|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **3GPP TSG RAN WG1 Meeting #100bis R1-200xxxx****e-Meeting, April 20th – 30th, 2020**

|  |
| --- |
| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.214** | **CR** | ***DRAFT*** | **rev** | **-** | **Current version:** | **15.9.0** |  |
|  |
| *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)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

|  |
| --- |
|  |
| ***Title:***  | Draft CR on 38.214 PDSCH resource mapping |
|  |  |
| ***Source to WG:*** | Qualcomm |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_newRAT-Core |  | ***Date:*** | 2020-04-24 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-15 |
|  | *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-12 (Release 12)Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | In section 5.1.4, there is a general description for PDSCH resource mapping. However, it is not fully clear how the configured or dynamically indicated resources are determined and when these resources are not available for PDSCH. Some more details are specified in section 5.1.4.1, while not all cases have been covered. In particular:* For a PDSCH scheduled by DCI format 1\_0 and for PDSCHs with SPS, it is not clear whether the resource sets configured by *rateMatchPattern(s)* that are not included in either of *rateMatchPattenGroup1* or *rateMatchPatternGroup2* are not available.
* When receiving PDSCH with SPS activated by DCI format 1\_1, it is not clear whether the REs corresponding to the configured resource sets in *rateMatchPatternGroup1* or *rateMatchPatternGroup2* are not available for the activated PDSCHs with SPS if a corresponding bit of the rate matching indicator field in DCI format 1\_1 activating the PDSCH with SPS is equal to 1.

In addition:* The spec uses the terminology “RB and symbol level resource sets”. However, this is not accurate and would have a risk of misinterpretation, since “the resource sets configured by *rateMatchPattern(s)*” is formed by the set(s) of three bit-maps, including *periodicityAndPattern*. It should be clarified that the resource sets are the unions of resource sets configured by *rateMatchPattern(s)*.
* For a given PDSCH, the rate match indicator field value should be applicable only to the scheduled PDSCH. For example, suppose there are two PDSCHs in one slot scheduled by two different DCI format 1\_1, and they overlap with part of the union of REs configured by *rateMatchPattern(s)* in the slot that belong to a *rateMatchPatternGroup1*. Then, for each PDSCH, whether to perform rate-match based on the resource sets in *rateMatchPatternGroup1* depends on the own scheduling DCI. This should be clear in the spec.
 |
|  |  |
| ***Summary of change:*** | * Clarify that for a PDSCH scheduled by DCI format 1\_0 and for PDSCHs with SPS, the resource sets configured by *rateMatchPattern(s)* that are not included in either of *rateMatchPattenGroup1* or *rateMatchPatternGroup2* are not available.
* Clarify that once the rate matching resource sets are indicated by a corresponding bit of the rate matching indicator field in the DCI format 1\_1, the pattern is valid not only for the first activated PDSCH with SPS, but also for the subsequent PDSCHs with SPS.
* Clarify that the rate-matching is perfomed according to the *rateMatchPattern(s)*, each of which includes three bit-maps (including *periodictyAndPattern*).
* Clarify that for a given PDSCH, the rate match indicator field value is valid only for the scheduled PDSCH
 |
|  |  |
| ***Consequences if not approved:*** | There will be different understanding between UE and gNB on PDSCH resource mapping, resulting in PDSCH decoding failure. |
|  |  |
| ***Clauses affected:*** | 5.1.4.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** | Isolated impact analysis:This CR has isolated impact. This CR impacts on PDSCH rate matching according to *rateMatchPattern(s)*. If the UE is implemented in accordance to this CR and the gNB is not, or the gNB is implemented in accordance to this CR and the UE is not, there will be different understanding between UE and gNB on PDSCH resource mapping, resulting in PDSCH decoding failure.  |

|  |  |
| --- | --- |
| ***This CR's revision history:*** |  |

 |

### 5.1.4 PDSCH resource mapping

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, P-RNTI or TC-RNTI, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst*, and if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.

When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Subclauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE is not expected to handle the case where PDSCH DM-RS REs are overlapping, even partially, with any RE(s) not available for PDSCH*.*

#### 5.1.4.1 PDSCH resource mapping with RB symbol level granularity

A UE may be configured with any of the following higher layer parameters indicating REs declared as not available for PDSCH:

- *rateMatchPatternToAddModList* given by *PDSCH-Config,* by *ServingCellConfig* or by *ServingCellConfigCommon* and configuring up to 4 *RateMatchPattern(s)* per BWP and up to 4 *RateMatchPattern(s)* per serving-cell. A *RateMatchPattern* may contain:

- within a BWP, when provided by *PDSCH-Config* or within a serving cell when provided by *ServingCellConfig* or *ServingCellConfigCommon*, a pair of reserved resources with numerology provided by higher layer parameter *subcarrierSpacing* given by *RateMatchPattern* when configured per serving cellor by numerology of associated BWP when configured per BWP.The pair of reserved resources are respectively indicated by an RB level bitmap (higher layer parameter *resourceBlocks* given by *RateMatchPattern* ) with 1RB granularity and a symbol level bitmap spanning one or two slots (higher layer parameters *symbolsInResourceBlock* given by *RateMatchPattern* ) for which the reserved RBs apply. A bit value equal to 1 in the RB and symbol level bitmaps indicates that the corresponding resource is not available for PDSCH. For each pair of RB and symbol level bitmaps, a UE may be configured with a time-domain pattern (higher layer parameter *periodicityAndPattern* given by *RateMatchPattern* ), where each bit of *periodicityAndPattern* corresponds to a unit equal to a duration of the symbol level bitmap, and a bit value equal to 1 indicates that the pair is present in the unit. The *periodicityAndPattern* can be {1, 2, 4, 5, 8, 10, 20 or 40} units long, but maximum of 40ms. The first symbol of *periodicityAndPattern* every 40ms/P periods is a first symbol in frame $n\_{f}$ mod 4 = 0, where P is the duration of *periodicityAndPattern* in units of ms. When *periodicityAndPattern* is not configured for a pair, for a symbol level bitmap spanning two slots, the bits of the first and second slots correspond respectively to even and odd slots of a radio frame, and for a symbol level bitmap spanning one slot, the bits of the slot correspond to every slot of a radio frame. The pair can be included in one or two groups of resource sets (higher layer parameters *rateMatchPatternGroup1*and *rateMatchPatternGroup2*). The *rateMatchPatternToAddModList* given by *ServingCellConfig* or *ServingCellConfigCommon* configuration in numerology *µ* applies only to PDSCH of the same numerology *µ*.

- within a BWP, a frequency domain resource of a CORESET configured by *ControlResourceSet* with *controlResourceSetId* or *ControlResourceSetZero* and time domain resource determined by the higher layer parameters *monitoringSlotPeriodicityAndOffset,* *duration* and *monitoringSymbolsWithinSlot* of all search-space-sets configured by *SearchSpace* and time domain resource of search-space-set zero configured by *searchSpaceZero* associated with the CORESET as well as CORESET duration configured by *ControlResourceSet* with *controlResourceSetId* or *ControlResourceSetZero.* This resource not available for PDSCH can be included in one or two groups of resource sets (higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2*).

A configured group *rateMatchPatternGroup1* or *rateMatchPatternGroup2* contains alist of indices of *rateMatchPattern(s)* forming a union of resource-sets not available for a PDSCH dynamically if a corresponding bit of the Rate matching indicator field of the DCI format 1\_1 scheduling the PDSCH is equal to 1. The REs corresponding to the union of resource-sets configured by *rateMatchPattern(s)* that are not included in either of the two groups are not available for a PDSCH scheduled by a DCI format 1\_0, a PDSCH scheduled by a DCI format 1\_1, and for PDSCHs with SPS. When receiving a PDSCH scheduled by a DCI format 1\_0 or PDSCHs with SPS activated by a DCI format 1\_0, the REs corresponding to configured resources in *rateMatchPatternGroup1* or *rateMatchPatternGroup2* are not available for the scheduled PDSCH or the activated PDSCHs with SPS. When receiving PDSCHs with SPS activated by a DCI format 1\_1, the REs corresponding to configured resources in *rateMatchPatternGroup1* or *rateMatchPatternGroup2* are not available for the PDSCHs with SPS if a corresponding bit of the Rate matching indicator field of the DCI format 1\_1 activating the PDSCHs with SPS is equal to 1.

For a bitmap pair included in one or two groups of resource sets, the dynamic indication of availability for PDSCH applies to a set of slot(s) where the *rateMatchPatternToAddModList* is present among the slots of scheduled PDSCH.

If a UE monitors PDCCH candidates of aggregation levels 8 and 16 with the same starting CCE index in non-interleaved CORESET spanning one OFDM symbol and if a detected PDCCH scheduling the PDSCH has aggregation level 8, the resources corresponding to the aggregation level 16 PDCCH candidate are not available for the PDSCH.

If a PDSCH scheduled by a PDCCH would overlap with resources in the CORESET containing the PDCCH, the resources corresponding to a union of the detected PDCCH that scheduled the PDSCH and associated PDCCH DM-RS are not available for the PDSCH. When *precoderGranularity* configured in a CORESET where the PDCCH was detected is equal to *allContiguousRBs*, the associated PDCCH DM-RS are DM-RS in all REGs of the CORESET. Otherwise, the associated DM-RS are the DM-RS in REGs of the PDCCH.

#### 5.1.4.2 PDSCH resource mapping with RE level granularity

A UE may be configured with any of the following higher layer parameters:

*-* REs indicated by the *RateMatchingPatternLTE-CRS* in *lte-CRS-ToMatchAround* in *ServingCellConfig* or *ServingCellConfigCommon* configuring common RS, in 15 kHz subcarrier spacing applicable only to 15 kHz subcarrier spacing PDSCH, of one LTE carrier in a serving cell are declared as not available for PDSCH. The *RateMatchingPatternLTE-CRS* configuration contains *v-Shift* consisting of LTE-CRS-vshift(s), *nrofCRS-Ports* consisting of LTE-CRS antenna ports 1, 2 or 4 ports, *carrierFreqDL* representing the offset in units of 15 kHz subcarriers from (reference) point A to the LTE carrier centre subcarrier location, *carrierBandwidthDL* representing the LTE carrier bandwidth, and may also configure *mbsfn-SubframeConfigList* representing MBSFN subframe configuration. A UE determines the CRS position within the slot according to Subclause 6.10.1.2 in [15, TS 36.211], where slot corresponds to LTE subframe.

- within a BWP, the UE can be configured with one or more ZP CSI-RS resource set configuration(s) for aperiodic, semi-persistent and periodic time-domain behaviours (higher layer parameters *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList,*  *sp-ZP-CSI-RS-ResourceSetsToAddModList* and *p-ZP-CSI-RS-ResourceSet* respectively comprised in *PDSCH-Config*), with each ZP-CSI-RS resource set consisting of at most 16 ZP CSI-RS resources (higher layer parameter *ZP-CSI-RS-Resource*) in numerology of the BWP. The REs indicated by *p-ZP-CSI-RS-ResourceSet* are declared as not available for PDSCH. The REs indicated by *sp-ZP-CSI-RS-ResourceSetsToAddModList* and aperiodic-ZP-CSI-RS-ResourceSetsToAddModList are declared as not available for PDSCH when their triggering and activation are applied, respectively. The following parameters are configured via higher layer signaling for each ZP CSI-RS resource configuration:

- *zp-CSI-RS-ResourceId* in *ZP-CSI-RS-Resource* determines ZP CSI-RS resource configuration identity.

- *nrofPorts* defines the number of CSI-RS ports, where the allowable values are given in Subclause 7.4.1.5 of [4, TS 38.211].

- *cdm-Type* defines CDM values and pattern, where the allowable values are given in Subclause 7.4.1.5 of [4, TS 38.211].

- *resourceMapping* given by *ZP-CSI-RS-Resource* defines the OFDM symbol and subcarrier occupancy of the ZP-CSI-RS resource within a slot that are given in Subclause 7.4.1.5 of [4, TS 38.211].

- *periodicityAndOffset* in*ZP-CSI-RS-Resource* defines the ZP-CSI-RS periodicity and slot offset for periodic/semi-persistent ZP-CSI-RS.

The UE may be configured with a DCI field for triggering the aperiodic ZP-CSI-RS. A list of *ZP-CSI-RS-ResourceSet(s)*, provided by higher layer parameter *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList* in*PDSCH-Config* , is configured for aperiodic triggering. The maximum number of aperiodic *ZP-CSI-RS-ResourceSet(s)* configured per BWP is 3. The bit-length of DCI field *ZP CSI-RS trigger* depends on the number of aperiodic *ZP-CSI-RS-ResourceSet(s)*configured (up to 2 bits). Each non-zero codepoint of *ZP CSI-RS trigger* in DCI format 1\_1 triggers one aperiodic *ZP-CSI-RS-*ResourceSet in the list *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList* by indicating the aperiodic ZP CSI-RS resource set ID. The DCI codepoint '01' triggers the resource set with ZP-CSI-RS-ResourceSetIds = 1, the DCI codepoint '10' triggers the resource set with ZP-CSI-RS-ResourceSetIds = 2, and the DCI codepoint '11' triggers the resource set with ZP-CSI-RS-ResourceSetIds = 3. Codepoint '00' is reserved for not triggering aperiodic ZP CSI-RS. When receiving PDSCH scheduled by DCI format 1\_0 or PDSCHs with SPS activated by DCI format 1\_0, the REs corresponding to configured resources in *aperiodic-ZP-CSI-RS-ResourceSetsToAddModList* are available for PDSCH.

When the UE is configured with multi-slot and single-slot PDSCH scheduling, the triggered aperiodic ZP CSI-RS is applied to all the slot(s) of the PDSCH scheduled by the PDCCH containing the trigger.

For a UE configured with a list of *ZP-CSI-RS-ResourceSet(s)* provided by higher layer parameter *sp-ZP-CSI-RS-ResourceSetsToAddModList*:

- when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command, as described in subclause 6.1.3.19 of [10, TS 38.321], for ZP CSI-RS resource(s), the corresponding action in [10, TS 38.321] and the UE assumption on the PDSCH RE mapping corresponding to the activated ZP CSI-RS resource(s) shall be applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH.

- when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, as described in subclause 6.1.3.19 of [10, TS 38.321], for activated ZP CSI-RS resource(s), the corresponding action in [10, TS 38.321] and the UE assumption on cessation of the PDSCH RE mapping corresponding to the de-activated ZP CSI-RS resource(s) shall be applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH.