved | 28 | 4 layers: TPMI=0 |
| | | 29 - 63 | Reserved |

If the number of information bits in format 4 is equal to the payload size for DCI format 1, 2, 2A, 2B or 2C associated with the configured DL transmission mode in the same serving cell, one zero bit shall be appended to format 4.

#### 7.1.4.22.3 Test description

##### 7.1.4.22.3.1 Pre-test conditions

System Simulator:

- Cell 1

- System information takes into account the parameters in table 7.1.2.11.3.1-1.

UE:

UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18] using parameters as specified in Table 7.1.4.22.3.3-1 and 7.1.4.22.3.3-2.
- The loop back size is set in such a way that one RLC SDU in DL shall result in 1 RLC SDU's in UL.
- No UL Grant is allocated; PUCCH is in synchronised state for sending Scheduling Requests.

#### 7.1.4.22.3.2 Test procedure sequence

**Table 7.1.4.22.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits one MAC PDU including two RLC SDUs | <-- | MAC PDU (2 RLC SDUs) | - | - |
| 2 | The SS transmits one UL Grant sufficient for transmitting loop back two RLC SDUs for two HARQ process X and Y, and both NDI indicate new transmission. | <-- | Uplink Grant<br>DCI: (DCI Format 4, redundancy version#1= 0, redundancy version#2= 0) | - | - |
| 3 | Check: Does the UE transmit two MAC PDUs both including one RLC SDU in HARQ process X and Y in a TTI, both redundancy version 0?<br>(Note 1) | --> | Transport block 1:<br>MAC PDU<br>Transport block 2:<br>MAC PDU | 1 | P |
| 4 | The SS transmits two NACKs for HARQ process X and Y | <-- | HARQ NACK#X<br>HARQ NACK#Y | - | - |
| 5 | Check: Does the UE retransmit the MAC PDUs for HARQ process X and Y, redundancy version 2?<br>(Note 1) | --> | Transport block 1:<br>MAC PDU<br>Transport block 2:<br>MAC PDU | 2 | P |
| 6 | The SS transmits a NACK for HARQ process X and ACK for HARQ process Y | <-- | HARQ NACK#X<br>HARQ ACK#Y | - | - |
| 7 | Check: Does the UE retransmit the MAC PDU for HARQ process X, redundancy version 3?<br>(Note 1) | --> | Transport block 1:<br>MAC PDU | 3 | P |
| 8 | The SS transmits ACK for HARQ process X | <-- | HARQ ACK#X | - | - |
| 9 | Check: Does the UE retransmit the MAC PDUs for HARQ process X and Y? | --> | Transport block 1:<br>MAC PDU<br>Transport block 2:<br>MAC PDU | 5 | F |
| 10 | The SS transmits one MAC PDU including one RLC SDU | <-- | MAC PDU (1 RLC SDU) | - | - |
| 11 | The SS transmits one UL grant for HARQ process X and Y, with NDI not toggled and redundancy version to be used as '1' for process X, with NDI toggled and redundancy version to be used as '3' for process Y | <-- | Uplink Grant | - | - |
| 12 | Check: Does the UE retransmit the MAC PDU for HARQ process X using redundancy version 1 and transmit a new MAC PDU sent by SS in step 10 for HARQ process Y using redundancy version 3?<br>(Note 1) | --> | Transport block 1:<br>MAC PDU (redundancy version 1)<br>Transport block 2:<br>MAC PDU (redundancy version 3) | 4 | P |
| Note 1: Transmission of a UL MAC PDU with a specific redundancy version by the UE is implicitly tested by receiving the UL MAC PDU correctly at SS. | | | | | |

#### 7.1.4.22.3.3 Specific message contents

**Table 7.1.4.22.3.3-1: MAC-MainConfig {*RRCConnectionReconfiguration* (preamble: Table 4.5.3.3-1, step 8)}**

| Derivation path: 36.508 table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| MAC-MainConfig-RBC ::= SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n6 | | |
| } | | | |
| } | | | |

**Table 7.1.4.22.3.3-2: RLC-Config-DRB-AM {*RRCConnectionReconfiguration (*preamble: Table 4.5.3.3-1, step 8)}**

| Derivation path: 36.508 clause 4.8.2.1.3.2, Table 4.8.2.1.3.2-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RLC-Config-DRB-AM ::= CHOICE { | | | |
| am SEQUENCE { | | | |
| ul-AM-RLC SEQUENCE { | | | |
| t-PollRetransmit | ms250 | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.5 PUSCH Hopping

### 7.1.5.1 Inter-TTI PUSCH hopping by uplink grant

#### 7.1.5.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state and 'Hopping-mode' is set to 'InterSubFrame'}
ensure that {
  when { UE receives for a TTI an uplink grant with 'Hopping flag' set as 1, 'N_UL_hop' bits indicating
Type 1 PUSCH Hopping }
    then { UE transmits UL data on resource blocks as per type 1 PUSCH hopping}
      }
```

#### 7.1.5.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 36.212 clause 5.3.3.1.1 and 36.213 clause 8.4, 8.4.1 & 8.4,2.

[TS 36.212, clause 5.3.3.1.1]

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \rceil$ bits
  - For PUSCH hopping:
    - $N_{UL\_hop}$ MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]

- $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil - N_{\mathrm{UL\_hop}}\right)$ bits provide the resource allocation of the first slot in the UL subframe

- For non-hopping PUSCH:

- $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil\right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]

[TS 36.213, clause 8.4]

The UE shall perform PUSCH frequency hopping if the single bit frequency hopping (FH) field in a corresponding PDCCH with DCI format 0 is set to 1 otherwise no PUSCH frequency hopping is performed.

A UE performing PUSCH frequency hopping shall determine its PUSCH resource allocation (RA) for the first slot of a subframe (*S1*) including the lowest index PRB ( $n_{PRB}^{S1}(n)$ ) in subframe $n$ from the resource allocation field in the latest PDCCH with DCI format 0 for the same transport block. If there is no PDCCH for the same transport block, the UE shall determine its hopping type based on

- the hopping information in the most recent semi-persistent scheduling assignment PDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled or

- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The resource allocation field in DCI format 0 excludes either 1 or 2 bits used for hopping information as indicated by Table 8.4-1 below where the number of PUSCH resource blocks is defined as

$$N_{RB}^{PUSCH} = \begin{cases} N_{RB}^{UL} - \tilde{N}_{RB}^{HO} - \left(N_{RB}^{UL} \bmod 2\right) & \text{Type1 PUSCH hopping} \\ N_{RB}^{UL} & \text{Type2 } \mathrm{N_{sb}} = 1 \text{ PUSCH hopping} \\ N_{RB}^{UL} - \tilde{N}_{RB}^{HO} & \text{Type2 } \mathrm{N_{sb}} > 1 \text{ PUSCH hopping} \end{cases}$$

For type 1 and type 2 PUSCH hopping, $\tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} = N_{\mathrm{RB}}^{\mathrm{HO}} + 1$ if $N_{\mathrm{RB}}^{\mathrm{HO}}$ is an odd number where $N_{\mathrm{RB}}^{\mathrm{HO}}$ defined in [3]. $\tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} = N_{\mathrm{RB}}^{\mathrm{HO}}$ in other cases. The size of the resource allocation field in DCI format 0 after excluding either 1 or 2 bits shall be $y = \left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil - N_{UL\_hop}$, where $N_{UL\_hop}$ = 1 or 2 bits. The number of contiguous RBs that can be assigned to a type-1 hopping user is limited to $\left\lfloor 2^y / N_{\mathrm{RB}}^{\mathrm{UL}} \right\rfloor$. The number of contiguous RBs that can be assigned to a type-2 hopping user is limited to $\min\left(\left\lfloor 2^y / N_{\mathrm{RB}}^{\mathrm{UL}} \right\rfloor, \left\lfloor N_{\mathrm{RB}}^{\mathrm{PUSCH}} / N_{sb} \right\rfloor\right)$,where the number of sub-bands $N_{\mathrm{sb}}$ is given by higher layers.

A UE performing PUSCH frequency hopping shall use one of two possible PUSCH frequency hopping types based on the hopping information. PUSCH hopping type 1 is described in section 8.4.1 and type 2 is described in section 8.4.2.

**Table 8.4-1: Number of Hopping Bits $N_{UL\_hop}$ vs. System Bandwidth**

| System BW $N_{RB}^{UL}$ | #Hopping bits for 2nd slot RA ($N_{UL\_hop}$) |
|---|---|
| 6-49 | 1 |
| 50-110 | 2 |

The parameter *Hopping-mode* provided by higher layers determines if PUSCH frequency hopping is "inter-subframe" or "intra and inter-subframe".

[TS 36.213, clause 8.4.1]

For PUSCH hopping type 1 the hopping bit or bits indicated in Table 8.4-1 determine $\tilde{n}_{PRB}(i)$ as defined in Table 8.4-2. The lowest index PRB ( $n_{PRB}^{S1}$ ) of the 1st slot RA in subframe $i$ is defined as $n_{PRB}^{S1}(i) = \tilde{n}_{PRB}^{S1}(i) + \tilde{N}_{\mathrm{RB}}^{\mathrm{HO}}/2$ , where $n_{PRB}^{S1}(i) = RB_{START}$ , and $RB_{\mathrm{START}}$ is obtained from the uplink scheduling grant as in Section 8.4 and Section 8.1.

The lowest index PRB ( $n_{PRB}(i)$ ) of the 2nd slot RA in subframe $i$ is defined as $n_{PRB}(i) = \tilde{n}_{PRB}(i) + \tilde{N}_{\mathrm{RB}}^{\mathrm{HO}}/2$ .

The set of physical resource blocks to be used for PUSCH transmission are $L_{\mathrm{CRBs}}$ contiguously allocated resource blocks from PRB index $n_{PRB}^{S1}$ for the 1st slot, and from PRB index $n_{PRB}(i)$ for the 2nd slot, respectively, where $L_{\mathrm{CRBs}}$ is obtained from the uplink scheduling grant as in Section 8.4 and Section 8.1.

If the *Hopping-mo*de is "inter-subframe", the 1st slot RA is applied to even CURRENT_TX_NB, and the 2nd slot RA is applied to odd CURRENT_TX_NB, where CURRENT_TX_NB is defined in [8].

[TS 36.213, clause 8.4.2]

**Table 8.4-2: PDCCH DCI Format 0 Hopping Bit Definition**

| **System BW** $N_{RB}^{UL}$ | **Number of Hopping bits** | **Information in hopping bits** | $\tilde{n}_{PRB}(i)$ |
|---|---|---|---|
| 6 – 49 | 1 | 0 | $\left(\left\lfloor N_{RB}^{PUSCH}/2\right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$ , |
| | | 1 | Type 2 PUSCH Hopping |
| 50 – 110 | 2 | 00 | $\left(\left\lfloor N_{RB}^{PUSCH}/4\right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$ |
| | | 01 | $\left(-\left\lfloor N_{RB}^{PUSCH}/4\right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$ |
| | | 10 | $\left(\left\lfloor N_{RB}^{PUSCH}/2\right\rfloor + \tilde{n}_{PRB}^{S1}(i)\right) \bmod N_{RB}^{PUSCH}$ |
| | | 11 | Type 2 PUSCH Hopping |

#### 7.1.5.1.3 Test description

##### 7.1.5.1.3.1 Pre-test conditions

System Simulator

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

#### 7.1.5.1.3.2 Test procedure sequence

**Table 7.1.5.1.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| | Exception: Steps 2 to 5 are executed as per table 7.1.5.1.3.2-2 | | | | |
| 2 | SS transmits a MAC PDU including 8 (FDD)/4(TDD) RLC SDU's | <-- | MAC PDU | - | - |
| 3 | The SS waits for 60 ms | - | - | - | - |
| | Exception: Steps 4 and 5 are repeated such that UE sends data in 8 ([FDD)/4(TDD) consecutive UL TTI's. | | | | |
| 4 | The SS is configured for Uplink Grant Allocation Type 2. SS transmits an UL Grant, allowing the UE to return 1 RLC SDU as received in step 2. Hopping flag' set as 1, all bits in '$N_{UL\_hop}$' are set as per table 7.1.5.3.2-2 for various execution runs | <-- | (UL Grant (C-RNTI)) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4? | - | - | 1 | P |
| Note 1: Steps 4 and 5 are repeated for 8 times corresponding to 8 sub frames for FDD and 4 for default TDD configuration 1.<br>Note 2: The grant allocated in step 4 is such that the loop back PDU's are received in 8 (FDD)/4(TDD) UL TTI's | | | | | |

**Table 7.1.5.1.3.2-2: Bandwidth dependent parameters**

| System BW | Number of Hopping bits | Execution Counter K | Information in hopping bits |
|---|---|---|---|
| 5 MHz | 1 | 1 | **0** |
| 10/20 MHz | 2 | 1 | **00** |
| | | 2 | **01** |
| | | 3 | **10** |

#### 7.1.5.1.3.3 Specific message contents.

None

### 7.1.5.2 Predefined intra-TTI PUSCH hopping (N_sb=1)

#### 7.1.5.2.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state, number of sub bands 'N-sb' is set to 1 and  'Hopping-mode'
is set to 'intraAndInterSubFrame'}
ensure that {
  when { UE receives for a TTI an uplink grant with 'Hopping flag' set as 1, 'N_UL_hop' bits all set to
1(Type 2 predefined hopping) }
    then { UE transmits data with predefined, intra-TTI PUSCH hopping}
      }
```

#### 7.1.5.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in : 3GPP TS 36.211 clause 5.3.4 , 36.212 clause 5.3.3.1.1 and 36.213 clause 8.4, 8.4.2.

[TS 36.211, clause 5.3.4]

If uplink frequency-hopping with predefined hopping pattern is enabled, the set of physical resource blocks to be used for transmission in slot $n_s$ is given by the scheduling grant together with a predefined pattern according to

$$\tilde{n}_{PRB}(n_s) = \left(\tilde{n}_{VRB} + f_{hop}(i)\cdot N_{RB}^{sb} + \left(\left(N_{RB}^{sb}-1\right) - 2\left(\tilde{n}_{VRB} \bmod N_{RB}^{sb}\right)\right)\cdot f_m(i)\right) \bmod (N_{RB}^{sb}\cdot N_{sb})$$

$$i = \begin{cases} \lfloor n_s/2 \rfloor & \text{inter-subframe hopping} \\ n_s & \text{intra and inter-subframe hopping} \end{cases}$$

$$n_{PRB}(n_s) = \begin{cases} \tilde{n}_{PRB}(n_s) & N_{sb}=1 \\ \tilde{n}_{PRB}(n_s) + \left\lceil N_{RB}^{HO}/2 \right\rceil & N_{sb}>1 \end{cases}$$

$$\tilde{n}_{VRB} = \begin{cases} n_{VRB} & N_{sb}=1 \\ n_{VRB} - \left\lceil N_{RB}^{HO}/2 \right\rceil & N_{sb}>1 \end{cases}$$

where $n_{VRB}$ is obtained from the scheduling grant as described in Section 8.1 in [4]. The parameter *pusch-HoppingOffset*, $N_{RB}^{HO}$, is provided by higher layers.. The size $N_{RB}^{sb}$ of each sub-band is given by,

$$N_{RB}^{sb} = \begin{cases} N_{RB}^{UL} & N_{sb}=1 \\ \left\lfloor \left(N_{RB}^{UL} - N_{RB}^{HO} - N_{RB}^{HO} \bmod 2\right)/N_{sb} \right\rfloor & N_{sb}>1 \end{cases}$$

where the number of sub-bands $N_{sb}$ is given by higher layers. The function $f_m(i)\in\{0,1\}$ determines whether mirroring is used or not. The parameter *Hopping-mode* provided by higher layers determines if hopping is "inter-subframe" or "intra and inter-subframe".

The hopping function $f_{hop}(i)$ and the function $f_m(i)$ are given by

$$f_{hop}(i) = \begin{cases} 0 & N_{sb}=1 \\ \left(f_{hop}(i-1) + \sum_{k=i\cdot 10+1}^{i\cdot 10+9} c(k)\times 2^{k-(i\cdot 10+1)}\right) \bmod N_{sb} & N_{sb}=2 \\ \left(f_{hop}(i-1) + \left(\sum_{k=i\cdot 10+1}^{i\cdot 10+9} c(k)\times 2^{k-(i\cdot 10+1)}\right) \bmod (N_{sb}-1) + 1\right) \bmod N_{sb} & N_{sb}>2 \end{cases}$$

$$f_m(i) = \begin{cases} i \bmod 2 & N_{sb}=1 \text{ and intra and inter-subframe hopping} \\ CURRENT\_TX\_NB \bmod 2 & N_{sb}=1 \text{ and inter-subframe hopping} \\ c(i\cdot 10) & N_{sb}>1 \end{cases}$$

where $f_{hop}(-1)$ =0 and the pseudo-random sequence $c(i)$ is given by section 7.2 and CURRENT_TX_NB indicates the transmission number for the transport block transmitted in slot $n_s$ as defined in [8]. The pseudo-random sequence generator shall be initialised with $c_{init} = N_{ID}^{cell}$ for FDD and $c_{init} = 2^9 \cdot (n_f \bmod 4) + N_{ID}^{cell}$ for TDD at the start of each frame.

[TS 36.212, clause 5.3.3.1.1]

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil$ bits
    - For PUSCH hopping:

- $N_{UL\_hop}$ MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]

- $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil - N_{\mathrm{UL\_hop}}\right)$ bits provide the resource allocation of the first slot in the UL subframe

- For non-hopping PUSCH:

- $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil\right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]

[TS 36.213, clause 8.4]

The UE shall perform PUSCH frequency hopping if the single bit frequency hopping (FH) field in a corresponding PDCCH with DCI format 0 is set to 1 otherwise no PUSCH frequency hopping is performed.

A UE performing PUSCH frequency hopping shall determine its PUSCH resource allocation (RA) for the first slot of a subframe (*S1*) including the lowest index PRB ( $n_{PRB}^{S1}(n)$ ) in subframe $n$ from the resource allocation field in the latest PDCCH with DCI format 0 for the same transport block. If there is no PDCCH for the same transport block, the UE shall determine its hopping type based on

- the hopping information in the most recent semi-persistent scheduling assignment PDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled or

- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The resource allocation field in DCI format 0 excludes either 1 or 2 bits used for hopping information as indicated by Table 8.4-1 below where the number of PUSCH resource blocks is defined as

$$N_{RB}^{PUSCH} = \begin{cases} N_{RB}^{UL} - \tilde{N}_{RB}^{HO} - \left(N_{RB}^{UL} \bmod 2\right) & \text{Type1 PUSCH hopping} \\ N_{RB}^{UL} & \text{Type2 } \mathrm{N_{sb}} = 1 \text{ PUSCH hopping} \\ N_{RB}^{UL} - \tilde{N}_{RB}^{HO} & \text{Type2 } \mathrm{N_{sb}} > 1 \text{ PUSCH hopping} \end{cases}$$

For type 1 and type 2 PUSCH hopping, $\tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} = N_{\mathrm{RB}}^{\mathrm{HO}} + 1$ if $N_{\mathrm{RB}}^{\mathrm{HO}}$ is an odd number where $N_{\mathrm{RB}}^{\mathrm{HO}}$ defined in [3]. $\tilde{N}_{\mathrm{RB}}^{\mathrm{HO}} = N_{\mathrm{RB}}^{\mathrm{HO}}$ in other cases. The size of the resource allocation field in DCI format 0 after excluding either 1 or 2 bits shall be $y = \left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2)\right\rceil - N_{UL\_hop}$, where $N_{UL\_hop}$ = 1 or 2 bits. The number of contiguous RBs that can be assigned to a type-1 hopping user is limited to $\left\lfloor 2^y / N_{\mathrm{RB}}^{\mathrm{UL}} \right\rfloor$. The number of contiguous RBs that can be assigned to a type-2 hopping user is limited to $\min(\left\lfloor 2^y / N_{\mathrm{RB}}^{\mathrm{UL}} \right\rfloor, \left\lfloor N_{\mathrm{RB}}^{\mathrm{PUSCH}} / N_{sb} \right\rfloor)$,where the number of sub-bands $N_{\mathrm{sb}}$ is given by higher layers.

A UE performing PUSCH frequency hopping shall use one of two possible PUSCH frequency hopping types based on the hopping information. PUSCH hopping type 1 is described in section 8.4.1 and type 2 is described in section 8.4.2.

**Table 8.4-1: Number of Hopping Bits $N_{UL\_hop}$ vs. System Bandwidth**

| System BW $N_{RB}^{UL}$ | #Hopping bits for 2nd slot RA ($N_{UL\_hop}$) |
|---|---|
| 6-49 | 1 |
| 50-110 | 2 |

The parameter *Hopping-mode* provided by higher layers determines if PUSCH frequency hopping is "inter-subframe" or "intra and inter-subframe".

[TS 36.213, clause 8.4.2]

In PUSCH hopping type 2 the set of physical resource blocks to be used for transmission in slot $n_s$ is given by the scheduling grant together with a predefined pattern according to [3] section 5.3.4. If the system frame number is not acquired by the UE yet, the UE shall not transmit PUSCH with type-2 hopping and $N_{sb}$>1 for TDD, where $N_{sb}$ is defined in [3].

**Table 8.4-2: PDCCH DCI Format 0 Hopping Bit Definition**

| System BW $N_{RB}^{UL}$ | Number of Hopping bits | Information in hopping bits | $\tilde{n}_{PRB}(i)$ |
|---|---|---|---|
| 6 – 49 | 1 | 0 | $\left(\left\lfloor N_{RB}^{PUSCH}/2\right\rfloor+\tilde{n}_{PRB}^{S1}(i)\right)\bmod N_{RB}^{PUSCH}$ , |
| | | 1 | Type 2 PUSCH Hopping |
| 50 – 110 | 2 | 00 | $\left(\left\lfloor N_{RB}^{PUSCH}/4\right\rfloor+\tilde{n}_{PRB}^{S1}(i)\right)\bmod N_{RB}^{PUSCH}$ |
| | | 01 | $\left(-\left\lfloor N_{RB}^{PUSCH}/4\right\rfloor+\tilde{n}_{PRB}^{S1}(i)\right)\bmod N_{RB}^{PUSCH}$ |
| | | 10 | $\left(\left\lfloor N_{RB}^{PUSCH}/2\right\rfloor+\tilde{n}_{PRB}^{S1}(i)\right)\bmod N_{RB}^{PUSCH}$ |
| | | 11 | Type 2 PUSCH Hopping |

#### 7.1.5.2.3 Test description

##### 7.1.5.2.3.1 Pre-test conditions

System Simulator

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

##### 7.1.5.2.3.2 Test procedure sequence

**Table 7.1.5.2.3.2-1: 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 8 (FDD)/4(TDD) RLC SDU's | <-- | MAC PDU | - | - |
| 3 | The SS waits for 60 ms | - | - | - | - |
| | Exception: Steps 4 and 5 are repeated such that UE sends data in 8 ([FDD)/4(TDD) consecutive UL TTI's. | | | | |
| 4 | The SS is configured for Uplink Grant Allocation Type 2. SS transmits an UL Grant, allowing the UE to return 1 RLC SDU as received in step 2. Hopping flag' set as 1, all bits in '$N_{UL\_hop}$' are set to 1. | <-- | (UL Grant (C-RNTI)) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4? | --> | MAC PDU | 1 | P |
| Note 1: steps 4 and 5 are repeated for 8 times corresponding to 8 sub frames for FDD and 4 for default TDD configuration 1.<br>Note 2: The grant allocated in step 4 is such that the loop back PDU's are received in 8 (FDD)/4(TDD) UL TTI's | | | | | |

#### 7.1.5.2.3.3 Specific message contents.

**Table 7.1.5.2.3.3-1: *SystemInformationBlockType2(preamble)***

| Derivation Path: 36.508 Table 4.4.3.3-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| radioResourceConfigCommon SEQUENCE {} | RadioResourceConfigCommonSIB-DEFAULT-7152 | | |
| } | | | |

**Table 7.1.5.2.3.3-2: RadioResourceConfigCommonSIB-DEFAULT-7152(Table 7.1.5.2.3.3-1)**

| Derivation Path: 36.508 Table 4.6.3-14 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigCommonSIB-DEFAULT-7152 ::= SEQUENCE { | | | |
| pusch-Config | PUSCH-ConfigCommon-DEFAULT-7152 | | |
| } | | | |

**Table 7.1.5.2.3.3-3: PUSCH-ConfigCommon-DEFAULT-7152(Table 7.1.5.2.3.3-2)**

| Derivation Path: 36.508 table 4.6.3-10 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PUSCH-ConfigCommon-DEFAULT-7152 ::= SEQUENCE { | | | |
| pusch-ConfigBasic SEQUENCE { | | | |
| n-SB | 1 | Default value | |
| hoppingMode | intraAndInterSubFrame | | |
| pusch-HoppingOffset | See subclause 4.6.8[36.508] | Default value | |
| } | | | |
| } | | | |

## 7.1.5.3 Predefined intra-TTI PUSCH hopping (N_sb=2/3/4)

#### 7.1.5.3.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_CONNECTED state, number of sub bands 'N-sb' is set to 2/3/4 and '*Hopping-mode*' is set to 'intraAndInterSubFrame'}
**ensure that** {
  **when** { UE receives for a TTI an uplink grant with 'Hopping flag' set as 1, '$N_{UL\_hop}$' bits all set to 1(Type 2 predefined hopping) }
    **then** { UE transmits data with predefined, inter-TTI PUSCH hopping}
      }

#### 7.1.5.3.2 Conformance requirements

Same Conformance requirements as in clause 7.1.5.2.2

#### 7.1.5.3.3 Test description

##### 7.1.5.3.3.1 Pre-test conditions

System Simulator

- Cell 1

UE:

None.

Preamble:

- The UE is in state Registered, Idle mode, Test Mode Activated (State 2A) according to [18].

7.1.5.3.3.2 Test procedure sequence

**Table 7.1.5.3.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| | EXCEPTION: Step 0 to 7 are repeated for execution counter k=1 to 3 | | | | |
| 0 | The SS transmits a Paging message in a paging occasion including a *systemInfoModification.* | <-- | *Paging* | - | - |
| 0a | From the beginning of the next modification period the SS transmits a modified *SystemInformationBlockType2* as specified. | - | - | - | - |
| 1 | The UE is brought to state Loopback Activated (state 4) according to [18] | - | - | - | - |
| 2 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 3 | SS transmits a MAC PDU including a RLC SDU | <-- | MAC PDU | 1 | - |
| 4 | The SS waits for 60 ms | | - | - | - |
| 5 | The SS is configured for Uplink Grant Allocation Type 2. SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 2. Hopping flag' set as 1, '$N_{UL\_hop}$' is set to 1. | <-- | (UL Grant (C-RNTI)) | - | - |
| 6 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4? | - | - | 1 | P |
| 7 | The SS releases the RRC connection | - | - | - | - |

7.1.5.3.3.3 Specific message contents.

**Table 7.1.5.3.3.3-1: *SystemInformationBlockType2 (Step 0 of Table* 7.1.5.3.3.2-1*)***

| Derivation Path: 36.331 clause 6.3.1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| ac-BarringInfo SEQUENCE {} | Not present | | |
| radioResourceConfigCommon SEQUENCE {} | RadioResourceConfigCommonSIB-DEFAULT-7153 | | |
| } | | | |

**Table 7.1.5.3.3.3-2: RadioResourceConfigCommonSIB-DEFAULT-7153**

| Derivation Path: 36.508 Table 4.6.3-14 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigCommonSIB-DEFAULT-7153 ::= SEQUENCE { | | | |
| pusch-Config | PUSCH-ConfigCommon-DEFAULT-7153 | | |
| } | | | |

**Table 7.1.5.3.3.3-3: PUSCH-ConfigCommon-DEFAULT-7153**

| Derivation Path: 36.508 table 4.6.3-10 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PUSCH-ConfigCommon-DEFAULT-7153 ::= SEQUENCE { | | | |
| pusch-ConfigBasic SEQUENCE { | | | |
| n-SB | 2 | | Execution counter k =1 |
| n-SB | 3 | | Execution counter k =2 |
| n-SB | 4 | | Execution counter k =3 |
| hoppingMode | intraAndInterSubFrame | | |
| pusch-HoppingOffset | See subclause 4.6.8 | Default value | |
| enable64QAM | FALSE | Default value | |
| } | | | |
| } | | | |

## 7.1.5.4 Predefined inter-TTI PUSCH hopping (N_sb=1)

### 7.1.5.4.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state, number of sub bands 'N-sb' is set to 1 and 'Hopping-mode'
is set to 'interSubFrame'}
ensure that {
  when { UE receives for a TTI an uplink grant with 'Hopping flag' set as 1, 'N_UL_hop' bits all set to
1(Type 2 predefined hopping) }
    then { UE transmits data with predefined, inter-TTI PUSCH hopping}
      }
with { UE in E-UTRA RRC_CONNECTED state, number of sub bands 'N-sb' is set to 1, 'Hopping-mode' is
set to 'interSubFrame' has transmitted a transport block with predefined, inter-TTI PUSCH hopping  }
ensure that {
  when { UE has to make a non adaptive retransmission) }
    then { UE transmits data with predefined, inter-TTI PUSCH hopping}
      }
```

### 7.1.5.4.2 Conformance requirements

Same Conformance requirements as in clause 7.1.5.2.2

### 7.1.5.4.3 Test description

#### 7.1.5.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.5.2.3.1

#### 7.1.5.4.3.2 Test procedure sequence

**Table 7.1.5.4.3.2-1: 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 | SS transmits a MAC PDU including a RLC SDU | <-- | MAC PDU | 1 | - |
| 3 | The SS waits for 60 ms. | - | - | - | - |
| 4 | The SS is configured for Uplink Grant Allocation Type 2. SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 2. Hopping flag' set as 1, all bits in '$N_{UL\_hop}$' are set to 1. | <-- | (UL Grant (C-RNTI)) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4? | - | MAC PDU | 1 | P |
| 6 | The SS transmits a HARQ NACK | <-- | HARQ NACK | - | - |
| 7 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4, for same HARQ process as in step 5? | --> | MAC PDU | 2 | P |
| 8 | The SS transmits a HARQ NACK | <-- | HARQ NACK | - | - |
| 9 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4, for same HARQ process as in step 7? | --> | MAC PDU | 2 | P |
| 10 | The SS transmits a HARQ NACK | <-- | HARQ NACK | - | - |
| 11 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 4, for same HARQ process as in step 9? | --> | MAC PDU | 2 | P |
| 12 | The SS transmits an HARQ ACK | <-- | HARQ ACK | - | - |
| Note: 4 HARQ transmissions is selected to be less than MaxHARQ-Tx (=5) | | | | | |

#### 7.1.5.4.3.3 Specific message contents.

None

### 7.1.5.5 Predefined inter-TTI PUSCH hopping (N_sb=2/3/4)

#### 7.1.5.5.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state, number of sub bands 'N-sb' is set to 2/3/4 and 'Hopping-mode' is set to 'interSubFrame'}
ensure that {
  when { UE receives for a TTI an uplink grant with 'Hopping flag' set as 1, 'N_UL_hop' bits are all set to 1(Type 2 predefined hopping) }
    then { UE transmits data with predefined, inter-TTI PUSCH hopping}
      }
```

#### 7.1.5.5.2 Conformance requirements

Same Conformance requirements as in clause 7.1.5.2.2

#### 7.1.5.5.3 Test description

#### 7.1.5.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.5.3.3.1

#### 7.1.5.5.3.2 Test procedure sequence

Same Test procedure sequence as in table 7.1.5.3.3.2-1

7.1.5.5.3.3 Specific message contents.

**Table 7.1.5.5.3.3-1: *SystemInformationBlockType2 (Step 0 of Table* 7.1.5.3.3.2-1*)***

| Derivation Path: 36.331 clause 6.3.1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SystemInformationBlockType2 ::= SEQUENCE { | | | |
| ac-BarringInfo SEQUENCE {} | Not present | | |
| radioResourceConfigCommon SEQUENCE {} | RadioResourceConfigCommonSIB-DEFAULT-7155 | | |
| } | | | |

**Table 7.1.5.5.3.3-2: RadioResourceConfigCommonSIB-DEFAULT-7155**

| Derivation Path: 36.508 Table 4.6.3-14 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioResourceConfigCommonSIB-DEFAULT-7155 ::= SEQUENCE { | | | |
| pusch-Config | PUSCH-ConfigCommon-DEFAULT-7155 | | |
| } | | | |

**Table 7.1.5.5.3.3-3: PUSCH-ConfigCommon-DEFAULT-7155**

| Derivation Path: 36.508 table 4.6.3-10 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PUSCH-ConfigCommon-DEFAULT-7155 ::= SEQUENCE { | | | |
| pusch-ConfigBasic SEQUENCE { | | | |
| n-SB | 2 | | Execution counter k =1 |
| n-SB | 3 | | Execution counter k =2 |
| n-SB | 4 | | Execution counter k =3 |
| hoppingMode | interSubFrame | Default value | |
| pusch-HoppingOffset | See subclause 4.6.8 | Default value | |
| enable64QAM | FALSE | Default value | |
| } | | | |
| } | | | |

## 7.1.6 DRX operation

### 7.1.6.1 DRX operation / Short cycle not configured / Parameters configured by RRC

7.1.6.1.1 Test Purpose (TP)

(1)

```
with { UE in CONNECTED mode }
ensure that {
  when { Long DRX cycle is configured and [(SFN * 10) + subframe number] modulo (LongDRX-Cycle) =
drxStartOffset }
    then { UE starts the OnDurationTimer and monitors the PDCCH for OnDurationTimer PDCCH-subframes
}
            }
```

(2)

```
with { UE in CONNECTED mode }
ensure that {
  when { Long DRX cycle is configured and a new DL transmission is indicated on the PDCCH during
Active Time }
```

```
    then { UE starts or restarts the Drx-InactivityTimer and monitors the PDCCH for Drx-
InactivityTimer PDCCH sub-frames starting from the next PDCCH sub-frame of the PDCCH sub-frame where
the DL new transmission was indicated }
            }
```

(3)

```
with { UE in CONNECTED mode }
ensure that {
  when { Long DRX cycle is configured and if a HARQ RTT Timer expires in this subframe and the data
in the soft buffer of the corresponding HARQ process was not successfully decoded }
    then { UE starts the drx-RetransmissionTimer for the corresponding HARQ process and monitors the
PDCCH for drx-RetransmissionTimer consecutive PDCCH-subframes }
            }
```

(4)

```
with { UE in CONNECTED mode }
ensure that {
  when { Long DRX cycle is configured and an uplink grant for a pending HARQ retransmission can
occur in this subframe }
    then { UE monitors the PDCCH in this subframe }
            }
```

#### 7.1.6.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in : TS 36.321, clauses 3.1 and 5.7.

[TS 36.321, clause 3.1]

**Active Time:** Time related to DRX operation, as defined in subclause 5.7, during which the UE monitors the PDCCH in PDCCH-subframes.

...

**DRX Cycle:** Specifies the periodic repetition of the On Duration followed by a possible period of inactivity (see figure 3.1-1 below).

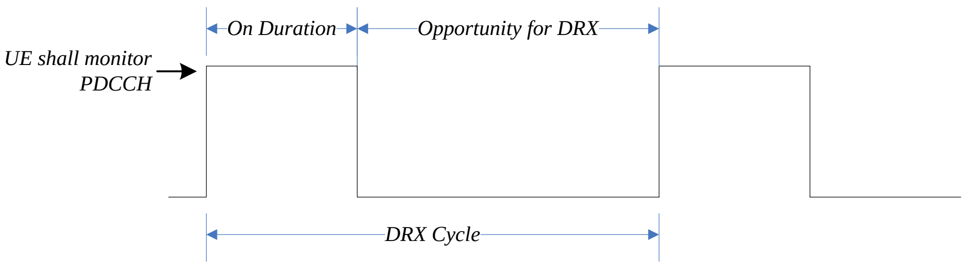


**Figure 3.1-1: DRX Cycle**

***drx-InactivityTimer***: Specifies the number of consecutive PDCCH-subframe(s) after successfully decoding a PDCCH indicating an initial UL or DL user data transmission for this UE.

***drx-RetransmissionTimer***: Specifies the maximum number of consecutive PDCCH-subframe(s) for as soon as a DL retransmission is expected by the UE.

***drxShortCycleTimer***: Specifies the number of consecutive subframe(s)the UE shall follow the short DRX cycle.

***drxStartOffset***: Specifies the subframe where the DRX Cycle starts.

...

**HARQ RTT Timer**: This parameter specifies the minimum amount of subframe(s) before a DL HARQ retransmission is expected by the UE.

...

***onDurationTimer***: Specifies the number of consecutive PDCCH-subframe(s) at the beginning of a DRX Cycle.

**PDCCH-subframe:** For FDD UE operation, this represents any subframe; for TDD, only downlink subframes and subframes including DwPTS.

[TS 36.321, clause 5.7]

The UE may be configured by RRC with a DRX functionality that controls the UE's PDCCH monitoring activity for the UE's C-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI and Semi-Persistent Scheduling C-RNTI (if configured). When in RRC_CONNECTED, if DRX is configured, the UE is allowed to monitor the PDCCH discontinuously using the DRX operation specified in this subclause; otherwise the UE monitors the PDCCH continuously. When using DRX operation, the UE shall also monitor PDCCH according to requirements found in other subclauses of this specification. RRC controls DRX operation by configuring the timers *onDurationTimer*, *drx-InactivityTimer*, *drx-RetransmissionTimer* (one per DL HARQ process except for the broadcast process), the *longDRX-Cycle*, the value of the *drxStartOffset* and optionally the *drxShortCycleTimer* and *shortDRX-Cycle*. A HARQ RTT timer per DL HARQ process (except for the broadcast process) is also defined (see subclause 7.7).

When a DRX cycle is configured, the Active Time includes the time while:

- *onDurationTimer* or *drx-InactivityTimer* or *drx-RetransmissionTimer* or *mac-ContentionResolutionTimer* (as described in subclause 5.1.5) is running; or
- a Scheduling Request sent on PUCCH is pending (as described in subclause 5.4.4); or
- an uplink grant for a pending HARQ retransmission can occur and there is data in the corresponding HARQ buffer; or
- a PDCCH indicating a new transmission addressed to the C-RNTI of the UE has not been received after successful reception of a Random Access Response for the explicitly signalled preamble (as described in subclause 5.1.4).

When DRX is configured, the UE shall for each subframe:

- If the Short DRX Cycle is used and [(SFN * 10) + subframe number] modulo (*shortDRX-Cycle*) = (*drxStartOffset*) modulo (*shortDRX-Cycle*); or
- if the Long DRX Cycle is used and [(SFN * 10) + subframe number] modulo (*LongDRX-Cycle*) = *drxStartOffset*:
    - start *onDurationTimer*.
- if a HARQ RTT Timer expires in this subframe and the data in the soft buffer of the corresponding HARQ process was not successfully decoded:
    - start the *drx-RetransmissionTimer* for the corresponding HARQ process.
- if a DRX Command MAC control element is received:
    - stop *onDurationTimer*;
    - stop *drx-InactivityTimer*.
- if *drx-InactivityTimer* expires or a DRX Command MAC control element is received in this subframe:
    - if the short DRX cycle is configured:
        - start or restart *drxShortCycleTimer*;
        - use the Short DRX Cycle.
    - else:
        - use the Long DRX cycle.
- if *drxShortCycleTimer* expires in this subframe:

    - use the long DRX cycle.

- during the Active Time, for a PDCCH-subframe if the subframe is not required for uplink transmission for half-duplex FDD UE operation and if the subframe is not part of a configured measurement gap:
    - monitor the PDCCH;
    - if the PDCCH indicates a DL transmission or if a DL assignment has been configured for this subframe:
        - start the HARQ RTT Timer for the corresponding HARQ process;
        - stop the *drx-RetransmissionTimer* for the corresponding HARQ process.
    - if the PDCCH indicates a new transmission (DL or UL):
        - start or restart *drx-InactivityTimer*.
- when not in Active Time, CQI/PMI/RI on PUCCH and SRS shall not be reported.

Regardless of whether the UE is monitoring PDCCH or not the UE receives and transmits HARQ feedback when such is expected.

NOTE: A UE may optionally choose to not send CQI/PMI/RI reports on PUCCH and/or SRS transmissions for up to 4 subframes following a PDCCH indicating a new transmission (UL or DL) received in the last subframe of active time. The choice not to send CQI/PMI/RI reports on PUCCH and/or SRS transmissions is not applicable for subframes where *onDurationTimer* is running.

#### 7.1.6.1.3 Test description

##### 7.1.6.1.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18] configured to return no data in UL.

##### 7.1.6.1.3.2 Test procedure sequence

For FDD, *NormalSF*(current SFN,current subframe number,y)=y; For TDD, *NormalSF*(current SFN,current subframe number,y) counts the minimum number of normal subframes needed to cover y number of PDCCH-subframes until next PDCCH-subframe available, starting from current subframe number on current SFN. For example at step 1, *drxStartOffset* can point to UL or DL subframe for TDD. If it points to a UL subframe, *NormalSF*(current SFN,current subframe number,0) counts the number of normal subframes until reach the first DL/special subframe available. If *drxStartOffset* points to a DL subframe, *NormalSF*(current SFN,current subframe number,0)=0.

For example at step 13, assuming *drxStartOffset* points to subframe number 0 at frame number A, *NormalSF*(A, 0, *onDurationTimer-2*) is first added, which counts 18 PDCCH-subframes/30 normal subframes in this case. The current subframe becomes subframe number 0 at frame number A+3. Secondly, *HARQ RTT timer* is added, which is 11 normal subframes. The current subframe becomes subframe number 1 at frame number A+4. To further add in *NormalSF*(A+4, 1, *drx-RetransmissionTimer-1*), which is to counts 5 PDCCH-subframes/9 normal subframes, the current subframe is subframe number 0 at frame number A+5.

**Table 7.1.6.1.3.2-1: Main Behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 0A | SS Transmits RRCConnectionReconfiguration to configure specific DRX parameters | <-- | - | - | - |
| 0B | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 1 | In the first PDCCH sub frame when the OnDurationTimer is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH.<br><br>i.e., on the subframe with the subframe number = [csfn1 + *NormalSF*(SFN1, csfn1, 0)] modulo 10, and system frame number = SFN1 + floor([csfn1 + *NormalSF*(SFN1, csfn1, 0)]/10); where [(SFN1 * 10) + csfn1] modulo (LongDRX-Cycle) = drxStartOffset | <-- | MAC PDU | - | - |
| 2 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 1? | --> | HARQ ACK | 1 | P |
| 3 | At least drx-InactivityTimer PDCCH-sub frames after the transmission of the MAC PDU in Step 1 has been indicated(This means the next DRX cycle or later after Step 1) in the last PDCCH sub frame while the onDurationTimer is still running, the SS indicates the transmission a DL MAC PDU on the PDDCH. (Note 4).<br><br>i.e., on the subframe with the subframe number = [csfn2 + *NormalSF*(SFN2,csfn2,onDurationTimer-1)] modulo 10, and system frame number = SFN2 + floor([csfn2 + *NormalSF*(SFN2,csfn2,onDurationTimer-1)]/10); where [(SFN2 * 10) + csfn2] modulo (LongDRX-Cycle) = drxStartOffset | <-- | MAC PDU | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | 1 | P |
| 5 | drx-InactivityTimer PDCCH-subframes after the transmission of the MAC PDU transmitted in step 3 was indicated on the PDCCH, the SS indicates the transmission of a DL MAC PDU on the PDCCH. (Note 4)<br><br>i.e. on the subframe with the subframe number = [csfn2 + *NormalSF*(SFN2,csfn2,onDurationTimer + drx-InactivityTimer-1)] modulo 10, and system frame number = SFN2 + floor([csfn2 + *NormalSF*(SFN2,csfn2,onDurationTimer+ drx-InactivityTimer-1)]/10) | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 5? | --> | HARQ ACK | 2 | P |
| 7 | At least drx-InactivityTimer PDCCH sub frames after the transmission of the MAC PDU in Step 5 has been indicated (This means the next DRX cycle or later after Step 3) and 1 PDCCH sub-frame before the OnDurationTimer expires, the SS indicates the transmission of a DL MAC PDU on the PDDCH. The DL MAC PDU transmitted is invalid. (Note 1, Note 4)<br><br>i.e., on the subframe with the subframe number = [csfn3 + *NormalSF*(SFN3, csfn3, onDurationTimer-2)] mod 10, and system | <-- | Invalid MAC PDU | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | frame number = SFN3 + floor([csfn3 + *NormalSF*(SFN3, csfn3, onDurationTimer-2)]/10); where [(SFN3 * 10) + csfn3] modulo (LongDRX-Cycle) = drxStartOffset | | | | |
| 8 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 7? | --> | HARQ NACK | 1 | P |
| 9 | In the first PDCCH sub frame when the Drx-RetransmissionTimer for the MAC PDU in Step 7 is started, the SS indicates the transmission of a DL MAC PDU on the PDCCH.<br><br>i.e., on the subframe with the subframe number = [csfn4 + *NormalSF*(SFN4, csfn4, 0)] modulo 10, and system frame number = SFN4 + floor([csfn4 + *NormalSF*(SFN4, csfn4, 0)]/10); where csfn4 = [csfn3 + *NormalSF*(SFN3, csfn3, onDurationTimer-2)+HARQ RTT timer] modulo 10 and SFN4=SFN3+floor([csfn3 + *NormalSF*(SFN3, csfn3, onDurationTimer-2)+HARQ RTT timer]/10)<br><br>For TDD the HARQ RTT timer is the HARQ RTT timer for the DL transmission in Step 7. | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 9? | --> | HARQ ACK | 3 | P |
| 11 | At least drx-InactivityTimer PDCCH sub frames after the transmission of the DL MAC PDU in Step 9 has been indicated (This means the next DRX cycle or later after Step 9) and 1 PDCCH sub-frame before the OnDurationTimer expires, the SS indicates the transmission of DL MAC PDU on the PDCCH. The DL MAC PDU transmitted is invalid(Note 1, Note 4)<br><br>i.e., on the subframe with the subframe number = [csfn5 + *NormalSF*(SFN5, csfn5, onDurationTimer-2)] modulo 10 and system frame number=SFN5+floor([csfn5 + *NormalSF*(SFN5, csfn5, onDurationTimer-2)]/10) ; where [(SFN5 * 10) + csfn5] modulo (LongDRX-Cycle) = drxStartOffset | <-- | Invalid MAC PDU | - | - |
| 12 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 11? | --> | HARQ NACK | 1 | P |
| 13 | In the last PDCCH sub frame when the drx-RetransmissionTimer for MAC PDU in Step 11 is still running, the SS indicates the transmission of a DL MAC PDU on the PDCCH.<br><br>i.e. on the subframe with subframe number = [csfn6 + *NormalSF*(SFN6,csfn6,drx-RetransmissionTimer -1)] modulo 10 and the system frame number=SFN6+floor([csfn6 + *NormalSF*(SFN6,csfn6,drx-RetransmissionTimer -1)]/10); where the csfn6 = [csfn5 + *NormalSF*(SFN5, csfn5, onDurationTimer-2)+HARQ RTT timer] modulo 10 and SFN6=SFN5+floor([csfn5 + *NormalSF*(SFN5, csfn5, onDurationTimer-2)+HARQ RTT timer]/10);<br><br>For TDD the HARQ RTT timer is the HARQ RTT timer for the DL transmission in Step 11. | <-- | MAC PDU | - | - |
| 14 | Check: Does the UE transmit a HARQ ACK for | --> | HARQ ACK | 3 | P |

| | | | | | |
|---|---|---|---|---|---|
| | the DL MAC PDU in Step 13? | | | | |
| 15 | The SS is configured for Uplink Grant Allocation Type 2. At least drx-InactivityTimer PDCCH sub frames after the transmission of the DL MAC PDU in Step 13 has been indicated in the last sub-frame when the onDuratiopnTimer is still running (This means the next DRX cycle or later after Step 7), the SS indicates an UL grant to the UE on the PDCCH. (Note 4)<br><br>i.e., on the subframe with the subframe number = [csfn7 + *NormalSF*(SFN7, csfn7, onDurationTimer-1)] modulo 10 and system frame number=SFN7 + floor([csfn7 + *NormalSF*(SFN7, csfn7, onDurationTimer-1)]/10); where [(SFN7 * 10) + csfn7] modulo (LongDRX-Cycle) = drxStartOffset | <-- | UL grant on PDCCH | - | - |
| 16 | Check: Does the UE transmit a Buffer Status Report on the UL indicating an empty buffer? | --> | Buffer Status Report MAC control element | - | - |
| 17 | X sub frames after the sub frame in which the UL grant was indicated on the PDCCH for the UL MAC PDU sent in the previous step the SS indicates the transmission of a DL MAC PDU on the PDCCH.<br><br>*X is the number of sub frames required to do a retransmission of the UL MAC PDU transmitted in the previous Step maxHARQ-Tx* -1 times (for FDD this is 8x *maxHARQ-Tx* sub frames, for TDD this is 10x *maxHARQ-Tx* sub frames considering the default configuration 1.). | <-- | MAC PDU | - | - |
| 18 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 17? | --> | HARQ ACK | 4 | P |

Note 1: Invalid MAC PDU is a MAC PDU that fails the CRC check.
Note 2: All the DL MAC PDU are transmitted with the NDI set on the PDCCH.
Note 3: Timer tolerances for the MAC DRX related timers measured in subframes or PDCCH subframes is 0. These timers are: drx-InactivityTimer, drx-RetransmissionTimer, HARQ RTT Timer.
Note 4: The drx-InactivityTimer is started in the next PDCCH sub-frame of the PDCCH sub-frame where DL new transmission is indicated.

#### 7.1.6.1.3.3 Specific message contents

**Table 7.1.6.1.3.3-1: specific Parameters in *RRCConnectionReconfiguration* (step 0A of table 7.1.6.1.3.2-1)**

| Derivation Path: 36.508 Table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| measConfig | Not present | | |
| mobilityControlInfo | Not present | | |
| dedicatedInfoNASList | Not present | | |
| radioResourceConfigDedicated::= SEQUENCE { | | | |
| srb-ToAddModList | Not present | | |
| drb-ToAddModList | Not present | | |
| drb-ToReleaseList | Not present | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue::= SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n5 | | |
| retxBSR-Timer | sf10240 | | |
| ttiBundling | FALSE | | |
| } | | | |
| drx-Config CHOICE { | | | |
| setup SEQUENCE { | | | |
| onDurationTimer | psf20 | | |
| drx-InactivityTimer | psf6 | | |
| drx-RetransmissionTimer | psf6 | | |
| longDRX-CycleStartOffset CHOICE { | | | |
| sf640 | 4 | | |
| } | | | |
| shortDRX | Not present | | |
| } | | | |
| } | | | |
| timeAlignmentTimerDedicated | infinity | | |
| phr-Config CHOICE { | | | |
| release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.6.2 DRX Operation / Short cycle not configured / DRX command MAC control element reception

#### 7.1.6.2.1 Test Purpose (TP)

(1)

```
with { UE in CONNECTED mode }
ensure that {
  when { long DRX cycle is configured and a DRX Command MAC control element is received }
    then { UE successfully decodes the MAC control PDU }
            }
```

(2)

```
with { UE in CONNECTED mode }
ensure that {
  when { long DRX cycle is configured and the HARQ RTT Timer is running and a DRX Command MAC
control element is received }
    then { UE continues running the HARQ RTT timer }
            }
```

(3)

```
with { UE in CONNECTED mode }
ensure that {
```

```
  when { long DRX cycle is configured and the drx-RetransmissionTimer is running and a DRX Command
MAC control element is received }
    then { UE continues running the drx-RetransmissionTimer and monitors the PDCCH }
          }
```

#### 7.1.6.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clauses 3.1 and 5.7.

[TS 36.321, clause 3.1]

**Active Time:** Time related to DRX operation, as defined in subclause 5.7, during which the UE monitors the PDCCH in PDCCH-subframes.

...

**DRX Cycle:** Specifies the periodic repetition of the On Duration followed by a possible period of inactivity (see figure 3.1-1 below).

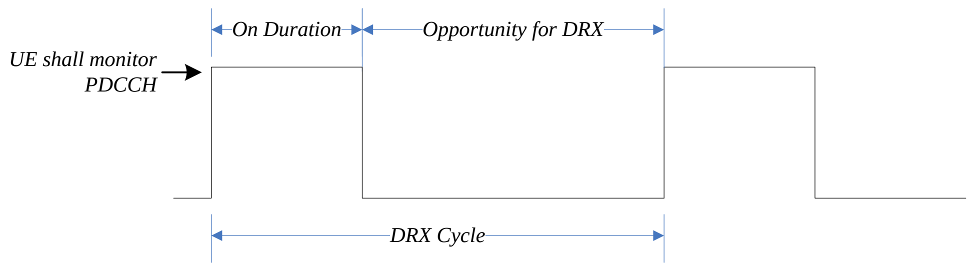


**Figure 3.1-1: DRX Cycle**

***drx-InactivityTimer***: Specifies the number of consecutive PDCCH-subframe(s) after successfully decoding a PDCCH indicating an initial UL or DL user data transmission for this UE.

***drx-RetransmissionTimer***: Specifies the maximum number of consecutive PDCCH-subframe(s) for as soon as a DL retransmission is expected by the UE.

***drxShortCycleTimer***: Specifies the number of consecutive subframe(s)the UE shall follow the short DRX cycle.

***drxStartOffset***: Specifies the subframe where the DRX Cycle starts.

...

**HARQ RTT Timer**: This parameter specifies the minimum amount of subframe(s) before a DL HARQ retransmission is expected by the UE.

...

***onDurationTimer***: Specifies the number of consecutive PDCCH-subframe(s) at the beginning of a DRX Cycle.

**PDCCH-subframe:** For FDD UE operation, this represents any subframe; for TDD, only downlink subframes and subframes including DwPTS.

[TS 36.321, clause 5.7]

- if a HARQ RTT Timer expires in this subframe and the data in the soft buffer of the corresponding HARQ process was not successfully decoded:
  - start the *drx-RetransmissionTimer* for the corresponding HARQ process.
- if a DRX Command MAC control element is received:
  - stop *onDurationTimer*;
  - stop drx-InactivityTimer.

- if *drx-InactivityTimer* expires or a DRX Command MAC control element is received in this subframe:
  - if the short DRX cycle is configured:
    - start or restart *drxShortCycleTimer*;
    - use the Short DRX Cycle.
  - else:
    - use the Long DRX cycle.
- if *drxShortCycleTimer* expires in this subframe:
  - use the long DRX cycle.
- during the Active Time, for a PDCCH-subframe except if the subframe is required for uplink transmission for half-duplex FDD UE operation and except if the subframe is part of a configured measurement gap:
  - monitor the PDCCH;
  - if the PDCCH indicates a DL transmission or if a DL assignment has been configured for this subframe:
    - start the HARQ RTT Timer for the corresponding HARQ process;
    - stop the *drx-RetransmissionTimer* for the corresponding HARQ process.
  - if the PDCCH indicates a new transmission (DL or UL):
    - start or restart *drx-InactivityTimer*.
- when not in Active Time, CQI/PMI/RI on PUCCH and SRS shall not be reported.

Regardless of whether the UE is monitoring PDCCH or not the UE receives and transmits HARQ feedback when such is expected.

#### 7.1.6.2.3 Test description

##### 7.1.6.2.3.1 Pre-test conditions

System Simulator:

- Cell 1

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18] configured to return no data in UL.

##### 7.1.6.2.3.2 Test procedure sequence

The definition of *NormalSF*(current SFN,current subframe number,y) can be found in clause 7.1.6.1.3.2.

**Table 7.1.6.2.3.2-1: Main Behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 0A | SS Transmits RRCConnectionReconfiguration to configure specific DRX parameters | <-- | - | - | - |
| 0B | The UE transmits RRCConnectionReconfigurationComplete | --> | - | - | - |
| 1 | In a PDCCH sub frame which is X PDCCH sub frames before the PDCCH sub-frame in which the onDurationTimer expires,<br> with drx-InactivityTimer< X < the number of PDCCH subframes encapsulated by HARQ RTT timer, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits an invalid MAC PDU.(Note 1)<br><br>i.e., on the subframe with the subframe number csfn2 = [csfn1+*NormalSF*(SFN1, csfn1, onDurationTimer-1-X)] modulo 10, and the system frame number SFN2 = SFN1+floor([csfn1+*NormalSF*(SFN1, csfn1, onDurationTimer-1-X)]/10); and [(SFN1 * 10) + csfn1] modulo (Long DRX Cycle) = drxStartOffset. | <-- | MAC PDU | - | - |
| 2 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 1? | --> | HARQ NACK | 1 | P |
| 3 | In a PDCCH sub frames before the onDurationTimer expires, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU with DRX MAC Control element.<br>UE successfully decodes the MAC PDU.<br><br>i.e., on the subframe with the subframe number csfn3 = [csfn1+*NormalSF*(SFN1, csfn1, onDurationTimer-1-X+Y)] modulo 10, and the system frame number SFN3 = SFN1+floor([csfn1+*NormalSF*(SFN1, csfn1, onDurationTimer-1-X+Y)]/10); and 0<Y<X) | <-- | MAC PDU(DRX MAC Control element) | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | 1 | P |
| 5 | In the PDCCH sub frame when the drx-RetransmissionTimer for the MAC PDU indicated in Step 1 on the PDCCH is started the SS indicates the transmission of a DL MAC PDU. The SS transmits an invalid MAC PDU.(Note 1)<br><br>i.e., on the subframe with the subframe number csfn5 = [csfn4+*NormalSF*(SFN4, csfn4, 0)] modulo 10, and the system frame number SFN5 = SFN4+floor([csfn4+*NormalSF*(SFN4, csfn4, 0)]/10); where csfn4 = [csfn2+HARQ RTT Timer] modulo 10, and the SFN4 = SFN2+floor([csfn2+HARQ RTT Timer]/10);<br><br>For TDD the HARQ RTT timer is the HARQ RTT timer for the DL transmission in Step 1 | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 5? | --> | HARQ NACK | 2,3 | P |
| 7 | Z PDCCH sub frames,<br> where Z>drx-InactivityTimer, before the PDCCH sub-frame in which the drx-RetransmissionTimer for the DL MAC PDU in | <-- | MAC PDU(DRX MAC Control element) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | Step 5 expires, the SS indicates the transmission of a DL MAC PDU. The SS transmits a DL MAC PDU with DRX MAC Control element.<br><br>i.e., on the subframe with the subframe number = [csfn6+*NormalSF*(SFN6, csfn6, drx-RetransmissionTimer –Z)] modulo 10, and the system frame number = SFN6+floor([csfn6+*NormalSF*(SFN6, csfn6, drx-RetransmissionTimer –Z)]/10); where csfn6 = [csfn5+HARQ RTT Timer] modulo 10, and the SFN6 = SFN5+floor([csfn5+HARQ RTT Timer]/10);<br><br>For TDD the HARQ RTT timer is the HARQ RTT timer for the DL transmission in Step 5. | | | | |
| 8 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 7? | --> | HARQ ACK | 2,3, 1 | P |
| 9 | In the last sub frame when the Drx-RetransmissionTimer for the DL MAC PDU indicated on the PDCCH in Step 5 is still running, the SS indicates the transmission of a DL MAC PDU.<br><br>i.e., on the subframe with the subframe number = [csfn6+*NormalSF*(SFN6, csfn6, drx-RetransmissionTimer –1)] modulo 10, and the system frame number = SFN6+floor([csfn6+*NormalSF*(SFN6, csfn6, drx-RetransmissionTimer –1)]/10); | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 9? | --> | HARQ ACK | 2,3 | P |

Note 1: Invalid MAC PDU is a MAC PDU that fails the CRC check.
Note 2: All DL MAC PDUs are transmitted with the NDI set on the PDCCH.
Note 3: Timer tolerances for the MAC DRX related timers measured in subframes or PDCCH subframes is 0. These timers are: drx-InactivityTimer, drx-RetransmissionTimer, HARQ RTT Timer.

7.1.6.2.3.3 Specific message contents

**Table 7.1.6.2.3.3-1: specific Parameters in *RRCConnectionReconfiguration* (step 0A of table 7.1.6.2.3.2-1)**

| Derivation Path: 36. 508 Table 4.6.1-8 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| measConfig | Not present | | |
| mobilityControlInfo | Not present | | |
| dedicatedInfoNASList | Not present | | |
| radioResourceConfigDedicated::= SEQUENCE { | | | |
| srb-ToAddModList | Not present | | |
| drb-ToAddModList | Not present | | |
| drb-ToReleaseList | Not present | | |
| mac-MainConfig CHOICE { | | | |
| explicitValue::= SEQUENCE { | | | |
| ul-SCH-Config SEQUENCE { | | | |
| maxHARQ-Tx | n5 | | |
| retxBSR-Timer | sf10240 | | |
| ttiBundling | FALSE | | |
| } | | | |
| drx-Config CHOICE { | | | |
| setup SEQUENCE { | | | |
| onDurationTimer | psf20 | | |
| drx-InactivityTimer | psf6 | | |
| drx-RetransmissionTimer | psf6 | | |
| longDRX-CycleStartOffset CHOICE { | | | |
| sf640 | 4 | | |
| } | | | |
| shortDRX | Not present | | |
| } | | | |
| } | | | |
| timeAlignmentTimerDedicated | infinity | | |
| phr-Config CHOICE { | | | |
| release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

# 7.1.7 Transport block size selection

## 7.1.7.0 Specific configurations

The configurations defined in table 7.1.7.0-1 is used after step 7 of table 4.5.3.3-1 [18] in the preamble and in all steps in the main behaviour of the test cases in clause 7.1.7.

**Table 7.1.7.0-1: Power allocation for OFDM symbols and reference signals, single SS Tx antenna**

| Physical Channel | EPRE Ratio | Comment |
|---|---|---|
| PBCH | PBCH_RA = 0 dB | |
| | PBCH_RB = 0 dB | |
| PSS | PSS_RA = 0 dB | |
| SSS | SSS_RA = 0 dB | |
| PCFICH | PCFICH_RB = 0 dB | |
| PDCCH | PDCCH_RA = 0 dB | |
| | PDCCH_RB = 0 dB | |
| PDSCH | PDSCH_RA = 0 dB | |
| | PDSCH_RB = 0 dB | |
| PHICH | PHICH_RB = 0 dB | |

The configurations defined in table 7.1.7.0-2 is used in step 8 of table 4.5.3.3-1 [18] in the preamble of the test cases in clause 7.1.7.

**Table 7.1.7.0-2: PDSCH-ConfigDedicated-DEFAULT**

| Derivation Path: 36.508 Table 4.6.3-6 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PDSCH-ConfigDedicated-DEFAULT ::= SEQUENCE { | | | |
| p-a | dB0 | | 1TX |
| | dB-3 | | 2TX |
| } | | | |

## 7.1.7.1 DL-SCH transport block size selection

### 7.1.7.1.1 DL-SCH transport block size selection / DCI format 1 / RA type 0

#### 7.1.7.1.1.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_CONNECTED state }
**ensure that** {
  **when** { UE on PDCCH receives DCI format 1 indicating Resource Allocation Type 0, a resource block assignment correspondent to $N_{\mathrm{PRB}}$ physical resource blocks and a modulation and coding scheme $I_{\mathrm{MCS}}$ }
    **then** { UE decodes the received transport block of size correspondent to the read $N_{\mathrm{PRB}}$ and $I_{\mathrm{MCS}}$ **and** forwards it to higher layers }
}

#### 7.1.7.1.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clause 5.3.3.1.2; TS 36.213, clauses 7.1.6.1, 7.1.7, 7.1.7.1, 7.1.7.2 and 7.1.7.2.1; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.2]

DCI format 1 is used for the scheduling of one PDSCH codeword.

The following information is transmitted by means of the DCI format 1:

- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

  If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

  - For resource allocation type 0 as defined in section 7.1.6.1 of [3]:

    - $\lceil N_{\mathrm{RB}}^{\mathrm{DL}} / P \rceil$ bits provide the resource allocation

...

  where the value of P depends on the number of DL resource blocks as indicated in section 7.1. 6 of [3]

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

If the number of information bits in format 1 is equal to that for format 0/1A, one bit of value zero shall be appended to format 1.

If the number of information bits in format 1 belongs to one of the sizes in Table 5.3.3.1.2-1, one or more zero bit(s) shall be appended to format 1 until the payload size of format 1 does not belong to one of the sizes in Table 5.3.3.1.2-1 and not equal to that of format 0/1A.

**Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

[TS 36.213 clause 7.1.6.1]

In resource allocations of type 0, 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 physical resource blocks (PRBs). Resource block group size ($P$) is a function of the system bandwidth as shown in Table 7.1.6.1-1. The total number of RBGs ( $N_{\mathrm{RBG}}$ ) for downlink system bandwidth of $N_{\mathrm{RB}}^{\mathrm{DL}}$ PRBs is given by $N_{RBG} = \lceil N_{\mathrm{RB}}^{\mathrm{DL}} / P \rceil$ where $\lfloor N_{\mathrm{RB}}^{\mathrm{DL}} / P \rfloor$ of the RBGs are of size P and if $N_{\mathrm{RB}}^{\mathrm{DL}} \bmod P > 0$ then one of the RBGs is of size $N_{\mathrm{RB}}^{\mathrm{DL}} - P \cdot \lfloor N_{\mathrm{RB}}^{\mathrm{DL}} / P \rfloor$. The bitmap is of size $N_{\mathrm{RBG}}$ 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 non-increasing RBG sizes starting at the lowest frequency. The order of RBG to bitmap bit mapping is in such way that RBG 0 to RBG $N_{\mathrm{RBG}} - 1$ are mapped to 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.

**Table 7.1.6.1-1: Type 0 Resource Allocation RBG Size vs. Downlink System Bandwidth**

| System Bandwidth $N_{\mathrm{RB}}^{\mathrm{DL}}$ | RBG Size (*P*) |
|---|---|
| ≤10 | 1 |
| 11 – 26 | 2 |
| 27 – 63 | 3 |
| 64 – 110 | 4 |

[TS 36.213 clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

...

else

- set the Table 7.1.7.2.1-1 column indicator $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

    set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{ \lfloor N'_{\mathrm{PRB}} \times 0.75 \rfloor, \quad 1 \right\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$ .

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal CP or configurations 0 and 4 with extended CP, shown in table 4.2-1 [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.213 clause 7.1.7.1]

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 to determine the modulation order ( $Q_m$ ) used in the physical downlink shared channel.

**Table 7.1.7.1-1: Modulation and TBS index table for PDSCH**

| MCS Index $I_{\mathrm{MCS}}$ | Modulation Order $Q_m$ | TBS Index $I_{\mathrm{TBS}}$ |
|---|---|---|
| 0 | 2 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 2 |
| 3 | 2 | 3 |
| 4 | 2 | 4 |
| 5 | 2 | 5 |
| 6 | 2 | 6 |
| 7 | 2 | 7 |
| 8 | 2 | 8 |
| 9 | 2 | 9 |
| 10 | 4 | 9 |
| 11 | 4 | 10 |
| 12 | 4 | 11 |
| 13 | 4 | 12 |
| 14 | 4 | 13 |
| 15 | 4 | 14 |
| 16 | 4 | 15 |
| 17 | 6 | 15 |
| 18 | 6 | 16 |
| 19 | 6 | 17 |
| 20 | 6 | 18 |
| 21 | 6 | 19 |
| 22 | 6 | 20 |
| 23 | 6 | 21 |
| 24 | 6 | 22 |
| 25 | 6 | 23 |
| 26 | 6 | 24 |
| 27 | 6 | 25 |
| 28 | 6 | 26 |
| 29 | 2 | reserved |
| 30 | 4 | |
| 31 | 6 | |

[TS 36.213 clause 7.1.7.2]

If the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
    - the UE shall set the TBS index ( $I_{\mathrm{TBS}}$ ) equal to $I_{\mathrm{MCS}}$ and determine its TBS by the procedure in Section 7.1.7.2.1.

...

else

- for $0 \le I_{\mathrm{MCS}} \le 28$ , the UE shall first determine the TBS index ( $I_{\mathrm{TBS}}$ ) using $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 except if the transport block is disabled in DCI formats 2 and 2A as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.2.
- for $29 \le I_{\mathrm{MCS}} \le 31$ , the TBS is assumed to be as determined from DCI transported in the latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$ . If there is no latest PDCCH for the same transport block

using $0 \le I_{\mathrm{MCS}} \le 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

- In DCI formats 2 and 2A a transport block is disabled if $I_{\mathrm{MCS}} = 0$ and if $rv_{idx}$ = 1 otherwise the transport block is enabled.

The NDI and HARQ process ID, as signalled on PDCCH, and the TBS, as determined above, shall be delivered to higher layers.

[TS 36.213 clause 7.1.7.2.1]

For $1 \le N_{\mathrm{PRB}} \le 110$, the TBS is given by the ( $I_{\mathrm{TBS}}$, $N_{\mathrm{PRB}}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |
| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |
| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |

| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |

| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.306 clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

#### 7.1.7.1.1.3 Test description

##### 7.1.7.1.1.3.1 Pre-test conditions

System Simulator:

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31] (to enable testing of $N_{\mathrm{PRB}}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

7.1.7.1.1.3.2 Test procedure sequence

**Table 7.1.7.1.1.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of a DL-SCH transport block received within a TTI |
|---|---|
| Category 1 | 10296 |
| Category 2 | 51024 |
| Category 3 | 75376 |
| Category 4 | 75376 |
| Category 5 | 149776 |

**Table 7.1.7.1.1.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data**

| $TB_{size}$ [bits] | Number of PDCP SDUs | PDCP SDU size [bits] See note 1 |
|---|---|---|
| 104 ≤ $TB_{size}$ ≤12096note 2 | 1 | 8*FLOOR(($TB_{size}$ – 96)/8) |
| 12097 ≤ $TB_{size}$ ≤24128 | 2 | 8*FLOOR(($TB_{size}$ – 128)/16)) |
| 24129 ≤ $TB_{size}$ ≤ 36152 | 3 | 8*FLOOR(($TB_{size}$ – 152)/24)) |
| 36153 ≤ $TB_{size}$ ≤48184 | 4 | 8*FLOOR(($TB_{size}$ – 184)/32)) |
| 48185 ≤ $TB_{size}$ ≤60208 | 5 | 8*FLOOR(($TB_{size}$ – 208)/40)) |
| 60209 ≤ $TB_{size}$ ≤ 72240 | 6 | 8*FLOOR(($TB_{size}$ – 240)/48)) |
| $TB_{size}$> 72240 | 7 | 8*FLOOR(($TB_{size}$ – 264)/56)) |

Note 1. Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 clause 9.9.4.12).

The PDCP SDU size of each PDCP SDU is

PDCP SDU size = ($TB_{size}$ – N*PDCP header size - AMD PDU header size - MAC header size – Size of Timing Advance – RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;
AMD PDU header size is CIEL[(16+(N-1)*12)/8] bytes which includes 16 standard AM header and (N-1) Length indicators; and

MAC header size = 40 bits as MAC header size can be
1) R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (16 bits for MAC SDU for RLC Status PDU)R/R/E/LCID MAC subheader (8 bits for MAC SDU) = for AMD PDU 8 + 8 16+bits = 32 bits
Or
2) R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for AMD PDU, Note: Length can be of 2 bytes depending upon the size of AMD PDU)+ R/R/E/LCID MAC subheader (8 bits for MAC SDU for RLC Status PDU) + = 8+24 + 8 bits = 40 bits

Therefore Maximum MAC header size can be 40 bits

Size of Timing Advance MAC CE is 8 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead)

RLC Status PDU size = 16 bits

This gives:

PDCP SDU size = 8*FLOOR(($TB_{size}$ – N*16- 8*CIEL((16+(N-1)*12)/8) – 64)/(8*N)) bits

Note 2: According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest $TB_{size}$ that can be tested is 104 bits.

**Table 7.1.7.1.1.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\mathrm{PRB}}$ | Allowed $N_{\mathrm{PRB}}$ Values |
|---|---|---|
| 10 Mhz | 50 | 2, 3, 5, 6, 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29, 30, 32, 33, 35, 36, 38, 39, 41, 42, 44, 45, 47, 48, 50 |
| 15 Mhz | 75 | 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, 55, 56, 59, 60, 63, 64, 67, 68, 71, 72, 75 |
| 20 Mhz | 100 | 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 |
| Note : Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | | |

**Table 7.1.7.1.1.3.2-2b: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

**Table 7.1.7.1.1.3.2-3: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| - | EXCEPTION: Steps 1 to 4 are repeated for allowed values of $N_{\mathrm{PRB}}$ as per table 7.1.7.1.1.3.2-2a and $I_{\mathrm{MCS}}$ from 0 to 28. | - | - | - | - |
| 1 | SS looks up $I_{\mathrm{TBS}}$ in table 7.1.7.1-1 in TS 36.213 based on the value of $I_{\mathrm{MCS}}$. SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\mathrm{PRB}}$ and $I_{\mathrm{TBS}}$. | - | - | - | - |
| - | EXCEPTION: Steps 2 to 4 are performed if $TB_{size}$ is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.7.1.1.3.2-1 and larger than or equal to 104 bits as specified in Table 7.1.7.1.1.3.2-2, and the effective channel code rate, as defined in TS 36.213 clause 7.1.7, is lower than or equal to 0.930. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs, depending on $TB_{size}$, in accordance with Table 7.1.7.1.1.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1 with RA type 0 and a resource block assignment (RBA) correspondent to $N_{\mathrm{PRB}}$ as specified in 7.1.6.1 in TS 36.213 and modulation and coding scheme $I_{\mathrm{MCS}}$.<br><br>If the number of information bits in format 1 is equal to that for format 0/1A, one bit of value zero shall | <-- | MAC PDU (NxPDCP SDUs)<br>DCI: (DCI Format 1, RA type 0, RBA( $N_{\mathrm{PRB}}$ ), $I_{\mathrm{MCS}}$ ) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | be appended to format 1 by the SS.<br><br>If the number of information bits in format 1 belongs to one of the sizes in Table 7.1.7.1.1.3.2-2b, one or more zero bit(s) shall be appended to format 1 by the SS until the payload size of format 1 does not belong to one of the sizes in Table 7.1.7.1.1.3.2-2b and not equal to that of format 0/1A. | | | | |
| 3A | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 4 | 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 |

#### 7.1.7.1.1.3.3 Specific Message Contents

**Table 7.1.7.1.1.3.3.1: MAC-MainConfig-RBC (preamble Table 4.5.3.3-1 [18]: Step 8)**

| Derivation Path: 36.508 Table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| retxBSR-Timer | sf320 | | |

**Table 7.1.7.1.1.3.3-2: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.7.1.2 DL-SCH transport block size selection / DCI format 1 / RA type 1

#### 7.1.7.1.2.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_CONNECTED state }
**ensure that** {
**when** { UE on PDCCH receives DCI format 1 indicating Resource Allocation Type 1, a resource block assignment correspondent to $N_{\text{PRB}}$ physical resource blocks and a modulation and coding scheme $I_{\text{MCS}}$
}

```
    then { UE decodes the received transport block of size correspondent to the read N_PRB and I_MCS
and forwards it to higher layers }
            }
```

#### 7.1.7.1.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clause 5.3.3.1.2; TS 36.213, clauses 7.1.6.2, 7.1.7, 7.1.7.1, 7.1.7.2 and 7.1.7.2.1; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.2]

DCI format 1 is used for the scheduling of one PDSCH codeword.

The following information is transmitted by means of the DCI format 1:

- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

  If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

  …

  - For resource allocation type 1 as defined in section 7.1.6.2 of [3]:

    - $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset

    - 1 bit indicates a shift of the resource allocation span

    - $\left(\lceil N_{RB}^{DL} / P \rceil - \lceil \log_2(P) \rceil - 1\right)$ bits provide the resource allocation

  where the value of P depends on the number of DL resource blocks as indicated in section 7.1. 6 of [3]

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

If the number of information bits in format 1 is equal to that for format 0/1A, one bit of value zero shall be appended to format 1.

If the number of information bits in format 1 belongs to one of the sizes in Table 5.3.3.1.2-1, one or more zero bit(s) shall be appended to format 1 until the payload size of format 1 does not belong to one of the sizes in Table 5.3.3.1.2-1 and not equal to that of format 0/1A.

**Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

[TS 36.213 clause 7.1.6.2]

In resource allocations of type 1, a resource block assignment information of size $N_{RBG}$ indicates to a scheduled UE the PRBs from the set of PRBs from one of $P$ RBG subsets. Also $P$ is the RBG size associated with the system bandwidth as shown in Table 7.1.6.1-1. A RBG subset $p$, where $0 \le p < P$, consists of every $P$ th RBG starting from RBG $p$. The resource block assignment information consists of three fields [4].

The first field with $\lceil \log_2(P) \rceil$ bits is used to indicate the selected RBG subset among $P$ RBG subsets.

The second field with one bit is used to indicate a shift of the resource allocation span within a subset. A bit value of 1 indicates shift is triggered. Shift is not triggered otherwise.

The third field includes a bitmap, where each bit of the bitmap addresses a single PRB in the selected RBG subset in such a way that MSB to LSB of the bitmap are mapped to the PRBs in the increasing frequency order. The PRB is allocated to the UE if the corresponding bit value in the bit field is 1, the PRB is not allocated to the UE otherwise. The portion of the bitmap used to address PRBs in a selected RBG subset has size $N_{RB}^{TYPE1}$ and is defined as

$$N_{\mathrm{RB}}^{\mathrm{TYPE1}} = \left\lceil N_{\mathrm{RB}}^{\mathrm{DL}} / P \right\rceil - \left\lceil \log_2(P) \right\rceil - 1$$

The addressable PRB numbers of a selected RBG subset start from an offset, $\Delta_{\mathrm{shift}}(p)$ to the smallest PRB number within the selected RBG subset, which is mapped to the MSB of the bitmap. The offset is in terms of the number of PRBs and is done within the selected RBG subset. If the value of the bit in the second field for shift of the resource allocation span is set to 0, the offset for RBG subset $p$ is given by $\Delta_{\mathrm{shift}}(p) = 0$. Otherwise, the offset for RBG subset $p$ is given by $\Delta_{\mathrm{shift}}(p) = N_{\mathrm{RB}}^{\mathrm{RBGsubset}}(p) - N_{\mathrm{RB}}^{\mathrm{TYPE1}}$, where the LSB of the bitmap is justified with the highest PRB number within the selected RBG subset. $N_{\mathrm{RB}}^{\mathrm{RBGsubset}}(p)$ is the number of PRBs in RBG subset $p$ and can be calculated by the following equation,

$$N_{\mathrm{RB}}^{\mathrm{RBGsubset}}(p) = \begin{cases} \left\lfloor \dfrac{N_{\mathrm{RB}}^{\mathrm{DL}} - 1}{P^2} \right\rfloor \cdot P + P & , p < \left\lfloor \dfrac{N_{\mathrm{RB}}^{\mathrm{DL}} - 1}{P} \right\rfloor \bmod P \\ \left\lfloor \dfrac{N_{\mathrm{RB}}^{\mathrm{DL}} - 1}{P^2} \right\rfloor \cdot P + (N_{\mathrm{RB}}^{\mathrm{DL}} - 1) \bmod P + 1 & , p = \left\lfloor \dfrac{N_{\mathrm{RB}}^{\mathrm{DL}} - 1}{P} \right\rfloor \bmod P \\ \left\lfloor \dfrac{N_{\mathrm{RB}}^{\mathrm{DL}} - 1}{P^2} \right\rfloor \cdot P & , p > \left\lfloor \dfrac{N_{\mathrm{RB}}^{\mathrm{DL}} - 1}{P} \right\rfloor \bmod P \end{cases}$$

Consequently, when RBG subset $p$ is indicated, bit $i$ for $i = 0, 1, \cdots, N_{\mathrm{RB}}^{\mathrm{TYPE1}} - 1$ in the bitmap field indicates PRB number,

$$n_{\mathrm{PRB}}^{\mathrm{RBGsubset}}(p) = \left\lfloor \frac{i + \Delta_{\mathrm{shift}}(p)}{P} \right\rfloor P^2 + p \cdot P + \left(i + \Delta_{\mathrm{shift}}(p)\right) \bmod P$$

[TS 36.213 clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

...

else

- set the Table 7.1.7.2.1-1 column indicator $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

    set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{ \left\lfloor N'_{\mathrm{PRB}} \times 0.75 \right\rfloor, \ 1 \right\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal CP or configurations 0 and 4 with extended CP, shown in table 4.2-1 [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.213 clause 7.1.7.1]

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 to determine the modulation order ( $Q_m$ ) used in the physical downlink shared channel.

**Table 7.1.7.1-1: Modulation and TBS index table for PDSCH**

| MCS Index $I_{\mathrm{MCS}}$ | Modulation Order $Q_m$ | TBS Index $I_{\mathrm{TBS}}$ |
|---|---|---|
| 0 | 2 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 2 |
| 3 | 2 | 3 |
| 4 | 2 | 4 |
| 5 | 2 | 5 |
| 6 | 2 | 6 |
| 7 | 2 | 7 |
| 8 | 2 | 8 |
| 9 | 2 | 9 |
| 10 | 4 | 9 |
| 11 | 4 | 10 |
| 12 | 4 | 11 |
| 13 | 4 | 12 |
| 14 | 4 | 13 |
| 15 | 4 | 14 |
| 16 | 4 | 15 |
| 17 | 6 | 15 |
| 18 | 6 | 16 |
| 19 | 6 | 17 |
| 20 | 6 | 18 |
| 21 | 6 | 19 |
| 22 | 6 | 20 |
| 23 | 6 | 21 |
| 24 | 6 | 22 |
| 25 | 6 | 23 |
| 26 | 6 | 24 |
| 27 | 6 | 25 |
| 28 | 6 | 26 |
| 29 | 2 | reserved |
| 30 | 4 | |
| 31 | 6 | |

[TS 36.213 clause 7.1.7.2]

If the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - the UE shall set the TBS index ( $I_{\mathrm{TBS}}$ ) equal to $I_{\mathrm{MCS}}$ and determine its TBS by the procedure in Section 7.1.7.2.1.

...

else

- for $0 \le I_{\mathrm{MCS}} \le 28$, the UE shall first determine the TBS index ( $I_{\mathrm{TBS}}$ ) using $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 except if the transport block is disabled in DCI formats 2 and 2A as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.2.

- for $29 \le I_{\mathrm{MCS}} \le 31$, the TBS is assumed to be as determined from DCI transported in the latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$. If there is no latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

– In DCI formats 2 and 2A a transport block is disabled if $I_{\mathrm{MCS}} = 0$ and if $rv_{idx} = 1$ otherwise the transport block is enabled.

The NDI and HARQ process ID, as signalled on PDCCH, and the TBS, as determined above, shall be delivered to higher layers.

[TS 36.213 clause 7.1.7.2.1]

For $1 \le N_{\mathrm{PRB}} \le 110$, the TBS is given by the ( $I_{\mathrm{TBS}}$, $N_{\mathrm{PRB}}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.306 clause 4.1]

The field *ue-Category* parameter defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

#### 7.1.7.1.2.3 Test description

##### 7.1.7.1.2.3.1 Pre-test conditions

System Simulator:

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31] (to enable testing of $N_{\text{PRB}}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

#### 7.1.7.1.2.3.2 Test procedure sequence

**Table 7.1.7.1.2.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of a DL-SCH transport block received within a TTI |
|---|---|
| Category 1 | 10296 |
| Category 2 | 51024 |
| Category 3 | 75376 |
| Category 4 | 75376 |
| Category 5 | 149776 |

**Table 7.1.7.1.2.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data**

| $TB_{size}$ [bits] | Number of PDCP SDUs | PDCP SDU size [bits] See note 1 |
|---|---|---|
| 104 ≤ $TB_{size}$ ≤12096 note 2 | 1 | 8*FLOOR(($TB_{size}$ - 96)/8) |
| 12097 ≤ $TB_{size}$ ≤24128 | 2 | 8*FLOOR(($TB_{size}$ – 128)/16)) |
| 24129 ≤ $TB_{size}$ ≤ 36152 | 3 | 8*FLOOR(($TB_{size}$ – 152)/24)) |
| 36153 ≤ $TB_{size}$ ≤48184 | 4 | 8*FLOOR(($TB_{size}$ – 184)/32)) |
| 48185 ≤ $TB_{size}$ ≤60208 | 5 | 8*FLOOR(($TB_{size}$ - 208)/40)) |
| 60209 ≤ $TB_{size}$ ≤ 72240 | 6 | 8*FLOOR(($TB_{size}$ – 240)/48)) |
| $TB_{size}$> 72240 | 7 | 8*FLOOR(($TB_{size}$ – 264)/56)) |

Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 clause 9.9.4.12).

The PDCP SDU size of each PDCP SDU is

PDCP SDU size = ($TB_{size}$ – N*PDCP header size - AMD PDU header size - MAC header size – Size of Timing Advance – RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;
AMD PDU header size is CIEL[(16+(N-1)*12)/8] bytes which includes 16 standard AM header and (N-1) Length indicators; and

MAC header size = 40 bits as MAC header can be

R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (16 bits for MAC SDU for RLC Status PDU) +R/R/E/LCID MAC subheader (8 bits for MAC SDU for AMD PDU) = 8 + 16+ 8 bits = 32 bits
OR
R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for AMD PDU, Note: Length can be 2 bytes depending on the size of AMD PDU) +R/R/E/LCID MAC subheader (8 bits for MAC SDU for RLC Status PDU) = 8 + 24+ 8 bits = 40 bits

Therefore maximum MAC header size can be 40 bits

Size of Timing Advance MAC CE is 8 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead)
RLC Status PDU size = 16 bits

This gives:

PDCP SDU size = 8*FLOOR(($TB_{size}$ – N*16- 8*CIEL((16+(N-1)*12)/8) – 64)/(8*N)) bits

Note 2: According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest $TB_{size}$ that can be tested is 104 bits.

**Table 7.1.7.1.2.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\mathrm{PRB}}$ | $N_{\mathrm{RB}}^{\mathrm{TYPE1}}$ |
|---|---|---|
| 10 Mhz | 50 | 14 |
| 15 Mhz | 75 | 16 |
| 20 Mhz | 100 | 22 |
| Note : Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | | |

**Table 7.1.7.1.2.3.2-2b: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

**Table 7.1.7.1.2.3.2-3: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| - | EXCEPTION: Steps 1 to 4 are repeated for values of $N_{\mathrm{PRB}}$ from 1 to $N_{\mathrm{RB}}^{\mathrm{TYPE1}}$ as per table 7.1.7.1.2.3.2-2a and $I_{\mathrm{MCS}}$ from 0 to 28. | - | - | - | - |
| 1 | SS looks up $I_{\mathrm{TBS}}$ in table 7.1.7.1-1 in TS 36.213 based on the value of $I_{\mathrm{MCS}}$. SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\mathrm{PRB}}$ and $I_{\mathrm{TBS}}$. | - | - | - | - |
| - | EXCEPTION: Steps 2 to 4 are performed if $TB_{size}$ is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.7.1.2.3.2-1 and larger than or equal to 104 bits as specified in Table 7.1.7.1.2.3.2-2, and the effective channel code rate, as defined in TS 36.213 clause 7.1.7, is lower than or equal to 0.930. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs, depending on $TB_{size}$, in accordance with Table 7.1.7.1.2.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1 with RA type 1 and a resource block assignment (RBA) correspondent to $N_{\mathrm{PRB}}$ as specified in 7.1.6.2 in TS 36.213 and modulation and coding scheme $I_{\mathrm{MCS}}$.<br><br>If the number of information bits in format 1 is equal to that for format 0/1A, one bit of value zero shall be appended to format 1 by the SS. | <-- | MAC PDU (NxPDCP SDUs)<br>DCI: (DCI Format 1, RA type 1, RBA( $N_{\mathrm{PRB}}$ ), $I_{\mathrm{MCS}}$ ) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | If the number of information bits in format 1 belongs to one of the sizes in Table 7.1.7.1.2.3.2-2b, one or more zero bit(s) shall be appended to format 1 by the SS until the payload size of format 1 does not belong to one of the sizes in Table 7.1.7.1.2.3.2-2b and not equal to that of format 0/1A. | | | | |
| 3A | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | | |
| 4 | 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 |

#### 7.1.7.1.2.3.3 Specific Message Contents

**Table 7.1.7.1.2.3.3.1: MAC-MainConfig-RBC (preamble Table 4.5.3.3-1 [18]: Step 8)**

| Derivation Path: 36.508 Table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| retxBSR-Timer | sf320 | | |

**Table 7.1.7.1.2.3.3-2: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.7.1.3 DL-SCH transport block size selection / DCI format 1A / RA type 2 / Localised VRB

#### 7.1.7.1.3.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_CONNECTED state }
**ensure that** {
  **when** { UE on PDCCH receives DCI format 1A indicating Resource Allocation Type 2 with Localized VRB, a resource block assignment correspondent to $N_{\mathrm{PRB}}$ physical resource blocks and a modulation and coding scheme $I_{\mathrm{MCS}}$ }

```
    then { UE decodes the received transport block of size correspondent to the read N_PRB  and I_MCS
and forwards it to higher layers }
          }
```

#### 7.1.7.1.3.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clauses 5.3.3.1.2 and 5.3.3.1.3; TS 36.213, clauses 7.1.6.3, 7.1.7, 7.1.7.1, 7.1.7.2 and 7.1.7.2.1; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.2]

...

**Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

[TS 36.212 clause 5.3.3.1.3]

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

…

Otherwise,

- Localized/Distributed VRB assignment flag – 1 bit as defined in 7.1.6.3 of [3]

- Resource block assignment – $\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{DL}}(N_{\mathrm{RB}}^{\mathrm{DL}}+1)/2) \rceil$ bits as defined in section 7.1.6.3 of [3]:

  - For localized VRB:

    $\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{DL}}(N_{\mathrm{RB}}^{\mathrm{DL}}+1)/2) \rceil$ bits provide the resource allocation

  - For distributed VRB:

    - If $N_{\mathrm{RB}}^{\mathrm{DL}} < 50$ or if the format 1A CRC is scrambled by RA-RNTI, P-RNTI, or SI-RNTI

      - $\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{DL}}(N_{\mathrm{RB}}^{\mathrm{DL}}+1)/2) \rceil$ bits provide the resource allocation

    - Else

      - 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{\mathrm{gap}} = N_{\mathrm{gap,1}}$ and value 1 indicates $N_{\mathrm{gap}} = N_{\mathrm{gap,2}}$

      - $(\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{DL}}(N_{\mathrm{RB}}^{\mathrm{DL}}+1)/2) \rceil - 1)$ bits provide the resource allocation

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

If the number of information bits in format 1A is less than that of format 0, zeros shall be appended to format 1A until the payload size equals that of format 0.

If the number of information bits in format 1A belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 1A.

...

[TS 36.213 clause 7.1.6.3]

In resource allocations of type 2, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated localized virtual resource blocks or distributed virtual resource blocks. In case of resource allocation signalled with PDCCH DCI format 1A, 1B or 1D, one bit flag indicates whether localized virtual resource blocks or distributed virtual resource blocks are assigned (value 0 indicates Localized and value 1 indicates Distributed VRB assignment) while distributed virtual resource blocks are always assigned in case of resource allocation signalled with PDCCH DCI format 1C. Localized VRB allocations for a UE vary from a single VRB up to a maximum number of VRBs spanning the system bandwidth. For DCI format 1A the distributed VRB allocations for a UE vary from a single VRB up to $N_{\mathrm{VRB}}^{\mathrm{DL}}$ VRBs, where $N_{\mathrm{VRB}}^{\mathrm{DL}}$ is defined in [3], if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI. With PDCCH DCI format 1B, 1D, or 1A with a CRC scrambled with C-RNTI, distributed VRB allocations for a UE vary from a single VRB up to $N_{\mathrm{VRB}}^{\mathrm{DL}}$ VRBs if $N_{\mathrm{RB}}^{\mathrm{DL}}$ is 6-49 and vary from a single VRB up to 16 if $N_{\mathrm{RB}}^{\mathrm{DL}}$ is 50-110. With PDCCH DCI format 1C, distributed VRB allocations for a UE vary from $N_{\mathrm{RB}}^{\mathrm{step}}$ VRB(s) up to $\lfloor N_{\mathrm{VRB}}^{\mathrm{DL}} / N_{\mathrm{RB}}^{\mathrm{step}} \rfloor \cdot N_{\mathrm{RB}}^{\mathrm{step}}$ VRBs with an increment step of $N_{\mathrm{RB}}^{\mathrm{step}}$, where $N_{\mathrm{RB}}^{\mathrm{step}}$ value is determined depending on the downlink system bandwidth as shown in Table 7.1.6.3-1.

**Table 7.1.6.3-1: $N_{\mathrm{RB}}^{\mathrm{step}}$ values vs. Downlink System Bandwidth**

| System BW ($N_{\mathrm{RB}}^{\mathrm{DL}}$) | $N_{\mathrm{RB}}^{\mathrm{step}}$ |
|---|---|
| | DCI format 1C |
| 6-49 | 2 |
| 50-110 | 4 |

For PDCCH DCI format 1A, 1B or 1D, a type 2 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block ( $RB_{start}$ ) and a length in terms of virtually contiguously allocated resource blocks $L_{CRBs}$. The resource indication value is defined by

if $(L_{CRBs} - 1) \le \lfloor N_{RB}^{DL} / 2 \rfloor$ then

$$RIV = N_{RB}^{DL}(L_{CRBs} - 1) + RB_{start}$$

else

$$RIV = N_{RB}^{DL}(N_{RB}^{DL} - L_{CRBs} + 1) + (N_{RB}^{DL} - 1 - RB_{start})$$

where $L_{CRBs} \ge 1$ and shall not exceed $N_{VRB}^{DL} - RB_{start}$.

For PDCCH DCI format 1C, a type 2 resource block assignment field consists of a resource indication value (*RIV*) corresponding to a starting resource block ( $RB_{start} = 0$ , $N_{\mathrm{RB}}^{\mathrm{step}}$, $2N_{\mathrm{RB}}^{\mathrm{step}}$,…, $(\lfloor N_{\mathrm{VRB}}^{\mathrm{DL}} / N_{\mathrm{RB}}^{\mathrm{step}} \rfloor - 1) N_{\mathrm{RB}}^{\mathrm{step}}$ ) and a length in terms of virtually contiguously allocated resource blocks ( $L_{CRBs} = N_{\mathrm{RB}}^{\mathrm{step}}$, $2N_{\mathrm{RB}}^{\mathrm{step}}$,…, $\lfloor N_{\mathrm{VRB}}^{\mathrm{DL}} / N_{\mathrm{RB}}^{\mathrm{step}} \rfloor \cdot N_{\mathrm{RB}}^{\mathrm{step}}$ ). The resource indication value is defined by

if $(L'_{CRBs} - 1) \le \lfloor N'^{DL}_{VRB} / 2 \rfloor$ then

$$RIV = N'^{DL}_{VRB}(L'_{CRBs} - 1) + RB'_{start}$$

else

$$RIV = N'^{DL}_{VRB}(N'^{DL}_{VRB} - L'_{CRBs} + 1) + (N'^{DL}_{VRB} - 1 - RB'_{start})$$

where $L'_{CRBs} = L_{CRBs} / N_{RB}^{step}$, $RB'_{start} = RB_{start} / N_{RB}^{step}$ and $N'^{DL}_{VRB} = \lfloor N_{VRB}^{DL} / N_{RB}^{step} \rfloor$. Here,

$L'_{CRBs} \ge 1$ and shall not exceed $N'^{DL}_{VRB} - RB'_{start}$.

[TS 36.213 clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

...

else

- set the Table 7.1.7.2.1-1 column indicator $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

  set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{\left\lfloor N'_{\mathrm{PRB}} \times 0.75 \right\rfloor, \quad 1\right\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal CP or configurations 0 and 4 with extended CP, shown in table 4.2-1 [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.213 clause 7.1.7.1]

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 to determine the modulation order ( $Q_m$ ) used in the physical downlink shared channel.

**Table 7.1.7.1-1: Modulation and TBS index table for PDSCH**

| MCS Index $I_{\mathrm{MCS}}$ | Modulation Order $Q_m$ | TBS Index $I_{\mathrm{TBS}}$ |
|---|---|---|
| 0 | 2 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 2 |
| 3 | 2 | 3 |
| 4 | 2 | 4 |
| 5 | 2 | 5 |
| 6 | 2 | 6 |
| 7 | 2 | 7 |
| 8 | 2 | 8 |
| 9 | 2 | 9 |
| 10 | 4 | 9 |
| 11 | 4 | 10 |
| 12 | 4 | 11 |
| 13 | 4 | 12 |
| 14 | 4 | 13 |
| 15 | 4 | 14 |
| 16 | 4 | 15 |
| 17 | 6 | 15 |
| 18 | 6 | 16 |
| 19 | 6 | 17 |
| 20 | 6 | 18 |
| 21 | 6 | 19 |
| 22 | 6 | 20 |
| 23 | 6 | 21 |
| 24 | 6 | 22 |
| 25 | 6 | 23 |
| 26 | 6 | 24 |
| 27 | 6 | 25 |
| 28 | 6 | 26 |
| 29 | 2 | reserved |
| 30 | 4 | |
| 31 | 6 | |

[TS 36.213 clause 7.1.7.2]

If the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - the UE shall set the TBS index ( $I_{\mathrm{TBS}}$ ) equal to $I_{\mathrm{MCS}}$ and determine its TBS by the procedure in Section 7.1.7.2.1.

...

else

– for $0 \le I_{\mathrm{MCS}} \le 28$, the UE shall first determine the TBS index ( $I_{\mathrm{TBS}}$ ) using $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 except if the transport block is disabled in DCI formats 2 and 2A as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.2.

– for $29 \le I_{\mathrm{MCS}} \le 31$, the TBS is assumed to be as determined from DCI transported in the latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$. If there is no latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

- In DCI formats 2 and 2A a transport block is disabled if $I_{\mathrm{MCS}} = 0$ and if $rv_{idx}$ = 1 otherwise the transport block is enabled.

The NDI and HARQ process ID, as signalled on PDCCH, and the TBS, as determined above, shall be delivered to higher layers.

[TS 36.213 clause 7.1.7.2.1]

For $1 \leq N_{\mathrm{PRB}} \leq 110$, the TBS is given by the ( $I_{\mathrm{TBS}}$ , $N_{\mathrm{PRB}}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.306 clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

#### 7.1.7.1.3.3 Test description

##### 7.1.7.1.3.3.1 Pre-test conditions

System Simulator:

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31] (to enable testing of $N_{PRB}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

#### 7.1.7.1.3.3.2 Test procedure sequence

**Table 7.1.7.1.3.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of a DL-SCH transport block received within a TTI |
|---|---|
| Category 1 | 10296 |
| Category 2 | 51024 |
| Category 3 | 75376 |
| Category 4 | 75376 |
| Category 5 | 149776 |

**Table 7.1.7.1.3.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data**

| $TB_{size}$ [bits] | Number of PDCP SDUs | PDCP SDU size [bits] See note 1 |
|---|---|---|
| $104 \le TB_{size} \le 12096$ note 2 | 1 | $8*FLOOR((TB_{size} - 96)/8)$ |
| $12097 \le TB_{size} \le 24128$ | 2 | $8*FLOOR((TB_{size} – 128)/16))$ |
| $24129 \le TB_{size} \le 36152$ | 3 | $8*FLOOR((TB_{size} – 152)/24))$ |
| $36153 \le TB_{size} \le 48184$ | 4 | $8*FLOOR((TB_{size} – 184)/32))$ |
| $48185 \le TB_{size} \le 60208$ | 5 | $8*FLOOR((TB_{size} - 208)/40))$ |
| $60209 \le TB_{size} \le 72240$ | 6 | $8*FLOOR((TB_{size} – 240)/48))$ |
| $TB_{size} > 72240$ | 7 | $8*FLOOR((TB_{size} – 264)/56))$ |

Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 clause 9.9.4.12).

The PDCP SDU size of each PDCP SDU is

PDCP SDU size = ($TB_{size}$ – N*PDCP header size -AMD PDU header size - MAC header size – Size of Timing Advance – RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;
AMD PDU header size is CIEL[(16+(N-1)*12)/8] bytes which includes 16 standard AM header and (N-1) Length indicators; and

MAC header size = 40 bits as MAC header can be
R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (16 bits for MAC SDU for RLC Status PDU) + R/R/E/LCID MAC subheader (8 bits for MAC SDU for AMD PDU) = 8 + 16+ 8 bits = 32 bits
Or
R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for AMD PDU, Note: Length can be 2 bytes depending on the size of AMD PDU) +R/R/E/LCID MAC subheader (8 bits for MAC SDU for RLC Status PDU) = 8 + 24+ 8 bits = 40 bits

Therefore maximum MAC header size can be 40 bits

Size of Timing Advance MAC CE is 8 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead)
RLC Status PDU size = 16 bits

This gives:

PDCP SDU size = $8*FLOOR((TB_{size} – N*16- 8*CIEL((16+(N-1)*12)/8) – 64)/(8*N))$ bits.

Note 2: According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest $TB_{size}$ that can be tested is 104 bits.

**Table 7.1.7.1.3.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\mathrm{PRB}}$ |
|---|---|
| 10 Mhz | 50 |
| 15 Mhz | 75 |
| 20 Mhz | 100 |
| Note : Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | |

**Table 7.1.7.1.3.3.2-2b: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

**Table 7.1.7.1.3.3.2-3: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| - | EXCEPTION: Steps 1 to 4 are repeated for values of $N_{\mathrm{PRB}}$ from 1 to Max $N_{\mathrm{PRB}}$ as per table 7.1.7.1.3.3.2-2a and $I_{\mathrm{MCS}}$ from 0 to 28. | - | - | - | - |
| 1 | SS looks up $I_{\mathrm{TBS}}$ in table 7.1.7.1-1 in TS 36.213 based on the value of $I_{\mathrm{MCS}}$ . SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\mathrm{PRB}}$ and $I_{\mathrm{TBS}}$ . | - | - | - | - |
| - | EXCEPTION: Steps 2 to 4 are performed if $TB_{size}$ is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.7.1.3.3.2-1 and larger than or equal to 104 bits as specified in Table 7.1.7.1.3.3.2-2, and the effective channel code rate, as defined in TS 36.213 clause 7.1.7, is lower than or equal to 0.930. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs, depending on $TB_{size}$, in accordance with Table 7.1.7.1.3.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1A with RA type 2 using Localized VRB and a resource block assignment (RBA) correspondent to $N_{\mathrm{PRB}}$ as specified in 7.1.6.3 in TS 36.213 and modulation and coding scheme $I_{\mathrm{MCS}}$ .<br><br>If the number of information bits in format 1A is less than that of format 0, zeros shall be appended by the SS to format 1A until the payload size equals that of format | <-- | MAC PDU (NxPDCP SDUs)<br>DCI: (DCI Format 1A, RA type 2, Localized/Distributed VRB assignment flag ='0', RBA( $N_{\mathrm{PRB}}$ ), $I_{\mathrm{MCS}}$ ) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | 0.<br><br>If the number of information bits in format 1A belongs to one of the sizes in Table 7.1.7.1.3.3.2-2b, one zero bit shall be appended by the SS to format 1A. | | | | |
| 3A | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 4 | 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 |

7.1.7.1.3.3.3 Specific Message Contents

**Table 7.1.7.1.3.3.3.1: MAC-MainConfig-RBC (preamble Table 4.5.3.3-1 [18]: Step 8)**

| Derivation Path: 36.508 Table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| retxBSR-Timer | sf320 | | |

**Table 7.1.7.1.3.3.3-2: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| accessStratumRelease | Any allowed value | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| pdcp-Parameters | Any allowed value | | |
| phyLayerParameters | Any allowed value | | |
| rf-Parameters | Any allowed value | | |
| measParameters | Any allowed value | | |
| featureGroupIndicators | Any allowed value | | |
| interRAT-Parameters | Any allowed value | | |
| nonCriticalExtension | Any allowed value | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.7.1.4 DL-SCH transport block size selection / DCI format 1A / RA type 2 / Distributed VRB

### 7.1.7.1.4.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
```

```
  when { UE on PDCCH receives DCI format 1A indicating Resource Allocation Type 2 with Distributed VRB, a resource block assignment correspondent to N_PRB physical resource blocks and a modulation and coding scheme I_MCS }
    then { UE decodes the received transport block of size correspondent to the read N_PRB and I_MCS and forwards it to higher layers }
          }
```

#### 7.1.7.1.4.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clauses 5.3.3.1.2 and 5.3.3.1.3; TS 36.213, clauses 7.1.6.3, 7.1.7, 7.1.7.1, 7.1.7.2 and 7.1.7.2.1; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.2]

...

**Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

[TS 36.212 clause 5.3.3.1.3]

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

…

Otherwise,

- Localized/Distributed VRB assignment flag – 1 bit as defined in 7.1.6.3 of [3]

- Resource block assignment – $\left\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \right\rceil$ bits as defined in section 7.1.6.3 of [3]:

  - For localized VRB:

    $\left\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \right\rceil$ bits provide the resource allocation

  - For distributed VRB:

    - If $N_{RB}^{DL} < 50$ or if the format 1A CRC is scrambled by RA-RNTI, P-RNTI, or SI-RNTI

      - $\left\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \right\rceil$ bits provide the resource allocation

    - Else

      - 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$

      - $(\left\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \right\rceil - 1)$ bits provide the resource allocation

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

If the number of information bits in format 1A is less than that of format 0, zeros shall be appended to format 1A until the payload size equals that of format 0.

If the number of information bits in format 1A belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 1A.

...

[TS 36.213 clause 7.1.6.3]

In resource allocations of type 2, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated localized virtual resource blocks or distributed virtual resource blocks. In case of resource allocation signalled with PDCCH DCI format 1A, 1B or 1D, one bit flag indicates whether localized virtual resource blocks or distributed virtual resource blocks are assigned (value 0 indicates Localized and value 1 indicates Distributed VRB assignment) while distributed virtual resource blocks are always assigned in case of resource allocation signalled with PDCCH DCI format 1C. Localized VRB allocations for a UE vary from a single VRB up to a maximum number of VRBs spanning the system bandwidth. For DCI format 1A the distributed VRB allocations for a UE vary from a single VRB up to $N_{\mathrm{VRB}}^{\mathrm{DL}}$ VRBs, where $N_{\mathrm{VRB}}^{\mathrm{DL}}$ is defined in [3], if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI. With PDCCH DCI format 1B, 1D, or 1A with a CRC scrambled with C-RNTI, distributed VRB allocations for a UE vary from a single VRB up to $N_{\mathrm{VRB}}^{\mathrm{DL}}$ VRBs if $N_{\mathrm{RB}}^{\mathrm{DL}}$ is 6-49 and vary from a single VRB up to 16 if $N_{\mathrm{RB}}^{\mathrm{DL}}$ is 50-110. With PDCCH DCI format 1C, distributed VRB allocations for a UE vary from $N_{\mathrm{RB}}^{\mathrm{step}}$ VRB(s) up to $\lfloor N_{\mathrm{VRB}}^{\mathrm{DL}} / N_{\mathrm{RB}}^{\mathrm{step}} \rfloor \cdot N_{\mathrm{RB}}^{\mathrm{step}}$ VRBs with an increment step of $N_{\mathrm{RB}}^{\mathrm{step}}$, where $N_{\mathrm{RB}}^{\mathrm{step}}$ value is determined depending on the downlink system bandwidth as shown in Table 7.1.6.3-1.

**Table 7.1.6.3-1: $N_{\mathrm{RB}}^{\mathrm{step}}$ values vs. Downlink System Bandwidth**

| System BW ($N_{\mathrm{RB}}^{\mathrm{DL}}$) | $N_{\mathrm{RB}}^{\mathrm{step}}$ DCI format 1C |
|---|---|
| 6-49 | 2 |
| 50-110 | 4 |

For PDCCH DCI format 1A, 1B or 1D, a type 2 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block ($RB_{start}$) and a length in terms of virtually contiguously allocated resource blocks $L_{CRBs}$. The resource indication value is defined by

if $(L_{CRBs} - 1) \le \lfloor N_{RB}^{DL} / 2 \rfloor$ then

$$RIV = N_{RB}^{DL}(L_{CRBs} - 1) + RB_{start}$$

else

$$RIV = N_{RB}^{DL}(N_{RB}^{DL} - L_{CRBs} + 1) + (N_{RB}^{DL} - 1 - RB_{start})$$

where $L_{CRBs} \ge 1$ and shall not exceed $N_{VRB}^{DL} - RB_{start}$.

For PDCCH DCI format 1C, a type 2 resource block assignment field consists of a resource indication value (*RIV*) corresponding to a starting resource block ($RB_{start} = 0$, $N_{\mathrm{RB}}^{\mathrm{step}}$, $2N_{\mathrm{RB}}^{\mathrm{step}}$,…, $(\lfloor N_{\mathrm{VRB}}^{\mathrm{DL}} / N_{\mathrm{RB}}^{\mathrm{step}} \rfloor - 1) N_{\mathrm{RB}}^{\mathrm{step}}$) and a length in terms of virtually contiguously allocated resource blocks ($L_{CRBs} = N_{\mathrm{RB}}^{\mathrm{step}}$, $2N_{\mathrm{RB}}^{\mathrm{step}}$,…, $\lfloor N_{\mathrm{VRB}}^{\mathrm{DL}} / N_{\mathrm{RB}}^{\mathrm{step}} \rfloor \cdot N_{\mathrm{RB}}^{\mathrm{step}}$). The resource indication value is defined by

if $(L'_{CRBs} - 1) \le \lfloor N'^{DL}_{VRB} / 2 \rfloor$ then

$$RIV = N'^{DL}_{VRB}(L'_{CRBs} - 1) + RB'_{start}$$

else

$$RIV = N'^{DL}_{VRB}(N'^{DL}_{VRB} - L'_{CRBs} + 1) + (N'^{DL}_{VRB} - 1 - RB'_{start})$$

where $L'_{CRBs} = L_{CRBs} / N_{RB}^{step}$, $RB'_{start} = RB_{start} / N_{RB}^{step}$ and $N'^{DL}_{VRB} = \lfloor N_{VRB}^{DL} / N_{RB}^{step} \rfloor$. Here,

$L'_{CRBs} \geq 1$ and shall not exceed $N'^{DL}_{VRB} - RB'_{start}$.

[TS 36.213 clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

...

else

- set the Table 7.1.7.2.1-1 column indicator $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

  set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{\lfloor N'_{\mathrm{PRB}} \times 0.75 \rfloor, \ 1\right\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal CP or configurations 0 and 4 with extended CP, shown in table 4.2-1 [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.213 clause 7.1.7.1]

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 to determine the modulation order ( $Q_m$ ) used in the physical downlink shared channel.

**Table 7.1.7.1-1: Modulation and TBS index table for PDSCH**

| MCS Index $I_{MCS}$ | Modulation Order $Q_m$ | TBS Index $I_{TBS}$ |
|---|---|---|
| 0 | 2 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 2 |
| 3 | 2 | 3 |
| 4 | 2 | 4 |
| 5 | 2 | 5 |
| 6 | 2 | 6 |
| 7 | 2 | 7 |
| 8 | 2 | 8 |
| 9 | 2 | 9 |
| 10 | 4 | 9 |
| 11 | 4 | 10 |
| 12 | 4 | 11 |
| 13 | 4 | 12 |
| 14 | 4 | 13 |
| 15 | 4 | 14 |
| 16 | 4 | 15 |
| 17 | 6 | 15 |
| 18 | 6 | 16 |
| 19 | 6 | 17 |
| 20 | 6 | 18 |
| 21 | 6 | 19 |
| 22 | 6 | 20 |
| 23 | 6 | 21 |
| 24 | 6 | 22 |
| 25 | 6 | 23 |
| 26 | 6 | 24 |
| 27 | 6 | 25 |
| 28 | 6 | 26 |
| 29 | 2 | reserved |
| 30 | 4 | |
| 31 | 6 | |

[TS 36.213 clause 7.1.7.2]

If the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - the UE shall set the TBS index ( $I_{TBS}$ ) equal to $I_{MCS}$ and determine its TBS by the procedure in Section 7.1.7.2.1.

...

else

- for $0 \le I_{MCS} \le 28$, the UE shall first determine the TBS index ( $I_{TBS}$ ) using $I_{MCS}$ and Table 7.1.7.1-1 except if the transport block is disabled in DCI formats 2 and 2A as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.2.
- for $29 \le I_{MCS} \le 31$, the TBS is assumed to be as determined from DCI transported in the latest PDCCH for the same transport block using $0 \le I_{MCS} \le 28$. If there is no latest PDCCH for the same transport block using $0 \le I_{MCS} \le 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

- In DCI formats 2 and 2A a transport block is disabled if $I_{\mathrm{MCS}} = 0$ and if $rv_{idx} = 1$ otherwise the transport block is enabled.

The NDI and HARQ process ID, as signalled on PDCCH, and the TBS, as determined above, shall be delivered to higher layers.

[TS 36.213 clause 7.1.7.2.1]

For $1 \le N_{\mathrm{PRB}} \le 110$, the TBS is given by the ( $I_{\mathrm{TBS}}$, $N_{\mathrm{PRB}}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.306 clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

#### 7.1.7.1.4.3 Test description

##### 7.1.7.1.4.3.1 Pre-test conditions

System Simulator:

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31] (to enable testing of $N_{\text{PRB}}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.
- DCI format 1C shall be used for BCCH, PCH and RAR (note).

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

NOTE: To maximize resources for DL-SCH TB size testing for DCI format 1A/RA type 2/Distributed VRB then the SS need to use DCI Format 1C for BCCH, PCH and RAR

7.1.7.1.4.3.2 Test procedure sequence

**Table 7.1.7.1.4.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of a DL-SCH transport block received within a TTI |
|---|---|
| Category 1 | 10296 |
| Category 2 | 51024 |
| Category 3 | 75376 |
| Category 4 | 75376 |
| Category 5 | 149776 |

**Table 7.1.7.1.4.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data**

| $TB_{size}$ [bits] | Number of PDCP SDUs | PDCP SDU size [bits] See note 1 |
|---|---|---|
| 104 ≤ $TB_{size}$ ≤12096<br>note 2 | 1 | 8*FLOOR(($TB_{size}$ - 96)/8) |
| 12097 ≤ $TB_{size}$ ≤24128 | 2 | 8*FLOOR(($TB_{size}$ – 128)/16)) |
| 24129 ≤ $TB_{size}$ ≤ 36152 | 3 | 8*FLOOR(($TB_{size}$ – 152)/24)) |
| 36153 ≤ $TB_{size}$ ≤48184 | 4 | 8*FLOOR(($TB_{size}$ – 184)/32)) |
| 48185 ≤ $TB_{size}$ ≤60208 | 5 | 8*FLOOR(($TB_{size}$ - 208)/40)) |
| 60209 ≤ $TB_{size}$ ≤ 72240 | 6 | 8*FLOOR(($TB_{size}$ – 240)/48)) |
| $TB_{size}$> 72240 | 7 | 8*FLOOR(($TB_{size}$ – 264)/56)) |

Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 clause 9.9.4.12).

The PDCP SDU size of each PDCP SDU is

PDCP SDU size = ($TB_{size}$ – N*PDCP header size - AMD PDU header size - MAC header size – Size of Timing Advance – RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;
AMD PDU header size is CIEL[(16+(N-1)*12)/8] bytes which includes 16 standard AM header and (N-1) Length indicators; and

MAC header size = 40 bits as MAC header can be

R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (16 bits for MAC SDU for RLC Status PDU) + R/R/E/LCID MAC subheader (8 bits for MAC SDU for AMD PDU) = 8 + 16 + 8 bits = 32 bits
OR
R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for AMD PDU, Note: Length can be 2 bytes depending on the size of AMD PDU) +R/R/E/LCID MAC subheader (8 bits for MAC SDU for RLC Status PDU) = 8 + 24+ 8 bits = 40 bits

Therefore maximum MAC header size can be 40 bits
Size of Timing Advance MAC CE is 8 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead)
RLC Status PDU size = 16 bits

This gives:

PDCP SDU size = 8*FLOOR(($TB_{size}$ – N*16- 8*CIEL((16+(N-1)*12)/8) – 64)/(8*N)) bits.

Note 2: According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest $TB_{size}$ that can be tested is 104 bits.

**Table 7.1.7.1.4.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\text{PRB}}$ | MAX VRB |
|---|---|---|
| 10 Mhz | 50 | 16 |
| 15 Mhz | 75 | 16 |
| 20 Mhz | 100 | 16 |
| Note : Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | | |

**Table 7.1.7.1.4.3.2-2b: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

**Table 7.1.7.1.4.3.2-3: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| - | EXCEPTION: Steps 1 to 4 are repeated for values of $N_{\text{PRB}}$ from 1 to 16[MAX VRB] and $I_{\text{MCS}}$ from 0 to 28. | - | - | - | - |
| 1 | SS looks up $I_{\text{TBS}}$ in table 7.1.7.1-1 in TS 36.213 based on the value of $I_{\text{MCS}}$. SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\text{PRB}}$ and $I_{\text{TBS}}$. | - | - | - | - |
| - | EXCEPTION: Steps 2 to 4 are performed if $TB_{size}$ is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.7.1.4.3.2-1 and larger than or equal to 104 bits as specified in Table 7.1.7.1.4.3.2-2, and the effective channel code rate, as defined in TS 36.213 clause 7.1.7 is lower than or equal to 0.930. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs, depending on $TB_{size}$, in accordance with Table 7.1.7.1.4.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1A with RA type 2 using Distributed VRB and a resource block assignment (RBA) correspondent to $N_{\text{PRB}}$ as specified in 7.1.6.3 in TS 36.213 and modulation and coding scheme $I_{\text{MCS}}$.<br><br>If the number of information bits in format 1A is less than that of format 0, zeros shall be appended by the SS to format 1A until the payload size equals that of format 0. | <-- | MAC PDU (NxPDCP SDUs)<br>DCI: (DCI Format 1A, RA type 2, Localized/Distributed VRB assignment flag ='1', RBA( $N_{\text{PRB}}$ ), $I_{\text{MCS}}$ ) | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | If the number of information bits in format 1A belongs to one of the sizes in Table 7.1.7.1.4.3.2-2b, one zero bit shall be appended by the SS to format 1A. | | | | |
| 3A | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 4 | 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 |

#### 7.1.7.1.4.3.3 Specific Message Contents

**Table 7.1.7.1.4.3.3.1: MAC-MainConfig-RBC (preamble Table 4.5.3.3-1 [18]: Step 8)**

| Derivation Path: 36.508 Table 4.8.2.1.5-1 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| retxBSR-Timer | sf320 | | |

**Table 7.1.7.1.4.3.3-2: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.7.1.5 DL-SCH transport block size selection / DCI format 2A / RA type 0 / Two transport blocks enabled / Transport block to codeword swap flag value set to ’0’

#### 7.1.7.1.5.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_CONNECTED state }
**ensure that** {
**when** { UE has two transport blocks enabled and on PDCCH receives DCI format 2A indicating Resource Allocation Type 0, a resource block assignment correspondent to $N_{\mathrm{PRB}}$ physical resource blocks, the Transport block to codeword swap flag value set to ’0’ and a modulation and coding scheme $I_{\mathrm{MCS}}$ for two transport blocks }
**then** { UE decodes the received transport blocks of sizes correspondent to the read $N_{\mathrm{PRB}}$ and $I_{\mathrm{MCS}}$ for transport block 1 and $I_{\mathrm{MCS}}$ for transport block 2 **and** forwards it to higher layers }
}

#### 7.1.7.1.5.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clauses 5.3.3.1.2, 5.3.3.1.5 and 5.3.3.1.5A; TS 36.213, clauses 7.1.6.1, 7.1.7, 7.1.7.1, 7.1.7.2 and 7.1.7.2.1; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.2]

...

**Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

[TS 36.212 clause 5.3.3.1.5]

**Table 5.3.3.1.5-1: Transport block to codeword mapping (two transport blocks enabled)**

| transport block to codeword swap flag value | codeword 0 (enabled) | codeword 1 (enabled) |
|---|---|---|
| 0 | transport block 1 | transport block 2 |
| 1 | transport block 2 | transport block 1 |

**Table 5.3.3.1.5-2: Transport block to codeword mapping (one transport block enabled)**

| Transport block 1 | transport block 2 | codeword 0 (enabled) | codeword 1 (disabled) |
|---|---|---|---|
| enabled | disabled | transport block 1 | - |
| disabled | enabled | transport block 2 | - |

[TS 36.212 clause 5.3.3.1.5A]

The following information is transmitted by means of the DCI format 2A:

- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

  If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

  - For resource allocation type 0 as defined in section 7.1.6.1 of [3]

    - $\lceil N_{\mathrm{RB}}^{\mathrm{DL}} / P \rceil$ bits provide the resource allocation

...

where the value of P depends on the number of DL resource blocks as indicated in subclause [7.1.6.1] of [3]

...

- Transport block to codeword swap flag – 1 bit

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

- New data indicator – 1 bit

- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

- New data indicator – 1 bit

- Redundancy version – 2 bits

...

Precoding information – number of bits as specified in Table 5.3.3.1.5A-1

If both transport blocks are enabled, the transport block to codeword mapping is specified according to Table 5.3.3.1.5-1.

In case one of the transport blocks is disabled, the transport block to codeword swap flag is reserved and the transport block to codeword mapping is specified according to Table 5.3.3.1.5-2.

The precoding information field is defined according to Table 5.3.3.1.5A -2. For a single enabled codeword, index 1 in Table 5.3.3.1.5A-2 is only supported for retransmission of the corresponding transport block if that transport block has previously been transmitted using two layers with open-loop spatial multiplexing.

For transmission with 2 antenna ports, the precoding information field is not present. The number of transmission layers is equal to 2 if both codewords are enabled; transmit diversity is used if codeword 0 is enabled while codeword 1 is disabled.

If the number of information bits in format 2A belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2A.

**Table 5.3.3.1.5A-1: Number of bits for precoding information**

| Number of antenna ports at eNodeB | Number of bits for precoding information |
|---|---|
| 2 | 0 |
| 4 | 2 |

**Table 5.3.3.1.5A-2: Content of precoding information field for 4 antenna ports**

| One codeword: Codeword 0 enabled, Codeword 1 disabled | | Two codewords: Codeword 0 enabled, Codeword 1 enabled | |
|---|---|---|---|
| Bit field mapped to index | Message | Bit field mapped to index | Message |
| 0 | 4 layers: Transmit diversity | 0 | 2 layers: precoder cycling with large delay CDD |
| 1 | 2 layers: precoder cycling with large delay CDD | 1 | 3 layers: precoder cycling with large delay CDD |
| 2 | reserved | 2 | 4 layers: precoder cycling with large delay CDD |
| 3 | reserved | 3 | reserved |

[TS 36.213 clause 7.1.6.1]

In resource allocations of type 0, 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 physical resource blocks (PRBs). Resource block group size ($P$) is a function of the system bandwidth as shown in Table 7.1.6.1-1. The total number of RBGs ( $N_{\mathrm{RBG}}$ ) for downlink system bandwidth of $N_{\mathrm{RB}}^{\mathrm{DL}}$ PRBs is given by $N_{RBG} = \lceil N_{\mathrm{RB}}^{\mathrm{DL}} / P \rceil$ where

$\lfloor N_{\mathrm{RB}}^{\mathrm{DL}} / P \rfloor$ of the RBGs are of size P and if $N_{\mathrm{RB}}^{\mathrm{DL}} \bmod P > 0$ then one of the RBGs is of size $N_{\mathrm{RB}}^{\mathrm{DL}} - P \cdot \lfloor N_{\mathrm{RB}}^{\mathrm{DL}} / P \rfloor$. The bitmap is of size $N_{\mathrm{RBG}}$ 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 non-increasing RBG sizes starting at the lowest frequency. The order of RBG to bitmap bit mapping is in such way that RBG 0 to RBG $N_{\mathrm{RBG}} - 1$ are mapped to 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.

**Table 7.1.6.1-1: Type 0 Resource Allocation RBG Size vs. Downlink System Bandwidth**

| System Bandwidth $N_{\mathrm{RB}}^{\mathrm{DL}}$ | RBG Size (*P*) |
|---|---|
| ≤10 | 1 |
| 11 – 26 | 2 |
| 27 – 63 | 3 |
| 64 – 110 | 4 |

[TS 36.213 clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit “modulation and coding scheme” field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

...

else

- set the Table 7.1.7.2.1-1 column indicator $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

    if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

        set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\{\lfloor N'_{\mathrm{PRB}} \times 0.75 \rfloor, \ 1\}$,

    else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal CP or configurations 0 and 4 with extended CP, shown in table 4.2-1 [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.213 clause 7.1.7.1]

The UE shall use $Q_m$ = 2 if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 to determine the modulation order ( $Q_m$ ) used in the physical downlink shared channel.

**Table 7.1.7.1-1: Modulation and TBS index table for PDSCH**

| MCS Index $I_{\mathrm{MCS}}$ | Modulation Order $Q_m$ | TBS Index $I_{\mathrm{TBS}}$ |
|---|---|---|
| 0 | 2 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 2 |
| 3 | 2 | 3 |
| 4 | 2 | 4 |
| 5 | 2 | 5 |
| 6 | 2 | 6 |
| 7 | 2 | 7 |
| 8 | 2 | 8 |
| 9 | 2 | 9 |
| 10 | 4 | 9 |
| 11 | 4 | 10 |
| 12 | 4 | 11 |
| 13 | 4 | 12 |
| 14 | 4 | 13 |
| 15 | 4 | 14 |
| 16 | 4 | 15 |
| 17 | 6 | 15 |
| 18 | 6 | 16 |
| 19 | 6 | 17 |
| 20 | 6 | 18 |
| 21 | 6 | 19 |
| 22 | 6 | 20 |
| 23 | 6 | 21 |
| 24 | 6 | 22 |
| 25 | 6 | 23 |
| 26 | 6 | 24 |
| 27 | 6 | 25 |
| 28 | 6 | 26 |
| 29 | 2 | reserved |
| 30 | 4 | |
| 31 | 6 | |

[TS 36.213 clause 7.1.7.2]

If the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - the UE shall set the TBS index ( $I_{\mathrm{TBS}}$ ) equal to $I_{\mathrm{MCS}}$ and determine its TBS by the procedure in Section 7.1.7.2.1.

...

else

- for $0 \le I_{\mathrm{MCS}} \le 28$, the UE shall first determine the TBS index ( $I_{\mathrm{TBS}}$ ) using $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 except if the transport block is disabled in DCI formats 2 and 2A as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.2.
- for $29 \le I_{\mathrm{MCS}} \le 31$, the TBS is assumed to be as determined from DCI transported in the latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$. If there is no latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

- In DCI formats 2 and 2A a transport block is disabled if $I_{\mathrm{MCS}} = 0$ and if $rv_{idx}$ = 1 otherwise the transport block is enabled.

The NDI and HARQ process ID, as signalled on PDCCH, and the TBS, as determined above, shall be delivered to higher layers.

[TS 36.213 clause 7.1.7.2.1]

For $1 \le N_{\mathrm{PRB}} \le 110$, the TBS is given by the ( $I_{\mathrm{TBS}}$, $N_{\mathrm{PRB}}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |
| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |
| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.306 clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

...

#### 7.1.7.1.5.3 Test description

##### 7.1.7.1.5.3.1 Pre-test conditions

System Simulator

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31] (to enable testing of $N_{\mathrm{PRB}}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.

UE:

None.

Preamble

- The UE is in state Loopback Activated (state 4) according to [18] condition 2TX to configure MIMO.

7.1.7.1.5.3.2 Test procedure sequence

**Table 7.1.7.1.5.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of a DL-SCH transport block received within a TTI |
|---|---|
| Category 1 | 10296 |
| Category 2 | 51024 |
| Category 3 | 75376 |
| Category 4 | 75376 |
| Category 5 | 149776 |

**Table 7.1.7.1.5.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data for transport block 1 and transport block 2**

| Total $TB_{size}$ (sum of the sizes of $TB_{size\#1}$ and $TB_{size\#2}$) (bits) | Number of PDCP SDUs | PDCP SDU size (bits] See note 1 |
|---|---|---|
| $136 \le TB_{size} \le 12120$ See note 2 | 1 | 8*FLOOR(($TB_{size}$ - 120)/8) |
| $12121 \le TB_{size} \le 24152$ | 2 | 8*FLOOR(($TB_{size}$ – 152)/16)) |
| $24153 \le TB_{size} \le 36176$ | 3 | 8*FLOOR(($TB_{size}$ – 176)/24)) |
| $36177 \le TB_{size} \le 48208$ | 4 | 8*FLOOR(($TB_{size}$ – 208)/32)) |
| $48209 \le TB_{size} \le 60232$ | 5 | 8*FLOOR(($TB_{size}$ - 232/40)) |
| $60233 \le TB_{size} \le 72264$ | 6 | 8*FLOOR(($TB_{size}$ – 264)/48)) |
| $72265 \le TB_{size} \le 84288$ | 7 | 8*FLOOR(($TB_{size}$ – 288)/56)) |
| $84289 \le TB_{size} \le 96320$ | 8 | 8*FLOOR(($TB_{size}$ – 320)/64)) |
| $96321 \le TB_{size} \le 108348$ | 9 | 8*FLOOR(($TB_{size}$ – 348)/72)) |
| $108349 \le TB_{size} \le 120376$ | 10 | 8*FLOOR(($TB_{size}$ – 376)/80)) |
| $120377 \le TB_{size} \le 132400$ | 11 | 8*FLOOR(($TB_{size}$ – 400)/88)) |
| $132401 \le TB_{size} \le 144432$ | 12 | 8*FLOOR(($TB_{size}$ – 432)/96)) |
| $TB_{size} \ge 144433$ | 13 | 8*FLOOR(($TB_{size}$ – 456)/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 clause 9.9.4.12).

The PDCP SDU size of each PDCP SDU is

PDCP SDU size = (Total TBsize –N*PDCP header size - AMD PDU header size - - MAC header size – Size of Timing Advance– RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;

AMD PDU header size is CEIL[(Number of TBs *16+(N-1)*12)/8] bytes which includes one 16 bit standard AM header per TB and N-1 Length indicators of 12 bits corresponding to the worst case when one of the PDCP SDU is split between the two transport blocks. If no PDCP SDU is split between the transport blocks then there will be only N-2 LIs and MAC padding will occur instead of one LI;

MAC header size = R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for RLC data PDU)+ Number of TBs R/R/E/LCID MAC subheaders (8 bits for MAC SDU for RLC status PDU) = 8 +24 + Number of TBs * 8 bits; If status PDU is not included or, MAC LI is included for MAC SDU for RLC status PDU instead of RLC data PDU, MAC padding will occur in place of unused bits

Size of Timing Advance MAC CE is 8 bits (if no Timing Advance needs to be sent, padding will occur instead);

RLC Status PDU size = 16 bits (including one ACK SQN triggered in execution X+1, due to loop back transmission in execution X and as all loop backed PDUs in execution X have been correctly received, the status PDU will carry an ACK SQN only.

| |
|---|
| This gives:<br><br>PDCP SDU size = 8*FLOOR((Total TBsize – N*16- 8*CEIL((2*16+(N-1)*12)/8) – 72)/(8*N)) bits<br><br>Note 2: According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest total TBsize that can be tested (corresponding to N=1, and PDCP SDU size of 16) is 136 bits. |

**Table 7.1.7.1.5.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\text{PRB}}$ | Allowed $N_{\text{PRB}}$ Values |
|---|---|---|
| 10 Mhz | 50 | 2, 3, 5, 6, 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29, 30, 32, 33, 35, 36, 38, 39, 41, 42, 44, 45, 47, 48, 50 |
| 15 Mhz | 75 | 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, 55, 56, 59, 60, 63, 64, 67, 68, 71, 72, 75 |
| 20 Mhz | 100 | 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 |
| Note : Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | | |

**Table 7.1.7.1.5.3.2-2b: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

**Table 7.1.7.1.5.3.2-3: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| - | EXCEPTION: Steps 1 to 4 are repeated for allowed values of $N_{\text{PRB}}$ as per table 7.1.7.1.5.3.2-2a and for each $I_{\text{MCS}}$ from 0 to 28 | - | - | - | - |
| 1 | SS looks up $I_{\text{TBS}}$ in table 7.1.7.1-1 in TS 36.213 based on the value of $I_{\text{MCS}}$. SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\text{PRB}}$ and $I_{\text{TBS}}$.<br><br>The SS uses the same $I_{\text{MCS}}$ and $TB_{size}$ for both transport blocks:<br><br>$I_{\text{MCS\#1}} = I_{\text{MCS\#2}} = I_{\text{MCS}}$<br>$TB_{size\#1} = TB_{size\#2} = TB_{size}$ | - | - | - | - |
| - | EXCEPTION: Steps 2 to 4 are performed if the sum of the sizes of $TB_{size\#1}$ and $TB_{size\#2}$ is less than or equal to UE capability “Maximum number of DL-SCH transport block bits received within a TTI” as specified in Table 7.1.7.1.5.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.7.1.5.3.2-2, and the effective channel code rate, as defined in TS 36.213 clause 7.1.7, | - | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | is lower than or equal to 0.930. | | | | |
| 2 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on $TB_{size\#1}$, and $TB_{size\#2}$ in accordance with Table 7.1.7.1.5.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs for transport block 1 and 2 concatenated into a MAC PDU per transport block and indicates on PDCCH DCI Format 2A with RA type 0 and a resource block assignment (RBA) correspondent to $N_{\mathrm{PRB}}$ as specified in 7.1.6.1 in TS 36.213 and modulation and coding scheme $I_{\mathrm{MCS\#1}}$ for transport block 1 and $I_{\mathrm{MCS\#2}}$ for transport block 2. The N PDCP SDUs are split between MAC PDU 1 and 2; | <-- | Transport block 1:<br>MAC PDU<br>Transport block 2:<br>MAC PDU<br>DCI: (DCI Format 2A, RA type 0, RBA( $N_{\mathrm{PRB}}$ ),<br>$I_{\mathrm{MCS\#1}}$, $I_{\mathrm{MCS\#2}}$) | - | - |
| 3a | SS transmits one or more UL Grants sufficient for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 4 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | ( N x PDCP SDUs) | 1 | P |

#### 7.1.7.1.5.3.3 Specific Message Contents

**Table 7.1.7.1.5.3.3-1: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

### 7.1.7.1.6 DL-SCH Transport Block Size selection / DCI format 2A / RA type 1 / Two transport blocks enabled / Transport block to codeword swap flag value set to '1'

#### 7.1.7.1.6.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
```

**when** { UE has two transport blocks enabled and on PDCCH receives DCI format 2A indicating Resource Allocation Type 1, a resource block assignment correspondent to $N_{\text{PRB}}$ physical resource blocks, the Transport block to codeword swap flag value set to '1' and a modulation and coding scheme $I_{\text{MCS}}$ for two transport blocks }

**then** { UE decodes the two transport blocks of sizes correspondent to the read $N_{\text{PRB}}$ and $I_{\text{MCS}}$ for transport block 1 and $I_{\text{MCS}}$ for transport block 2 **and** forwards it to higher layers }

}

### 7.1.7.1.6.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clauses 5.3.3.1.2, 5.3.3.1.5 and 5.3.3.1.5A; TS 36.213, clauses 7.1.6.1, 7.1.7, 7.1.7.1, 7.1.7.2 and 7.1.7.2.1; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.2]

...

**Table 5.3.3.1.2-1: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

[TS 36.212 clause 5.3.3.1.5]

**Table 5.3.3.1.5-1: Transport block to codeword mapping (two transport blocks enabled)**

| transport block to codeword swap flag value | codeword 0 (enabled) | codeword 1 (enabled) |
|---|---|---|
| 0 | transport block 1 | transport block 2 |
| 1 | transport block 2 | transport block 1 |

[TS 36.212 clause 5.3.3.1.5A]

The following information is transmitted by means of the DCI format 2A:

- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

  If downlink bandwidth is less than or equal to 10 PRBs, there is no resource allocation header and resource allocation type 0 is assumed.

- Resource block assignment:

...

  - For resource allocation type 1 as defined in section 7.1.6.2 of [3]

    - $\lceil \log_2(P) \rceil$ bits of this field are used as a header specific to this resource allocation type to indicate the selected resource blocks subset

    - 1 bit indicates a shift of the resource allocation span

    - $\left( \lceil N_{\text{RB}}^{\text{DL}} / P \rceil - \lceil \log_2(P) \rceil - 1 \right)$ bits provide the resource allocation

  where the value of P depends on the number of DL resource blocks as indicated in subclause [7.1.6.1] of [3]

...

- Transport block to codeword swap flag – 1 bit

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

- New data indicator – 1 bit

- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]

- New data indicator – 1 bit

- Redundancy version – 2 bits

...

If both transport blocks are enabled, the transport block to codeword mapping is specified according to Table 5.3.3.1.5-1.

...

If the number of information bits in format 2A belongs to one of the sizes in Table 5.3.3.1.2-1, one zero bit shall be appended to format 2A.

[TS 36.213 clause 7.1.6.1]

In resource allocations of type 0, 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 physical resource blocks (PRBs). Resource block group size ($P$) is a function of the system bandwidth as shown in Table 7.1.6.1-1. The total number of RBGs ( $N_{\mathrm{RBG}}$ ) for downlink system bandwidth of $N_{\mathrm{RB}}^{\mathrm{DL}}$ PRBs is given by $N_{RBG} = \lceil N_{\mathrm{RB}}^{\mathrm{DL}} / P \rceil$ where $\lfloor N_{\mathrm{RB}}^{\mathrm{DL}} / P \rfloor$ of the RBGs are of size P and if $N_{\mathrm{RB}}^{\mathrm{DL}} \bmod P > 0$ then one of the RBGs is of size $N_{\mathrm{RB}}^{\mathrm{DL}} - P \cdot \lfloor N_{\mathrm{RB}}^{\mathrm{DL}} / P \rfloor$. The bitmap is of size $N_{\mathrm{RBG}}$ 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 non-increasing RBG sizes starting at the lowest frequency. The order of RBG to bitmap bit mapping is in such way that RBG 0 to RBG $N_{\mathrm{RBG}} - 1$ are mapped to 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.

**Table 7.1.6.1-1: Type 0 Resource Allocation RBG Size vs. Downlink System Bandwidth**

| System Bandwidth $N_{\mathrm{RB}}^{\mathrm{DL}}$ | RBG Size (*P*) |
|---|---|
| ≤10 | 1 |
| 11 – 26 | 2 |
| 27 – 63 | 3 |
| 64 – 110 | 4 |

[TS 36.213 clause 7.1.7]

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit “modulation and coding scheme” field ( $I_{\mathrm{MCS}}$ ) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

...

else

- set the Table 7.1.7.2.1-1 column indicator $N'_{\mathrm{PRB}}$ to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\left\{\left\lfloor N'_{\mathrm{PRB}} \times 0.75 \right\rfloor, \ 1\right\}$,

else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.930, 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. For the special subframe configurations 0 and 5 with normal CP or configurations 0 and 4 with extended CP, shown in table 4.2-1 [3], there shall be no PDSCH transmission in DwPTS of the special subframe.

[TS 36.213 clause 7.1.7.1]

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 to determine the modulation order ($Q_m$) used in the physical downlink shared channel.

**Table 7.1.7.1-1: Modulation and TBS index table for PDSCH**

| MCS Index $I_{\mathrm{MCS}}$ | Modulation Order $Q_m$ | TBS Index $I_{\mathrm{TBS}}$ |
|---|---|---|
| 0 | 2 | 0 |
| 1 | 2 | 1 |
| 2 | 2 | 2 |
| 3 | 2 | 3 |
| 4 | 2 | 4 |
| 5 | 2 | 5 |
| 6 | 2 | 6 |
| 7 | 2 | 7 |
| 8 | 2 | 8 |
| 9 | 2 | 9 |
| 10 | 4 | 9 |
| 11 | 4 | 10 |
| 12 | 4 | 11 |
| 13 | 4 | 12 |
| 14 | 4 | 13 |
| 15 | 4 | 14 |
| 16 | 4 | 15 |
| 17 | 6 | 15 |
| 18 | 6 | 16 |
| 19 | 6 | 17 |
| 20 | 6 | 18 |
| 21 | 6 | 19 |
| 22 | 6 | 20 |
| 23 | 6 | 21 |
| 24 | 6 | 22 |
| 25 | 6 | 23 |
| 26 | 6 | 24 |
| 27 | 6 | 25 |
| 28 | 6 | 26 |
| 29 | 2 | reserved |
| 30 | 4 | |
| 31 | 6 | |

[TS 36.213 clause 7.1.7.2]

If the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:

- the UE shall set the TBS index ( $I_{\mathrm{TBS}}$ ) equal to $I_{\mathrm{MCS}}$ and determine its TBS by the procedure in Section 7.1.7.2.1.

...

else

- for $0 \le I_{\mathrm{MCS}} \le 28$, the UE shall first determine the TBS index ( $I_{\mathrm{TBS}}$ ) using $I_{\mathrm{MCS}}$ and Table 7.1.7.1-1 except if the transport block is disabled in DCI formats 2 and 2A as specified below. For a transport block that is not mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.1. For a transport block that is mapped to two-layer spatial multiplexing, the TBS is determined by the procedure in Section 7.1.7.2.2.

- for $29 \le I_{\mathrm{MCS}} \le 31$, the TBS is assumed to be as determined from DCI transported in the latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$. If there is no latest PDCCH for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

- In DCI formats 2 and 2A a transport block is disabled if $I_{\mathrm{MCS}} = 0$ and if $rv_{idx}$ = 1 otherwise the transport block is enabled.

The NDI and HARQ process ID, as signalled on PDCCH, and the TBS, as determined above, shall be delivered to higher layers.

[TS 36.213 clause 7.1.7.2.1]

For $1 \le N_{\mathrm{PRB}} \le 110$, the TBS is given by the ( $I_{\mathrm{TBS}}$ , $N_{\mathrm{PRB}}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |
| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |
| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |
| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.306 clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

...

#### 7.1.7.1.6.3 Test description

##### 7.1.7.1.6.3.1 Pre-test conditions

System Simulator

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31] (to enable testing of $N_{PRB}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.

UE:

None.

Preamble

- The UE is in state Loopback Activated (state 4) according to [18] condition 2TX to configure MIMO.

#### 7.1.7.1.6.3.2 Test procedure sequence

**Table 7.1.7.1.6.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of a DL-SCH transport block received within a TTI |
|---|---|
| Category 1 | 10296 |
| Category 2 | 51024 |
| Category 3 | 75376 |
| Category 4 | 75376 |
| Category 5 | 149776 |

**Table 7.1.7.1.6.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data for transport block 1 and transport block 2**

| Total $TB_{size}$ (sum of the sizes of $TB_{size\#1}$ and $TB_{size\#2}$) (bits) | Number of PDCP SDUs | PDCP SDU size (bits] See note 1 |
|---|---|---|
| $136 \le TB_{size} \le 12120$ See note 2 | 1 | 8*FLOOR((TBsize - 120)/8) |
| $12121 \le TB_{size} \le 24152$ | 2 | 8*FLOOR((TBsize – 152)/16)) |
| $24153 \le TB_{size} \le 36176$ | 3 | 8*FLOOR((TBsize – 176)/24)) |
| $36177 \le TB_{size} \le 48208$ | 4 | 8*FLOOR((TBsize – 208)/32)) |
| $48209 \le TB_{size} \le 60232$ | 5 | 8*FLOOR((TBsize - 232/40)) |
| $60233 \le TB_{size} \le 72264$ | 6 | 8*FLOOR((TBsize – 264)/48)) |
| $72265 \le TB_{size} \le 84288$ | 7 | 8*FLOOR((TBsize – 288)/56)) |
| | 8 | $84289 \le TB_{size} \le 96320$ 8*FLOOR((TBsize – 320)/64)) |
| $84321 \le TB_{size} \le 108348$ | 9 | 8*FLOOR((TBsize – 348)/72)) |
| $96321 \le TB_{size} \le 108348$ | 10 | 8*FLOOR((TBsize – 376)/80)) |
| $108349 \le TB_{size} \le 120376$ | 11 | 8*FLOOR((TBsize – 400)/88)) |
| $120377 \le TB_{size} \le 132400$ | 12 | 8*FLOOR((TBsize – 432)/96)) |
| $132401 \le TB_{size} \le 144432$ | 13 | 8*FLOOR((TBsize – 456)/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 clause 9.9.4.12).

The PDCP SDU size of each PDCP SDU is

PDCP SDU size = (Total TBsize –N*PDCP header size - AMD PDU header size - - MAC header size – Size of Timing Advance– RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;

AMD PDU header size is CEIL[(Number of TBs *16+(N-1)*12)/8] bytes which includes one 16 bit standard AM header per TB and N-1 Length indicators of 12 bits corresponding to the worst case when one of the PDCP SDU is split between the two transport blocks. If no PDCP SDU is split between the transport blocks then there will be only N-2 LIs and MAC padding will occur instead of one LI;

MAC header size = R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for RLC data PDU)+ Number of TBs R/R/E/LCID MAC subheaders (8 bits for MAC SDU for RLC status PDU) = 8 +24 + Number of TBs * 8 bits; If status PDU is not included or, MAC LI is included for MAC SDU for RLC status PDU instead of RLC data PDU, MAC padding will occur in place of unused bits

Size of Timing Advance MAC CE is 8 bits (if no Timing Advance needs to be sent, padding will occur instead);

RLC Status PDU size = 16 bits (including one ACK SQN triggered in execution X+1, due to loop back transmission in execution X and as all loop backed PDUs in execution X have been correctly received, the status PDU will carry an ACK SQN only.

| | |
|---|---|
| | This gives: |
| | PDCP SDU size = 8*FLOOR((Total TBsize – N*16- 8*CEIL((2*16+(N-1)*12)/8) – 72)/(8*N)) bits |
| Note 2: | According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest total TBsize that can be tested (corresponding to N=1, and PDCP SDU size of 16) is 136 bits. |

**Table 7.1.7.1.6.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\text{PRB}}$ | Allowed $N_{\text{PRB}}$ Values |
|---|---|---|
| 10 Mhz | 50 | 2, 3, 5, 6, 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, 24, 26, 27, 29, 30, 32, 33, 35, 36, 38, 39, 41, 42, 44, 45, 47, 48, 50 |
| 15 Mhz | 75 | 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, 55, 56, 59, 60, 63, 64, 67, 68, 71, 72, 75 |
| 20 Mhz | 100 | 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 |
| Note: Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | | |

**Table 7.1.7.1.6.3.2-2b: Ambiguous Sizes of Information Bits**

| |
|---|
| {12, 14, 16 ,20, 24, 26, 32, 40, 44, 56} |

**Table 7.1.7.1.6.3.2-3: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U – S | Message | | |
| - | EXCEPTION: Steps 1 to 4 are repeated for allowed values of $N_{\text{PRB}}$ as per table 7.1.7.1.6.3.2-2a and for each $I_{\text{MCS}}$ from 0 to 28 | - | - | - | - |
| 1 | SS looks up $I_{\text{TBS}}$ in table 7.1.7.1-1 in TS 36.213 based on the value of $I_{\text{MCS}}$. SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\text{PRB}}$ and $I_{\text{TBS}}$.<br><br>The SS uses the same $I_{\text{MCS}}$ and $TB_{size}$ for both transport blocks:<br><br>$I_{\text{MCS\#1}} = I_{\text{MCS\#2}} = I_{\text{MCS}}$<br>$TB_{size\#1} = TB_{size\#2} = TB_{size}$ | - | - | - | - |
| - | EXCEPTION: Steps 2 to 4 are performed if the sum of the sizes of $TB_{size\#1}$ and $TB_{size\#2}$ is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.7.1.6.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.7.1.6.3.2-2, and the effective channel code rate, as defined in TS 36.213 clause 7.1.7, | - | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | is lower than or equal to 0.930. | | | | |
| 2 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on $TB_{size\#1}$ and $TB_{size\#2}$, in accordance with Table 7.1.7.1.6.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs for transport block 1 and 2 concatenated into a MAC PDU per transport block and indicates on PDCCH DCI Format 2A with RA type 1 and a resource block assignment (RBA) correspondent to $N_{\mathrm{PRB}}$ as specified in 7.1.6.1 in TS 36.213, transport block to codeword swap flag value set to '1' and modulation and coding scheme $I_{\mathrm{MCS\#1}}$ for transport block 1 and $I_{\mathrm{MCS\#2}}$ for transport block 2. . The N PDCP SDUs are split between MAC PDU 1 and 2; | <-- | Transport block 1: MAC PDU Transport block 2: MAC PDU DCI: (DCI Format 2A, RA type 1, RBA( $N_{\mathrm{PRB}}$ ), Transport block to codeword swap flag value set to='1', $I_{\mathrm{MCS\#1}}$, $I_{\mathrm{MCS\#2}}$) | - | - |
| 3a | SS transmits one or more UL Grants sufficient for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 4 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | ( $N_1$ x PDCP SDUs, $N_2$ x PDCP SDUs) | 1 | P |

7.1.7.1.6.3.3 Specific Message Contents

**Table 7.1.7.1.6.3.3-1: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.7.2 UL-SCH transport block size support

### 7.1.7.2.1 UL-SCH transport block size selection / DCI format 0

#### 7.1.7.2.1.1 Test Purpose (TP)

(1)

**with** { UE in E-UTRA RRC_CONNECTED state }
**ensure that** {
**when** { UE has pending data for transmission and receives a Resource Block Assignment correspondent to $N_{\mathrm{PRB}}$ physical resource blocks and a modulation and coding scheme $I_{\mathrm{MCS}}$ for PUSCH scheduling }
**then** { UE transmits MAC PDU on PUSCH on the granted resources using a transport block size correspondent to the read $N_{\mathrm{PRB}}$ and $I_{\mathrm{MCS}}$ }
}

#### 7.1.7.2.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.212, clause 5.3.3.1.1; TS 36.213, clauses 8.1, 8.6, 8.6.1, 8.6.2 and 7.1.7.2.1; TS 36.211, clause 5.3.3; and TS 36.306 clause 4.1.

[TS 36.212 clause 5.3.3.1.1]

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \right\rceil$ bits
  - For PUSCH hopping:
  - $N_{UL\_hop}$ MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]
  - $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \right\rceil - N_{\mathrm{UL\_hop}}\right)$ bits provide the resource allocation of the first slot in the UL subframe
  - For non-hopping PUSCH:
    - $\left(\left\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \right\rceil\right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]
- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]

[TS 36.213 clause 8.1]

The resource allocation information indicates to a scheduled UE a set of contiguously allocated virtual resource block indices denoted by $n_{\mathrm{VRB}}$. A resource allocation field in the scheduling grant consists of a resource indication value ($RIV$) corresponding to a starting resource block ( $RB_{\mathrm{START}}$ ) and a length in terms of contiguously allocated resource blocks ( $L_{\mathrm{CRBs}} \geq 1$). The resource indication value is defined by

if $(L_{\mathrm{CRBs}}-1) \leq \left\lfloor N_{\mathrm{RB}}^{\mathrm{UL}}/2 \right\rfloor$ then

$$RIV = N_{\mathrm{RB}}^{\mathrm{UL}}(L_{\mathrm{CRBs}}-1) + RB_{\mathrm{START}}$$

else

$$RIV = N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}} - L_{\mathrm{CRBs}} + 1) + (N_{\mathrm{RB}}^{\mathrm{UL}} - 1 - RB_{\mathrm{START}})$$

A UE shall discard PUSCH resource allocation in the corresponding PDCCH with DCI format 0 if consistent control information is not detected.

[TS 36.213 clause 8.6]

To determine the modulation order, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme and redundancy version" field ( $I_{\mathrm{MCS}}$ ) in the DCI, and
- check the "CQI request" bit in DCI, and
- compute the total number of allocated PRBs ( $N_{\mathrm{PRB}}$ ) based on the procedure defined in Section 8.1, and
- compute the number of coded symbols for control information..

[TS 36.213 clause 8.6.1]

For $0 \le I_{\mathrm{MCS}} \le 28$, the modulation order ( $Q_m$ ) is determined as follows:

- If the UE is capable of supporting 64QAM in PUSCH and has not been configured by higher layers to transmit only QPSK and 16QAM, the modulation order is given by $Q_m^{'}$ in Table 8.6.1-1.
- If the UE is not capable of supporting 64QAM in PUSCH or has been configured by higher layers to transmit only QPSK and 16QAM, $Q_m^{'}$ is first read from Table 8.6.1-1. The modulation order is set to $Q_m = \min(4, Q_m^{'})$.
- If the parameter *ttiBundling* provided by higher layers is set to *TRUE*, then the resource allocation size is restricted to $N_{\mathrm{PRB}} \le 3$ and the modulation order is set to $Q_m = 2$.

For $29 \le I_{\mathrm{MCS}} \le 31$, If $I_{\mathrm{MCS}} = 29$, the "CQI request" bit in DCI format 0 is set to 1 and $N_{\mathrm{PRB}} \le 4$, the modulation order is set to $Q_m = 2$. Otherwise, the modulation order shall be determined from the DCI transported in the latest PDCCH with DCI format 0 for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$. If there is no PDCCH with DCI format 0 for the same transport block using $0 \le I_{\mathrm{MCS}} \le 28$, the modulation order shall be determined from

- the most recent semi-persistent scheduling assignment PDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,

the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The UE shall use $I_{\mathrm{MCS}}$ and Table 8.6.1-1 to determine the redundancy version (*rv<sub>idx</sub>*) to use in the physical uplink shared channel.

**Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH**

| MCS Index $I_{MCS}$ | Modulation Order $Q_m^{'}$ | TBS Index $I_{TBS}$ | Redundancy Version $rv_{idx}$ |
|---|---|---|---|
| 0 | 2 | 0 | 0 |
| 1 | 2 | 1 | 0 |
| 2 | 2 | 2 | 0 |
| 3 | 2 | 3 | 0 |
| 4 | 2 | 4 | 0 |
| 5 | 2 | 5 | 0 |
| 6 | 2 | 6 | 0 |
| 7 | 2 | 7 | 0 |
| 8 | 2 | 8 | 0 |
| 9 | 2 | 9 | 0 |
| 10 | 2 | 10 | 0 |
| 11 | 4 | 10 | 0 |
| 12 | 4 | 11 | 0 |
| 13 | 4 | 12 | 0 |
| 14 | 4 | 13 | 0 |
| 15 | 4 | 14 | 0 |
| 16 | 4 | 15 | 0 |
| 17 | 4 | 16 | 0 |
| 18 | 4 | 17 | 0 |
| 19 | 4 | 18 | 0 |
| 20 | 4 | 19 | 0 |
| 21 | 6 | 19 | 0 |
| 22 | 6 | 20 | 0 |
| 23 | 6 | 21 | 0 |
| 24 | 6 | 22 | 0 |
| 25 | 6 | 23 | 0 |
| 26 | 6 | 24 | 0 |
| 27 | 6 | 25 | 0 |
| 28 | 6 | 26 | 0 |
| 29 | reserved | | 1 |
| 30 | | | 2 |
| 31 | | | 3 |

[TS 36.213 clause 8.6.2]

For $0 \le I_{MCS} \le 28$, the UE shall first determine the TBS index ( $I_{TBS}$ ) using $I_{MCS}$ and Table 8.6.1-1. The UE shall then follow the procedure in Section 7.1.7.2.1 to determine the transport block size.

For $29 \le I_{MCS} \le 31$, If $I_{MCS} = 29$, the "CQI request" bit in DCI format 0 is set to 1 and $N_{PRB} \le 4$, then there is no transport block for the UL-SCH and only the control information feedback for the current PUSCH reporting mode is transmitted by the UE. Otherwise, the transport block size shall be determined from the initial PDCCH for the same transport block using $0 \le I_{MCS} \le 28$. If there is no initial PDCCH with DCI format 0 for the same transport block using $0 \le I_{MCS} \le 28$, the transport block size shall be determined from

- the most recent semi-persistent scheduling assignment PDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,
- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

[TS 36.213 clause 7.1.7.2.1]

For $1 \le N_{PRB} \le 110$, the TBS is given by the ( $I_{TBS}$, $N_{PRB}$ ) entry of Table 7.1.7.2.1-1.

**Table 7.1.7.2.1-1: Transport block size table (dimension 27×110)**

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 0 | 16 | 32 | 56 | 88 | 120 | 152 | 176 | 208 | 224 | 256 |
| 1 | 24 | 56 | 88 | 144 | 176 | 208 | 224 | 256 | 328 | 344 |
| 2 | 32 | 72 | 144 | 176 | 208 | 256 | 296 | 328 | 376 | 424 |
| 3 | 40 | 104 | 176 | 208 | 256 | 328 | 392 | 440 | 504 | 568 |
| 4 | 56 | 120 | 208 | 256 | 328 | 408 | 488 | 552 | 632 | 696 |
| 5 | 72 | 144 | 224 | 328 | 424 | 504 | 600 | 680 | 776 | 872 |
| 6 | 328 | 176 | 256 | 392 | 504 | 600 | 712 | 808 | 936 | 1032 |
| 7 | 104 | 224 | 328 | 472 | 584 | 712 | 840 | 968 | 1096 | 1224 |
| 8 | 120 | 256 | 392 | 536 | 680 | 808 | 968 | 1096 | 1256 | 1384 |
| 9 | 136 | 296 | 456 | 616 | 776 | 936 | 1096 | 1256 | 1416 | 1544 |
| 10 | 144 | 328 | 504 | 680 | 872 | 1032 | 1224 | 1384 | 1544 | 1736 |
| 11 | 176 | 376 | 584 | 776 | 1000 | 1192 | 1384 | 1608 | 1800 | 2024 |
| 12 | 208 | 440 | 680 | 904 | 1128 | 1352 | 1608 | 1800 | 2024 | 2280 |
| 13 | 224 | 488 | 744 | 1000 | 1256 | 1544 | 1800 | 2024 | 2280 | 2536 |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 1992 | 2280 | 2600 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2152 | 2472 | 2728 | 3112 |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2280 | 2600 | 2984 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2536 | 2856 | 3240 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 2792 | 3112 | 3624 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 2984 | 3496 | 3880 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3240 | 3752 | 4136 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | 2472 | 2984 | 3496 | 4008 | 4584 | 4968 |
| 22 | 520 | 1064 | 1608 | 2152 | 2664 | 3240 | 3752 | 4264 | 4776 | 5352 |
| 23 | 552 | 1128 | 1736 | 2280 | 2856 | 3496 | 4008 | 4584 | 5160 | 5736 |
| 24 | 584 | 1192 | 1800 | 2408 | 2984 | 3624 | 4264 | 4968 | 5544 | 5992 |
| 25 | 616 | 1256 | 1864 | 2536 | 3112 | 3752 | 4392 | 5160 | 5736 | 6200 |
| 26 | 712 | 1480 | 2216 | 2984 | 3752 | 4392 | 5160 | 5992 | 6712 | 7480 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| 0 | 288 | 328 | 344 | 376 | 392 | 424 | 456 | 488 | 504 | 536 |
| 1 | 376 | 424 | 456 | 488 | 520 | 568 | 600 | 632 | 680 | 712 |
| 2 | 472 | 520 | 568 | 616 | 648 | 696 | 744 | 776 | 840 | 872 |
| 3 | 616 | 680 | 744 | 808 | 872 | 904 | 968 | 1032 | 1096 | 1160 |
| 4 | 776 | 840 | 904 | 1000 | 1064 | 1128 | 1192 | 1288 | 1352 | 1416 |
| 5 | 968 | 1032 | 1128 | 1224 | 1320 | 1384 | 1480 | 1544 | 1672 | 1736 |
| 6 | 1128 | 1224 | 1352 | 1480 | 1544 | 1672 | 1736 | 1864 | 1992 | 2088 |
| 7 | 1320 | 1480 | 1608 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2472 |
| 8 | 1544 | 1672 | 1800 | 1928 | 2088 | 2216 | 2344 | 2536 | 2664 | 2792 |
| 9 | 1736 | 1864 | 2024 | 2216 | 2344 | 2536 | 2664 | 2856 | 2984 | 3112 |
| 10 | 1928 | 2088 | 2280 | 2472 | 2664 | 2792 | 2984 | 3112 | 3368 | 3496 |
| 11 | 2216 | 2408 | 2600 | 2792 | 2984 | 3240 | 3496 | 3624 | 3880 | 4008 |
| 12 | 2472 | 2728 | 2984 | 3240 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 |
| 13 | 2856 | 3112 | 3368 | 3624 | 3880 | 4136 | 4392 | 4584 | 4968 | 5160 |
| 14 | 3112 | 3496 | 3752 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 |
| 15 | 3368 | 3624 | 4008 | 4264 | 4584 | 4968 | 5160 | 5544 | 5736 | 6200 |
| 16 | 3624 | 3880 | 4264 | 4584 | 4968 | 5160 | 5544 | 5992 | 6200 | 6456 |
| 17 | 4008 | 4392 | 4776 | 5160 | 5352 | 5736 | 6200 | 6456 | 6712 | 7224 |
| 18 | 4392 | 4776 | 5160 | 5544 | 5992 | 6200 | 6712 | 7224 | 7480 | 7992 |
| 19 | 4776 | 5160 | 5544 | 5992 | 6456 | 6968 | 7224 | 7736 | 8248 | 8504 |
| 20 | 5160 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8248 | 8760 | 9144 |
| 21 | 5544 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 9912 |
| 22 | 5992 | 6456 | 6968 | 7480 | 7992 | 8504 | 9144 | 9528 | 10296 | 10680 |
| 23 | 6200 | 6968 | 7480 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 |
| 24 | 6712 | 7224 | 7992 | 8504 | 9144 | 9912 | 10296 | 11064 | 11448 | 12216 |
| 25 | 6968 | 7480 | 8248 | 8760 | 9528 | 10296 | 10680 | 11448 | 12216 | 12576 |
| 26 | 8248 | 8760 | 9528 | 10296 | 11064 | 11832 | 12576 | 13536 | 14112 | 14688 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 568 | 600 | 616 | 648 | 680 | 712 | 744 | 776 | 776 | 808 |
| 1 | 744 | 776 | 808 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1064 |
| 2 | 936 | 968 | 1000 | 1064 | 1096 | 1160 | 1192 | 1256 | 1288 | 1320 |
| 3 | 1224 | 1256 | 1320 | 1384 | 1416 | 1480 | 1544 | 1608 | 1672 | 1736 |
| 4 | 1480 | 1544 | 1608 | 1736 | 1800 | 1864 | 1928 | 1992 | 2088 | 2152 |
| 5 | 1864 | 1928 | 2024 | 2088 | 2216 | 2280 | 2344 | 2472 | 2536 | 2664 |
| 6 | 2216 | 2280 | 2408 | 2472 | 2600 | 2728 | 2792 | 2984 | 2984 | 3112 |
| 7 | 2536 | 2664 | 2792 | 2984 | 3112 | 3240 | 3368 | 3368 | 3496 | 3624 |
| 8 | 2984 | 3112 | 3240 | 3368 | 3496 | 3624 | 3752 | 3880 | 4008 | 4264 |
| 9 | 3368 | 3496 | 3624 | 3752 | 4008 | 4136 | 4264 | 4392 | 4584 | 4776 |
| 10 | 3752 | 3880 | 4008 | 4264 | 4392 | 4584 | 4776 | 4968 | 5160 | 5352 |
| 11 | 4264 | 4392 | 4584 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 5992 |
| 12 | 4776 | 4968 | 5352 | 5544 | 5736 | 5992 | 6200 | 6456 | 6712 | 6712 |
| 13 | 5352 | 5736 | 5992 | 6200 | 6456 | 6712 | 6968 | 7224 | 7480 | 7736 |
| 14 | 5992 | 6200 | 6456 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 |
| 15 | 6456 | 6712 | 6968 | 7224 | 7736 | 7992 | 8248 | 8504 | 8760 | 9144 |
| 16 | 6712 | 7224 | 7480 | 7736 | 7992 | 8504 | 8760 | 9144 | 9528 | 9912 |
| 17 | 7480 | 7992 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10296 | 10680 |
| 18 | 8248 | 8760 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 |
| 19 | 9144 | 9528 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 |
| 20 | 9912 | 10296 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 |
| 21 | 10680 | 11064 | 11448 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 |
| 22 | 11448 | 11832 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 |
| 23 | 12216 | 12576 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 |
| 24 | 12960 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 |
| 25 | 13536 | 14112 | 14688 | 15264 | 15840 | 16416 | 16992 | 17568 | 18336 | 19080 |
| 26 | 15264 | 16416 | 16992 | 17568 | 18336 | 19080 | 19848 | 20616 | 21384 | 22152 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **31** | **32** | **33** | **34** | **35** | **36** | **37** | **38** | **39** | **40** |
| 0 | 840 | 872 | 904 | 936 | 968 | 1000 | 1032 | 1032 | 1064 | 1096 |
| 1 | 1128 | 1160 | 1192 | 1224 | 1256 | 1288 | 1352 | 1384 | 1416 | 1416 |
| 2 | 1384 | 1416 | 1480 | 1544 | 1544 | 1608 | 1672 | 1672 | 1736 | 1800 |
| 3 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2152 | 2216 | 2280 | 2344 |
| 4 | 2216 | 2280 | 2344 | 2408 | 2472 | 2600 | 2664 | 2728 | 2792 | 2856 |
| 5 | 2728 | 2792 | 2856 | 2984 | 3112 | 3112 | 3240 | 3368 | 3496 | 3496 |
| 6 | 3240 | 3368 | 3496 | 3496 | 3624 | 3752 | 3880 | 4008 | 4136 | 4136 |
| 7 | 3752 | 3880 | 4008 | 4136 | 4264 | 4392 | 4584 | 4584 | 4776 | 4968 |
| 8 | 4392 | 4584 | 4584 | 4776 | 4968 | 4968 | 5160 | 5352 | 5544 | 5544 |
| 9 | 4968 | 5160 | 5160 | 5352 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 |
| 10 | 5544 | 5736 | 5736 | 5992 | 6200 | 6200 | 6456 | 6712 | 6712 | 6968 |
| 11 | 6200 | 6456 | 6712 | 6968 | 6968 | 7224 | 7480 | 7736 | 7736 | 7992 |
| 12 | 6968 | 7224 | 7480 | 7736 | 7992 | 8248 | 8504 | 8760 | 8760 | 9144 |
| 13 | 7992 | 8248 | 8504 | 8760 | 9144 | 9144 | 9528 | 9912 | 9912 | 10296 |
| 14 | 8760 | 9144 | 9528 | 9912 | 9912 | 10296 | 10680 | 11064 | 11064 | 11448 |
| 15 | 9528 | 9912 | 10296 | 10296 | 10680 | 11064 | 11448 | 11832 | 11832 | 12216 |
| 16 | 9912 | 10296 | 10680 | 11064 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 17 | 11064 | 11448 | 11832 | 12216 | 12576 | 12960 | 13536 | 13536 | 14112 | 14688 |
| 18 | 12216 | 12576 | 12960 | 13536 | 14112 | 14112 | 14688 | 15264 | 15264 | 15840 |
| 19 | 13536 | 13536 | 14112 | 14688 | 15264 | 15264 | 15840 | 16416 | 16992 | 16992 |
| 20 | 14688 | 14688 | 15264 | 15840 | 16416 | 16992 | 16992 | 17568 | 18336 | 18336 |
| 21 | 15840 | 15840 | 16416 | 16992 | 17568 | 18336 | 18336 | 19080 | 19848 | 19848 |
| 22 | 16992 | 16992 | 17568 | 18336 | 19080 | 19080 | 19848 | 20616 | 21384 | 21384 |
| 23 | 17568 | 18336 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22152 | 22920 |
| 24 | 19080 | 19848 | 19848 | 20616 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 |
| 25 | 19848 | 20616 | 20616 | 21384 | 22152 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 26 | 22920 | 23688 | 24496 | 25456 | 25456 | 26416 | 27376 | 28336 | 29296 | 29296 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **41** | **42** | **43** | **44** | **45** | **46** | **47** | **48** | **49** | **50** |
| 0 | 1128 | 1160 | 1192 | 1224 | 1256 | 1256 | 1288 | 1320 | 1352 | 1384 |
| 1 | 1480 | 1544 | 1544 | 1608 | 1608 | 1672 | 1736 | 1736 | 1800 | 1800 |
| 2 | 1800 | 1864 | 1928 | 1992 | 2024 | 2088 | 2088 | 2152 | 2216 | 2216 |
| 3 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2728 | 2792 | 2856 | 2856 |
| 4 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3496 | 3496 | 3624 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4264 | 4392 | 4392 |
| 6 | 4264 | 4392 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 |
| 7 | 4968 | 5160 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 6200 |
| 8 | 5736 | 5992 | 5992 | 6200 | 6200 | 6456 | 6456 | 6712 | 6968 | 6968 |
| 9 | 6456 | 6712 | 6712 | 6968 | 6968 | 7224 | 7480 | 7480 | 7736 | 7992 |
| 10 | 7224 | 7480 | 7480 | 7736 | 7992 | 7992 | 8248 | 8504 | 8504 | 8760 |
| 11 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 |
| 12 | 9528 | 9528 | 9912 | 9912 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 |
| 13 | 10680 | 10680 | 11064 | 11448 | 11448 | 11832 | 12216 | 12216 | 12576 | 12960 |
| 14 | 11832 | 12216 | 12216 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14112 |
| 15 | 12576 | 12960 | 12960 | 13536 | 13536 | 14112 | 14688 | 14688 | 15264 | 15264 |
| 16 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 15264 | 15840 | 15840 | 16416 |
| 17 | 14688 | 15264 | 15264 | 15840 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 |
| 18 | 16416 | 16416 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 19 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 | 20616 | 20616 | 21384 | 21384 |
| 20 | 19080 | 19848 | 19848 | 20616 | 20616 | 21384 | 22152 | 22152 | 22920 | 22920 |
| 21 | 20616 | 21384 | 21384 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 |
| 22 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 |
| 23 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 27376 | 27376 | 28336 | 28336 |
| 24 | 25456 | 25456 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 25 | 26416 | 26416 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 31704 | 31704 |
| 26 | 30576 | 30576 | 31704 | 32856 | 32856 | 34008 | 35160 | 35160 | 36696 | 36696 |

| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **51** | **52** | **53** | **54** | **55** | **56** | **57** | **58** | **59** | **60** |
| 0 | 1416 | 1416 | 1480 | 1480 | 1544 | 1544 | 1608 | 1608 | 1608 | 1672 |
| 1 | 1864 | 1864 | 1928 | 1992 | 1992 | 2024 | 2088 | 2088 | 2152 | 2152 |
| 2 | 2280 | 2344 | 2344 | 2408 | 2472 | 2536 | 2536 | 2600 | 2664 | 2664 |
| 3 | 2984 | 2984 | 3112 | 3112 | 3240 | 3240 | 3368 | 3368 | 3496 | 3496 |
| 4 | 3624 | 3752 | 3752 | 3880 | 4008 | 4008 | 4136 | 4136 | 4264 | 4264 |
| 5 | 4584 | 4584 | 4776 | 4776 | 4776 | 4968 | 4968 | 5160 | 5160 | 5352 |
| 6 | 5352 | 5352 | 5544 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 | 6200 |
| 7 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 7224 | 7224 |
| 8 | 7224 | 7224 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8504 |
| 9 | 7992 | 8248 | 8248 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 |
| 10 | 9144 | 9144 | 9144 | 9528 | 9528 | 9912 | 9912 | 10296 | 10296 | 10680 |
| 11 | 10296 | 10680 | 10680 | 11064 | 11064 | 11448 | 11448 | 11832 | 11832 | 12216 |
| 12 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 |
| 13 | 12960 | 13536 | 13536 | 14112 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 |
| 14 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 |
| 15 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 |
| 16 | 16416 | 16992 | 16992 | 17568 | 17568 | 18336 | 18336 | 19080 | 19080 | 19848 |
| 17 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 18 | 19848 | 20616 | 21384 | 21384 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 |
| 19 | 22152 | 22152 | 22920 | 22920 | 23688 | 24496 | 24496 | 25456 | 25456 | 25456 |
| 20 | 23688 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 |
| 21 | 25456 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 |
| 22 | 27376 | 28336 | 28336 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 |
| 23 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 |
| 24 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 |
| 25 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 |
| 26 | 37888 | 37888 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 |

| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** | **69** | **70** |
| 0 | 1672 | 1736 | 1736 | 1800 | 1800 | 1800 | 1864 | 1864 | 1928 | 1928 |
| 1 | 2216 | 2280 | 2280 | 2344 | 2344 | 2408 | 2472 | 2472 | 2536 | 2536 |
| 2 | 2728 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 3112 | 3112 | 3112 |
| 3 | 3624 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 4008 | 4008 | 4136 |
| 4 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 | 4776 | 4968 | 4968 | 4968 |
| 5 | 5352 | 5544 | 5544 | 5736 | 5736 | 5736 | 5992 | 5992 | 5992 | 6200 |
| 6 | 6456 | 6456 | 6456 | 6712 | 6712 | 6968 | 6968 | 6968 | 7224 | 7224 |
| 7 | 7480 | 7480 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8504 | 8504 |
| 8 | 8504 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 9 | 9528 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 11064 | 11064 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 10680 | 11064 | 11064 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 |
| 11 | 12216 | 12576 | 12576 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 12 | 14112 | 14112 | 14112 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 13 | 15840 | 15840 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 18336 |
| 14 | 17568 | 17568 | 18336 | 18336 | 18336 | 19080 | 19080 | 19848 | 19848 | 19848 |
| 15 | 18336 | 19080 | 19080 | 19848 | 19848 | 20616 | 20616 | 20616 | 21384 | 21384 |
| 16 | 19848 | 19848 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 |
| 17 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 |
| 18 | 24496 | 24496 | 24496 | 25456 | 25456 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 19 | 26416 | 26416 | 27376 | 27376 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 |
| 20 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 21 | 30576 | 31704 | 31704 | 31704 | 32856 | 32856 | 34008 | 34008 | 35160 | 35160 |
| 22 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 |
| 23 | 35160 | 35160 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 40576 |
| 24 | 36696 | 37888 | 37888 | 39232 | 39232 | 40576 | 40576 | 42368 | 42368 | 42368 |
| 25 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 |
| 26 | 45352 | 45352 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 52752 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **71** | **72** | **73** | **74** | **75** | **76** | **77** | **78** | **79** | **80** |
| 0 | 1992 | 1992 | 2024 | 2088 | 2088 | 2088 | 2152 | 2152 | 2216 | 2216 |
| 1 | 2600 | 2600 | 2664 | 2728 | 2728 | 2792 | 2792 | 2856 | 2856 | 2856 |
| 2 | 3240 | 3240 | 3240 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3624 |
| 3 | 4136 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 | 4584 | 4584 | 4776 |
| 4 | 5160 | 5160 | 5160 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 |
| 5 | 6200 | 6200 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 |
| 6 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 | 7992 | 8248 | 8248 | 8248 |
| 7 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9912 |
| 8 | 9912 | 9912 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 |
| 9 | 11064 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 | 12576 | 12576 |
| 10 | 12576 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 11 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15840 | 15840 | 15840 | 16416 |
| 12 | 16416 | 16416 | 16416 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 13 | 18336 | 18336 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 14 | 20616 | 20616 | 20616 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 15 | 22152 | 22152 | 22152 | 22920 | 22920 | 23688 | 23688 | 23688 | 24496 | 24496 |
| 16 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 26416 |
| 17 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 29296 |
| 18 | 28336 | 28336 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 19 | 30576 | 30576 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 |
| 20 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 |
| 21 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 |
| 22 | 37888 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 23 | 40576 | 40576 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 |
| 24 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 25 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 |
| 26 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 59256 |

| $I_{TBS}$ | $N_{PRB}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **81** | **82** | **83** | **84** | **85** | **86** | **87** | **88** | **89** | **90** |
| 0 | 2280 | 2280 | 2280 | 2344 | 2344 | 2408 | 2408 | 2472 | 2472 | 2536 |
| 1 | 2984 | 2984 | 2984 | 3112 | 3112 | 3112 | 3240 | 3240 | 3240 | 3240 |
| 2 | 3624 | 3624 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 3 | 4776 | 4776 | 4776 | 4968 | 4968 | 4968 | 5160 | 5160 | 5160 | 5352 |
| 4 | 5736 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 5 | 7224 | 7224 | 7224 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 6 | 8504 | 8504 | 8760 | 8760 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 |
| 7 | 9912 | 9912 | 10296 | 10296 | 10296 | 10680 | 10680 | 10680 | 11064 | 11064 |
| 8 | 11448 | 11448 | 11448 | 11832 | 11832 | 12216 | 12216 | 12216 | 12576 | 12576 |
| 9 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 | 14112 |
| 10 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 11 | 16416 | 16416 | 16992 | 16992 | 16992 | 17568 | 17568 | 17568 | 18336 | 18336 |
| 12 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 20616 | 20616 |
| 13 | 20616 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 | 22920 |
| 14 | 22920 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 24496 | 25456 | 25456 | 25456 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 |
| 16 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 29296 | 29296 |
| 17 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 32856 |
| 18 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 |
| 19 | 35160 | 35160 | 35160 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 |
| 20 | 37888 | 37888 | 39232 | 39232 | 39232 | 40576 | 40576 | 40576 | 42368 | 42368 |
| 21 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 |
| 22 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 48936 | 48936 |
| 23 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 |
| 24 | 48936 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 |
| 25 | 51024 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 |
| 26 | 59256 | 59256 | 61664 | 61664 | 61664 | 63776 | 63776 | 63776 | 66592 | 66592 |

| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **91** | **92** | **93** | **94** | **95** | **96** | **97** | **98** | **99** | **100** |
| 0 | 2536 | 2536 | 2600 | 2600 | 2664 | 2664 | 2728 | 2728 | 2728 | 2792 |
| 1 | 3368 | 3368 | 3368 | 3496 | 3496 | 3496 | 3496 | 3624 | 3624 | 3624 |
| 2 | 4136 | 4136 | 4136 | 4264 | 4264 | 4264 | 4392 | 4392 | 4392 | 4584 |
| 3 | 5352 | 5352 | 5352 | 5544 | 5544 | 5544 | 5736 | 5736 | 5736 | 5736 |
| 4 | 6456 | 6456 | 6712 | 6712 | 6712 | 6968 | 6968 | 6968 | 6968 | 7224 |
| 5 | 7992 | 7992 | 8248 | 8248 | 8248 | 8504 | 8504 | 8760 | 8760 | 8760 |
| 6 | 9528 | 9528 | 9528 | 9912 | 9912 | 9912 | 10296 | 10296 | 10296 | 10296 |
| 7 | 11064 | 11448 | 11448 | 11448 | 11448 | 11832 | 11832 | 11832 | 12216 | 12216 |
| 8 | 12576 | 12960 | 12960 | 12960 | 13536 | 13536 | 13536 | 13536 | 14112 | 14112 |
| 9 | 14112 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 | 15840 | 15840 |
| 10 | 15840 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 | 17568 |
| 11 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 | 19848 | 19848 | 19848 | 19848 |
| 12 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 | 22920 | 22920 |
| 13 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 25456 | 25456 | 25456 | 25456 |
| 14 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 28336 | 28336 | 28336 | 28336 |
| 15 | 28336 | 28336 | 28336 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 |
| 16 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 |
| 17 | 32856 | 32856 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 | 36696 |
| 18 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 |
| 19 | 39232 | 39232 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 43816 |
| 20 | 42368 | 42368 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 |
| 21 | 45352 | 46888 | 46888 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 51024 |
| 22 | 48936 | 48936 | 51024 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 55056 |
| 23 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 |
| 24 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 |
| 25 | 57336 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 | 63776 |
| 26 | 66592 | 68808 | 68808 | 68808 | 71112 | 71112 | 71112 | 73712 | 73712 | 75376 |

| $I_{\mathrm{TBS}}$ | $N_{\mathrm{PRB}}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** |
| 0 | 2792 | 2856 | 2856 | 2856 | 2984 | 2984 | 2984 | 2984 | 2984 | 3112 |
| 1 | 3752 | 3752 | 3752 | 3752 | 3880 | 3880 | 3880 | 4008 | 4008 | 4008 |
| 2 | 4584 | 4584 | 4584 | 4584 | 4776 | 4776 | 4776 | 4776 | 4968 | 4968 |
| 3 | 5992 | 5992 | 5992 | 5992 | 6200 | 6200 | 6200 | 6200 | 6456 | 6456 |
| 4 | 7224 | 7224 | 7480 | 7480 | 7480 | 7480 | 7736 | 7736 | 7736 | 7992 |
| 5 | 8760 | 9144 | 9144 | 9144 | 9144 | 9528 | 9528 | 9528 | 9528 | 9528 |
| 6 | 10680 | 10680 | 10680 | 10680 | 11064 | 11064 | 11064 | 11448 | 11448 | 11448 |
| 7 | 12216 | 12576 | 12576 | 12576 | 12960 | 12960 | 12960 | 12960 | 13536 | 13536 |
| 8 | 14112 | 14112 | 14688 | 14688 | 14688 | 14688 | 15264 | 15264 | 15264 | 15264 |
| 9 | 15840 | 16416 | 16416 | 16416 | 16416 | 16992 | 16992 | 16992 | 16992 | 17568 |
| 10 | 17568 | 18336 | 18336 | 18336 | 18336 | 18336 | 19080 | 19080 | 19080 | 19080 |
| 11 | 20616 | 20616 | 20616 | 21384 | 21384 | 21384 | 21384 | 22152 | 22152 | 22152 |
| 12 | 22920 | 23688 | 23688 | 23688 | 23688 | 24496 | 24496 | 24496 | 24496 | 25456 |
| 13 | 26416 | 26416 | 26416 | 26416 | 27376 | 27376 | 27376 | 27376 | 28336 | 28336 |
| 14 | 29296 | 29296 | 29296 | 29296 | 30576 | 30576 | 30576 | 30576 | 31704 | 31704 |
| 15 | 30576 | 31704 | 31704 | 31704 | 31704 | 32856 | 32856 | 32856 | 34008 | 34008 |
| 16 | 32856 | 32856 | 34008 | 34008 | 34008 | 34008 | 35160 | 35160 | 35160 | 35160 |
| 17 | 36696 | 36696 | 36696 | 37888 | 37888 | 37888 | 39232 | 39232 | 39232 | 39232 |
| 18 | 40576 | 40576 | 40576 | 40576 | 42368 | 42368 | 42368 | 42368 | 43816 | 43816 |
| 19 | 43816 | 43816 | 43816 | 45352 | 45352 | 45352 | 46888 | 46888 | 46888 | 46888 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 46888 | 46888 | 48936 | 48936 | 48936 | 48936 | 48936 | 51024 | 51024 | 51024 |
| 21 | 51024 | 51024 | 51024 | 52752 | 52752 | 52752 | 52752 | 55056 | 55056 | 55056 |
| 22 | 55056 | 55056 | 55056 | 57336 | 57336 | 57336 | 57336 | 59256 | 59256 | 59256 |
| 23 | 57336 | 59256 | 59256 | 59256 | 59256 | 61664 | 61664 | 61664 | 61664 | 63776 |
| 24 | 61664 | 61664 | 63776 | 63776 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 |
| 25 | 63776 | 63776 | 66592 | 66592 | 66592 | 66592 | 68808 | 68808 | 68808 | 71112 |
| 26 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 | 75376 |

[TS 36.211 clause 5.3.3]

The block of complex-valued symbols $d(0),\ldots,d(M_{\mathrm{symb}}-1)$ is divided into $M_{\mathrm{symb}}/M_{\mathrm{sc}}^{\mathrm{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l\cdot M_{\mathrm{sc}}^{\mathrm{PUSCH}}+k)=\frac{1}{\sqrt{M_{\mathrm{sc}}^{\mathrm{PUSCH}}}}\sum_{i=0}^{M_{\mathrm{sc}}^{\mathrm{PUSCH}}-1} d(l\cdot M_{\mathrm{sc}}^{\mathrm{PUSCH}}+i)e^{-j\frac{2\pi ik}{M_{\mathrm{sc}}^{\mathrm{PUSCH}}}}$$
$$k=0,\ldots,M_{\mathrm{sc}}^{\mathrm{PUSCH}}-1$$
$$l=0,\ldots,M_{\mathrm{symb}}/M_{\mathrm{sc}}^{\mathrm{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),\ldots,z(M_{\mathrm{symb}}-1)$. The variable $M_{\mathrm{sc}}^{\mathrm{PUSCH}}=M_{\mathrm{RB}}^{\mathrm{PUSCH}}\cdot N_{\mathrm{sc}}^{\mathrm{RB}}$, where $M_{\mathrm{RB}}^{\mathrm{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\mathrm{RB}}^{\mathrm{PUSCH}}=2^{\alpha_2}\cdot 3^{\alpha_3}\cdot 5^{\alpha_5}\le N_{\mathrm{RB}}^{\mathrm{UL}}$$

where $\alpha_2,\alpha_3,\alpha_5$ is a set of non-negative integers.

[TS 36.306 clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

**Table 4.1-2: Uplink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI | Support for 64QAM in UL |
|---|---|---|
| Category 1 | 5160 | No |
| Category 2 | 25456 | No |
| Category 3 | 51024 | No |
| Category 4 | 51024 | No |
| Category 5 | 75376 | Yes |

#### 7.1.7.2.1.3 Test description

##### 7.1.7.2.1.3.1 Pre-test conditions

System Simulator:

- Cell 1.
- Uplink and downlink bandwidth set to the maximum bandwidth for the E-UTRA Band under test as specified in Table 5.6.1-1 in [31](to enable testing of $N_{\text{PRB}}$ up to maximum value). For Band 18, Band 19 and Band 25, based on industry requirement, uplink and downlink bandwidth set to 10MHz.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) according to [18].

##### 7.1.7.2.1.3.2 Test procedure sequence

**Table 7.1.7.2.1.3.2-1: Maximum $TB_{size}$ for different UE categories**

| UE Category | Maximum number of bits of an UL-SCH transport block transmitted within a TTI |
|---|---|
| Category 1 | 5160 |
| Category 2 | 25456 |
| Category 3 | 51024 |
| Category 4 | 51024 |
| Category 5 | 75376 |

**Table 7.1.7.2.1.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data**

| $TB_{size}$ [bits] | Number of PDCP SDUs, $N_{SDUs}$ | PDCP SDU size [bits] See note 1 |
|---|---|---|
| 104 ≤ $TB_{size}$ ≤12096 note 2 | 1 | 8*FLOOR(($TB_{size}$ – 96)/8) |
| 12097 ≤ $TB_{size}$ ≤24128 | 2 | 8*FLOOR(($TB_{size}$ – 128)/16)) |
| 24129 ≤ $TB_{size}$ ≤ 36152 | 3 | 8*FLOOR(($TB_{size}$ – 152)/24)) |
| 36153 ≤ $TB_{size}$ ≤48184 | 4 | 8*FLOOR(($TB_{size}$ – 184)/32)) |
| 48185 ≤ $TB_{size}$ ≤60208 | 5 | 8*FLOOR(($TB_{size}$ – 208)/40)) |
| 60209 ≤ $TB_{size}$ ≤ 72240 | 6 | 8*FLOOR(($TB_{size}$ – 240)/48)) |
| $TB_{size}$> 72240 | 7 | 8*FLOOR(($TB_{size}$ 264/56)) |

Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 clause 9.9.4.12).

N PDCP SDUs are transmitted in N AMD PDUs concatenated into a MAC PDU. The PDCP SDU size of each PDCP SDU is

PDCP SDU size = ($TB_{size}$ – N*PDCP header size - N*AMD PDU header size - MAC header – Size of Timing Advance – RLC Status PDU size) / N, where

PDCP header size is 16 bits for the RLC AM and 12-bit SN case;
AMD PDU header size is 16 bits;
MAC header si40 bits as MAC header size can be:

1) R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (16 bits for MAC SDU for RLC Status PDU) + R/R/E/LCID MAC subheader (8 bits for MAC SDU for AMD PDU) = 8 + 16 + 8 bits= 32 bits
or

2) R/R/E/LCID MAC subheader (8 bits for Timing Advance) + R/R/E/LCID MAC subheader (24 bits for MAC SDU for AMD PDU, Note: Length can be of 2 bytes depending upon the size of AMD PDU)+ R/R/E/LCID MAC subheader (8 bits for MAC SDU for RLC Status PDU) + = 8+24 + 8 bits = 40 bits

Therefore Maximum MAC header size can be 40 bits

Size of Timing Advance MAC CE is 8 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead)

RLC Status PDU size = 16 bit sIze =

This gives:

PDCP SDU size = 8*FLOOR(($TB_{size}$ – N*16- 8*CIEL((16+(N-1)*12)/8) –64)/(8*N)) bits.

Note 2: According to TS 36.213 Table 7.1.7.2.1-1 and the final PDCP SDU size formula in Note 1, the smallest $TB_{size}$ that can be tested is 104 bits.

**Table 7.1.7.2.1.3.2-2a: Bandwidth Dependent Parameters**

| Max Bandwidth | Max $N_{\mathrm{PRB}}$ |
|---|---|
| 10 Mhz | 50 |
| 15 Mhz | 75 |
| 20 Mhz | 100 |
| Note: Maximum bandwidth for EUTRA bands is 10/15/20 Mhz. | |

**Table 7.1.7.2.1.3.2-3: 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: Steps 2 to 7 are | - | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | repeated for values of $N_{\mathrm{PRB}}$ from 1 to Max $N_{\mathrm{PRB}}$ and $I_{\mathrm{MCS}}$ from 0 to 28, where $N_{\mathrm{PRB}}$ satisfies values equal to $2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \leq N_{\mathrm{RB}}^{\mathrm{UL}}$ and where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers. | | | | |
| 2 | SS looks up $I_{\mathrm{TBS}}$ in table 8.6.1-1 in TS 36.213 based on the value of $I_{\mathrm{MCS}}$. SS looks up $TB_{size}$ in table 7.1.7.2.1-1 in TS 36.213 based on values of $N_{\mathrm{PRB}}$ and $I_{\mathrm{TBS}}$. | - | - | - | - |
| - | EXCEPTION: Steps 3 to 7 are performed if $TB_{size}$ is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.7.2.1.3.2-1 and larger than or equal to 104 bits as specified in Table 7.1.7.2.1.3.2-2. | - | - | - | - |
| 3 | SS creates one or more PDCP SDUs, depending on $TB_{size}$, in accordance with Table 7.1.7.2.1.3.2-2. | - | - | - | - |
| 4 | After 300ms, the SS transmits all PDCP SDUs ($N_{SDUs}$) as created in step 3 in a MAC PDU. | <-- | MAC PDU ($N_{SDUs}$ x PDCP SDU) | - | - |
| 5 | After 60ms of step 4, the allocates an uplink grant SS indicating DCI Format 0 with a RVI correspondent to $N_{\mathrm{PRB}}$ as specified in 8.1 in TS 36.213 and modulation and coding scheme $I_{\mathrm{MCS}}$ as specified in Table 8.6.1-1 in TS 36.213. | <-- | (UL Grant)<br>DCI: (DCI Format 0, RVI ($N_{\mathrm{PRB}}$), $I_{\mathrm{MCS}}$) | - | - |
| 6 | Void | - | - | - | - |
| 7 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 4 using the Resource Block Assignment and modulation and coding scheme as configured by the SS in step 5? | --> | MAC PDU ($N_{SDUs}$ x PDCP SDU) | 1 | P |

#### 7.1.7.2.1.3.3 Specific Message Contents

**Table 7.1.7.2.1.3.3-1: *UECapabilityInformation (Preamble* Table 4.5.2.3-1 [18]: Step 13*)***

| Derivation Path: 36.508 table 4.6.1-23 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| UECapabilityInformation ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| ueCapabilityInformation-r8 SEQUENCE { | | | |
| ue-CapabilityRAT-ContainerList SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF SEQUENCE { | 1 entry | | |
| ueCapabilityRAT-Container | | | |
| ue-EUTRA-Capability SEQUENCE { | | | |
| ue-Category | Checked against UE Category indications in the PICS | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.8 Reporting of Rank Indicator (RI)

### 7.1.8.1 Periodic RI reporting using PUCCH / Category 1 UE / Transmission mode 3/4

#### 7.1.8.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { Category 1 UE is configured to transmission mode 3}
    then { UE always reports RI equals to one}
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state }
ensure that {
  when { Category 1 UE is configured to transmission mode 4}
    then { UE always reports RI equals to one}
            }
```

#### 7.1.8.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 36.306 clause 4 and clause 4.1, TS 36.213 clause 7.2.2.

[TS 36.306, clause 4]

The following subclauses define the UE radio access capability parameters. Only parameters for which there is the possibility for UEs to signal different values are considered as UE radio access capability parameters. Therefore, mandatory capabilities that are the same for all UEs are not listed here.

[TS 36.306, clause 4.1]

The field *ue-Category* defines a combined uplink and downlink capability. The parameters set by the UE Category are defined in subclause 4.2. Tables 4.1-1 and 4.1-2 define the downlink and, respectively, uplink physical layer parameter values for each UE Category.

**Table 4.1-1: Downlink physical layer parameter values set by the field *ue-Category***

| UE Category | Maximum number of DL-SCH transport block bits received within a TTI | Maximum number of bits of a DL-SCH transport block received within a TTI | Total number of soft channel bits | Maximum number of supported layers for spatial multiplexing in DL |
|---|---|---|---|---|
| Category 1 | 10296 | 10296 | 250368 | 1 |
| Category 2 | 51024 | 51024 | 1237248 | 2 |
| Category 3 | 102048 | 75376 | 1237248 | 2 |
| Category 4 | 150752 | 75376 | 1827072 | 2 |
| Category 5 | 299552 | 149776 | 3667200 | 4 |

[TS 36.213, clause 7.2.2]

A UE is semi-statically configured by higher layers to periodically feed back different CQI, PMI, and RI on the PUCCH using the reporting modes given in Table 7.2.2-1 and described below.

**Table 7.2.2-1: CQI and PMI Feedback Types for PUCCH reporting Modes**

| | | PMI Feedback Type | |
|---|---|---|---|
| | | No PMI | Single PMI |
| PUCCH CQI Feed-back Type | Wideband (wideband CQI) | Mode 1-0 | Mode 1-1 |
| | UE Selected (subband CQI) | Mode 2-0 | Mode 2-1 |

For each of the transmission modes defined in Section 7.1, the following reporting modes are supported on PUCCH:

- Transmission mode 1 : Modes 1-0, 2-0
- Transmission mode 2 : Modes 1-0, 2-0
- Transmission mode 3 : Modes 1-0, 2-0
- Transmission mode 4 : Modes 1-1, 2-1
- Transmission mode 5 : Modes 1-1, 2-1
- Transmission mode 6 : Modes 1-1, 2-1
- Transmission mode 7 : Modes 1-0, 2-0
- Transmission mode 8 : Modes 1-1, 2-1 if the UE is configured with PMI/RI reporting; modes 1-0, 2-0 if the UE is configured without PMI/RI reporting

Four CQI/PMI and RI reporting types with distinct periods and offsets are supported for each PUCCH reporting mode as given in Table 7.2.2-3:

- Type 1 report supports CQI feedback for the UE selected sub-bands
- Type 2 report supports wideband CQI and PMI feedback.
- Type 3 report supports RI feedback
- Type 4 report supports wideband CQI

The periodicity $N_p$ (in subframes) and offset $N_{OFFSET,CQI}$ (in subframes) for CQI/PMI reporting are determined based on the parameter *cqi-pmi-ConfigIndex* ($I_{CQI/PMI}$) given in Table 7.2.2-1A for FDD and table 7.2.2-1C for TDD. The periodicity $M_{RI}$ and relative offset $N_{OFFSET,RI}$ for RI reporting are determined based on the parameter *ri-ConfigIndex* ($I_{RI}$) given in

Table 7.2.2-1B. Both *cqi-pmi-ConfigIndex* and *ri-ConfigIndex* are configured by higher layer signalling. The relative reporting offset for RI $N_{OFFSET,RI}$ takes values from the set $\{0,-1,...,-(N_p-1)\}$

- Wideband feedback
  - Mode 1-1 description:
    - In the subframe where RI is reported (only for transmission mode 4 and transmission mode 8):
      - A UE shall determine a RI assuming transmission on set *S* subbands.
      - The UE shall report a type 3 report consisting of one RI
    - In the subframe where CQI/PMI is reported:
      - A single precoding matrix is selected from the codebook subset assuming transmission on set *S* subbands
      - A UE shall report a type 2 report on each respective successive reporting opportunity consisting of
        - A single wideband CQI value which is calculated assuming the use of a single precoding matrix in all subbands and transmission on set *S* subbands.
        - The selected single precoding matrix indicator (wideband PMI)
        - When RI>1, a 3-bit wideband spatial differential CQI, which is shown in Table 7.2-2.
      - For transmission mode 4 and transmission mode 8, the PMI and CQI are calculated conditioned on the last reported periodic RI. For other transmission modes they are calculated conditioned on transmission rank 1.

### 7.1.8.1.3 Test description

#### 7.1.8.1.3.1 Pre-test conditions

System Simulator:

- Cell 1
- System Simulator transmits according to the rank reported by UE

UE:

None.

Preamble:

- The UE is in state Generic RB Established (state 3) according to [18]

#### 7.1.8.1.3.2 Test procedure sequence

**Table 7.1.8.1.3.2-1: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| - | EXCEPTION: Step 1 is repeated 5 times | - | - | - | - |
| 1 | CHECK: Does the UE transmit PUCCH type 3 report with RI set to 1? (NOTE) | --> | (*RI*) | 1 | P |
| 2 | The SS transmits a MAC PDU containing an *RRCConnectionReconfiguration* message to reconfigure the UE transmission mode to tm4 | <-- | MAC PDU *(RRCConnectionReconfiguration)* | - | - |
| 3 | The UE transmits a MAC PDU containing an *RRCConnectionReconfigurationComplete* message | --> | MAC PDU *(RRCConnectionReconfigurationComplete)* | - | - |
| - | EXCEPTION: Step 4 is repeated 5 times | - | - | - | - |
| 4 | CHECK: Does the UE transmit PUCCH type 3 report with RI set to 1? (NOTE) | --> | (*RI*) | 2 | P |
| 5 | Check: Does the test result of CALL generic procedure in TS 36.508 subclause 6.4.2.3 indicate that UE is in E-UTRA RRC_CONNECTED state? | - | - | 2 | - |
| Note: In this test case, it is configured for wideband CQI/PMI reporting for transmission mode tm3 and tm4, the reporting instances of RI reporting are subframes satisfying: $\left(10\times n_f+\lfloor n_s/2\rfloor-N_{OFFSET,CQI}-N_{OFFSET,RI}\right)\bmod\left(N_P\cdot M_{RI}\right)=0$ the default configuration in TS 36.508, the cqi-pmi-ConfigIndex( $I_{CQI/PMI}$ ) = 25(FDD)/24(TDD), ri-ConfigIndex( $I_{RI}$ ) = 483(FDD) / 484(TDD), as per the Table 7.2.2-1A, 7.2.2-1B and 7.2.2-1C in TS 36.213, the periodicity $N_p$ (in subframes) = 20ms(FDD) / 20ms(TDD), $N_{OFFSET,CQI}$ (in subframes) = 8ms(FDD) / 8ms(TDD), The periodicity $M_{RI}$ = 8(FDD) / 8(TDD) and relative offset $N_{OFFSET,RI}$ = 0(FDD) / -1(TDD) | | | | | |

#### 7.1.8.1.3.3 Specific message contents

**Table 7.1.8.1.3.3-1: RRCConnectionReconfiguration (step 2, Table 7.1.8.1.3.2-1)**

| |
|---|
| Derivation Path: 36.508 table 4.6.1-8, condition SRB2-DRB(1, 0) |

**Table 7.1.8.1.3.3-2: PhysicalConfigDedicated-DEFAULT (step 2, Table 7.1.8.1.3.2-1)**

| Derivation Path: 36.331 clause 6.3.2 | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PhysicalConfigDedicated-DEFAULT ::= SEQUENCE { | | | |
| antennaInfo CHOICE { | | | |
| defaultValue | NULL | | |
| explicitValue SEQUENCE { | | | 2TX |
| transmissionMode | tm4 | | |
| codebookSubsetRestriction CHOICE { | | | |
| n2TxAntenna-tm4 | '111111' | BIT STRING (SIZE (6)) | |
| } | | | |
| ue-TransmitAntennaSelection CHOICE { | | | |
| Release | NULL | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

## 7.1.9 Activation/Deactivation of SCells

### 7.1.9.1 CA / Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer

#### 7.1.9.1.1 CA / Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer / Intra-band Contiguous CA

##### 7.1.9.1.1.1 Test Purpose (TP)

(1)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell configure }
ensure that {
  when { the UE receives an Activation MAC Control Element activating the Scell }
    then { the UE starts monitoring PDCCH on activated Scell }
            }
```

(2)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell activated }
ensure that {
  when { the UE receives an UL grant on Scell PDCCH}
    then { the UE restarts the sCellDeactivationTimer }
            }
```

(3)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell activated }
ensure that {
  when { the UE sCellDeactivationTimer expires}
    then { the UE deactivates the Scell and stops monitoring PDCCH on Scell }
            }
```

(4)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell Activated }
ensure that {
  when { the UE receives a deactivation MAC Control Element deactivating the Scell }
    then { the UE deactivates the Scell and stops monitoring PDCCH on Scell }
            }
```

(5)

```
with { UE in E-UTRA RRC_CONNECTED state with SCell activated }
ensure that {
  when { the UE receives a DL assignment on Scell PDCCH}
    then { the UE restarts the sCellDeactivationTimer }
            }
```

##### 7.1.9.1.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 36.321, clause 5.13 & 6.1.3.8.

[TS 36.321, clause 5.13]

If the UE is configured with one or more SCells, the network may activate and deactivate the configured SCells. The PCell is always activated. The network activates and deactivates the SCell(s) by sending the Activation/Deactivation MAC control element described in subclause 6.1.3.8. Furthermore, the UE maintains a *sCellDeactivationTimer* timer per configured SCell and deactivates the associated SCell upon its expiry. The same initial timer value applies to each instance of the *sCellDeactivationTimer* and it is configured by RRC. The configured SCells are initially deactivated upon addition and after a handover.

The UE shall for each TTI and for each configured SCell:

- if the UE receives an Activation/Deactivation MAC control element in this TTI activating the SCell, the UE shall in the TTI according to the timing defined in [2]:

    - activate the SCell; i.e. apply normal SCell operation including:
        - SRS transmissions on the SCell;
        - CQI/PMI/RI/PTI reporting for the SCell;
        - PDCCH monitoring on the SCell;
        - PDCCH monitoring for the SCell
    - start or restart the *sCellDeactivationTimer* associated with the SCell;
- else, if the UE receives an Activation/Deactivation MAC control element in this TTI deactivating the SCell; or
- if the *sCellDeactivationTimer* associated with the activated SCell expires in this TTI:
    - in the TTI according to the timing defined in [2]:
        - deactivate the SCell;
        - stop the *sCellDeactivationTimer* associated with the SCell;
        - flush all HARQ buffers associated with the SCell.
- if PDCCH on the activated SCell indicates an uplink grant or downlink assignment; or
- if PDCCH on the Serving Cell scheduling the activated SCell indicates an uplink grant or a downlink assignment for the activated SCell:
    - restart the *sCellDeactivationTimer* associated with the SCell;
- if the SCell is deactivated:
    - not transmit SRS on the SCell;
    - not report CQI/PMI/RI/PTI for the SCell;
    - not transmit on UL-SCH on the SCell;
    - not monitor the PDCCH on the SCell;
    - not monitor the PDCCH for the SCell.

[TS 36.321, clause 6.1.3.8]

The Activation/Deactivation MAC control element is identified by a MAC PDU subheader with LCID as specified in table 6.2.1-1. It has a fixed size and consists of a single octet containing seven C-fields and one R-field. The Activation/Deactivation MAC control element is defined as follows (figure 6.1.3.8-1).

- $C_i$: if there is an SCell configured with *SCellIndex* i as specified in [8], this field indicates the activation/deactivation status of the SCell with *SCellIndex* i , else the UE shall ignore the $C_i$ field. The $C_i$ field is set to "1" to indicate that the SCell with *SCellIndex* i shall be activated. The $C_i$ field is set to "0" to indicate that the SCell with *SCellIndex* i shall be deactivated;
- R: Reserved bit, set to “0”.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $C_7$ | $C_6$ | $C_5$ | $C_4$ | $C_3$ | $C_2$ | $C_1$ | R | Oct 1 |

**Figure 6.1.3.8-1: Activation/Deactivation MAC control element**

#### 7.1.9.1.1.3 Test description

##### 7.1.9.1.1.3.1 Pre-test conditions

System Simulator:

- Cell 1 (PCell) and Cell 3(SCell)
- Cell 3 is an Active SCell according to [18] cl. 6.3.4.

UE:

None.

Preamble:

- The UE is in state Loopback Activated (state 4) on Cell 1 according to [18].

##### 7.1.9.1.1.3.2 Test procedure sequence

**Table 7.1.9.1.1.3.2-1: Time instances of cell power level and parameter changes**

| | Parameter | Unit | Cell 1 | Cell 3 |
|---|---|---|---|---|
| T0 | Cell-specific RS EPRE | dBm/15kHz | -85 | -85 |

**Table 7.1.9.1.1.3.2-2: Main behaviour**

| St | Procedure | Message Sequence | | TP | Verdict |
|---|---|---|---|---|---|
| | | U - S | Message | | |
| 1 | The SS transmits an *RRConnectionReconfiguration* message containing a *sCellToAddModList* on Cell 1 with SCell (Cell 3) addition. | <-- | *RRCConnectionReconfiguration* | - | - |
| 2 | The UE transmit an *RRCConnectionReconfigurationComplete* message. | --> | *RRCConnectionReconfigurationComplete* | - | - |
| 3 | The SS transmits Activation MAC control element to activate Scell (Cell 3). | <-- | MAC PDU (Activation ($C_1$=1)) | - | - |
| 4 | 200 ms after step 3, the SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing an RLC PDU ) | <-- | MAC PDU ($CC_2$) | - | - |
| 5 | Check: Does the UE transmit a Scheduling Request on PUCCH? | --> | (SR) | 1 | P |
| 6 | The SS sends an UL grant suitable for transmitting loop back PDU on Cell 1. | <-- | (UL Grant) | - | - |
| 7 | The UE transmit a MAC PDU containing the loop back PDU corresponding to step 4 | --> | MAC PDU | - | - |
| 7a | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 7 | <-- | MAC PDU ($CC_1$) | - | - |
| 8 | 200 ms after step 6, the SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing an RLC PDU ) | <-- | MAC PDU ($CC_2$) | - | - |
| 9 | Check: Does the UE transmit a Scheduling Request on PUCCH? | --> | (SR) | 2 | P |
| 10 | The SS sends an UL grant suitable for transmitting loop back PDU on Cell 1. | <-- | (UL Grant) | - | - |
| 11 | The UE transmit a MAC PDU containing the loop back PDU corresponding to step 8 | --> | MAC PDU | - | - |
| 12 | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 11 | <-- | MAC PDU ($CC_1$) | - | - |
| 13 | 400 ms after step 10, the SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing an RLC PDU ) | <-- | MAC PDU ($CC_2$) | - | - |
| 14 | Check: Does the UE transmit a Scheduling Request on PUCCH in next 1 second? | --> | (SR) | 3 | F |
| 15 | The SS transmits Activation MAC control element to activate Scell (Cell 3). | <-- | MAC PDU (Activation ($C_1$=1)) | - | - |
| 16 | 200 ms after step 15 The SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing just padding or RLC status PDU, but no RLC data PDU ) | <-- | MAC PDU ($CC_2$) | - | - |
| 17 | 400 ms after step 15 the SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing an RLC PDU ) | <-- | MAC PDU ($CC_2$) | - | - |
| 18 | Check: Does the UE transmit a Scheduling Request on PUCCH? | --> | (SR) | 1,5 | P |
| 19 | The SS sends an UL grant suitable for transmitting loop back PDU on Cell 1. | <-- | (UL Grant) | - | - |
| 19 | The UE transmit a MAC PDU containing the loop back PDU corresponding to step 17 | --> | MAC PDU | - | - |
| 20 | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 19 | <-- | MAC PDU ($CC_1$) | - | - |
| 21 | The SS transmits Deactivation MAC control element to de-activate Scell (Cell 3). | <-- | MAC PDU (Deactivation ($C_1$=0)) | - | - |
| 22 | The SS indicates a new transmission on PDCCH of $CC_2$ and transmits a MAC PDU (containing an RLC PDU ) | <-- | MAC PDU ($CC_2$) | - | - |
| 23 | Check: Does the UE transmit a Scheduling Request on PUCCH in next 1 second? | --> | (SR) | 4 | F |

#### 7.1.9.1.3.3 Specific message contents

**Table 7.1.9.1.1.3.3-1: *RRCConnectionReconfiguration* (Table 7.1.9.1.1.3.2-1, step 1)**

| Derivation path: 36.508 table 4.6.1-8 condition SCell_AddMod | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| RRCConnectionReconfiguration ::= SEQUENCE { | | | |
| criticalExtensions CHOICE { | | | |
| c1 CHOICE{ | | | |
| rrcConnectionReconfiguration-r8 SEQUENCE { | | | |
| RadioResourceConfigDedicated SEQUENCE { | | | |
| mac-MainConfig CHOICE { | | | |
| explicit | MAC-MainConfig-RBC | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |
| } | | | |

**Table 7.1.9.1.1.3.3-2: MAC-MainConfig-RBC (Table 7.1.9.1.1.3.3-1)**

| Derivation path: 36.508 table 4.8.2.1.5-1 condition DRX_L | | | |
|---|---|---|---|
| **Information Element** | **Value/Remark** | **Comment** | **Condition** |
| MAC-MainConfig-RBC SEQUENCE { | | | |
| timeAlignmentTimerDedicated | Infinity | | |
| mac-MainConfig-v1020 SEQUENCE { | | | |
| sCellDeactivationTimer-r10 | rf32 | 320 milliseconds | |
| } | | | |
| } | | | |

**Table 7.1.9.1.1.3.3-3: *SCellToAddMod-r10* (Table 7.1.9.1.1.3.3-1)**

| Derivation Path: 36.508, Table 4.6.3-19D | | | |
|---|---|---|---|
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SCellToAddMod-r10 ::= SEQUENCE { | | | |
| sCellIndex-r10 | 1 | | |
| cellIdentification-r10 SEQUENCE { | | | |
| physCellId-r10 | PhysicalCellIdentity of Cell 3 | | |
| dl-CarrierFreq-r10 | Same downlink EARFCN as used for Cell 3 | | |
| } | | | |
| } | | | |

### 7.1.9.1.2 CA / Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.9.1.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA.
- Cells configuration: Cell 10 replaces Cell 3.
- Cell 10 is an Active SCell according to [18] cl. 6.3.4.