**3GPP TSG RAN WG1 #112bis-e R1-23xxxxx**

**e-Meeting, April 17th – April 26th, 2023**

**Source: Moderator (MediaTek)**

**Title: [112bis-e-R17-Others-01] Email discussion on other Rel-17 maintenance**

**Agenda item: 7.2**

**Document for:** **Discussion and Decision**

Introduction

This document intends to provide discussion summary on the following **3 issues** in RAN1#112-bis-e meeting:

1. two contributions [1, 2, MTK], one discussion paper and one CR, are submitted to clarify the relation between SUL indicator and *pusch-Config*/*pucch-Config* for DCI 0\_0
2. two contributions [3, 4, MTK], one discussion paper and one CR, propose to add periodicities of n80 and n160 to *periodicityAndPattern* in *RateMatchPattern* to avoid unnecessary resource waste when NCD-SSB is configured
3. one contribution [5, Qualcomm] proposes introducing new Rel-17 UE capability for “extended value range for aperiodic CSI-RS triggering offset” to address the ambiguity of applicability for *aperiodicTriggeringOffset-r16/r17* with various SCS combinations and FR2-2

As guided by the Chairman, for the **3 issues** listed above, this contribution provides summary of the submitted contributions (Section 4.1, 4.2, 4.3), discussion points (Section 2.1, 2.2, 2.3), and possible RAN1 consensus during this meeting (Section 3.1, 3.2, 3.3, TBD).

[112bis-e-R17-Others-01] Email discussion on other Rel-17 maintenance by April 21 – James (MediaTek)

R1-2303363 On the relation between SUL indicator and pusch-Config/pucch-Config for DCI 0\_0 MediaTek Inc.

R1-2303364 [R17] Draft 38.212 CR on SUL indicator and pusch-Config/pucch-Config for DCI 0\_0 MediaTek Inc.

R1-2303365 On rate match pattern periodicity MediaTek Inc.

R1-2303366 Draft CR for 38.214 on rate match pattern periodicity MediaTek Inc.

R1-2303565 Clarification on A-CSI-RS triggering offset Qualcomm Incorporated

Discussion points (phase 1 until 18-Apr)

## For [1, 2, MTK] related to SUL indicator and pusch/pucch-Config for DCI 0\_0

In [1, MTK], it is mentioned that

1. from current spec 38.212 V17.5.0 7.3.1.1.1, the determination of PUSCH transmission scheduled by DCI 0\_0 on NUL (normal uplink) or SUL shown in Table 1 (prioritizing PUCCH carrier for PUSCH transmission) seems not matching the RAN1 #90bis agreement that the default location of the PUSCH is the same carrier as used by PUCCH. During RAN1 #112, this issue was discussed under R15 CR agenda (Section 7.1) and companies have diverse view on current R15 spec (some companies think it’s reasonable while some think it’s not supported).

Agreement: (RAN1 #90bis)

* UE specific RRC signalling (re-)configures the location of the PUCCH, either on the SUL carrier or on a non-SUL UL carrier in a SUL band combination
  + The default location of the PUSCH is the same carrier as used by PUCCH



**Table 1: PUSCH transmission behavior on NUL (normal uplink) or SUL scheduled by DCI 0\_0 implied in current spec**

**38.212 V17.5.0** 7.3.1.1.1:



For 1), as companies can not have aligned understanding under R15 CR discussion (agenda 7.1) during RAN1 #112, it is proposed in [1] to revisit this issue in R17 (agenda 7.2) during RAN1 #112-bis-e, with the following proposal:

**Proposal 1: RAN1 to** **draw the following conclusion for R17:**

* **If an UL cell has NUL and SUL carrier, and *pusch-config* is configured, then the UL carrier configured with *pucch-config* should also be configured with *pusch-config***

**and sent an LS to RAN2 to clarify it in R17 38.331 spec.**

Besides, there is one remaining issue not discussed during RAN1 #112:

1. Only one carrier of NUL/SUL configured with *pusch-Config* but no carriers configured with *pucch-Config* (E.g. only cell-specific *pucch-ConfigCommon* is configured, as *pucch-Config* is an optional IE)

For 2), it is proposed in [1] to adopt a R17 38.212 CR to clarify this scenario:

**Proposal 2: Adopt the R17 CR (detailed CR text in Section 4.1 of this document) to 38.212 V17.5.0 7.3.1.1.1 about SUL indicator and *pusch-Config*/*pucch-Config* for DCI 0\_0.**

The following discussions points are devised to discuss the Proposals 1 & 2 above:

#### Discussion point 2.1-1:

**Do you support the proposal 1 from [1, MTK] to draw the following RAN1 conclusion for R17?**

* **If an UL cell has NUL and SUL carrier, and *pusch-config* is configured, then the UL carrier configured with *pucch-config* should also be configured with *pusch-config***

**If your answer is “No”, Please assist to elaborate (if possible) you understanding on how the RAN1 #90bis agreement for SUL:**

**“UE specific RRC signalling … the default location of the PUSCH is the same carrier as used by PUCCH”**

**is reflected in current spec (38.212 V17.5.0 7.3.1.1.1)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comment** |
| MTK | Yes | We think a RAN1 agreement should be reflected in spec. Although RAN1 can not achieve consensus for R15/R16 in last meeting, we think a amendment in R17 is still helpful. |
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#### Discussion point 2.1-2:

**If you answer to Discussion point 2.1-1 is “Yes”, are you fine with RAN1 to send an LS to RAN2 to capture the RAN1 conclusion in R17 38.331 spec?**

**If your answer is “Not fine”, Please assist to elaborate on your reason and suggested way forward (Ex. capture it in RAN1 spec instead) if possible.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Fine or Not fine** | **Comment** |
| MTK | Fine | Normally a RRC configuration constraint is described in 38.331, so we propose to send an LS to RAN2. We can also be fine to capture it in RAN1 spec (Ex. 212) if companies think this way is better. |
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#### Discussion point 2.1-3:

**Do you support the proposal 2 from [1, MTK] to adopt the R17 CR (detailed CR text in Section 4.1 of this document) to 38.212 V17.5.0 7.3.1.1.1 to address the following scenario:**

* **Only one carrier of NUL/SUL configured with *pusch-Config* but no carriers configured with *pucch-Config* (E.g. only cell-specific *pucch-ConfigCommon* is configured, as *pucch-Config* is an optional IE)**

**🡪 PUSCH transmission should happen on the carrier configured with *pusch-Config***

**(Note that the proposed CR is to cover a scenario for the branch “if the UL/SUL indicator is present”, so the current spec under the branch “if the UL/SUL indicator is not present” does not apply)**

**If your answer is “No”, Please assist to elaborate on your reason, how UE should behave when “UL/SUL indicator is present” and “*pucch-Config* is not configured”, and suggested revision/way forward, if possible.**

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| --- | --- | --- |
| **Company** | **Yes or No** | **Comment** |
| MTK | Yes | Due to the reason that *pucch-Config* is an optional IE, we think the UE behavior of   * Only one carrier of NUL/SUL configured with *pusch-Config* but no carriers configured with *pucch-Config*   should be specified in spec. |
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## For [3, 4, MTK] related to rate matching periodicity with NCD-SSB

In [3, MTK], it is mentioned that the maximum periodicity of *RateMatchPattern* is only 40ms which is less than the configurable periodicities of 80ms and 160ms for NCD-SSB. Considering trade-off between signaling overhead and specification completeness, it is proposed to add periodicities of n80 and n160 to *RateMatchPattern* to avoid unnecessary resource waste when NCD-SSB is configured with a periodicity of 80ms or 160ms at least for 15kHz and 30kHz SCS.

Proposal 1: Add periodicities of n80 and n160 to *periodicityAndPattern* in *RateMatchPattern*.

* Send LS to RAN2
* The companion draft 38.214 CR is provided in R1-2303366 [4]

Detailed spec quote and proposed CR text from [3, 4, MTK] can be found in Section 4.2 of this document. The following discussions points are devised to discuss the Proposals 1 above:

#### Discussion point 2.2-1:

**Do you support the proposal from [3, MTK] to “add periodicities of n80 and n160 to *periodicityAndPattern* in *RateMatchPattern*” (an LS to RAN2 is needed) to avoid unnecessary resource waste when NCD-SSB is configured with a periodicity of 80ms or 160ms?**

**If your answer is “No”, please assist to elaborate on the reasoning of your answer if possible.**

**If you have other views, please also elaborate.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comment** |
| MTK | Yes | We think the proposal assists to avoid unnecessary resource waste when NCD-SSB is configured with a periodicity of 80ms or 160ms. |
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#### Discussion point 2.2-2:

**If you answer to Discussion point 2.2-1 is “Yes”, are you fine with the proposed draft 38.214 CR provided in R1-2303366 [4, MTK] (CR text from [4, MTK] can be found in Section 4.2 of this document)?**

**If your answer is “Not fine”, please assist to elaborate on your reason and suggested revision if possible.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Fine or Not fine** | **Comment** |
| MTK | Fine |  |
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## For [5, Qualcomm] related to value range of A-CSI-RS triggering offset

In [5], it is mentioned that TS 38.331 specifies three RRC parameters for aperiodic CSI-RS triggering offset, *aperiodicTriggeringOffset*, *aperiodicTriggeringOffset-r16*, and *aperiodiTriggeringOffset-r17*, as follows.

|  |  |
| --- | --- |
| NZP-CSI-RS-ResourceSet ::= SEQUENCE {  […]  aperiodicTriggeringOffset INTEGER(0..6) OPTIONAL, -- Need S  […]  aperiodicTriggeringOffset-r16 INTEGER(0..31) OPTIONAL -- Need S  […]  aperiodicTriggeringOffset-r17 INTEGER (0..124) OPTIONAL, -- Need S  […]  }   |  | | --- | | ***aperiodicTriggeringOffset, aperiodicTriggeringOffset-r16, aperiodicTriggeringOffset-r17***  Offset X between the slot containing the DCI that triggers a set of aperiodic NZP CSI-RS resources and the slot in which the CSI-RS resource set is transmitted. For *aperiodicTriggeringOffset*, the value 0 corresponds to 0 slots, value 1 corresponds to 1 slot, value 2 corresponds to 2 slots, value 3 corresponds to 3 slots, value 4 corresponds to 4 slots, value 5 corresponds to 16 slots, value 6 corresponds to 24 slots. For *aperiodicTriggeringOffset-r16* and *aperiodicTriggeringOffset-r17*, the value indicates the number of slots. *aperiodicTriggeringOffset-r17* is applicable to SCS 480 kHz and 960 kHz, and only the values of integer multiples of 4 are valid, i.e. 0, 4, 8, and so on. The network configures only one of the fields. When neither field is included, the UE applies the value 0. | |

(The related RAN1 38.214 specification for aperiodic CSI-RS triggering with an offset is detailed in Section 4.3 of this document.)

For the aperiodic CSI-RS triggering offset, **two issues are identified**:

**Issue 1: Extended value range for aperiodic CSI-RS triggering offset requires UE to support *crossSlotScheduling-r16***

Two separate agreements related to value range of aperiodic CSI-RS triggering offset in Rel-16 from

* “cross-slot scheduling for UE power saving” in RAN1#100bis and
* “aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies” in RAN1 #100

are shown below:

|  |
| --- |
| Agreements: (RAN1#100bis)  […]   * Aperiodic CSI-RS triggering offset value range is extended from {0, 1, 2, 3, 4, 16, 24} to {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24}   […] |
| Agreements: (RAN1#100)  When µPDCCH < µCSI-RS, X∈{0, 1, …, 31} |

However, TS 38.306 specifies a single UE capability to address the extended value range for aperiodic CSI-RS triggering offset. That is *crossSlotScheduling-r16* as follows.

| ***crossSlotScheduling-r16***  Indicates whether UE supports dynamic indication of applicable minimum scheduling restriction by DCI format 0\_1 and 1\_1, and the minimum scheduling offset for PDSCH and aperiodic CSI-RS triggering offset (K0), and PUSCH (K2), and the extended value range for aperiodic CSI-RS triggering offset. Support of this feature is reported for licensed and unlicensed bands, respectively. When this field is reported, either of *non-SharedSpectrumChAccess-r16* or *sharedSpectrumChAccess-r16* shall be reported, at least. | UE | No | No | No |
| --- | --- | --- | --- | --- |

**Observation**:

* It is unclear what “the extended value range for aperiodic CSI-RS triggering offset” means and which RAN1 agreement it maps to (the one from RAN1#100bis or the one from RAN1 #100). It should be noted that the RAN1 #100 agreement is only for cross-carrier A-CSI-RS triggering with PDCCH of lower SCS to A-CSI-RS of higher SCS.
* It is unclear whether/how *crossSlotScheduling-r16* is required to be supported for extended value range for aperiodic CSI-RS triggering offset for FR2-2

**Issue 2: R16 parameter (or R17 parameter) seems applicable to the UEs that do not support the extended value range for aperiodic CSI-RS offset**

**Observation**: It seems not clear for which UE the parameter *aperiodicTriggeringOffset-r16* is configurable.

* For example, it is possible to interpret the spec such that a UE not supporting extended value range for aperiodic CSI-RS triggering offset (e.g., a UE not indicating support of *crossSlotScheduling-r16*) can be provided the aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* as long as the value is from {0, 1, 2, 3, 4, 16, 24}.
* Similarly, one may read the spec such that a UE not supporting FR2-2 can be provided the aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* as long as the value is from the value range the UE supports (e.g., {0, 1, 2, 3, 4, 16, 24} or {0, 1, …, 31}.

To resolve the above two issues, it is proposed in [5, Qualcomm] to introduce a new Rel-17 UE capability that indicates supported value range, RRC parameter, and {}.

**Proposal A:**

* Introduce new Rel-17 UE capability for “extended value range for aperiodic CSI-RS triggering offset for ”
  + Per-FS
  + UE indicates support for one or multiple from the following:
    - Value range {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* for
    - Value range {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* for
    - Value range {0, 1, …, 31} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* for
* Introduce new Rel-17 UE capability for “extended value range for aperiodic CSI-RS triggering offset for ”
  + Per-FS
  + UE indicates support for one or multiple from the following:
    - Value range {0, 4, 8, 12, …, 60, 64, 96} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* for and or
    - Value range {0, 4, 8, 12, …, 60, 64, 96} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* for and or
    - Value range {0, 4, 8, …, 124} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* for and or

The following discussions points are devised to discuss the Proposals A above:

#### Discussion point 2.3-1:

**Do you support the proposal A from [5, Qualcomm] to introduce new Rel-17 UE capability for “extended value range for aperiodic CSI-RS triggering offset for } and {”} to resolve Issue 1 and Issue 2 listed above?**

**If your answer is “No”, please assist to elaborate on the reasoning of your answer if possible, and how the identified ambiguity (observation) in Issue 1 and Issue 2 described above can be addressed by current spec.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comment** |
| MTK | Yes | The proposal seems to resolve Issue 1 and Issue 2 nicely. |
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Resulted RAN1 conclusion/agreement (phase 2)

## For [1, 2, MTK] related to SUL indicator and pusch/pucch-Config for DCI 0\_0

TBD based on outcome/situation of phase 1 discussion.

## For [3, 4, MTK] related to rate matching periodicity with NCD-SSB

TBD based on outcome/situation of phase 1 discussion.

## For [5, Qualcomm] related to value range of A-CSI-RS triggering offset

TBD based on outcome/situation of phase 1 discussion.

Summary of contribution inputs

## For [1, 2, MTK] related to SUL indicator and pusch/pucch-Config for DCI 0\_0

In [1, MTK], it is mentioned that from current spec 38.212 [6] V17.5.0 7.3.1.1.1, the determination of PUSCH transmission scheduled by DCI 0\_0 on NUL (normal uplink) or SUL seems not matching the RAN1 #90bis agreement that the default location of the PUSCH is the same carrier as used by PUCCH.

Agreement: (RAN1 #90bis)

* UE specific RRC signalling (re-)configures the location of the PUCCH, either on the SUL carrier or on a non-SUL UL carrier in a SUL band combination
  + The default location of the PUSCH is the same carrier as used by PUCCH

Besides, there is one remaining issue not discussed during RAN1 #112:

* Only one carrier of NUL/SUL configured with *pusch-Config* but no carriers configured with *pucch-Config* (E.g. only cell-specific *pucch-ConfigCommon* is configured)

For the not matching RAN1 #90bis agreement part, the following two observations and one proposal are drawn:

**Observation 1: In 38.212 V17.5.0 7.3.1.1.1, there is related spec on the relation between SUL indicator and *pusch-Config*/*pucch-Config* for DCI 0\_0. Current spec implies the PUSCH transmission behavior on NUL (normal uplink) or SUL shown in Table 1 (prioritizing PUCCH carrier for PUSCH transmission). During RAN1 #112, this issue was discussed under R15 CR agenda (Section 7.1) and companies have diverse view on current R15 spec (some companies think it’s reasonable while some think it’s not supported).**

**Observation 2: In RAN1 #90bis, it was agreed that for UE specific RRC configuration of SUL/non-SUL UL carrier, “the default location of the PUSCH is the same carrier as used by PUCCH”.**

**Proposal 1: RAN1 to draw the following conclusion for R17:**

* **If an UL cell has NUL and SUL carrier, and *pusch-config* is configured, then the UL carrier configured with *pucch-config* should also be configured with *pusch-config***

**and sent an LS to RAN2 to clarify it in R17 38.331 spec.**



**Table 1: PUSCH transmission behavior on NUL (normal uplink) or SUL scheduled by DCI 0\_0 implied in current spec**

For the part of remaining issue not discussed during RAN1 #112, the following observation and proposal are drawn:

**Observation 3: There is one remaining issue not discussed during RAN1 #112:**

* **Only one carrier of NUL/SUL configured with *pusch-Config* but no carriers configured with *pucch-Config* (E.g. only cell-specific *pucch-ConfigCommon* is configured)**

**Looking again at the RAN1 #90bis agreement, it only regulates the UE-specific RRC configuration. Hence, for the scenario mentioned above, it seems more reasonable to transmit PUSCH on the carrier configured with *pusch-Config*.**

**Proposal 2: Adopt the following R17 CR to 38.212 V17.5.0 7.3.1.1.1 about SUL indicator and *pusch-Config*/*pucch-Config* for DCI 0\_0, to reflect the inference in Observation 3:**

**7.3.1.1 DCI formats for scheduling of PUSCH**

**7.3.1.1.1 Format 0\_0**

**…**

**- UL/SUL indicator – 1 bit for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell as defined in Table 7.3.1.1.1-1 and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).**

**- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is not configured on UL and SUL the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured;**

**- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is configured on only one carrier of UL or SUL, and the higher layer parameter *pucch-Config* is not configured on UL and SUL, the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pusch-Config* is configured;**

**…**

## For [3, 4, MTK] related to rate matching periodicity with NCD-SSB

In [3, MTK], it is mentioned that the maximum periodicity of *RateMatchPattern* is only 40ms which is less than the configurable periodicities of 80ms and 160ms for NCD-SSB. Considering trade-off between signaling overhead and specification completeness, it is proposed to add periodicities of n80 and n160 to *RateMatchPattern* to avoid unnecessary resource waste when NCD-SSB is configured with a periodicity of 80ms or 160ms at least for 15kHz and 30kHz SCS.

Proposal 1: Add periodicities of n80 and n160 to *periodicityAndPattern* in *RateMatchPattern*.

* Send LS to RAN2
* The companion draft 38.214 CR is provided in R1-2303366 [4]

38.331:

|  |
| --- |
| *NonCellDefiningSSB* information element  NonCellDefiningSSB-r17 ::= SEQUENCE {  absoluteFrequencySSB-r17 ARFCN-ValueNR,  ssb-Periodicity-r17 ENUMERATED { ms5, ms10, ms20, ms40, **ms80, ms160**, spare2, spare1 } OPTIONAL, -- Need S  ssb-TimeOffset-r17 ENUMERATED { ms5, ms10, ms15, ms20, ms40, ms80, spare2, spare1 } OPTIONAL, -- Need S  ...  } |

RateMatchPattern ::= SEQUENCE {

rateMatchPatternId RateMatchPatternId,

patternType CHOICE {

bitmaps SEQUENCE {

resourceBlocks BIT STRING (SIZE (275)),

symbolsInResourceBlock CHOICE {

oneSlot BIT STRING (SIZE (14)),

twoSlots BIT STRING (SIZE (28))

},

periodicityAndPattern CHOICE {

n2 BIT STRING (SIZE (2)),

n4 BIT STRING (SIZE (4)),

n5 BIT STRING (SIZE (5)),

n8 BIT STRING (SIZE (8)),

n10 BIT STRING (SIZE (10)),

n20 BIT STRING (SIZE (20)),

n40 BIT STRING (SIZE (40))

}

38.214:

|  |
| --- |
| Clause 5.1.4.1 of TS 38.214  The periodicityAndPattern can be {1, 2, 4, 5, 8, 10, 20 or 40} units long, but maximum of 40 msec. |

**Companion draft 38.214 CR from R1-2303366 [4]:**

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

The procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying only the parameters of *rateMatchPatternGroup1DCI-1-2*, *rateMatchPatternGroup2DCI-1-2* instead of *rateMatchPatternGroup1* and *rateMatchPatternGroup2*. …

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

- … A *RateMatchPattern* may contain:

- … 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, 20,40, 80, or 160} units long, but maximum of 160 msec. The first symbol of *periodicityAndPattern* every 160 msec/P periods is a first symbol in frame mod 16 = 0, where P is the duration of *periodicityAndPattern* in units of msec. 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. ...

<Unchanged texts omitted>

## For [5, Qualcomm] related to value range of A-CSI-RS triggering offset

In [5], it is mentioned that TS 38.331 specifies three RRC parameters for aperiodic CSI-RS triggering offset, *aperiodicTriggeringOffset*, *aperiodicTriggeringOffset-r16*, and *aperiodiTriggeringOffset-r17*, as follows.

|  |  |
| --- | --- |
| NZP-CSI-RS-ResourceSet ::= SEQUENCE {  […]  aperiodicTriggeringOffset INTEGER(0..6) OPTIONAL, -- Need S  […]  aperiodicTriggeringOffset-r16 INTEGER(0..31) OPTIONAL -- Need S  […]  aperiodicTriggeringOffset-r17 INTEGER (0..124) OPTIONAL, -- Need S  […]  }   |  | | --- | | ***aperiodicTriggeringOffset, aperiodicTriggeringOffset-r16, aperiodicTriggeringOffset-r17***  Offset X between the slot containing the DCI that triggers a set of aperiodic NZP CSI-RS resources and the slot in which the CSI-RS resource set is transmitted. For *aperiodicTriggeringOffset*, the value 0 corresponds to 0 slots, value 1 corresponds to 1 slot, value 2 corresponds to 2 slots, value 3 corresponds to 3 slots, value 4 corresponds to 4 slots, value 5 corresponds to 16 slots, value 6 corresponds to 24 slots. For *aperiodicTriggeringOffset-r16* and *aperiodicTriggeringOffset-r17*, the value indicates the number of slots. *aperiodicTriggeringOffset-r17* is applicable to SCS 480 kHz and 960 kHz, and only the values of integer multiples of 4 are valid, i.e. 0, 4, 8, and so on. The network configures only one of the fields. When neither field is included, the UE applies the value 0. | |

The RAN1 specification for aperiodic CSI-RS triggering with an offset is specified in TS38.214 are as follows.

|  |
| --- |
| 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology  […]  When aperiodic CSI-RS is used with aperiodic reporting, the CSI-RS offset is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16* or *aperiodicTriggeringOffset-r17*. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} slots for or {0, 4, 8, 12, …, 60, 64, 96} slots for and , where is the subcarrier spacing configurations for CSI-RS.  […]  5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies  […]  Aperiodic CSI-RS timing:  - When the aperiodic CSI-RS is used with aperiodic CSI reporting, the CSI-RS triggering offset *X* is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16* or *aperiodicTriggeringOffset-r17,* including the case that the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP or *minimumSchedulingOffsetK2* for any UL BWP and all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'typeD' in the corresponding TCI states. The CSI-RS triggering offset has the values of {0, 1, …, 31} slots for or {0, 4, 8, …, 124} slots for and when the µPDCCH < µCSIRS and {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} for or {0, 4, 8, 12, …, 60, 64, 96} slots for and when the µPDCCH > µCSIRS.. The aperiodic CSI-RS is transmitted in a slot , if UE is configured with *ca-SlotOffset* for at least one of the triggered and triggering cell, and *Ks* = , otherwise, and where […] |

For the above specifications, **two issues are identified with proposed solutions**.

**Issue 1: Extended value range for aperiodic CSI-RS triggering offset requires UE to support *crossSlotScheduling-r16***

Two separate agreements related to value range of aperiodic CSI-RS triggering offset in Rel-16 from

* “cross-slot scheduling for UE power saving” in RAN1#100bis and
* “aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies” in RAN1 #100

are shown below:

|  |
| --- |
| Agreements: (RAN1#100bis)  […]   * Aperiodic CSI-RS triggering offset value range is extended from {0, 1, 2, 3, 4, 16, 24} to {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24}   […] |
| Agreements: (RAN1#100)  When µPDCCH < µCSI-RS, X∈{0, 1, …, 31} |

However, TS 38.306 specifies a single UE capability to address the extended value range for aperiodic CSI-RS triggering offset. That is *crossSlotScheduling-r16* and specified as follows.

| ***crossSlotScheduling-r16***  Indicates whether UE supports dynamic indication of applicable minimum scheduling restriction by DCI format 0\_1 and 1\_1, and the minimum scheduling offset for PDSCH and aperiodic CSI-RS triggering offset (K0), and PUSCH (K2), and the extended value range for aperiodic CSI-RS triggering offset. Support of this feature is reported for licensed and unlicensed bands, respectively. When this field is reported, either of *non-SharedSpectrumChAccess-r16* or *sharedSpectrumChAccess-r16* shall be reported, at least. | UE | No | No | No |
| --- | --- | --- | --- | --- |

**Observation**:

* It is unclear what “the extended value range for aperiodic CSI-RS triggering offset” means and which RAN1 agreement it maps to (the one from RAN1#100bis or the one from RAN1 #100). It should be noted that the RAN1 #100 agreement is only for cross-carrier A-CSI-RS triggering with PDCCH of lower SCS to A-CSI-RS of higher SCS.
* It is unclear whether/how *crossSlotScheduling-r16* is required to be supported for extended value range for aperiodic CSI-RS triggering offset for FR2-2

**Issue 2: R16 parameter (or R17 parameter) seems applicable to the UEs that do not support the extended value range for aperiodic CSI-RS offset**

**Observation**: The possible values for *aperiodicTriggeringOffset-r16* with µPDCCH >= µCSIRS and with µPDCCH < µCSIRS for are clear from the spec. However, it is not clear for which UE the parameter *aperiodicTriggeringOffset-r16* is configurable.

* For example, it is possible to interpret the spec such that a UE not supporting extended value range for aperiodic CSI-RS triggering offset (e.g., a UE not indicating support of *crossSlotScheduling-r16*) can be provided the aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* as long as the value is from {0, 1, 2, 3, 4, 16, 24}.
* Similarly, one may read the spec such that a UE not supporting FR2-2 can be provided the aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* as long as the value is from the value range the UE supports (e.g., {0, 1, 2, 3, 4, 16, 24} or {0, 1, …, 31}.

To resolve the above two issues, it is proposed to introduce a new Rel-17 UE capability that indicates supported value range, RRC parameter, and {}.

**Proposal:**

* Introduce new Rel-17 UE capability for “extended value range for aperiodic CSI-RS triggering offset for ”
  + Per-FS
  + UE indicates support for one or multiple from the following:
    - Value range {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* for
    - Value range {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* for
    - Value range {0, 1, …, 31} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r16* for
* Introduce new Rel-17 UE capability for “extended value range for aperiodic CSI-RS triggering offset for ”
  + Per-FS
  + UE indicates support for one or multiple from the following:
    - Value range {0, 4, 8, 12, …, 60, 64, 96} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* for and or
    - Value range {0, 4, 8, 12, …, 60, 64, 96} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* for and or
    - Value range {0, 4, 8, …, 124} for aperiodic CSI-RS triggering offset by *aperiodicTriggeringOffset-r17* for and or

References

[1] R1-2303363, “On the relation between SUL indicator and pusch-Config/pucch-Config for DCI 0\_0”, MediaTek, RAN1 #112bis-e

[2] R1-2303364, “[R17] Draft 38.212 CR on SUL indicator and pusch-Config/pucch-Config for DCI 0\_0”, MediaTek, RAN1 #112bis-e

[3] R1-2303365, “On rate match pattern periodicity”, MediaTek, RAN1 #112bis-e

[4] R1-2303366, “Draft CR for 38.214 on rate match pattern periodicity”, MediaTek, RAN1 #112bis-e

[5] R1-2303565, “Clarification on A-CSI-RS triggering offset”, Qualcomm Incorporated, RAN1 #112bis-e

[6] 3GPP TS 38.212 V17.5.0, “NR; Multiplexing and channel coding”