**3GPP TSG-RAN WG1 Meeting #107-e *R1-21xxxxx***

**e-Meeting, November 11–19, 2021**

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| *CR-Form-v12.1* |
| **DRAFT CHANGE REQUEST** |
|  |
|  | **38.212** | **CR** |  | **rev** |  | **Current version:** | **16.7.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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|  |
| ***Title:***  | Introduction of Coverage Enhancements |
|  |  |
| ***Source to WG:*** | Huawei |
| ***Source to TSG:*** | R1 |
|  |  |
| ***Work item code:*** | NR\_cov\_enh-Core |  | ***Date:*** | 2021-12-2 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Inclusion of Rel-17 Coverage enhancements |
|  |  |
| ***Summary of change:*** | Support of Rel-17 Coverage enhancements:1. Clause 6.2.3: Update to reflect that only one CB is supported for TBoMS;
2. Subclauses under Clause 6.3.2.4: Update to support UCI multiplexing on TBoMS.
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|  |  |
| ***Consequences if not approved:*** | Coverage enhancement will be incomplete |
|  |  |
| ***Clauses affected:*** | 6.2.3, 6.3.2.4.1.1, 6.3.2.4.1.2, 6.3.2.4.1.3, 6.3.2.4.1.4, 6.3.2.4.1.5 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.211, TS 38.214  |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |   |
|  |  |
| ***Other comments:*** | **Isolated Impact Analysis:** |
|  |  |
| ***This CR's revision history:*** |  |

6.2.3 Code block segmentation andcode block CRC attachment

The bits input to the code block segmentation are denoted by  where  is the number of bits in the transport block (including CRC).

Code block segmentation and code block CRC attachment are performed according to Clause 5.2.2.

The bits after code block segmentation are denoted by, where  is the code block number and  is the number of bits for code block number  according to Clause 5.2.2.

When the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is larger than 1, the value of *B* is no larger than 3840 if and no larger than 8448 otherwise, where coding rate is indicated by the MCS index according to Clause 6.1.4.1 in [6, TS 38.214].

< Unchanged parts are omitted >

### 6.3.2 Uplink control information on PUSCH

< Unchanged parts are omitted >

#### 6.3.2.4 Rate matching

##### 6.3.2.4.1 UCI encoded by Polar code

6.3.2.4.1.1 HARQ-ACK

For HARQ-ACK transmission on PUSCH not using repetition type B with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table, or if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is equal to 1, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:

 

where

-  is the number of HARQ-ACK bits;

- if , ; otherwise  is the number of CRC bits for HARQ-ACK determined according to Clause 6.3.1.2.1;

- ;

-  is the number of code blocks for UL-SCH of the PUSCH transmission;

- if the DCI format scheduling the PUSCH transmission includes a CBGTI field indicating that the UE shall not transmit the -th code block, =0; otherwise,  is the -th code block size for UL-SCH of the PUSCH transmission;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

-  is configured by higher layer parameter *scaling*;

-  is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission.

For HARQ-ACK transmission on PUSCH not using repetition type B with UL-SCH, and if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is larger than 1, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:

where

- is the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI;

- is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission of TB processing over multiple slots in the slot with the HARQ-ACK transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission of TB processing over multiple slots in the slot with the HARQ-ACK transmission and is the total number of OFDM symbols of the PUSCH in the slot, including all OFDM symbols used for DMRS;

- is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission of TB processing over multiple slots in the slot with the HARQ-ACK transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

For HARQ-ACK transmission on an actual repetition of a PUSCH with repetition Type B with UL-SCH, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:

where

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission assuming a nominal repetition without segmentation, and is the total number of OFDM symbols in a nominal repetition of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH assuming a nominal repetition without segmentation, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH assuming a nominal repetition without segmentation, where is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission assuming a nominal repetition without segmentation;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the actual repetition of the PUSCH transmission, and is the total number of OFDM symbols in the actual repetition of the PUSCH transmission, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the actual repetition of the PUSCH transmission, ;

- for any OFDM symbol that does not carry DMRS of the actual repetition of the PUSCH transmission, where is the number of subcarriers in OFDM symbol that carries PTRS, in the actual repetition of the PUSCH transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

For HARQ-ACK transmission on PUSCH without UL-SCH, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:

 

where

-  is the number of HARQ-ACK bits;

- if , ; otherwise  is the number of CRC bits for HARQ-ACK defined according to Clause 6.3.1.2.1;;

- ;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

-  is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission;

-  is the code rate of the PUSCH, determined according to Clause 6.1.4.1 of [6, TS38.214];

-  is the modulation order of the PUSCH;

-  is configured by higher layer parameter *scaling*.

The input bit sequence to rate matching is  where  is the code block number, and  is the number of coded bits in code block number .

Rate matching is performed according to Clause 5.4.1 by setting  and the rate matching output sequence length to , where

-  is the number of code blocks for UCI determined according to Clause 5.2.1;

-  is the number of transmission layers of the PUSCH;

-  is the modulation order of the PUSCH;

- .

The output bit sequence after rate matching is denoted as  where  is the length of rate matching output sequence in code block number .

6.3.2.4.1.2 CSI part 1

For CSI part 1 transmission on PUSCH not using repetition type B with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table, or if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is equal to 1, the number of coded modulation symbols per layer for CSI part 1 transmission, denoted as , is determined as follows:

where

-  is the number of bits for CSI part 1;

- if , ; otherwise  is the number of CRC bits for CSI part 1 determined according to Clause 6.3.1.2.1;

- ;

-  is the number of code blocks for UL-SCH of the PUSCH transmission;

- if the DCI format scheduling the PUSCH transmission includes a CBGTI field indicating that the UE shall not transmit the -th code block, =0; otherwise, is the -th code block size for UL-SCH of the PUSCH transmission;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

- if HARQ-ACK is present for transmission on the same PUSCH with UL-SCH and without CG-UCI, where is the number of coded modulation symbols per layer for HARQ-ACK transmitted on the PUSCH as defined in clause 6.3.2.4.1.1 if number of HARQ-ACK information bits is more than 2, and  if the number of HARQ-ACK information bits is no more than 2 bits, where  is the number of reserved resource elements for potential HARQ-ACK transmission in OFDM symbol , for , in the PUSCH transmission, defined in Clause 6.2.7; or

- if both HARQ-ACK and CG-UCI are present on the same PUSCH with UL-SCH, where is the number of coded modulation symbols per layer for HARQ-ACK and CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.5; or

- if CG-UCI is present on the same PUSCH with UL-SCH and without HARQ-ACK, where is the number of coded modulation symbols per layer for CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.4;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

-  is configured by higher layer parameter *scaling*.

For CSI part 1 transmission on PUSCH not using repetition type B with UL-SCH, and if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is larger than 1, the number of coded modulation symbols per layer for CSI part 1 transmission, denoted as , is determined as follows:

where

- is the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI;

- is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission of TB processing over multiple slots in the slot with the CSI part 1 transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission of TB processing over multiple slots in the slot with the CSI part 1 transmission and is the total number of OFDM symbols of the PUSCH in the slot, including all OFDM symbols used for DMRS;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

For CSI part 1 transmission on an actual repetition of a PUSCH with repetition Type B with UL-SCH, the number of coded modulation symbols per layer for CSI part 1 transmission, denoted as , is determined as follows:

where

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission assuming a nominal repetition without segmentation, and is the total number of OFDM symbols in a nominal repetition of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH assuming a nominal repetition without segmentation, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH assuming a nominal repetition without segmentation, where is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission assuming a nominal repetition without segmentation;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the actual repetition of the PUSCH transmission, and is the total number of OFDM symbols in the actual repetition of the PUSCH transmission, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the actual repetition of the PUSCH transmission, ;

- for any OFDM symbol that does not carry DMRS of the actual repetition of the PUSCH transmission, where is the number of subcarriers in OFDM symbol that carries PTRS, in the actual repetition of the PUSCH transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

For CSI part 1 transmission on PUSCH without UL-SCH, the number of coded modulation symbols per layer for CSI part 1 transmission, denoted as , is determined as follows:

if there is CSI part 2 to be transmitted on the PUSCH,

 

else

 

end if

where

-  is the number of bits for CSI part 1;

- if , ; otherwise  is the number of CRC bits for CSI part 1 determined according to Clause 6.3.1.2.1;

- ;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

-  is the number of coded modulation symbols per layer for HARQ-ACK transmitted on the PUSCH if number of HARQ-ACK information bits is more than 2, and  if the number of HARQ-ACK information bits is no more than 2 bits, where  is the number of reserved resource elements for potential HARQ-ACK transmission in OFDM symbol , for , in the PUSCH transmission, defined in Clause 6.2.7;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

-  is the code rate of the PUSCH, determined according to Clause 6.1.4.1 of [6, TS38.214];

-  is the modulation order of the PUSCH.

The input bit sequence to rate matching is  where  is the code block number, and  is the number of coded bits in code block number .

Rate matching is performed according to Clause 5.4.1 by setting  and the rate matching output sequence length to , where

-  is the number of code blocks for UCI determined according to Clause 5.2.1;

-  is the number of transmission layers of the PUSCH;

-  is the modulation order of the PUSCH;

- .

The output bit sequence after rate matching is denoted as  where  is the length of rate matching output sequence in code block number .

6.3.2.4.1.3 CSI part 2

For CSI part 2 transmission on PUSCH not using repetition type B with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table, or if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is equal to 1, the number of coded modulation symbols per layer for CSI part 2 transmission, denoted as , is determined as follows:

where

-  is the number of bits for CSI part 2;

- if , ; otherwise  is the number of CRC bits for CSI part 2 determined according to Clause 6.3.1.2.1;

- ;

-  is the number of code blocks for UL-SCH of the PUSCH transmission;

- if the DCI format scheduling the PUSCH transmission includes a CBGTI field indicating that the UE shall not transmit the -th code block, =0; otherwise, is the -th code block size for UL-SCH of the PUSCH transmission;

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

- if HARQ-ACK is present for transmission on the same PUSCH with UL-SCH and without CG-UCI, where is the number of coded modulation symbols per layer for HARQ-ACK transmitted on the PUSCH as defined in clause 6.3.2.4.1.1 if number of HARQ-ACK information bits is more than 2, and  if the number of HARQ-ACK information bits is 1 or 2 bits; or

- if both HARQ-ACK and CG-UCI are present on the same PUSCH with UL-SCH, where is the number of coded modulation symbols per layer for HARQ-ACK and CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.5; or

- if CG-UCI is present on the same PUSCH with UL-SCH and without HARQ-ACK, where is the number of coded modulation symbols per layer for CG-UCI transmitted on the PUSCH as defined in clause 6.3.2.4.1.4;

-  is the number of coded modulation symbols per layer for CSI part 1 transmitted on the PUSCH;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, .

-  is configured by higher layer parameter *scaling*.

For CSI part 2 transmission on PUSCH not using repetition type B with UL-SCH, and if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is larger than 1, the number of coded modulation symbols per layer for CSI part 2 transmission, denoted as , is determined as follows:

where

- is the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI;

- is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission of TB processing over multiple slots in the slot with the CSI part 2 transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission of TB processing over multiple slots in the slot with the CSI part 2 transmission and is the total number of OFDM symbols of the PUSCH in the slot, including all OFDM symbols used for DMRS;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

For CSI part 2 transmission on an actual repetition of a PUSCH with repetition Type B with UL-SCH, the number of coded modulation symbols per layer for CSI part 2 transmission, denoted as , is determined as follows:

where

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission assuming a nominal repetition without segmentation, and is the total number of OFDM symbols in a nominal repetition of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH assuming a nominal repetition without segmentation, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH assuming a nominal repetition without segmentation, where is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission assuming a nominal repetition without segmentation;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the actual repetition of the PUSCH transmission, and is the total number of OFDM symbols in the actual repetition of the PUSCH transmission, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the actual repetition of the PUSCH transmission, ;

- for any OFDM symbol that does not carry DMRS of the actual repetition of the PUSCH transmission, where is the number of subcarriers in OFDM symbol that carries PTRS, in the actual repetition of the PUSCH transmission;

- and all the other notations in the formula are defined the same as for PUSCH not using repetition type B and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

For CSI part 2 transmission on PUSCH without UL-SCH, the number of coded modulation symbols per layer for CSI part 2 transmission, denoted as , is determined as follows:

 

where

-  is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

-  is the number of subcarriers in OFDM symbol  that carries PTRS, in the PUSCH transmission;

-  is the number of coded modulation symbols per layer for HARQ-ACK transmitted on the PUSCH if number of HARQ-ACK information bits is more than 2, and  if the number of HARQ-ACK information bits is 1 or 2 bits;

-  is the number of coded modulation symbols per layer for CSI part 1 transmitted on the PUSCH;

-  is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission and  is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, .

The input bit sequence to rate matching is  where  is the code block number, and  is the number of coded bits in code block number .

Rate matching is performed according to Clause 5.4.1 by setting  and the rate matching output sequence length to , where

-  is the number of code blocks for UCI determined according to Clause 5.2.1;

-  is the number of transmission layers of the PUSCH;

-  is the modulation order of the PUSCH;

- .

The output bit sequence after rate matching is denoted as  where  is the length of rate matching output sequence in code block number .

6.3.2.4.1.4 CG-UCI

For CG-UCI transmission on PUSCH with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table, or if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is equal to 1, the number of coded modulation symbols per layer for CG-UCI transmission, denoted as , is determined as follows:

where

- is the number of CG-UCI bits;

- is the number of CRC bits for CG-UCI determined according to Clause 6.3.1.2.1;

- ;

- is the number of code blocks for UL-SCH of the PUSCH transmission;

- is the *r*-th code block size for UL-SCH of the PUSCH transmission;

- is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

- is the number of subcarriers in OFDM symbol *l* that carries PTRS, in the PUSCH transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol *l*, for =0,1,2,…, , in the PUSCH transmission and is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

- is configured by higher layer parameter *scaling*;

- is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission.

For CG-UCI transmission on PUSCH with UL-SCH, and if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is larger than 1, the number of coded modulation symbols per layer for CG-UCI transmission, denoted as , is determined as follows:

where

- is the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI;

- is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission of TB processing over multiple slots in the slot with the CG-UCI transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission of TB processing over multiple slots in the slot with the CG-UCI transmission and is the total number of OFDM symbols of the PUSCH in the slot, including all OFDM symbols used for DMRS;

- is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission of TB processing over multiple slots in the slot with the CG-UCI transmission;

- and all the other notations in the formula are defined the same as for PUSCH with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

The input bit sequence to rate matching is where *r* is the code block number, and is the number of coded bits in code block number *r*.

Rate matching is performed according to Clause 5.4.1 by setting and the rate matching output sequence length to , where

- is the number of code blocks for UCI determined according to Clause 5.2.1;

- is the number of transmission layers of the PUSCH;

- is the modulation order of the PUSCH;

- .

The output bit sequence after rate matching is denoted as where is the length of rate matching output sequence in code block number *r*.

6.3.2.4.1.5 HARQ-ACK and CG-UCI

For HARQ-ACK and CG-UCI transmission on PUSCH with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table, or if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is equal to 1, the number of coded modulation symbols per layer for HARQ-ACK and CG-UCI transmission, denoted as , is determined as follows:

where

- is the number of HARQ-ACK bits;

- is the number of CG-UCI bits;

- if , ; otherwise is the number of CRC bits for HARQ-ACK and CG-UCI determined according to Clause 6.3.1.2.1;

- ;

- is the number of code blocks for UL-SCH of the PUSCH transmission;

- is the *r*-th code block size for UL-SCH of the PUSCH transmission;

- is the scheduled bandwidth of the PUSCH transmission, expressed as a number of subcarriers;

- is the number of subcarriers in OFDM symbol *l* that carries PTRS, in the PUSCH transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol *l*, for =0,1,2,…, , in the PUSCH transmission and is the total number of OFDM symbols of the PUSCH, including all OFDM symbols used for DMRS;

- for any OFDM symbol that carries DMRS of the PUSCH, ;

- for any OFDM symbol that does not carry DMRS of the PUSCH, ;

- is configured by higher layer parameter *scaling*;

- is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission.

For HARQ-ACK and CG-UCI transmission on PUSCH with UL-SCH, and if *numberOfSlotsTBoMS* is present in the resource allocation table and the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI is larger than 1, the number of coded modulation symbols per layer for HARQ-ACK and CG-UCI transmission, denoted as , is determined as follows:

where

- is the value of *numberOfSlotsTBoMS* in the row indicated by the Time domain resource assignment field in DCI;

- is the number of subcarriers in OFDM symbol that carries PTRS, in the PUSCH transmission of TB processing over multiple slots in the slot with the HARQ-ACK and CG-UCI transmission;

- is the number of resource elements that can be used for transmission of UCI in OFDM symbol , for , in the PUSCH transmission of TB processing over multiple slots in the slot with the HARQ-ACK and CG-UCI transmission and is the total number of OFDM symbols of the PUSCH in the slot, including all OFDM symbols used for DMRS;

- is the symbol index of the first OFDM symbol that does not carry DMRS of the PUSCH, after the first DMRS symbol(s), in the PUSCH transmission of TB processing over multiple slots in the slot with the HARQ-ACK and CG-UCI transmission;

- and all the other notations in the formula are defined the same as for PUSCH with UL-SCH and if *numberOfSlotsTBoMS* is not present in the resource allocation table.

The input bit sequence to rate matching is where *r* is the code block number, and is the number of coded bits in code block number *r*.

Rate matching is performed according to Clause 5.4.1 by setting and the rate matching output sequence length to , where

- is the number of code blocks for UCI determined according to Clause 5.2.1;

- is the number of transmission layers of the PUSCH;

- is the modulation order of the PUSCH;

- .

The output bit sequence after rate matching is denoted as where is the length of rate matching output sequence in code block number *r*.