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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change Request** | | | | | | | |
| **Document** | **O-RAN.WG4.CUS.0** | **ver** | **10.00** | **CR** | **QCM-0043** | **rev** | **3** | |

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| --- | --- | --- | --- |
| ***Title:*** | Support for new Section Extension 23 to support sending multiple symbol mcScaleOffset values in a single Section. | | |
| ***Source to WG:*** | QCM | | |
| ***Target WG :*** | **WG4** | | |
| ***Category:*** | **B** | ***CR Creation Date*** | 2022.04.07 |
|  | *Use one of the following* ***categories****:* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)* ***F*** *(correction)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | |

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| --- | --- |
| ***Reason for Change:*** | * In 5GNR DM-RS and PT-RS reference signals experience the same channel as data and therefore share beam weights.​ * Despite of the above ORAN C-Plane limitations require representing DM-RS and PT-RS in different sections than data when modulation compression is used with DL channels. ​ * In some cases this section duplication can also lead to beam weights duplications to avoid race conditions resulting from packet reordering. |
| ***Summary of change:*** | * The proposal defines a section extension using which both data and its reference signals can be grouped in the same section.​ * The proposal further optimizes PTRS representation so that it can be packed within a single Section instead of up to 10 sections if Extension 6 is used to describe it​ * Proposed extension is based on SE5 and adds symbol bitmaps and RB periodicity info into each of its entries​ |
| ***Consequences if not aproved:*** | Multiple sections shall be used with SE=5 to specify data and reference signals with same beamIds but different MCS values; processing multiple sections compromises computation efficiency in O-RU; also in some cases can double the number of beamweights sent over fronthaul link. |

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| ***Clauses affected:*** | All | | | | |
|  | **Y** | **N** |  | |  |
| ***Other specs*** | **Y** |  | Other core specifications: | pull-request#295 | |
| ***affected:*** |  | **x** | Test specifications: | <fill in related CRs if “Y”> | |
| ***(show related CRs)*** |  | **X** | O&M Specifications: | <fill in related CRs if “Y”> | |
| ***Supporting material:***  ***Other comments:*** | https://oranalliance.atlassian.net/wiki/download/attachments/2431582550/QCM-2022.04.07-oRAN.WG4.SecExt-22-ModCompression-MulSym-v1.0.pdf?api=v2 | | | | |

\*\*\*Start of Changes#1\*\*\*

### 

### 7.7.23 SE 23: Arbitarary symbol pattern modulation compression paramaters

#### 7.7.23.1 Overview

This Section Extension ~~is required for~~ enables specifying ~~sending in a single section~~ multiple sets of “mcScaleReMask, csf and mcScaleOffset” values for one or more ‘SymPrbPatterns’. The term SymPrbPattern is used to specify set of PRBs that can span an entire PRB range (specified using prbPattern) and multiple symbols (specified using symMask). Proposed extension is motivated by the fact that in 5G NR reference signals like DM-RS, ~~and~~ PT-RS and data channel experience the same channel conditions (~~single~~same beamId) but may use different MCS and hence different mcScaleOffset. This section extension applies to Section Types 1, 3 and 5.

This section extension has a nested structure comprising of two loops. The outermost loop which is bounded by the field “numSymPrbPattern” shall specify multiple SymPrbPatterns. The innermost loop is bounded by the field “numMcScaleOffset” and shall specify multiple sets of “mcScaleReMask, csf and mcScaleOffset” per SymPrbPattern. Refer Table 7.7.23.1 for details of the structure of SE 23.

If Section Extension 23 is present in a section description, then the following requirements shall apply:

1. Requirements 1, 2 and 3 as specified in clause 7.7.6.1 for SE 6.
2. SE 23 using a combination of symMask, prbPattern and mcScaleReMask shall specify mcScaleOffset values for all the symbols and REs whose scheduling information is specified in the section header (startSymbolId) and section description (numSymbols, reMask) or via the use of SE 6 or SE 12.
3. Specifically for SE 6 and SE 12 prbPattern shall apply to all allocated non-contiguous PRBs jumping over the un-allocated RBGs.
4. Any PRB on time-freq grid shall be addressed by only one SymPrbPattern in any instance of SE 23
5. Each data section shall specify only one instance of SE 23 per eAxCId.. When SE 23 is used in combination with SE 10 refer to clause 7.9.10.
6. For every “SymPrbPattern” all REs in the PRBs as designated in the reMask in section header shall be assigned “mcScaleReMask, csf and mcScaleOffset” value. No bit in any of the mcScaleReMasks shall be set (=1) in a position where the reMask has a zero, and every reMask bit that is set (=1) shall have exactly one bit =1 in one of the mcScaleReMasks.

e.g. For section header reMask = 1111 1111 1111 b, union of mcScaleReMask-1 = 1010 1010 1010 b and mcScaleReMask-2 = 0101 0101 0101 b shall be equal to the reMask value.

1. The number of “mcScaleReMask, csf and mcScaleOffset” sets which can be specified per “SymPrbPattern” is restricted by the M-Plane O-RU capability parameter “max-mcscale-offset-per-prb”.

Table 7.7.23-1: Section Extension 23 for modulation compression for multiple symbols

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 (msb) | | | 1 | 2 | | 3 | | | 4 | | 5 | 6 | 7(lsb) | # of  bytes |  |
| ef | | | extType = 0x16 | | | | | | | | | | | 1 | Octet N |
| extLen[15:0] | | | | | | | | | | | | | | 1 | N+1 |
| numSymPrbPattern[3:0] | | | | | | | | | | reserved | | | | 1 | N+2 |
| reserved | | | | | | | | | | | | | | 1 | N+3 |
| reserved | | | | | symMask[13:8] (1) | | | | | | | | | 1 | N+4 |
| symMask[7:0] (1) | | | | | | | | | | | | | | 1 | N+5 |
| numMcScaleOffset  [3:0] (1) | | | | | | | | prbPattern[3:0] (1) | | | | | | 1 | N+6 |
| reserved | | | | | | | | | | | | | | 1 | N+7 |
| reserved | | | | | | | | mcScaleReMask[11:8] (1.1) | | | | | | 1 | N+8 |
| mcScaleReMask[7:0] (1.1) | | | | | | | | | | | | | | 1 | N+9 |
| csf (1.1) | | mcScaleOffset[14:8] (1.1) | | | | | | | | | | | | 1 | N+10 |
| mcScaleOffset[7:0] (1.1) | | | | | | | | | | | | | | 1 | N+11 |
| reserved (1.2) | | | | | | | mcScaleReMask [11:8] (1.2) | | | | | | | 1 | N+12 |
| mcScaleReMask [7:0] (1.2) | | | | | | | | | | | | | | 1 | N+13 |
| csf (1.2) | mcScaleOffset[14:8] (1.2) | | | | | | | | | | | | | 1 | N+14 |
| mcScaleOffset[7:0] (1.2) | | | | | | | | | | | | | | 1 | N+15 |
| … | | | | | | | | | | | | | |  |  |
| reserved | | | | | symMask[13:8] (n) | | | | | | | | |  |  |
| symMask1[7:0] (n) | | | | | | | | | | | | | |  |  |
| numMcScaleOffset  [3:0] (n) | | | | | | | prbPattern[3:0] (n) | | | | | | |  |  |
| reserved | | | | | | | | | | | | | |  |  |
| reserved | | | | | | | mcScaleReMask [11:8] (n.1) | | | | | | |  |  |
| mcScaleReMask [7:0] (n.1) | | | | | | | | | | | | | |  |  |
| csf (n.1) | mcScaleOffset[14:8] (n.1) | | | | | | | | | | | | |  |  |
| mcScaleOffset[7:0] (n.1) | | | | | | | | | | | | | |  |  |

##### 

##### 7.7.23.2 numSymPrbPattern (number of symbol and resource block patterns)

**Description**: This parameter specifies ~~is used to indicate~~ the number of ~~unique symbol and prb patterns~~ SymPrbPatterns specified by SE 23 instance. ~~Each pattern is a unique combination of symMask and prbPattern in the section extension (up to 16) (value of zero means one) This field is the common part of the extension header which is followed by mcScaleOffset for multiple mcScaleReMask per symPrbPattern.~~

**Value range**: {0001b - 1111b} or {1 – 15} in decimal

**Type:** unsigned integer

**Field length:** 4 bits.

##### 7.7.23.3 symMask (symbol mask part of symPrbPattern)

**Description**: This parameter is a bitmask for the symbols specified by SymPrbPattern. ~~value where the ”symMask” in combination with “prbPattern” shall specify a unique symPrbPattern to which multiple unique sets of “mcScaleReMask, csf and mcScaleOffset values” shall apply to REs within the symPrbPattern.~~

0: ‘SymPrbPattern’ does not apply to the associated symbol.

1: ‘SymPrbPattern’ applies to the associated symbol.

**Value range:** {00 0000 0000 0001b - 11 1111 1111 1111b}.

**Type:** unsigned integer (bit mask).

**Field length:** 14 bits.

##### 7.7.23.4 prbPattern (resource block pattern part of symPrbPattern)

**Description**: This parameter is a 4-bit pattern mask for the PRBs specified by SymPrbPattern.~~where the “prbPattern” in combination with “symMask” shall uniquely specify a symPrbPattern to which multiple unique sets of “mcScaleReMask, csf and mcScaleOffset values” shall apply to REs within the symPrbPattern.~~ This pattern repeats over all the allocated PRBs. When there are allocation discontinuities e.g.SE 6, SE 12, the pattern only applies to the allocated PRBs. If the prb range is not a multiple of 4 then the last prbPattern shall be truncated. In the specified mask LSB represents the lowest frequency PRB and MSB represents the highest frequency PRB in the prbPattern.

0: ‘SymPrbPattern’ does not apply to the associated PRB

1: ‘SymPrbPattern’ applies to the associated PRB.

**Value range:** {0000b - 1111b}.

**Type:** unsigned integer (bit mask).

**Field length:** 4 bits.

##### 7.7.23.5 numMcScaleOffset (number of modulation compression scaling value per symPrbPattern)

**Description**: This parameter indicates the number of modulation compression parameter sets i.e., “mcScaleReMask, csf and mcScaleOffset values”, present for each “SymPrbPattern”. Refer to requirement#6 in clause 7.7.23.1 for limits that apply to this parameter.

**Value range:** {0001b-1111b} or {1 – 15} in decimal

1 – 12: Valid range

0, 13, 14, 15: reserved

**Type:** unsigned integer.

**Field length:** 4 bits.

##### 7.7.23.6 mcScaleReMask (modulation compression power scale RE mask)

**Description**: refer to clause 7.7.5.2 Note: This parameter as used for Section Extension 23 shall apply only to PRBs, and symbol specified by “SymPrbPattern”.

##### 7.7.23.7 csf (constellation shift flag)

**Description**: refer to clause refer to clause 7.7.7.2

##### 7.7.23.8 Interaction with Other Section Extensions

Table 7.7.23‑1: Section Extension = 23 Interactions with other Section Extensions

|  |  |  |
| --- | --- | --- |
| **Section Extension** | **Title** | **Interaction with existing Section Extensions** |
| 1 | Beamforming Weights | ~~No special handling needed ​~~  This Section Extension is independent of SE 23 |
| 2 | Beamforming Attributes | SE 2 can be used with SE 23 only if the Beamforming Attribute transferred using SE 2 is same for DL data and control channel (DM-RS and PT-RS) ​ |
| 3 | DL Precoding | ~~No special handling needed~~  This Section Extension is independent of SE 23 |
| 4 | Modulation Compression | SE 23 cannot co-exist with this Section Extension |
| 5 | Modulation Compression (Additional) | SE 23 cannot coexist with this Section Extension |
| 6 | Non-Contiguous PRB | SE 6 can be used with SE 23. SE 23 shall apply to PRB allocations with SE 6. ~~with restriction that both extensions shall be used together to specify the same RB and symbol allocations. Hence, ‘symbolMask’ in SE=6 and union of ‘symMask’ field in SE=23 shall be same~~. SE6 specifies the RBs that are allocated while SE 23 shall provide the ModComp parameters for only the allocated RBs. SE 23 ‘prbPattern’ shall jump over the unallocated RBGs. |
| s7 | eAxC Mask | ​ ~~No interaction​~~This Section Extension is independent of SE 23 |
| 8 | Regularization factor | ~~No interaction​~~  This Section Extension is independent of SE 23 |
| 9 | DSS Parameters | ~~No interaction​~~  This Section Extension is independent of SE 23 |
| 10 | Group Configuration for multiple ports | No special handling needed ​. Refer to clause 7.9.10 for the interaction details. |
| 11 | Flexible Beamforming Weights | ~~It is suggested to use SE=23 with SE=11 when multiple PRB bundles and associated beamIds are specified with SE=11, one instance of SE=23 shall be associated with each.~~  This Section Extension is independent of SE 23 |
| 12 | Non-Contiguous PRB Allocation with Frequency Ranges | Interaction same as SE 6 |
| 13 | PRB Allocation with Frequency Hopping | Interaction same as SE 6 |
| 14 | Nulling-Layer Info | ~~No interaction​~~​  This Section Extension is independent of SE 23 |
| 15 | Mixed Numerology Info for ueId-based beamforming | ~~No interaction​~~  This Section Extension is independent of SE 23 |
| 16 | Antenna Information in UE Channel Information based UL beamforming | ~~No interaction​~~  This Section Extension is independent of SE 23 |
| 17 | Indication of User Port group | ~~No interaction​~~​  This Section Extension is independent of SE 23 |
| 18 | Uplink Transmission Management | ~~No interaction​~~​  This Section Extension is independent of SE 23 |
| 19 | Compact multiple port beamforming information | SE=19 is used for specifying separate beamforming weights for data and reference signals (CSI-RS), usage of SE=23 with SE=19 hence is hence restricted |
| 20 | Puncturing Extension | ~~SE=20 can be used with SE=23 and interaction behavior shall be same as SE=6~~  This Section Extension is independent of SE 23 |
| 21 | Variable PRB group size for channel information | ~~No interaction​~~  This Section Extension is independent of SE 23 |

\*\*\*End of Change#1\*\*\*

\*\*\*Start of Change#2\*\*\*

Table 7.6.1‑1: Section Extension commands

| **extType** | **meaning** | **extLen** | **extension parameters** | **octets** | **meaning** |
| --- | --- | --- | --- | --- | --- |
| 23 | Multiple symbol modulation compression paramaters | var | numSymPrbPattern  symMask  prbPattern  numMcScaleOffset  mcScaleReMask  csf | 4b  14b  4b  4b  12b  1b | number of symbol and resource block pattern  symbol mask part of symPrbPattern  physical resource block pattern part of symPrbPattern  number of modulation compression scaling value per symPrbPattern  modulation compression power scale RE mask  constellation shift flag |
| 24-127 | reserved | 1 (1 word) | Reserved  reserved | 1  1 | for future use  for future use |

\*\*\*End of Change#2\*\*\*

\*\*\*Start of Change#3\*\*\*

### 7.9.10 Modulation compression with Section Extension 10

Section Extension 10 is used for group configuration of multiple ports. Section Extension 4, Section Extension 5 and Section Extension 23 are used for modulation compression. Extension type 10 can be used together with extension type 4 or 5 or 23. When all parameter values of Section Extension 4 or 5 or 23 is same for all eAxC\_IDs, one single Section Type 4 or 5 or 23 shall be appended after Section Extension 10. When parameter values are different for all eAxCs, Section Extension 4 or 5 or 23 for all eAxC\_IDs in sequence based on eAxC\_ID order shall be appended after Section Extension 10.

If O-RU receives only one Section Extension 4 or 5 or 23 with Section Extension 10, O-RU applies same parameters to all eAxC\_IDs. If O-RU receives equal to the number of the eAxC\_IDs grouped, O-RU applies the Section Extension 4 or 5 or 23 in the order of how eAxC\_IDs are grouped. Any other number of Section Extension 4 or 5 or 23 is an error condition. O-RU shall use numPortc parameter in Section Extension 10 to identify number of Section Extension 4 or 5 or 23that are present.

EXAMPLE 1: Example with 4 Layers (numPortc=3), beamGroupType=00b or 01b for Section Extension 10 and all eAxC\_IDs share same modulation compression parameters is shown in Table 7.9.10‑1. One Section Extension 5 is appended after Section Extension 10 in this case (Section Extension 5 with two scaler values, modulation compression parameters is used in this example).

\*\*\*End of Change#3\*\*\*

\*\*\*Start of Change#4\*\*\*

Table 10.2‑1 : O-RAN mandatory and optional features

| Category | Feature of O-DU or O-RU | O-DU support | O-RU support | Additional information |
| --- | --- | --- | --- | --- |
| **Section Types and Section Extensions** | Multiple symbol mcScaleOffset using Section Extension=23 | Optional | Optional | Multiple symbol mcScaleOffset using Section Extension=23 |

\*\*\*End of Change#4\*\*\*