**3GPP TSG RAN WG1 Meeting #114bis R1-230XXXX**

**Xiamen, China, October 9 - 13, 2023**

**Source: Moderator (Lenovo)**

**Title: Feature lead summary #1 on multi-cell PUSCH/PDSCH scheduling with a single DCI**

**Agenda item:** **8.12.1**

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

# Introduction

This document summarizes the contributions submitted under the “8.12.1 **Multi-cell PUSCH/PDSCH scheduling with a single DCI**” agenda item of the Rel-18 work item on “Multi-Carrier Enhancements (MCE) for NR”.

The Rel-18 WI Multi-carrier enhancements was agreed during RAN#94-e meeting [1], where one of the objectives is targeted to specify a solution for multi-cell PUSCH/PDSCH scheduling with a single DCI. The detailed objectives in the WID are listed below:

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| **1. Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI [RAN1]**   * **Identify the maximum number of cells that can be scheduled simultaneously** * **Consider both intra-band and inter-band CA operation** * **Consider both FR1 and FR2** * ***The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling*** |

In this contribution, we summarize the related issues and proposals based on the contributions submitted in RAN1#114bis under the agenda item 8.12.1 [1]-[21]. The whole feature lead summary is structured as follows:

From section 2 to 5, the main issues raised by company contributions are divided into 4 sections. In each section, the background and related proposals submitted in this meeting are listed firstly in the corresponding sub-section, then summary on one or several sub-issues is provided in the next sub-section from moderator’s perspective. Based on the above summary, a set of proposals is recommended by moderator followed by one or multiple tables to collect company views for the initial proposals in the first round of e-mail discussion. If present, in each sub-section, the proposals will be updated round by round based on companies’ inputs. As e-mail discussion goes on, more sub-sections may be provided for further e-mail discussion and update.

In section 6, some proposals on high layer parameters are selected for discussion based on companies’ inputs.

In section 8, some proposals are selected for discussion in the online/offline sessions.

In Section 10, the agreements made in previous RAN1/RAN meetings are listed for reference.

Companies are highly encouraged to provide views as soon as possible. Moderator will try to update the proposals based on companies’ inputs at least on daily basis.

# Scenarios and basic framework

## Background and submitted proposals

On simultaneous support of both Rel-18 dynamic waveform switching and Rel-18 multi-cell scheduling, below proposals are provided for RAN1#114-bis meeting:

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| **Spreadtrum:**  *P15: Inclusion of Transform precoder indicator field in DCI format 3\_0 can be configured per set of cell.*   * *If configured, transform precoder indicator field type is Type-1A, 1bit.*   **Vivo:**  *Proposal 14. The inclusion of dynamic waveform indication in DCI format 0\_3 is supported and can be configurable.*  *Proposal 15. For the type of dynamic waveform indication in DCI format 0\_3, it can be Type-2 or configurable between {Type-2, Type-1A}, where Type-2 should be used at least when the co-scheduled cells are inter-band CA cells.*  **LG:**  *Proposal 11: Consider Transform precoder indicator field (introduced for dynamic waveform switching) in DCI format 0\_3 as Type-1A field.*  *Proposal 12: Clarify the size of DMRS sequence initialization filed in DCI format 0\_3 as the following.*   * *1 bit if at least one of co-scheduled cells is configured with CP-OFDM waveform (i.e., transform precoder is disabled) or DWS operation (i.e., Transform precoder indicator field is present)* * *0 bit otherwise*   **Samsung:**  *Proposal 16: Conclude on the applicability of dynamic waveform switching (DWS) to MC-DCI format 0\_3.*  **DOCOMO:**  *Proposal 11: Dynamic waveform switching indicator can be included in DCI format 0\_3.*   * *The field type should be Type-1A.*   *Proposal 8: Clarify that DMRS sequence initialization field in DCI format 0\_3/1\_3 can be 0 bit when transform precoder is enabled for all the cells in a set of cells or higher layer parameter dmrs-SequenceInitializationDCI-0-3/dmrs-SequenceInitializationDCI-1-3 is not configured for all the cells in a set of cells.*  **Ericsson:**  *P4: Introduce an RRC parameter dynamicTransformPrecoderIndicationDCI-0-3 that configures presence of the transform precoder indicator field in DCI format 0\_3.*  *P5: Adopt* *TP5 for 38.212 to include the Transform precoder indicator for DCI 0\_3 reflecting that the dynamic waveform switching field is supported for DCI 0\_3.*  *P6: Adopt TP6 for 38.212 for updating DMRS sequence initialization for DCI 0\_3 reflecting that the field is applicable to only the cells for which transform precoding is not enabled.* |

On simultaneous support of both MBS and multi-cell scheduling, below proposals are provided for RAN1#114-bis meeting:

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| **Huawei:**  *Proposal 10: UE does not expect to multiplex multi-cell PDSCH/PUSCH scheduling related HARQ-ACK information and Rel-17 MBS HARQ-ACK information in the same HARQ-ACK codebook.*  **ZTE:**  *Proposal 6: Adopt the following TP for sub-clause 7.3.1.1.4 in TS38.212.*  **Lenovo:**  *Proposal 1: Simultaneous configuration of both multicast reception and multi-cell scheduling for a UE is supported.*  *Proposal 2: 3rd DAI for multicast is included in DCI format 0\_3.*  *Proposal 3: Endorse above TP1.* |

On simultaneous support of both Rel-17 coverage enhancement and multi-cell scheduling, below proposals are provided for RAN1#114-bis meeting:

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| **Nokia:**  *Proposal 2.3: RAN1 to decide to either support or not support the combination of DCI format 0\_3 and Rel-17 PUSCH coverage enhancements features (TBoMS, Available Slot counting, DM-RS bundling) during RAN1#114.*   * *We would be open to support the Rel-17 Coverage enhancement features also with DCI format 0\_3.*   **CMCC:**  *Proposal 7. PUSCH repetition Type A and TBoMS can be supported for multi-cell PUSCH scheduling with DCI format 0\_3. And take the following TP for TS 38.214 section 6.1.2.1.*  **Lenovo:**  *Proposal 8: Simultaneous configuration of both TBoMS and multi-cell scheduling for a UE is not supported.* |

## Moderator summary and proposals based on contributions

* On simultaneous support of both Rel-18 dynamic waveform switching and Rel-18 multi-cell scheduling

For Rel-18 dynamic waveform switching, a new field named Transform precoder indicator is introduced in DCI format 0\_1/0\_2. In detail, 1 bit is needed if the higher layer parameter *dynamicTransformPrecoderIndicationDCI-0-1* is configured to 'enabled' and if the UE is configured to monitor DCI format 0\_1 with CRC scrambled by C-RNTI or MCS-C-RNTI, where the bit value of 0 indicates that transform precoder is enabled and the bit value of 1 indicates that transform precoder is disabled. For Rel-18 multi-cell scheduling using DCI format 0\_3, it is beneficial for intra-band CA case where PUSCH waveform switching is dynamically indicated and applied for all the co-scheduled cells.

For RAN1#114-bis meeting, six companies [Spreadtrum, vivo, LG, DOCOMO, Ericsson] propose including Transform precoder indicator in DCI format 0\_3. Furthermore, 4 companies [Spreadtrum, LG, DOCOMO, Ericsson] propose Transform precoder indicator as a Type-1A field and applicable to all the co-scheduled cells, while 1 company [vivo] suggest Transform precoder indicator as Type-2 or configurable between {Type-2, Type-1A}, where Type-2 should be used at least when the co-scheduled cells are inter-band CA cells.

Considering DCI overhead and similar UL coverage situation for co-scheduled cells, it is reasonable to regard the Transform precoder indicator as Type-1A. If a single bit Transform precoder indicator is included in DCI format 0\_3, a higher layer parameter similar to *dynamicTransformPrecoderIndicationDCI-0-1* is needed and included in RRC parameter list. Hence, Proposal 1-1 is provided for further discussion.

In addition, as mentioned by 2 companies [LG, Ericsson], DMRS sequence initialization field for DCI format 0\_3 in TS38.212 needs to be updated to reflect the condition that 1-bit DMRS sequence initialization field is only applicable to the cells for which transform precoding is not enabled. Hence, Proposal 1-2 is provided for further discussion.

* On simultaneous support of both Rel-17 multicast and Rel-18 multi-cell scheduling

In Rel-17 MBS, for multicast HARQ-ACK feedback multiplexing on PUSCH, a third UL DAI is included in the DCI format 0\_1 dedicated for multicast, i.e., with one bit for semi-static HARQ-ACK codebook for multicast if the higher layer parameter *fdmed-ReceptionMulticast* is configured or 2 bits for the dynamic HARQ-ACK codebook for multicast if dynamic HARQ-ACK codebook is configured for multicast.

Considering the HARQ-ACK feedback for multicast may be overlapped in time domain with PUSCHs co-scheduled by a DCI format 0\_3, e.g., the HARQ-ACK feedback for multicast is to be transmitted in slot n overlapped with at least one PUSCH scheduled by DCI format 0\_3, then HARQ-ACK feedback for multicast needs to be multiplexed on one PUSCH together with HARQ-ACK feedback for unicast in the same PUSCH.

Since a UE supporting multicast reception may also support UL multi-cell scheduling, there seems no reason to exclude this case, the 3rd UL DAI for multicast HARQ-ACK feedback needs to be included in DCI format 0\_3 as what we have done in DCI format 0\_1 and DCI format 0\_2 and 1st UL DAI needs to be updated with consideration of multicast in case of FDMed unicast and multicast is not configured.

Hence, Proposal 1-3 is provided for further discussion.

* On simultaneous support of both Rel-17 coverage enhancement and Rel-18 multi-cell scheduling

TBoMS is introduced in Rel-17 UL coverage enhancement which is targeted for improving UL coverage via one TB transmitted over multiple slots. For Rel-18 UL multi-cell scheduling, the intention is to use a single DCI for joint scheduling multiple UL serving cells for increasing data rate via CA and reducing DCI overhead via joint scheduling. For a UE in UL coverage limited case, it does not make sense to configure UL CA for the UE. Since TBoMS and multi-cell scheduling are targeted for separate use cases and should not be supported simultaneously. This is similar to other coverage enhancement technologies, e.g., Available Slot counting, DM-RS bundling.

Hence, Proposal 1-4 is provided for further discussion.

### 1st round of discussions

#### Proposal 1-1:

* Inclusion of dynamic waveform switching indicator in DCI format 0\_3 is configurable.
* Introduce an RRC parameter *dynamicTransformPrecoderIndicationDCI-0-3* that configures presence of the transform precoder indicator field in DCI format 0\_3.
* This field is applied to all the co-scheduled cells for which *dynamicTransformPrecoderIndicationDCI-0-3* is configured to ‘enabled’.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Do not support We don’t see a need to support this with MC-DCI scheduling, as the motivation for this type of ‘PUSCH coverage enhancement’ feature may not be needed.  Note, that proposal 1-4 says we don’t do Rel-16 Cov. improvements with 0\_3 – so the same should be applying here. |
| Spreadtrum | Fine with the proposal, with additional comments:   1. It can change into *dynamicTransformPrecoderIndicationDCI-0-1* in second sub-bullet. 2. It is Type-1A field with 1 bit. |
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#### Proposal 1-2:

* DMRS sequence initialization field in DCI format 0\_3 is
* 1 bit if at least one of co-scheduled cells is configured with disabled transform precoder or Transform precoder indicator field is present;
* 0 bit otherwise.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Support |
| Spreadtrum | “or Transform precoder indicator field is present” depends on Proposal 1-1. |
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#### Proposal 1-3:

* 3rd DAI for multicast HARQ-ACK codebook is included in DCI format 0\_3.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | We don’t see a big need for this. |
| Spreadtrum | Agree with Nokia. |
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#### Proposal 1-4:

* Not support the combination of DCI format 0\_3 and Rel-17 PUSCH coverage enhancements (TBoMS, Available Slot counting, DM-RS bundling).

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | We thought this could be maybe supported, as there is no DCI impact really. So clearly we are not supporting this proposal as is.  If there is no consensus to support this feature combination, then it should be a related conclusion. |
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# DCI format design

Based on contributions submitted by companies, below issues are prioritized for discussion in this meeting. Within each sub-section, the summary from moderator’s perspective is listed and followed by draft proposals for further discussion round by round.

## Scheduling possibilities

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| **Spreadtrum:**  *P4: For a serving cell provided in MC-DCI-SetofCells, a UE does not expect to monitor PDCCH candidates on more than one scheduling cells for detection of DCI formats scheduling on the serving cell.*  **Vivo:**  *Proposal 1. Clarify in the RRC parameter list or adopt the TP1 for TS 38.213 that**: For any cell in a set of cells configured for multi-cell scheduling, UE is not expected to be configured with more than one scheduling cell to monitor PDCCH candidates for the scheduled cell, regardless of the DCI format.*  **OPPO:**  *Proposal 5: Include the following text in draft CR of TS38.213:*  UE does not expect to be configured with more than one scheduling cell for a scheduled cell provided in *MC-DCI-SetofCells*.  **ETRI:**  *Proposal 1: For a serving cell provided in MC-DCI-SetofCells, UE does not expect to be configured to monitor mcDCI from one scheduling cell and scDCI from another scheduling cell if the serving cell is configured as the reference cell of the set of cells that it belongs.*  **ITRI:**  *Proposal: For a serving cell provided in MC-DCI-SetofCells, a UE is not expected to monitor PDCCH candidates in more than one scheduling cells for the detection of DCI formats scheduling the serving cell.*  **MTK:**  *Proposal 3: RAN1 to agree the following:*   * *For a serving cell provided in MC-DCI-SetofCells, a UE does not expect to monitor PDCCH candidates on more than one scheduling cells for detection of DCI formats scheduling on the serving cell.* |

### Moderator summary and proposals based on contributions

In previous RAN1 meeting, majority companies don’t support simultaneously monitoring DCI format 0\_X/1\_X and legacy DCI format(s) from different cells for a UE. From moderator’s point of view, supporting monitoring DCI format 0\_X/1\_X and legacy DCI format(s) from different cells is not essential to complete this multi-cell scheduling in Rel-18 so as to be deprioritized in Rel-18.

For maintenance phase, six companies [Spreadtrum, vivo, OPPO, ETRI, ITRI, MTK] propose clear spec description to capture this restriction, e.g., *For a serving cell provided in MC-DCI-SetofCells, a UE is not expected to monitor PDCCH candidates in more than one scheduling cells for the detection of DCI formats scheduling on the serving cell.*

Hence, Proposal 2-1 is provided for further discussion.

### 1st round of discussions

#### Proposal 2-1:

* For a serving cell provided in *MC-DCI-SetofCells*, a UE does not expect to be configured to monitor PDCCH candidates on more than one scheduling cells for detection of DCI formats scheduling on the serving cell.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Fine in principle – but the proposal needs some minor changes (it is scheduling the serving cell and not scheduling on the serving cell):  For a serving cell provided in *MC-DCI-SetofCells*, a UE does not expect to be configured to monitor PDCCH candidates on more than one scheduling cell~~s~~ for detection of DCI formats scheduling ~~on~~ the serving cell. |
| Spreadtrum | We support the intention, also agree with Nokia’s change. |
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## Scheduling in case of SCell dormancy or deactivation

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| **Huawei:**  *Proposal 9: BWP with firstActiveUplinkBWP-Id/firstActiveDownlinkBWP-Id should be used to determine the size for DCI 0\_3/1\_3 when the co-scheduled cell is inactive.*  **Spreadtrum:**  *P5: Reference cell cannot be in dormant DL BWP or deactivated.*  *P6: UE does not expect PDSCH/PUSCH scheduling on a co-scheduled cell which is in dormant DL BWP or deactivated by DCI format 0\_3/1\_3*  **Nokia:**  *Proposal 2.1: If the reference cell of a set of cells is dormant/inactive, the UE continues to monitor for the multi-cell DCI 0\_3/1\_3 for the set of cells and the BDs / CCEs / DCI size of DCI 0\_3/1\_3 are still counted on the reference cell (38.213 impact).*  *Proposal 2.2: The UE does not expect to be scheduled by the DCI format 0\_3/1\_3 for PDSCH / PUSCH on cells being dormant / inactive (38.213 impact).*  **LG:**  *Proposal 9: Consider the case where an invalid cell (e.g. in deactivated state or with dormant BWP or with UL/DL collision or with invalid FDRA/TDRA) is included within co-scheduled cells.*   * *Drop the PDSCH/PUSCH scheduled for the invalid cell and the corresponding HARQ-ACK feedback is omitted or mapped as NACK.*   **Fujitsu:**  *Proposal 4: For DCI format 1\_3:*   * *If an Scell in the scheduled cell set is deactivated and its firstActiveDownlinkBWP-Id is not set to dormant BWP, the UE determines the size of DCI format 1\_3 according to the DL BWP provided by firstActiveDownlinkBWP-Id.* * *If an Scell in the scheduled cell set is deactivated and its firstActiveDownlinkBWP-Id is set to dormant BWP, or an Scell in the scheduled cell set is dormant, the UE determines the size of DCI format 1\_3 according to the DL BWP provided by firstWithinActiveTimeBWP-Id for the SCell if provided; otherwise (i.e. if firstWithinActiveTimeBWP-Id for the SCell is not provided), according to the DL BWP provided by firstOutsideActiveTimeBWP-Id for the SCell.*   *Proposal 5: For DCI format 0\_3:*   * *If an Scell in the scheduled cell set is deactivated, the UE determines the size of DCI format 0\_3 according to the UL BWP provided by firstActiveUplinkBWP-Id.*   **Samsung:**  *Proposal 7:* *When a search space set for DCI format 0\_3/1\_3 is not on an active DL BWP of the “reference” cell or when the “reference” cell is deactivated or has a dormant active DL BWP:*   * *The UE does not monitor PDCCH for DCI format 0\_3/1\_3 for the corresponding set of cells configured for multi-cell scheduling and calculation of PDCCH monitoring limits is as in Rel-17.*   *Proposal 22: When a cell from a set of cells MC-DCI-SetofCells is deactivated or dormant, the UE determines sizes of DCI fields of a DCI format 0\_3/1\_3, when applicable, based on a reference BWP as in Rel-17 DSS.*  **Apple:**  *Proposal 2: For multi-cell scheduling, adopt one of the options if the reference cell for a set of cells is indicated as dormant:*   * *Option 1: When scheduling cell is within the set, reference cell is indicated as dormant and scheduling cell is not the reference cell, then the UE can disregard the currently configured reference cell and assume that the scheduling cell is reference cell* * *Option 2: When scheduling cell is not within the set and reference cell is indicated as dormant, then two possibilities can be considered:* * *Option 2a: UE doesn’t expect reference cell to be indicated as dormant* * *Option 2b: if reference cell is indicated as dormant, then UE is not required to monitor for multi-cell scheduling for that set*   *Proposal 3: For multi-cell scheduling, if one or more of the co-scheduled cells within the set are indicated as dormant, then multi-cell scheduling can schedule other remaining non-dormant cells and the DCI size can be determined based on only the cells that are not dormant*  **DOCOMO:**  *Proposal 10:*   * *When SCell dormancy or deactivation is indicated for the cell which is configured to monitor DCI format 0\_3/1\_3, UE does not expect to receive DCI format 0\_3/1\_3 on the cell.* * *When SCell dormancy or deactivation is indicated for the cell which is included in a set of cells for muti-cell scheduling but not configured to monitor DCI format 0\_3/1\_3, UE does not expect to receive DCI format 0\_3/1\_3 which schedules PUSCH/PDSCH on the cell.*   **Qualcomm:**  *Proposal 1: Clarify following:*   * *A UE does not monitor PDCCH for DCI format 0\_3/1\_3 for a set of cells on a scheduling cell if the scheduling cell or the reference cell for the set of cells is deactivated or dormant* * *Otherwise, the UE monitors PDCCH for DCI format 0\_3/1\_3 for the set of cells on the scheduling cell* * *A DCI format 0\_3/1\_3 does not schedule PUSCH/PDSCH on a deactivated/dormant SCell(s) in the set of cells*   *Send an LS to RAN2 to capture the above in TS38.321* |

### Moderator summary and proposals based on contributions

For multi-cell scheduling, in RAN1#112 meeting, RAN1 has already agreed that SCell dormancy indicator is included in multi-cell DCI format. For a UE configured with multi-cell scheduling, the UE behavior is unclear when the scheduling cell, the reference cell, or any cell within the set of cells is indicated as dormant or deactivated. This issue needs to be addressed during maintenance phase.

For RAN1#114-bis meeting, nine companies [Huawei, Spreadtrum, Nokia, LG, Fujitsu, Samsung, Apple, DOCOMO, Qualcomm] propose this SCell dormancy or deactivated issue. Based on the inputs, there are several issues: (1) if the scheduling cell is indicated dormant or deactivated, should the UE continue to monitor DCI format 0\_3/1\_3 on the scheduling cell? OR simplify the UE behaviour in spec by excluding this case? (2) if the reference cell is not the scheduling cell while indicated dormant or deactivated, should the UE continue to monitor DCI format 0\_3/1\_3 on the scheduling cell for the set of cells and count the BD/CCE budget and DCI size budget of DCI 0\_3/1\_3 still on the reference cell? OR simplify the UE behaviour in spec by excluding this case? (3) If one cell within the set of cells is indicated dormancy or deactivated, how does the UE determine the size of DCI format 0\_3/1\_3 as it is determined based on active BWPs according to current spec?

Hence, Proposal 2-2 and Proposal 2-3 are provided for further discussion.

### 1st round of discussions

#### Proposal 2-2:

* For a UE configured with a set of cells by *MC-DCI-SetofCells*,
* the UE does not expect to monitor DCI format 0\_3/1\_3 on the scheduling cell for the set of cells if the scheduling cell is indicated deactivated or dormant.
* the UE continues to monitor DCI format 0\_3/1\_3 on the scheduling cell for the set of cells and count the BD/CCE budget and DCI size budget of the DCI format 0\_3/1\_3 on the reference cell if the reference cell is not the scheduling cell and indicated dormant or deactivated.
* the UE does not expect PUSCH/PDSCH scheduling by DCI format 0\_3/1\_3 on a cell indicated dormant/inactive.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | 1. Fine with the first bullet in principle – maybe some wording change needed:  * the UE is~~does~~ not expected to monitor DCI format 0\_3/1\_3 on the scheduling cell for the set of cells if the scheduling cell is indicated deactivated or dormant.  1. Support the 2nd bullet 2. No strong view here UE does not expect (i.e. scheduling restriction) or UE neglecting the scheduled PUSCH/PDSCH. |
| Spreadtrum | 1. For the first bullet, if scheduling cell is on dormant DL BWP, there would be no PDCCH monitoring, so no DCI 1\_3/0\_3 monitoring too. this also applies to deactivated SCell, no PDCCH monitoring.    1. Thus first bullet should be a conclusion: the UE does not ~~expect to~~ monitor DCI format 0\_3/1\_3 on the scheduling cell for the set of cells if the scheduling cell is indicated deactivated or dormant 2. For the second bullet, if reference cell is on the dormant DL BWP, there would be no PDCCH-config, then no Search space linking to a search space on the scheduling cell, so this cell is no longer a reference cell under this case. Therefore, we suggest if the reference cell is not the scheduling cell, it cannot be in dormant DL BWP. |
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#### Proposal 2-3:

* For a UE configured with a set of cells by *MC-DCI-SetofCells*,
* If an SCell within the set of cells is deactivated and its *firstActiveDownlinkBWP-Id* is not set to dormant BWP, the UE determines the size of DCI format 1\_3 according to the DL BWP provided by *firstActiveDownlinkBWP-Id*.
* If an SCell within the set of cells is dormant, or if an SCell within the set of cells is deactivated and its *firstActiveDownlinkBWP-Id* is set to dormant BWP,
  + the UE determines the size of DCI format 1\_3 according to the DL BWP provided by *firstWithinActiveTimeBWP-Id* for the SCell if provided;
  + otherwise, according to the DL BWP provided by *firstOutsideActiveTimeBWP-Id* for the SCell.
* If an SCell within the set of cells is deactivated, the UE determines the size of DCI format 0\_3 according to the UL BWP provided by *firstActiveUplinkBWP-Id*.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Spreadtrum | For second bullet, if we just want the size of a field, it can use *firstActiveDownlinkBWP* directly, no matter dormant BWP or not. |
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## Search space configuration, DCI size and BD/CCE budget

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| **Huawei:**  *Proposal 3: Support approach 1 for determining bit width of Type-2 fields when the table(s) defining combinations of co-scheduled cells for the set of cells is configured.*  **Spreadtrum:**  *P1: Same reference cell for a set of cells is used, no matter of BWP switching.*  *P2: It needs to clarify whether or not separate reference cells for DCI format 0\_3 and 1\_3 can be support.*  *P3: A same reference cell is for both of DCI format 0\_3 and 1\_3, If the UE monitors PDCCH candidates for detection both of them.*  *P5: Reference cell cannot be in dormant DL BWP or deactivated.*  *P7: For DCI size alignment, Step 4D is processed only when only of DCI format 0\_3 and 1\_3 are configured.*  *P14: “zero-padding on DCI format level” applies for DCI format 0\_3/1\_3.*   * *Sufficient zeros are padded to the end of each DCI format corresponding to each cell combination to ensure same size across different cell combinations*   **Vivo:**  *Proposal 9. Regarding the total field size of mc-DCI when the table defining combinations of co-scheduled cells for the set of cells is configured, the zero padding is per DCI performed (approach 1), no further changes are needed.*  *Proposal 10. For the case the scheduled cell combination is indicated by FDRA (i.e., when ScheduledCellCombo-ListDCI-0-3 or ScheduledCellCombo-ListDCI-1-3 is not configured), there is no need to consider zero padding. Adopt the following TP to the CR 38.212.*  **ZTE:**  *Proposal 1: DCI format level padding should be adopted for DCI format 0\_3/1\_3.*  *Proposal 9: In case the reference cell is one cell of the set of cells which search space of DCI format 0\_3/1\_3 is configured on and associated with the search space of the scheduling cell with the same search space ID if search space of the DCI format 0\_3/1\_3 is configured on the cell in addition to the scheduling cell, use the n\_CI for the set of cells to derive the CCE resource of the candidates of the same aggregation level in the USS with same ID in one scheduled cell and the scheduling cell respectively. Adopt the following TP for sub-clause 10.1 in TS38.213.*  *Proposal 10: The cell in the set of scheduled cells for multi-cell scheduling without any USS configured is not counted as one cell for M\_total\_μ/C\_total\_μ calculation. Adopt the following TP for sub-clause 10.1 in TS38.213.*  **LG:**  *Proposal 3: Consider the following options to interpret Type 2 fields in DCI format 0\_3/1\_3 according to source/target BWP index across the cells in case of BWP switching by the DCI.*   * *Opt 1: Apply the existing DCI interpretation rule per each of co-scheduled cells individually by comparing the size of single-cell field (within Type 2 field) configured for source BWP index and the size of single-cell field configured for target BWP index (for a same cell)* * *Opt 2: Apply the existing DCI interpretation rule for entire Type 2 field by comparing the size of entire Type 2 field determined for source BWP index and the sum of single-cell field sizes corresponding to the co-scheduled cells configured for target BWP index*   *Proposal 10: Consider the following aspects for the composition of (Type 2 based) DCI fields in DCI format 0\_3/1\_3.*   * *Determination on the size of the fields corresponding to the invalid (e.g. deactivated or dormant) cell in the DCI* * *Fallback to the field sizes in legacy DCI in case when only one cell is scheduled by the DCI*   **ETRI:**  *Proposal 3: For UEs capable of Rel-18 multi-cell scheduling, when the number of BDs/CCEs monitored for a serving cell provided in MC-DCI-SetofCells is zero, the serving cell is not counted as a scheduled cell in the BD/CCE budget calculation.*  **Samsung:**  *Proposal 8: For a UE with search space sharing capability, clarify that “serving cell ” can include “set of cells MC-DCI-SetofCells associated with nCI-Value having value ” (TP #2 in Section 8).*  *Proposal 20: For determination of the total bit-width of a Type-2 field in DCI format 0\_3/1\_3, when ‘scheduling cells indicator’ is based on ScheduledCellCombo-ListDCI-0-3 or ScheduledCellCombo-ListDCI-1-3:*   * *Adopt Approach 2 (“zero padding on DCI field level”), i.e., zeros are padded at the end of each DCI field, as needed, to ensure a same DCI field size across different cell combinations.*   *Proposal 21: Clarify in TS 38.213 v18.0.0 that the existing procedure for DCI field parsing (via truncation or zero-padding) also applies to “row entries” of a Type-1B field (other than TDRA) and “blocks” of a Type-2 field of a DCI format 0\_3/1\_3.*   * *Note: The existing procedure is already applicable to Type-1A fields.*   **Xiaomi:**  *Proposal 4: Adopt text proposal#2 for clause 7.3.1.0 of TS 38.212.*  **CMCC:**  *Proposal 5. Support Approach 1 (“zero-padding on DCI format level”) to ensure same size across different cell combinations as specified in current 38.212 draft CR.*  **MTK:**  *Proposal 2: From UE side perspective, we would prefer not to have any dynamic DCI parsing. However, as this would lead to large spec impact for the latest draft CR by editor in [2], and Approach 1/2 both cannot avoid dynamic DCI parsing, we think it can be fine to take Approach 1 as currently specified in [2].*   * *Approach 1 from [3] (“zero-padding on DCI format level”): for a Type-2 field, DCI format 0\_3/1\_3 includes M values when M cells are co-scheduled, and then sufficient zeros are padded to the end of each DCI format corresponding to each cell combination to ensure same size across different cell combinations.*   **DOCOMO:**  *Proposal 3:*   * *When ScheduledCellCombo-ListDCI-0-3 is configured, zeros are appended to the end of DCI format 0\_3 until the payload size is the same for all the co-scheduled cells combinations if necessary.* * *When ScheduledCellCombo-ListDCI-1-3 is configured, zeros are appended to the end of DCI format 1\_3 until the payload size is the same for all the co-scheduled cells combinations if necessary.* |

### Moderator summary and proposals based on contributions

* On DCI size padding

For DCI format 0\_3/1\_3, when co-scheduled cells are indicated by the Scheduled cell indicator, the required number of bits for each Type-2 field can be different depending on the actual scheduled combination of co-scheduled cells. For RAN1#114-bis meeting, there are two DCI padding ways used for determining the size of DCI format 0\_3/1\_3 and companies’ views are summarized below:

* Approach 1: zero-padding on DCI format level: padding zeros to the end of the DCI format to ensure alignments with the largest payload size.
  + Supported by Huawei, Spreadtrum, vivo, ZTE, CMCC, MTK, DOCOMO
* Approach 2: zero-padding on DCI field level: padding zeros to the end of each DCI field to ensure alignments with the largest payload size.
  + Supported by Samsung,

As mentioned by companies supporting approach 1, DCI format level zero padding is adopted for DCI format 1\_1/0\_1 for multi-slot scheduling according to the current specification: *If the number of information bits in DCI format 0\_1 scheduling a single PUSCH prior to padding is not equal to the number of information bits in DCI format 0\_1 scheduling multiple PUSCHs for the same serving cell, zeros shall be appended to the DCI format 0\_1 with smaller size until the payload size is the same for scheduling a single PUSCH and multiple PUSCHs.*

From the moderator’s point of view, both approaches lead to floating field positions and can lead to same DCI size as the largest payload size when the table(s) defining combinations of co-scheduled cells for the set of cells is configured. Hence, the simple way is to follow Approach 1 in DCI format level padding as the current TS38.212-i00.

Hence, Proposal 2-4 is provided for further discussion.

* On DCI size alignment

In the latest TS38.212-i00, for step 4D during DCI size alignment procedure, the UE applies zero padding to whichever of DCI format 0\_3 or 1\_3 that has a smaller size until it equals to the larger one. However, if only one of DCI format 0\_3 and DCI format 1\_3 is counted on reference cell, there is no need to perform alignment procedure between DCI format 0\_3 and DCI format 1\_3.

A similar TP for step 4D is proposed by 2 companies [Spreadtrum, xiaomi] to change the wording when only one of DCI format 0\_3 and DCI format 1\_3 is counted on reference cell. Moderator thinks the TP is reasonable and simple and provide one proposal for discussing it.

### 1st round of discussions

#### Proposal 2-4:

* When *ScheduledCellCombo-ListDCI-0-3* or *ScheduledCellCombo-ListDCI-1-3* is configured, DCI format level padding is adopted for DCI format 0\_3 or DCI format 1\_3, respectively.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Support |
| Spreadtrum | Support |
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#### Proposal 2-5:

* Below TP on TS38.212-i00 is adopted.
* Reason for change: If only one of DCI format 0\_3 and DCI format 1\_3 is counted on the reference cell, step 4D is not needed.
* Summary of change: Delete the case that reference cell is used for counting the size of only one of DCI format 0\_3 and DCI format 1\_3.
* Consequence if not approved: Unclear UE behaviour as there is only one DCI format.

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| **7.3.1.0 DCI size alignment**  -----------------------omitted text-----------------------  Step 4D:   * If the total number of different DCI sizes configured to monitor is more than 4 for the cell after applying the above steps and the cell is the serving cell for counting the size of ~~one or~~ both DCI format 0\_3 and DCI format 1\_3 as defined in Clause 10.1 of [5, TS38.213], or if the total number of different DCI sizes with C-RNTI configured to monitor is more than 3 for the cell after applying the above steps and the cell is the serving cell for counting the size of ~~one or~~ both DCI format 0\_3 and DCI format 1\_3 as defined in Clause 10.1 of [5, TS38.213]   -----------------------omitted text----------------------- |

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support |
| Spreadtrum | Support |
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# DCI field design

Based on contributions submitted by companies, below issues are prioritized for discussion in this meeting. Within each sub-section, the summary from moderator’s perspective is listed and followed by draft proposals for further discussion round by round.

## SCell dormancy indication

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| **Huawei:**  *Proposal 6: If configured, the SCell dormancy indication field should belong to Type-1A field.*  *Proposal 7: RAN1 should follow the existing rule to decide whether the SCell dormancy indication field is present in DCI format 0\_3/1\_3, i.e., the field is only present when this format is carried by PDCCH on the primary cell within DRX Active Time and the UE is configured with at least two DL BWPs for an SCell.*  *Proposal 8: Adopt the TP on SCell dormancy indication for clause 7.3.1.1.4 and clause 7.3.1.2.4 of TS 38.212 by implementing the following (supported in legacy for single cell scheduling)*   * *Method 1: Reusing the bitmap indication in DCI format 0\_1/1\_1.* * *Method 2: Repurposing fields like MCS, NDI, RV, HARQ process number, antenna port(s) and DMRS sequence initialization in DCI format 1\_3 to indicate SCell dormancy when all Type 0 FDRA bits in DCI format 1\_3 are equal to 0 and all Type 1 FDRA bits in DCI format 1\_3 are equal to 1.*   **Spreadtrum:**  *P11: SCell dormancy indication can only carried by PDCCH on the primary cell*  *P12: DCI format 0\_3 or a DCI format 1\_3 for a set of serving cells including PSCell can have SCell dormancy indication field.*  *P17: Not support the case 2 dormancy indication (without PDSCH scheduling) by DCI format 1\_3*  **Vivo:**  *Proposal 11. Mc-DCI including SCell dormancy indication without any scheduled PDSCH/PUSCH is not supported.*  *Proposal 12. If a co-scheduled cell becomes inactive or dormant, the gNB is still allowed to indicate a cell combination including that cell in DCI format 0\_3/1\_3, while the UE simply ignores the scheduling information for the inactive/dormant cell. The following TP4 is adopted.*  *Proposal 13. If a co-scheduled cell becomes inactive, the active BWP is assumed to be the BWP with firstActiveDownlinkBWP-Id for that cell when determining the mc-DCI format size and field size.*  **ZTE:**  *Proposal 5: Adopt the following TP for sub-clause 7.3.1.2.4 in TS38.212.*  **Nokia:**  *Proposal 2.5: The SCell dormancy indication field (if configured to be present) is to be of Type1A (with 0-5bit, as for DCI formats 0\_1/1\_1). SCell dormancy indication using a combination of DCI fields in case of invalid FDRA is not supported.*  *Proposal 3.3: Add the following note to dormancyDCI-1-3/ dormancyDCI-0-3 (rows 17 & 18)*   * *Note: The Scell dormancy indication field presence can only be enable for a set of cells scheduled from PCell.*   **OPPO:**  *Proposal 2: SCell dormancy indication field is defined up to 5 bits. The corresponding 38.212 TP is as following.*  *Proposal 3: When any cell in the set of co-scheduled cells is dormant, UE monitors DCI format 0\_3/1\_3 by assuming no dormant scheduled cell and ignores the scheduling for the dormant cell(s).*  **Fujitsu:**  *Proposal 1: For both DCI format 0\_3 and 1\_3, adopt the TP below for TS 38.212.*  SCell dormancy indication – 0 bit if higher layer parameter *dormancyDCI-1-3* is not enabled; otherwise 1, 2, 3, 4, or 5 bits bitmap determined according to the number of different *DormancyGroupID(s)* provided by higher layer parameter *dormancyGroupWithinActiveTime,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *dormancyGroupWithinActiveTime,* with MSB to LSB of the bitmap corresponding to the first to last configured SCell group in ascending order of *DormancyGroupID*. The field is only present when this format is carried by PDCCH on the primary cell within DRX Active Time and the UE is configured with at least two DL BWPs for an SCell.  *Proposal 2: For Scell dormancy indication per Scell by DCI format 1\_3, support simultaneous PDSCH scheduling and the indication per Scell when the DCI includes Scheduled cells indicator field.*  *Proposal 3: When DCI format 1\_3 includes Scheduled cells indicator field, if all bits in a block in the FDRA field are set to 0 for resource allocation type 0 or set to 1 for resource allocation type 1 or set to 0 or 1 for dynamic switch resource allocation type, this block is reserved and the corresponding block in the fields below are used for Scell dormancy indication.*   * *TB1: modulation and coding scheme* * *TB1: new data indicator* * *TB1: redundancy version* * *HARQ process number*   **CMCC:**  *Proposal 1. The SCell dormancy indication in DCI format 1\_3/0\_3 can be defined as Type-1A field, and take the following TP for TS 38.212 section 7.3.1.1.4 and section 7.3.1.2.4.*  Proposal 2. For SCell dormancy behaviour when UE detects DCI format 0\_3/1\_3, take the following TP for TS 38.213 section 10.3:  **Samsung:**  *Proposal 13: The explicit SCell dormancy field in DCI format 0\_3/1\_3:*   * *is present when both dormancyDCI-0-3/dormancyDCI-1-3 and dormancyGroupWithinActiveTime are configured;* * *includes a bitmap of size 1, 2, 3, 4, or 5 bits according to the number of configured dormancy cell groups;* * *The bitmap is interpreted same as that in DCI format 0\_1/1\_1;* * *is provided by a PDCCH on the PCell;* * *The PCell may or may not be co-scheduled by the DCI format 0\_3/1\_3;* * *The DCI format 0\_3/1\_3 can co-schedule cells other than PCell;* * *does not indicate a dormancy cell group to switch to dormant BWP when the dormancy cell group includes cell(s) that are co-scheduled by DCI format 0\_3/1\_3;*   *Proposal 14: Implicit SCell dormancy indication via DCI format 0\_3/1\_3:*   * *is applicable when dormancyDCI-0-3/dormancyDCI-1-3 is not configured;* * *is provided by a PDCCH on the PCell;* * *The DCI format 0\_3/1\_3 can co-schedule PCell and/or other cells from the set of cells;* * *is provided by repurposing fields corresponding to a non-scheduled cell with smallest cell index;* * *{One-shot HARQ ACK request, FDRA} fields are used for validation;* * *When ScheduledCellCombo-ListDCI-0-3/1-3 is not provided, a different reserved value (e.g., all 1s) is used for SCell dormancy indication to distinguish from other non-scheduled cells;* * *{MCS, NDI, RV, HPN} fields, as well as AP when configured as Type-2 field, are repurposed as the bitmap for SCell dormancy indication* * *does not indicate a dormancy cell group to switch to dormant BWP when the dormancy cell group includes cells that are co-scheduled by DCI format 0\_3/1\_3.*   **ETRI:**  *Proposal 4: For SCell dormancy indication based on DCI format 1\_3, the separate field (i.e., SCell dormancy indication field) is used for the following cases:*   * *When ScheduledCellCombo-ListDCI-1-3 is configured* * *When ScheduledCellCombo-ListDCI-1-3 is not configured, and DCI schedules PDSCH for all serving cells in the set of cells*   *Proposal 5: For SCell dormancy indication based on DCI format 1\_3, the SCell dormancy indication field is reserved and existing fields are re-purposed for the dormancy indication for the following case:*   * *When ScheduledCellCombo-ListDCI-1-3 is not configured, and DCI schedules PDSCH for a subset of serving cells in the set of cells or DCI schedules no PDSCH*   *Proposal 6: The existing fields in DCI format 1\_3 at least include MCS, NDI, RV, and HARQ process number corresponding to one of non-scheduled cell(s) in the set of cells.*  *Proposal 7: UE does not expect a case where a SCell is indicated as dormancy and at the same time is scheduled based on the same mcDCI.*  *Proposal 8: Rel-18 SCell dormancy indication field in DCI format 0\_3/1\_3 is only present when this format is carried on PCell within DRX active time and when UE is configured with at least two DL BWPs for a target SCell.*  **DOCOMO:**  *Proposal 5:*  *Minimum applicable scheduling offset indicator, SCell dormancy indicator and PDCCH monitoring adaptation indicator in DCI format 0\_3/1\_3 should be Type-1A field.*  *However, the scope of this WI is multi-cell PDSCH scheduling with a single DCI and using the DCI without DL assignment seems not essential. Given that RAN1 is in maintenance phase, we think it is not necessary to be supported.*  **Ericsson:**  *P1: For SCell dormancy indication via DCI 1\_3/0\_3,*   * *For Case 1, reuse the existing RRC parameters (e.g. dormancy groups, etc) that are applicable for SCell dormancy indication field in DCI 1\_1/0\_1.* * *For Case 2, reuse the same fields as DCI 1\_1 Case 2 dormancy indication fields* * *Adopt TP1 for 38.213 to correct the details of SCell dormancy Case 1 and Case 2 for DCI 1\_3 and Case 1 for DCI 0\_3.* * *Adopt TP2 for 38.212 to correct the details of SCell dormancy Case 1 and Case 2 for DCI 1\_3 and Case 1 for DCI 0\_3.*   **Qualcomm:**  *Proposal 2:*  *Support* *SCell dormancy indication Case 1 and Case 2 by a DCI format 0\_3/1\_3*   * *For Case 1:* * *SCell dormancy indication field of up to 5 bits is included in the DCI format 0\_3/1\_3 monitored on the PCell with set-CIF value equal to 0* * *Each bit of the SCell dormancy indication field indicates dormant BWP for an SCell group, same as for DCI format 0\_1/1\_1* * *For Case 2:* * *FDRA field for the PCell in the DCI format 1\_3 monitored on the PCell with set-CIF value equal to 0 are set to:* * *All 0s for RA Type 0* * *All 1s for RA Type 1* * *All 0s or 1s for dynamic switching of RA Type* * *The sequence of following fields are used as bit-map for SCell dormancy indication* * *MCS for TB1 for the PCell* * *NDI for TB1 for the PCell* * *RV for TB1 for the PCell* * *HARQ process number for the PCell* * *Antenna port(s) for the PCell with the field being configured as Type-2* * *DMRS sequence initialization* * *Note: the DCI format 1\_3 for Case 2 SCell dormancy indication can schedule PDSCH(s) on SCell(s)* |

### Moderator summary and proposals based on contributions

According to the legacy spec, there are two existing options for indicating SCell dormancy for DCI format 0\_1/1\_1.

* Option 1: Bitmap based indication by SCell dormancy indication field with up to 5 bits with each bit corresponding to one of the configured SCell groups.
* Option 2: Repurpose MCS, NDI, RV, HARQ process number, antenna port(s) and DMRS sequence initialization to indicate SCell dormancy in case of one-shot HARQ-ACK request not present or set to '0', and FDRA field set to an invalid value.

For RAN1#114-bis meeting, 13 companies [Huawei, Spreadtrum, vivo, ZTE, Nokia, OPPO, Fujitsu, CMCC, Samsung, ETRI, DOCOMO, Ericsson, Qualcomm] propose SCell dormancy indication methods in DCI format 0\_3/1\_3. Two companies [Huawei, Spreadtrum] propose RAN1 should follow the existing rule to decide whether the SCell dormancy indication field is present in DCI format 0\_3/1\_3, i.e., the field is only present when this DCI format is carried by PDCCH on the primary cell within DRX Active Time and the UE is configured with at least two DL BWPs for an SCell. Six companies [Huawei, ZTE, Fujitsu, Samsung, Ericsson, Qualcomm] propose supporting both bitmap-based indication and repurposing based indication, while six companies [Spreadtrum, vivo, Nokia, OPPO, CMCC, DOCOMO] don’t support repurposing based indication.

For multi-cell PDSCH scheduling, DCI format 1\_3 is designed to reduce the control overhead and improve spectral/power efficiency on scheduling data over multiple cells. Using DCI format 1\_3 without data scheduling for SCell dormancy indication is not cost-efficient due to the larger payload size of DCI format 1\_3 compared to legacy DCI format 1\_1. Furthermore, invalid FDRA field is used to indicate whether the corresponding cell is scheduled or not so that it is not appropriate to reuse FDRA field to trigger the repurposing-based indication.

Considering using the DCI format 1\_3 without DL scheduling seems not essential in maintenance phase, moderator prefer not supporting repurposing based indication.

Hence, below proposal is provided for further discussion.

### 1st round of discussions

#### Proposal 3-1:

* Below TP on TS38.212-i00 is adopted.

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| 7.3.1.1.4 Format 0\_3 <omitted text>  - SCell dormancy indication – 0 bit if higher layer parameter *dormancyDCI-0-3* is not enabled; otherwise ~~x bits~~ 1, 2, 3, 4 or 5 bits bitmap determined according to the number of different *DormancyGroupID(s)* provided by higher layer parameter *dormancyGroupWithinActiveTime,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *dormancyGroupWithinActiveTime,* with MSB to LSB of the bitmap corresponding to the first to last configured SCell group in ascending order of *DormancyGroupID*. The field is only present when this format is carried by PDCCH on the primary cell within DRX Active Time and the UE is configured with at least two DL BWPs for an SCell.  <omitted text> 7.3.1.2.4 Format 1\_3 <omitted text>  - SCell dormancy indication – 0 bit if higher layer parameter *~~SCell-dormancy-indication-Present~~* *dormancyDCI-1-3* is not enabled; otherwise ~~x bits.~~ 1, 2, 3, 4 or 5 bits bitmap determined according to the number of different *DormancyGroupID(s)* provided by higher layer parameter *dormancyGroupWithinActiveTime,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *dormancyGroupWithinActiveTime,* with MSB to LSB of the bitmap corresponding to the first to the last configured SCell group in ascending order of *DormancyGroupID*. The field is only present when this format is carried by PDCCH on the primary cell within DRX Active Time and the UE is configured with at least two DL BWPs for an SCell.  <omitted text> |

Companies are encouraged to provide comments in the table below.

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| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support in principle.  On the condition for 0 bit, we are wondering if this should be based only on the enabled bitfield – or also having the legacy condition of 0bit if the group is configured, i.e.:   - SCell dormancy indication – 0 bit if higher layer parameter *dormancyDCI-0-3* and *dormancyGroupWithinActiveTime* are ~~is~~ not configured~~enabled~~; ...  - SCell dormancy indication – 0 bit if higher layer parameters *dormancyDCI-1-3~~SCell-dormancy-indication-Present~~* and *dormancyGroupWithinActiveTime* are ~~is~~ not configured~~enabled~~; |
| Spreadtrum | Support |
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## Minimum applicable scheduling offset indicator

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| **Huawei:**  *Proposal 4: If configured, the minimum applicable scheduling offset indicator should belong to Type-1A field.*  *Proposal 5: Adopt the TP on Minimum applicable scheduling offset indicator for clause 7.3.1.1.4 and clause 7.3.1.2.4 of TS 38.212.*  **Speadtrum:**  *P13: minimum applicable scheduling offset indicator is Type-1A field, with 1 bit length.*  **Vivo:**  *Proposal 5. Minimum applicable scheduling offset indicator is defined as Type1A with 1 bit in a mc-DCI format. Adopt the following TP3 for 38.212.*  **Nokia:**  *Proposal 2.4: The Minimum applicable scheduling offset indicator (if configured to be present) is to be of Type1A (with 1bit).*  **OPPO:**  *Proposal 1: The minimum applicable scheduling offset indicator field is defined as 1-bit Type 1A field. The corresponding TP for 38.212 is given as following.*  **CMCC:**  *Proposal 4. The minimum applicable scheduling offset indicator in DCI format 1\_3/0\_3 can be defined as Type-1A field, and take the following TP for TS 38.212 section 7.3.1.1.4 and section 7.3.1.2.4.*  The 1 bit indication is used to determine the minimum applicable K0 for the active DL BWP and the minimum applicable K2 value for the active UL BWP, if configured respectively, according to Table 7.3.1.1.2-33. If the minimum applicable K0 is indicated, the minimum applicable value of the aperiodic CSI-RS triggering offset for an active DL BWP shall be the same as the minimum applicable K0 value.  **Samsung:**  *Proposal 18: Adopt the minimum applicable scheduling offset indicator field in DCI format 0\_3/1\_3 as a Type-1A field with 1 bit or a Type-1B field with up to 2 bits.*  **Apple:**  *Proposal 4: RAN1 should discuss the application of default beams for multiple scheduled cells in case when scheduling offset may not*  *Proposal 5: For determining the default beams corresponding to each of the co-scheduled cells, the TCI state associated with the lowest index from the joint TCI table for each of the co-scheduled cells can be applied*  *Proposal 6: For applying the default beam individually for each of the co-scheduled cell based on the scheduling offset between the DCI and corresponding scheduled PDSCHs, following condition can be adopted:*   * *When the scheduling offset between the DCI and corresponding scheduled PDSCHs is shorter than the timeDurationForQCL, i.e. there is not enough time between the DCI reception and applying the indicated beam at the start of PDSCH reception at UE.*   **MTK:**  *Proposal 1: The type of “minimum applicable scheduling offset indicator” in DCI format 0\_X/1\_X can be determined as Type-1A field (common field), which means there would be 1 bit in DCI format 0\_X/1\_X if this feature is configured.*  **Langbo:**  *Proposal 1: The field for minimum applicable scheduling offset indicator is of Type1A and existing RRC parameters minimumSchedulingOffsetK2 and minimumSchedulingOffsetK0 are reused.*  *Proposal 2: The scheduled cell with smallest serving cell index is used as a reference cell for the determination of an application delay for minimum scheduling offset restrictions.*  **DOCOMO:**  *Proposal 5:*  *Minimum applicable scheduling offset indicator, SCell dormancy indicator and PDCCH monitoring adaptation indicator in DCI format 0\_3/1\_3 should be Type-1A field.*  **Ericsson:**  *P3: Adopt TP4 for 38.212 to reflect that minimum applicable scheduling offset indicator field in DCI 0\_3/1\_3 is 1 bit and is single common field applicable for all scheduled cells.*  **Qualcomm:**  *Proposal 3: Minimum scheduling offset indicator is Type-1A and is applicable to all the cells in the set*   * *Adopt TP in [1]* |

### Moderator summary and proposals based on contributions

In RAN1#112 meeting, RAN1 agree that inclusion of minimum applicable scheduling offset indicator in DCI format 0\_3/1\_3 is configurable. For RAN1#114-bis meeting, 12 companies [Huawei, Spreadtrum, vivo, Nokia, OPPO, CMCC, Samsung, MTK, Langbo, DOCOMO, Ericsson, Qualcomm] propose minimum applicable scheduling offset indicator is a Type-1A field and applicable to all the co-scheduled cells by DCI format 0\_3/1\_3.

Considering that that all co-scheduled cells by a DCI format 0\_3/1\_3 have same SCS, it is natural to assume that the scheduling offset if applied would be similar among all the co-scheduled cells by the DCI format 0\_3/1\_3. Then, a single field is enough to apply a common scheduling offset to all co-scheduled cells by the DCI format 0\_3/1\_3. This application is based on existing RRC parameters. In case a cell is not configured with minimum scheduling offset values, this field would not apply for the cell.

Hence, below proposal is provided for further discussion.

### 1st round of discussions

#### Proposal 3-2:

* The Minimum applicable scheduling offset indicator, if configured to be present in DCI format 0\_3/1\_3, is of Type-1A field with 1 bit.
* Below TP on TS38.212-i00 is adopted.

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| 7.3.1.1.4 Format 0\_3  < Unchanged parts are omitted >  - Minimum applicable scheduling offset indicator – 0 or 1 bit  - 0 bit if higher layer parameter *minimumSchedulingOffsetK0DCI-0-3* is not configured;  - ~~x~~ 1 bit~~s~~ otherwise. The 1 bit indication is used to determine the minimum applicable K2 for the active UL BWP and the minimum applicable K0 value for the active DL BWP, if configured respectively, according to Table 7.3.1.1.2-33. If the minimum applicable K0 is indicated, the minimum applicable value of the aperiodic CSI-RS triggering offset for an active DL BWP for each scheduled cell shall be the same as the minimum applicable K0 value.  The field is only applicable to a scheduled cell configured with the *minimumSchedulingOffsetK2*, and is applied to the applicable scheduled cells in the scheduled cell set independently.  < Unchanged parts are omitted >  7.3.1.2.4 Format 1\_3  < Unchanged parts are omitted >  - Minimum applicable scheduling offset indicator – 0 or 1 bit  - 0 bit if higher layer parameter *minimumSchedulingOffsetK0DCI-1-3* is not configured;  - ~~x~~ 1 bit~~s~~ otherwise. The 1 bit indication is used to determine the minimum applicable K0 for the active DL BWP and the minimum applicable K2 value for the active UL BWP, if configured respectively, according to Table 7.3.1.1.2-33. If the minimum applicable K0 is indicated, the minimum applicable value of the aperiodic CSI-RS triggering offset for an active DL BWP for each scheduled cell shall be the same as the minimum applicable K0 value.  The field is only applicable to a scheduled cell configured with the *minimumSchedulingOffsetK0*, and is applied to the applicable scheduled cells in the scheduled cell set independently.  < Unchanged parts are omitted > |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support |
| Spreadtrum | Support |
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## PDCCH monitoring adaptation indication

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| --- |
| **CMCC:**  Proposal 3. *The PDCCH monitoring adaptation indication in DCI format 1\_3/0\_3 can be defined as Type-1A field, and* take the following TP for TS 38.213 section 10.4:  **DOCOMO:**  *Proposal 5:*  *Minimum applicable scheduling offset indicator, SCell dormancy indicator and PDCCH monitoring adaptation indicator in DCI format 0\_3/1\_3 should be Type-1A field.*  **Ericsson:**  *P2: Adopt TP3 for 38.213 to reflect that PDCCH monitoring adaptation indication field is included in DCI format 0\_3/1\_3.* |

### Moderator summary and proposals based on contributions

In RAN1#112 meeting, RAN1 agree that inclusion of PDCCH monitoring adaptation indication in DCI format 0\_3/1\_3 is configurable. For RAN1#114-bis meeting, 3 companies [CMCC, DOCOMO, Ericsson] propose PDCCH monitoring adaptation indication is a Type-1A field and applicable to all the co-scheduled cells by DCI format 0\_3/1\_3.

Considering this field has been already captured in DCI format 0\_3/1\_3 in TS38.212-i00 while not in TS38.213-i00, 2 companies [CMCC, Ericsson] propose a similar TP to reflect it.

Therefore, below proposal is provided for further discussion.

### 1st round of discussions

#### Proposal 3-3:

* Below TP on TS38.213-i00 is adopted.

|  |
| --- |
| 10.4 Search space set group switching and skipping of PDCCH monitoring  <Omit unchanged text>  A UE can be provided a set of durations by *pdcch-SkippingDurationList* for PDCCH monitoring on an active DL BWP of a serving cell and, if the UE is not provided *searchSpaceGroupIdList-r17* on the active DL BWP of the serving cell, a DCI format 0\_1,~~and~~ a DCI format 0\_2 and a DCI format 0\_3 that schedule PUSCH transmission, and a DCI format 1\_1,~~and~~ a DCI format 1\_2 and a DCI format 1\_3 that schedule PDSCH receptions can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits.  <Omit unchanged text>  A UE can be provided group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on an active DL BWP of a serving cell and, if the UE is not provided *pdcch-SkippingDurationList* for the active DL BWP of the serving cell, a DCI format 0\_1,~~and~~ a DCI format 0\_2 and a DCI format 0\_3 that schedule PUSCH transmissions and a DCI format 1\_1,~~and~~ a DCI format 1\_2 and a DCI format 1\_3 that schedule PDSCH receptions can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits for the serving cell.  <Omit unchanged text>  A UE can be provided a set of durations by *pdcch-SkippingDurationList* and group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on an active DL BWP of a serving cell and, a DCI format 0\_1,~~and~~ a DCI format 0\_2 and a DCI format 0\_3 that schedule PUSCH transmissions, and a DCI format 1\_1,~~and~~ a DCI format 1\_2 and a DCI format 1\_3 that schedule PDSCH receptions can include a PDCCH monitoring adaptation field of 2 bits.  <Omit unchanged text> |

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support in principle  Maybe possible to use DCI format 1\_1, 1\_2 and 1\_3 instead to make this more compact (but the detailed wording could be left to the editor). |
| Spreadtrum | Support |
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## FDRA on unlicensed spectrum

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| --- |
| **Spreadtrum:**  *P10: When all the scheduled cells indicated by Frequency domain resource assignment field and resource allocation Type 2 is configured, set to all '0's for resource allocation type 2 with , or set to all ‘1’s for resource allocation type 2 with to indicate whether the corresponding cell is scheduled or not.*  **Xiaomi:**  *Proposal 7: Adopt text proposal#5 for clause 6.1.2.2.3 of TS 38.214.*  **Samsung:**  *Proposal 17: For the UL MC-DCI format 0\_3, when ScheduledCellCombo-ListDCI-0-3 is not configured, the following special values indicate that a cell is not scheduled:*   * *all 0s for FDRA Type-2 with 30 kHz SCS, and all 1s for FDRA Type-2 with 15 kHz SCS.* |

### Moderator summary and proposals based on contributions

Rel-18 multi-cell scheduling supports operation on unlicensed bands as well as resource allocation Type 2 for DCI format 0\_3. When *ScheduledCellCombo-ListDCI-0-3* is not configured, per-cell FDRA field is used to indicate whether the corresponding cell is scheduled or not, i.e., an invalid code point indicates the cell is not scheduled; a valid code point indicates the cell is scheduled. Similar as validation of SPS/CG release per Table 10.2-2 of TS 38.213 v18.0.0, i.e., all '0's for resource allocation type 2 with μ=1, or set to all ‘1’s for resource allocation type 2 with μ=0, indicating the corresponding cell is not scheduled.

**Table 10.2-2 for validation of SPS/CG release**

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2/4\_1/4\_2 |
| HARQ process number  (if present) | set to all '0's | set to all '0's |
| Redundancy version  (if present) | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with  set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*  set to all '1's for FDRA Type 1 |

For RAN1#114-bis meeting, similar proposals are provided by 3 companies [Spreadtrum, xiaomi, Samsung]. Hence, below proposal is used for further discussion.

### 1st round of discussions

#### Proposal 3-4:

* For DCI format 0\_3, when *ScheduledCellCombo-ListDCI-0-3* is not configured, all '0's for FDRA Type 2 with μ=1 or all ‘1’s for FDRA Type 2 with μ=0 indicates the corresponding cell is not scheduled.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support in principle  But to align also for DCI format 1\_3, then we may need a change also for the dynamic switch for 1\_3 – maybe this could be treated in a single TP (so maybe better to agree on a TP directly, then having an agreement here):  If the higher layer parameter *ScheduledCellCombo-ListDCI-1-3* for the scheduled cell set is not configured, each block is also used to indicate whether the corresponding cell is scheduled or not as follows:  - if all bits of a block are set to 0 for resource allocation type 0 or set to 1 for resource allocation type 1 or ~~set to 0 or 1 for~~ dynamic switch resource allocation type, the cell corresponding to the block is not scheduled;  - otherwise, the cell corresponding to the block is scheduled.  **On another note, the Xiaomi TP is for 38.214 (and not related to this issue here) and suggesting to add 0\_3 for Type 2 RA there (which seems to be needed as well – in addition to the TP above that has mainly 38.212 impact.** |
| Spreadtrum | Support the proposal. |
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## Other DCI fields

|  |
| --- |
| **Spreadtrum:**  *P8: When the bit length of a scheduled cell is less than the Type-1A field length in the DCI 1\_3/0\_3, it can use corresponding LSB bits to a scheduled cell. It can be treated as an error case if the invalid value is indicated.*  **Vivo:**  *Proposal 2. Adopt TP2 for TS 38.212 to clarify that: for DCI format 0-3/1-3, is the maximum number of UL/DL BWPs configured by higher layers across all the cells configured by higher layer parameters, excluding the initial UL/DL BWP.*  *Proposal 6. Reuse legacy priority index parameter, i.e., priorityIndicatorDCI-0-1-r16 and priorityIndicatorDCI-1-1-r16 to configure the priority index value for a cell in the cell set.*  *Proposal 7. For a cell combination scheduled by a DCI format 0\_3/1\_3, if all co-scheduled cells in the cell combination are configured with priority index for the corresponding active BWPs, the value of priority index can be 1 or 0. If there is at least one co-scheduled cell without priority index configured for its active BWP, the value of priority index in the DCI format is expected to be 0, and the priority index 0 is applied to all scheduled PUSCHs/PDSCHs.*  *Proposal 8. Adopt TP4 for TS 38.213.*  **ZTE:**  *Proposal 2: Adopt the following TP for sub-clause 7.3.1.1.4 and 7.3.1.2.4 in TS38.212.*  *Proposal 3: Adopt the following TP for sub-clause 6.1 in TS38.214.*  *Proposal 4: For a set of cells configured for multi-cell scheduling using DCI format 0\_X/1\_X, the size of a Type-1A field in the DCI format 0\_X/1\_X is determined as maximum field size of active BWP among all cells within the set of cells. And adopt one of following alternatives.*   * *Alt.1 If the field size for one of co-scheduled cells is smaller than the determined field size in the DCI format 0\_X/1\_X, LSB(s) of the field is applied. If one of co-scheduled cells does not have related configuration for this field or the field indicates an inapplicable value for the cell, the UE ignore this field for the cell.* * *Alt.2 If the number of entries for one of co-scheduled cells is smaller than the maximum number of entries among all the co-scheduled cells, (DCI field value mod N) is applied, where N is the number of entries for the one of co-scheduled cell. If one of co-scheduled cells does not have related configuration for this field, the UE ignore this field for the one of co-scheduled cells.*   *Proposal 7: In order to obtain the same OLPC parameter sets indicated by DCI format 0\_3, represent ‘10’ as ‘1’ for the cell with 1 bit OLPC. The following TP for sub-clause 7.3.1.1.4 in TS38.212 should be adopted.*  *Proposal 8: Adopt the following TP for sub-clause 7.3.1.1.4 in TS38.212.*  **Nokia:**  *Proposal 2.6: For Type 1A DCI fields (or DCI fields configured as Type 1A), for scheduled cell with a smaller required DCI size only the required LSB bits are used for the DCI field value determination. The bitwidth determination is to be based on the target BWP indicated by the BWP indicator.*  **LG:**  *Proposal 1: Consider the following alternatives for Type 1A field to handle the cell X configured with smaller number of DCI code-points/states than the maximum number among the cells configured for multi-cell scheduling.*   * *Alt 1: Interpret LSB part within Type 1A field for the cell X* * *Alt 2: Fill (high) DCI code-points/states with valid values for the cell X* * *Alt 3: Apply default value if invalid code-point/state for the cell X is indicated* * *Alt 4: Assume no change from latest indication if invalid code-point/state for the cell X is indicated* * *Alt 5: Assume no scheduling on cell X if invalid code-point/state for the cell X is indicated*   *Proposal 2: Clarify the followings to handle different Priority indicator (denoted as “PI”) configuration (i.e., presence or absence) across co-scheduled cells.*   * *Apply the priority indicated via DCI format 0\_3 if all co-scheduled cells are configured with PI* * *Assume LP for all co-scheduled cells if at least one among the cells is not configured with PI*   *Proposal 4: Clarify the following cases to update the reference TCI (code-point) table for Type 1B based TCI field in DCI format 1\_3 based on TCI state update by MAC CE.*   * *Case 1: When the number of TCI code-points configured in the reference table is smaller than those activated by MAC CE (e.g. the activated TCI code-point not contained in the reference table is not indicated/supported by DCI format 1\_3?)* * *Case 2: When the number of TCI code-points configured in the reference table is larger than those activated by MAC CE (e.g. how to handle the table row containing a non-activated TCI code-point for a cell? treat the row itself as invalid? or assume no scheduling for the cell? or apply a default TCI for the cell?)*   *Proposal 6: Clarify that the smallest cell index to apply CSI request field in DCI format 0\_3 is determined among the cells configured with (non-zero) CSI request bits.*  *Proposal 7: Clarify that if the size of HPN/RV field for DCI format 0\_3/1\_3 is not configured, then the size of HPN/RV field in the DCI format 0\_3/1\_3 is determined as that in legacy DCI format.*  *Proposal 8: Consider the following alternatives to handle different MCS-C-RNTI (associated MCS table) configuration (i.e., presence or absence) across co-scheduled cells.*   * *Alt 1: Not allow MCS-C-RNTI based scheduling for the co-scheduled cell combination having at least one cell without MCS-C-RNTI configuration* * *Alt 2: Apply MCS table associated with C-RNTI for the cell without MCS-C-RNTI configuration even if DCI format 0\_3/1\_3 is scheduled based on MCS-C-RNTI* * *Alt 3: Assume no scheduling on the cell without MCS-C-RNTI configuration if DCI format 0\_3/1\_3 is scheduled based on MCS-C-RNTI*   *Proposal 13: Clarify how to handle (i.e., how to determine a TCI state for) the cell configured with two TCI states for a TCI code-point as the following.*   * *The first TCI state between the two TCI states (associated with a TCI code-point) is applied to the cell in case when it is scheduled by DCI format 1\_3*   **Xiaomi:**  *Proposal 1: MC UE interprets Type-1A field with LSB of bits if the configured bit width for cell#r is smaller than .*  *Proposal 2: Adopt Text proposal#1 to achieve a unified solution on determining bit width for type 1A fields.*  *Proposal 3: The following options can be considered to determine the bit width of CSI request field:*   * *Option 1: It is the maximum field size of active BWPs among the cells within the set of cells.* * *Option 2: It is configured by the higher layer parameter reportTriggerSizeDCI-0-3.* * *Option 3: It is determined by the reportTriggerSize configured for the cell with the smallest serving cell index among the scheduled cells.*   **CATT:**  *P3: For type-1A field, when the valid field of a scheduled cell is smaller than the field size in DCI format 0\_3/1\_3, the valid LSB within the field for a scheduled cell can be used.*  **OPPO:**  *Proposal 4: If the indicated value of a Type-1A field exceeds the value range allowed by a co-scheduled cell, UE ignores the indicated value, and continues using the existing value, for the co-scheduled cell.*  **CMCC:**  *Proposal 6. For Type-1A field, when invalid values/codepoints for a co-scheduled cell are indicated, UE interprets LSBs in the field for the cell based on its available configuration.*  **Lenovo:**  *Proposal 7: UE does not perform BWP switching for a cell if the BWP indicator in DCI format 0\_3/1\_3 indicates an invalid code point for the cell.*  **Samsung:**  *Proposal 9 (RRC / MAC-CE impact): Support a new MAC-CE (instead of RRC parameter tci-ListDCI-1-3) to indicate the joint multi-cell TCI table for DCI format 1\_3.*  *Proposal 10: Clarify the following in TS 38.214 v18.0.0 in case of Rel-17 unified framework:*   * *When a DCI format 1\_3 indicates a row of the joint multi-cell TCI table, the row entries corresponding to non-scheduled cells provide indicated TCI states for the corresponding cells.*   *Proposal 11: For TCI state field in DCI format 1\_3, clarify that following in TS 38.214 v18.0.0:*   * *A value of the TCI state field in DCI format 1\_3 provides new indicated DL/UL/joint TCI states for the co-scheduled cells and for cells in corresponding lists of cells indicated by simultaneousU-TCI-UpdateList.* * *Same holds for non-scheduled cells if Proposal 10 is agreed.*   *Proposal 12: Revert the RAN1#112 agreement on configuration of two SRS resource sets for DCI 0\_3 (it is against the RAN#97 Conclusion) and adopt the following in TS 38.214 v18.0.0: A UE does not expect to be configured more than one SRS resource set with ‘codebook’ or ‘non-codebook’ for DCI format 0\_3.*  *Proposal 15: The BWP indicator field of a DCI format 0\_3/1\_3 applies only to co-scheduled cells from a set of cells indicated by the DCI format 0\_3/1\_3 – The indicated BWP switching does not apply to non-scheduled cells from the set of cells.*  *Proposal 19: Support PDSCH/PUSCH repetitions via DCI formats 0\_3/1\_3, down-select from the following options:*   * *Option 1: {SLIV, mapping type, scheduling offset K0 (or K2), number of PDSCH (or PUSCH) repetitions} is indicated separately or jointly for the co-scheduled PDSCHs/PUSCHs;* * *Option 2: The number of repetitions of co-scheduled PDSCHs/PUSCHs is determined by pdsch-aggregationFactor/pusch-aggregationFactor.*   **Apple:**  *Proposal 1: For DMRS antenna port indication with format 0\_X/1\_X, when the field type is 1A and when the indicated index by single bitfield is not valid/available in the DMRS table for a co-scheduled cell, then a default index is applied for DMRS antenna port indication from one of the below options:*   * *Option 1: default index can be the lowest index value in the table for the co-scheduled cell* * *Option 2: default index can be the higher valid index value in the table for the co-scheduled cell*   **DOCOMO:**  *Proposal 1: For Type-1A fields in DCI format 0\_3/1\_3, if the size of the information field is larger than the one required for the DCI format interpretation for a cell that is indicated by Scheduled cells indicator field or Frequency domain resource assignment field, the UE uses a number of least significant bits of the DCI field equal to the one required for the cell that is indicated by Scheduled cells indicator field or Frequency domain resource assignment field.*  *Proposal 2:*   * *The value indicated by priority indicator field in DCI format 0\_3 is applied to co-scheduled cells only when all the co-scheduled cells are configured with priorityIndicatorDCI-0-1-r16 or priorityIndicatorDCI-0-2-r16.* * *The value indicated by priority indicator field in DCI format 1\_3 is applied to co-scheduled cells only when all the co-scheduled cells are configured with priorityIndicatorDCI-1-1-r16 or priorityIndicatorDCI-1-2-r16.*   *Proposal 7: The following revision in TS38.214 section 6.1.2.1 should be confirmed.*  **Qualcomm:**  *Proposal 4:*   * *The priority indicator field in a DCI format 0\_3/1\_3 is Type-1A field* * *The value of the priority indicator field in a DCI format 0\_3 equally applies to PUSCH(s) on all the co-scheduled cell(s) by the DCI format 0\_3* * *The value of the priority indicator field in a DCI format 1\_3 applies to the PUCCH for HARQ-ACK of the scheduled PDSCH(s) on all the co-scheduled cell(s) by the DCI format 1\_3*   *Proposal 7:*   * *For Antenna port(s) field in DCI format 1\_3, when the field is configured as type1a, the UE expects that RRC parameters for PDSCH receptions scheduled by the DCI format 1\_3 for any cell in the set for the DCI format 1\_3 are configured such that single Table from Tables 7.3.1.2.2-1, 7.3.1.2.2-2, 7.3.1.2.2-3, and 7.3.1.2.2-4 in TS38.212 is used.* * *For Antenna port(s) field in DCI format 0\_3, when the field is configured as type1a, the UE expects that RRC parameters for PUSCH transmissions scheduled by the DCI format 0\_3 for any cell in the set for the DCI format 0\_3 are configured such that single Table from Tables 7.3.1.1.2-6, 7.3.1.1.2-6A, 7.3.1.1.2-7, 7.3.1.1.2-7A, 7.3.1.1.2-8, 7.3.1.1.2-9, 7.3.1.1.2-10, 7.3.1.1.2-11, 7.3.1.1.2-12, 7.3.1.1.2-13, 7.3.1.1.2-14, 7.3.1.1.2-14, 7.3.1.1.2-15, 7.3.1.1.2-16, 7.3.1.1.2-17, 7.3.1.1.2-18, 7.3.1.1.2-19, 7.3.1.1.2-20, 7.3.1.1.2-21, 7.3.1.1.2-22, 7.3.1.1.2-23, 7.3.1.1.2-24, and 7.3.1.1.2-25 in TS38.212 is used.* * *For TPMI field in DCI format 0\_3, when the field is configured as type1a, the UE expects that RRC parameters for PUSCH transmissions scheduled by the DCI format 0\_3 for any cell in the set for the DCI format 0\_3 are configured such that single Table from Tables 7.3.1.1.2-2, 7.3.1.1.2-2A, 7.3.1.1.2-B, 7.3.1.1.2-3, 7.3.1.1.2-3A, 7.3.1.1.2-4, 7.3.1.1.2-4A, 7.3.1.1.2-5, and 7.3.1.1.2-5A in TS38.212 is used.* * *For SRI field in DCI format 0\_3, when the field is configured as type1a, the UE expects that RRC parameters for PUSCH transmissions scheduled by the DCI format 0\_3 for any cell in the set for the DCI format 0\_3 are configured such that single Table from Tables 7.3.1.1.2-28, 7.3.1.1.2-29, 7.3.1.1.2-30, 7.3.1.1.2-31, 7.3.1.1.2-32, 7.3.1.1.2-32A, and 7.3.1.1.2-32B in TS38.212 is used.* |

### Moderator summary and proposals based on contributions

* On the case where Type-1A field indicates an invalid code point for a co-scheduled cell

For a set of cells configured for multi-cell scheduling by DCI format 0\_3/1\_3, the size of a Type-1A field is determined according to the maximum field size of the active BWPs within the set of cells. There is one open issue is how to interpret the Type-1A field indication for a scheduled cell when the maximum valid field size of the scheduled cell is smaller than the field size in the DCI format 0\_3/1\_3. Taking BWP indicator as one example, since different cells in same cell set may be configured with different number of BWPs, the size of the BWP indicator in DCI format 0\_3/1\_3 should be determined based on the maximum number of BWPs among the cells in same cell set. So the problem is how to interpret the invalid code points of the BWP indicator for a cell configured with smaller number of BWPs in the cell set. This issue also happens to other Type-1A fields.

For RAN1#114-bis meeting, nine companies [Spreadtrum, Nokia, LG, Xiaomi, CATT, OPPO, CMCC, Lenovo, DOCOMO] mention this open issue, wherein seven companies [Spreadtrum, Nokia, LG, Xiaomi, CATT, CMCC, DOCOMO] propose using the corresponding valid LSB bits as the indication to the scheduled cell, while three companies [LG, OPPO, Lenovo] propose no changes from latest indication if invalid code point is indicated for the scheduled cell.

Hence, below proposal is provided for further discussion.

* On priority indicator

Regarding the Priority indicator field in DCI format 0\_3/1\_3, the following agreement was made in RAN1#112.

|  |
| --- |
| **Agreement**   * Priority indicator in DCI format 0\_X belongs to Type-1A field.   + The indicated priority is applied to all the co-scheduled PUSCH(s) * Priority indicator in DCI format 1\_X belongs to Type-1A field.   + The indicated priority indicator is applied to the PUCCH. * RRC parameters is introduced to configure the presence of priority indicator in DCI format 0\_X/1\_X   + This parameter is per set of cells |

In R16, the presence of a priority indicator in a DCI is per BWP configured. Therefore, for a set of cells configured for multi-cell scheduling using DCI format 0\_3/1\_3, some cells within the set of cells may be not configured with such priority indicator, while other cells are configured with a priority indicator. Hence, how to interpret the priority indicator should be clarified when priority indicator is configured independently across the set of cells.

Therefore, below proposal is provided for further discussion.

* On two SRS resource sets

According to conclusion in RAN#97, multi-TRP operation was excluded from Rel-18 multi-cell scheduling design. Hence, the fields corresponding to second TRP, such as 2nd SRI, 2nd TPMI, 2nd SRS resource sets, should be excluded from DCI 0\_3/1\_3.

However, below agreement is made in RAN1#112 when the multi-TRP operation and multi-cell scheduling are configured simultaneously.

|  |
| --- |
| **Agreement**  If the UE is configured with two SRS resource sets with ‘codebook’ or ‘non-codebook’, a PUSCH scheduled by DCI format 0\_X is always associated with the first SRS resource set with ‘codebook’ or ‘non-codebook’. |

For RAN1#114-bis meeting, two companies [ZTE, Samsung] point out this inconsistency and provide one TP to make spec more accurate. Hence, one proposal is provided for further discussion.

### 1st round of discussions

#### Proposal 3-5:

* For a cell scheduled by DCI format 0\_3/1\_3, if the size of a Type-1A field in DCI format 0\_3/1\_3 is larger than the one required for the Type-1A field for the cell, a number of LSBs of the Type-1A field which is equal to the one required for the cell is used.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support |
| Spreadtrum | Support |
|  |  |
|  |  |
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#### Proposal 3-6:

* The value indicated by priority indicator in DCI format 0\_3 is applied to co-scheduled cells only when all the co-scheduled cells are configured with *priorityIndicatorDCI-0-1-r16* or *priorityIndicatorDCI-0-2-r16*.
* The value indicated by priority indicator in DCI format 1\_3 is applied to co-scheduled cells only when all the co-scheduled cells are configured with *priorityIndicatorDCI-1-1-r16* or *priorityIndicatorDCI-1-2-r16*.

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Support the first bullet (0\_3): For PUSCH priority this is feasible (as one needs the specific beta offsets etc for it).  But for the HARQ priority, there is no need for such restriction as this just defines the priority of the HARQ-ACK bits (and CB) the HARQ bits are mapped to. So for DCI format 1\_3 this seems an unnecessary restriction and we do not support the 2nd bullet. |
| Spreadtrum | Support |
|  |  |
|  |  |
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#### Proposal 3-7:

* A UE does not expect to be configured more than one SRS resource set with ‘codebook’ or ‘non-codebook’ for DCI format 0\_3.
* This reverts the RAN1#112 agreement on configuration of two SRS resource sets for DCI format 0\_3:

Companies are encouraged to provide comments in the table below.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | Do not support: RAN1 took this agreement having had the guidance from RAN. And please note, that the RAN1 agreement (and the current specs) do not support multi-TRP transmission anyhow, as only the first SRS resource set (... i.e. a single TRP) can be scheduled. |
| Spreadtrum | Support |
|  |  |
|  |  |
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# HARQ enhancements

Based on contributions submitted by companies, below issues are prioritized for discussion in this meeting. Within each sub-section, the summary from moderator’s perspective is listed and followed by draft proposals for further discussion round by round.

## Background and submitted proposals

Regarding this issue, companies’ views are summarized as below:

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| **Spreadtrum:**  *P16: For HARQ-ACK codebook retransmission indication, the MCS field of the cell with the smallest serving cell index when ScheduledCellCombo-ListDCI-1-3 is configured, otherwise MCS field of the non-scheduled cell with the smallest serving cell index is used.*  **LG:**  *Proposal 5: Consider the following options to determine the MCS field used for indication of the enhanced Type-3 CB index (in DCI format 1\_3) in case of Type-3 CB triggering without PDSCH scheduling.*   * *Opt 1: If at least one of co-scheduled cells is indicated with invalid FDRA value, then the Type-3 CB index is indicated via the MCS field corresponding to one of the cell(s) indicated with invalid FDRA value, and no PDSCH scheduling is assumed for all the co-scheduled cells.* * *Opt 2: If at least one of co-scheduled cells is indicated with invalid FDRA value, then the Type-3 CB index is indicated via the MCS field corresponding to one of the cell(s) indicated with invalid FDRA value, and no PDSCH scheduling is assumed for the cell whose MCS field is referred for Type-3 CB index indication while PDSCH is scheduled for other cell(s).*   **CATT:**  *P1: For supporting DCI format 1\_3 triggering enhanced Type-3 HARQ-ACK reporting, using MCS field of smallest or largest index of cell which has no PDSCH transmission to indicate pdsch-HARQ-ACK-EnhType3Index.*  *P2: For supporting DCI format 1\_3 triggering HARQ-ACK codebook retransmission, using MCS field of smallest or largest index of cell scheduled to indicate value of .*  **Xiaomi:**  *Proposal 5: Adopt text proposal#3 for clause 9.1.3.1 of TS 38.213.*  *Proposal 6: Adopt text proposal#4 for clause 9.1.3.1 of TS 38.213.*  **Lenovo:**  *Proposal 4: Endorse above TP2 on DL DAI.*  *Proposal 5: Endorse above TP3.*  *Proposal 6: Endorse above TP4.*  **MTK:**  *Proposal 4: RAN1 to check*   * *Whether or not DCI formats for single/multi-cell scheduling also include DAI for single/multi-cell scheduling?*   **Samsung:**  *Proposal 1: For Type-2 HARQ-ACK codebook, when a PDCCH MO for a PDCCH reception that provides a DCI format 1\_3 is before an active DL BWP change on a serving cell from a set of cells, and the DCI format 1\_3 does not trigger the DL BWP change for the serving cell, down-select from the following options:*   * *Option 1: HARQ-ACK information bits corresponding to the serving cell is skipped;* * *Option 2: HARQ-ACK information bits corresponding to the entire DCI format 1\_3 is skipped.*   *Also, conclude on similar issue for the case of UL BWP switching for the cell with PUCCH transmission.*  *Proposal 2: For the Type-2 HARQ-ACK codebook, the set index parameter s is assigned such that agreed ordering of HARQ-ACK bits based on smallest cell index is preserved. Clarify in TS 38.213 v18.0.0 or in 38.331 that:*   * *The UE expects that serving cells in a first set of cells have smaller cell indexes than serving cells in a second set of cells, when the first set has a smaller set index than the second set.*   *Proposal 3: For a UE configured with DCI format 1\_3, a transmit power of a PUCCH with UCI payload size is determined based on , with details as described in the TP #1 in Section 8.*  *Proposal 4: For HARQ-ACK multiplexing on a PUSCH scheduled by a DCI format 1\_3, the threshold for switching between puncturing and rate matching is the maximum number of HARQ-ACK bits associated with a DCI format 1\_3.*  *Proposal 5: If a PUCCH overlaps with PUSCHs scheduled by SC-DCI formats and PUSCHs scheduled by an DCI format 0\_3, the UE multiplexes the UCI in a PUSCH scheduled by an SC-DCI format as in Rel-17.*  *Proposal 6: For multi-PUSCHs scheduled by DCI format 0\_3, when the corresponding UL grant indicates UL DAI but a PUCCH with HARQ-ACK is absent throughout the multi-PUSCHs, the UE does not multiplex HARQ-ACK on any of the PUSCHs.*  **Qualcomm:**  *Proposal 5:*  *If a DCI format 1\_3 has a one-shot HARQ-ACK request field with value 1, and if the UE is not provided pdsch-HARQ-ACK-EnhType3DCI-FieldDCI-1-3, the index of enhanced Type-3 HARQ-ACK codebook is provided by the value of the MCS field for TB1 of a cell in the DCI format 1\_3, where the cell is with the smallest serving cell index amongst the cells with the FDRA field in the DCI format 1\_3 being set to:*   * *All 0s for RA Type 0* * *All 1s for RA Type 1* * *All 0s or 1s for dynamic switching of RA Type*   *Proposal 6:*   * *DCI format 1\_3 that triggers HARQ-ACK re-transmission does not schedule PDSCH on any of the cells* * *If the HARQ-ACK retransmission indicator field value in the DCI format 1\_3 is ‘1’, the UE determines slot m as m = n – l where l is determined by a one-to-one mapping in ascending order among the values of the MCS field for TB1 of a scheduled cell in the DCI format 1\_3 and the values from -7 to 24.* |

## Moderator summary and proposals based on contributions

* On enhanced Type-3 HARQ-ACK codebook determination

When enhanced Type-3 HARQ-ACK codebook is triggered by DCI format 1\_3, one open issue is how to determine the MCS field used for indication of the Type-3 HARQ-ACK codebook index in DCI format 1\_3 in case of Type-3 CB triggering without PDSCH scheduling. It is straightforward to use the MCS field of the cell with smallest index among the cells with invalid FDRA field value to determine the index of enhanced Type3 HARQ-ACK for this case.

Hence, Proposal 4-1 is provided for further discussion.

* On HARQ-ACK codebook retransmission

According to current specification, for DCI format 1\_1 or 1\_2, if the HARQ-ACK retransmission indicator field value in a DCI format is '1’, gNB does not schedule a PDSCH reception, and use the MCS filed to indicate . UE will perform one HARQ-ACK codebook retransmission according to scheduling signal.

For multi-cells scheduling using DCI format 1\_3, it can schedule up to four cells within a cell set and the DCI format includes up to four MCS fields. When the UE is indicated more than one scheduled cell without scheduling PDSCH by DCI format 1\_3, it is not clear which cell’s MCS field can be used to indicate value of . Similar as above, it is straightforward to use the MCS field of the cell with smallest index among the cells with invalid FDRA field value to indicate the value of *l*.

Hence, Proposal 4-2 is provided for discussion.

## 1st round of discussions

#### Proposal 4-1:

* For an enhanced Type-3 HARQ-ACK codebook triggered by a DCI format 1\_3, the MCS field corresponding to a cell with smallest serving cell index among the co-scheduled cells with invalid FDRA field values is used to indicate the index of the enhanced Type-3 HARQ-ACK codebook.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Support in principle.  We may need to be carefull with the wording, as if the FDRA field is not valid for FDRA field type of scheduling indication, that cell is not ‘co-scheduled’  So maybe better to say:   * For an enhanced Type-3 HARQ-ACK codebook triggered by a DCI format 1\_3, the MCS field corresponding to a cell with smallest serving cell index ~~among the co-scheduled cells~~ with invalid FDRA field values is used to indicate the index of the enhanced Type-3 HARQ-ACK codebook.   Or even better, try to work on a TP for 9.1.4 of TS 38.213 directly. |
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#### Proposal 4-2:

* For HARQ-ACK retransmission triggered by a DCI format 1\_3, the MCS field corresponding to a cell with smallest serving cell index among the co-scheduled cells with invalid FDRA field values is used to indicate the value of *l*.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Support in principle.  Same comment as for 4-1:  We may need to be careful with the wording, as if the FDRA field is not valid for FDRA field type of scheduling indication, that cell is not ‘co-scheduled’  So maybe better to say:   * For HARQ-ACK retransmission triggered by a DCI format 1\_3, the MCS field corresponding to a cell with smallest serving cell index ~~among the co-scheduled cells~~ with invalid FDRA field values is used to indicate the value of *l*. |
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# High layer parameters

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| **Huawei:**  *Proposal 1: Single joint table is configured per set of cells for TDRA field.*   * *Entries for each CC are interpreted based on the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3.* * *Out-of-range indexes are avoided by gNB implementation.*   *Proposal 2: The maximum size of TDRA-FieldIndexListDCI-1-3 and TDRA-FieldIndexListDCI-0-3 can be 128****.***  **Spreadtrum:**  *P9: For Type-1B configuration:*  *Single joint table is configured per set of cells for each of Type 1B fields other than TDRA (i.e., rateMatchListDCI-1-3, zp-CSI-RSListDCI-1-3, tci-ListDCI-1-3, srs-RequestListDCI-1-3, srs-OffsetListDCI-1-3, srs-RequestListDCI-0-3, srs-OffsetListDCI-0-3).*   * *Entries for each CC are interpreted based on the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3.* * *Out-of-range indexes are avoided by gNB implementation.*   *Single joint table is configured per set of cells for TDRA (i.e., TDRA-FieldIndexListDCI-1-3, TDRA-FieldIndexListDCI-0-3).*   * *Entries of the joint table for TDRA (i.e., TDRA-FieldIndexDCI-1-3) are configured for each BWP of each CC, i.e., the maximum size of TDRA-FieldIndexDCI-1-3 can be increased from 4 to [16].* * *Columns of the indicated entry corresponding to the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3 are applied.*   **Vivo:**  *Proposal 3. The field description of TDRA-FieldIndexDCI-1-3 and TDRA-FieldIndexDCI-0-3 should be updated as below***:** *- the first TDRA index in a row of TDRA-FieldIndexDCI-1-3 or TDRA-FieldIndexDCI-0-3 is for BWP with the smallest BWP-Id that can be indicated by the BWP indicator field, as specified in 38.212, for ~~of~~ the first cell in ScheduledCell-ListDCI-1-3, second TDRA index in a row is for BWP with the next smaller BWP Id of the first cell and so on. - the number of TDRA indices in a row of TDRA-FieldIndexDCI-1-3 or TDRA-FieldIndexDCI-0-3 should be the same as the total number of BWPs across cells included in ScheduledCell-ListDCI-1-3 or ScheduledCell-ListDCI-0-3 that can be indicated by the BWP indicator field.*  *Proposal 4. Update the value range of SRS-OffsetCombo to “SEQUENCE (SIZE (1..4)) OF INTEGER (0..3)”.*  **ZTE:**  *Proposal 11: For the joint tables for Type-1B*   * *Single joint table is configured per set of cells for each of Type 1B fields other than TDRA (i.e., rateMatchListDCI-1-3, zp-CSI-RSListDCI-1-3, tci-ListDCI-1-3, srs-RequestListDCI-1-3, srs-OffsetListDCI-1-3, srs-RequestListDCI-0-3, srs-OffsetListDCI-0-3).* * *Entries for each CC are interpreted based on the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3.* * *Out-of-range indexes are avoided by gNB implementation.* * *Single joint table is configured per set of cells for TDRA (i.e., TDRA-FieldIndexListDCI-1-3, TDRA-FieldIndexListDCI-0-3).* * *Entries of the joint table for TDRA (i.e., TDRA-FieldIndexDCI-1-3) are configured for each BWP of each CC, i.e., the maximum size of TDRA-FieldIndexDCI-1-3 can be increased from 4 to [16].* * *Columns of the indicated entry corresponding to the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3 are applied.*   *Proposal 12: The number of rows should be 32 and 64 for the joint TDRA table for downlink scheduling and uplink scheduling, respectively. (i.e., maxNrofDL-Allocations-1-3=32, maxNrofUL-Allocations-0-3=64).*  *Proposal 13: The recommend proposal in last meeting for Zp-CSI-RSListDCI-1-3, rateMatchDCI-1-3, SRS offset indicator should be agreed.*   * *For ZP-CSI-DCI-1-3, the first index is for the first cell in ScheduledCell-ListDCI-1-3 configured with ZP CSI-RS trigger and so on.* * *For rateMatchDCI-1-3, the first bitmap is for the first cell in ScheduledCell-ListDCI-1-3 configured with rate matching indicator and so on.* * *For SRS-OffsetCombo, the first index is for the first cell in ScheduledCell-ListDCI-1-3 configured with SRS offset indicator and so on.*   **Nokia:**  *Proposal 3.1: On the table size for UL/DL TDRA indication (rows 28 to 31):*   * *The maximum table size for 1\_3 in column K of row 28 should be 64 (4 times the value range per cell, i.e. 4\*maxNrofDL-Allocations=64)* * *The maximum table size for 0\_3 in column K of row 30 should be 128 (2 times the value range per cell, i.e. 2\*maxNrofUL-Allocations-r16 =128)* * *The maximum number of rows of the TDRA table (in rows 29 & 31) should correspond to the maximum number of configurable UL/DL BWPs for a set of cells, i.e. 16.*   *Proposal 3.2: Adopt the following changes on row 39 (SRS-RequestCombo)*   * *Based on the RAN guidance, set the value range in column K to BIT STRING(SIZE(2..3)* * *In the column P - Comment:* * *Remove the earlier note in brackets* * *Add a note based on the RAN guidance as:  “Note:*    + - *The bit size per cell in the row of the joint SRS request configuration table is 2 for a cell configured without SUL, and the size is 3 for a cell configured with SUL*       * *Note that simultaneous transmission between {SUL and SUL} and between {SUL and NUL} is not supported in Rel-18*     - *When a cell configured with SUL is one of co-scheduled cells of DCI format 0\_3, UE does not expect that only SUL carrier in the cell is configured for PUSCH transmission on the cell*       * *PUSCH transmission(s) triggered by DCI format 0\_3 is performed only on NUL carrier(s)”*   **CATT:**  *P4: Single joint table is configured per set of cells for each of Type 1B fields (i.e., TDRA-FieldIndexListDCI-1-3, TDRA-FieldIndexListDCI-0-3, rateMatchListDCI-1-3, zp-CSI-RSListDCI-1-3, tci-ListDCI-1-3, srs-RequestListDCI-1-3, srs-OffsetListDCI-1-3, srs-RequestListDCI-0-3, srs-OffsetListDCI-0-3).*   * *Entries of the joint table are configured for each BWP of each CC, i.e., the maximum size of each row can be increased from 4 to [16].* * *Columns of the indicated entry corresponding to the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3 are applied.*   *P5: The maximum size of TDRA-FieldIndexListDCI-1-3/ TDRA-FieldIndexListDCI-0-3 can be increased to increase to 64.*  *P6: When the DCI format 1\_1 is not provided for a BWP of scheduled cell, the TDRA index for a scheduled cell ponts to:*   * *Alt.1: a corresponding TDRA in the TDRA table applicable for DCI format 1\_0/0\_0 if provided, otherwise, to apply the default TDRA table defined in TS 38.214.* * *Alt.2: a corresponding TDRA in the default TDRA table defined in TS 38.214.*   *P7: The number of entries in a row of TCI-DCI-1-3 should be the same as the number of cells, that configured with TCI state list , included in ScheduledCell-ListDCI-1-3. And the minimum size of TCI-DCI-1-3 should be change from 2 to 1.*  *P8: The maximum size of tci-ListDCI-1-3 should be change from 8 to 16.*  **OPPO:**  *Proposal 6: The maximum size of an entry in TDRA table is 16.*  *Proposal 7: The maximum number of entries in a TDRA table for DCI format 0\_3/1\_3 is 64.*  **ETRI:**  *Proposal 2: Clarify the followings in the specification (or in the RRC parameter list):*   * *Each serving cell configured in ScheduledCell-ListDCI-1-3 is referred by at least one ScheduledCellCombo in ScheduledCellCombo-ListDCI-1-3.* * *Each serving cell configured in ScheduledCell-ListDCI-1-0 is referred by at least one ScheduledCellCombo in ScheduledCellCombo-ListDCI-1-0.*   **Samsung:**  *Proposal 23: Conclude on whether or not to introduce the following new RRC parameters for DCI 0\_3, or to reuse the existing RRC parameters applicable to DCI format 0\_1:*   * *betaOffsetsCrossPri0DCI-0-3, betaOffsetsCrossPri1DCI-0-3, and UCI-OnPUSCH-DCI-0-3.*   *Proposal 24: Adopt the value range of the RRC parameter for TDRA field in DCI format 0\_3/1\_3: up to 32 or 64 rows for the DL joint TDRA table, and up to 64 or 128 rows for the UL joint TDRA table.*  **DOCOMO:**  *Proposal 4:*   * *The value range of TDRA-FieldIndexDCI-0-3 and TDRA-FieldIndexDCI-1-3 should be confirmed as SIZE(2..16) OF INTEGER(0..maxNrofDLAllocations-1)* * *The value range of TDRA-FieldIndexListDCI-0-3 should be supported as SIZE(1..64)* * *The value range of TDRA-FieldIndexListDCI-1-3 should be supported as SIZE(1..32)*   *Proposal 6: The value range of SRS-RequestCombo should be BIT STRING (2..3).* |

## Moderator summary and proposals based on contributions

* On TDRA table design

Regarding the joint table configuration of TDRA and other Type-1B fields, proposed agreement 3.1 was discussed in the last meeting, as shown below.

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| **Proposed agreement 3.1**   * Single joint table is configured per set of cells for each of Type 1B fields other than TDRA (i.e., rateMatchListDCI-1-3, zp-CSI-RSListDCI-1-3, tci-ListDCI-1-3, srs-RequestListDCI-1-3, srs-OffsetListDCI-1-3, srs-RequestListDCI-0-3, srs-OffsetListDCI-0-3).   + Entries for each CC are interpreted based on the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3.   + Out-of-range indexes are avoided by gNB implementation. * Single joint table is configured per set of cells for TDRA (i.e., TDRA-FieldIndexListDCI-1-3, TDRA-FieldIndexListDCI-0-3).   + Entries of the joint table for TDRA (i.e., TDRA-FieldIndexDCI-1-3) are configured for each BWP of each CC, i.e., the maximum size of TDRA-FieldIndexDCI-1-3 can be increased from 4 to [16].   + Columns of the indicated entry corresponding to the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3 are applied. |

Considering the above proposal is more aligned with previous RAN1 agreements and can work properly. It is a good way to further discuss based on it. Hence, a same proposal is provided for discussion.

In addition, for legacy PDSCH or PUSCH scheduling, the value range for TDRA table of PDSCH is (0..16) and the value range for TDRA table of PUSCH is (0..64). For multi-cell scheduling, four companies [Huawei, ZTE, Nokia, CATT] suggest introducing a larger TDRA table size than the legacy TDRA table size to ensure scheduling flexibility for DCI format 0\_3/1\_3, e.g., 64 or 128 rows for the TDRA table of DCI format 1\_3 or DCI format 0\_3.

Hence, a proposal is provided for further discussion.

* On SRS request

At the previous RAN1 meetings, it has been discussed for higher layer parameter discussion how many bits are required for *SRS-RequestCombo*, then following agreement was made at the RAN#101 meeting.

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| * The bit size per cell in the row of the joint SRS request configuration table is “BIT STRING(SIZE(2..3))”, where the size is 2 for a cell configured without SUL, and the size is 3 for a cell configured with SUL   + Note that simultaneous transmission between {SUL and SUL} and between {SUL and NUL} is not supported in Rel-18 * When a cell configured with SUL is one of co-scheduled cells of DCI format 0\_3, UE does not expect that only SUL carrier in the cell is configured for PUSCH transmission on the cell   + PUSCH transmission(s) triggered by DCI format 0\_3 is performed only on NUL carrier(s) |

For RAN1#114-bis meeting, 2 companies [Nokia, DOCOMO] propose the value range of *SRS-RequestCombo* in RRC parameter list should be confirmed as BIT STRING (2…3) based on above agreement.

## 1st round of discussions

#### Proposal 5-1:

* Single joint table is configured per set of cells for each of Type-1B fields other than TDRA (i.e., rateMatchListDCI-1-3, zp-CSI-RSListDCI-1-3, tci-ListDCI-1-3, srs-RequestListDCI-1-3, srs-OffsetListDCI-1-3, srs-RequestListDCI-0-3, srs-OffsetListDCI-0-3).
* Entries for each CC are interpreted based on the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3.
* Out-of-range indexes are avoided by gNB implementation.
* Single joint table is configured per set of cells for TDRA (i.e., TDRA-FieldIndexListDCI-1-3, TDRA-FieldIndexListDCI-0-3).
* Entries of the joint table for TDRA (i.e., TDRA-FieldIndexDCI-1-3) are configured for each BWP of each CC.
* Columns of the indicated entry corresponding to the new/target BWPs per cell that is indicated by the BWP indicator field of DCI 0\_3/1\_3 are applied.
* The maximum size of TDRA-FieldIndexListDCI-1-3 is 64.
* The maximum size of TDRA-FieldIndexListDCI-0-3 is 128.

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Support |
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#### Proposal 5-2:

* The value range of *SRS-RequestCombo* should be BIT STRING (2..3).

Companies are encouraged to provide comments in the table below.

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| **Company** | **Comment** |
| Nokia/NSB | Support |
| Spreadtrum | Support |
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# Others

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| **Spreadtrum:**  *P18: UE PDSCH reception preparation time of cross carrier scheduling with different SCS for PDCCH and PDSCH is also applied to multi-cell scheduling.*  **DOCOMO:**  *Proposal 9: Discuss potential updates for TS 38.300 for multi-cell scheduling and consider the following TP as a starting point.*   |  | | --- | | 10.10 Multi-carrier scheduling  Multi-carrier scheduling with Scheduled cell set indicator field allows the PDCCH of a serving cell to schedule resources on one or more serving cells with a single DCI but with the following restrictions:   * When a serving cell is configured with a PDCCH which schedules PDSCH(s)/PUSCH(s) on a cell set(s), the PUSCH/PDSCH on serving cells in the cell set(s) is always scheduled by a PDCCH on the serving cell; * When PCell is configured with a PDCCH which schedules PDSCH(s)/PUSCH(s) on serving cells in a cell set(s), that PCell’s PDSCH and PUSCH cannot be scheduled by a PDCCH on an SCell; * When an SCell is configured with a PDCCH which schedules PDSCH(s)/PUSCH(s) on serving cells in a cell set(s), PDSCH/PUSCH on PCell is not scheduled from that SCell; * The scheduling PDCCH and the scheduled PDSCH(s)/PUSCH(s) can use the same or different numerologies; * The co-scheduled PDSCH(s)/PUSCH(s) with a PDCCH use the same numerology. | |

# Proposals for online/offline discussion

# References

1. [R1-2308919](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2308919.zip) Maintenance of multi-cell PDSCCH/PUSCH scheduling with a single DCI Huawei, HiSilicon
2. [R1-2308998](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2308998.zip) Remaining issues on multi-cell PUSCH/PDSCH scheduling with a single DCI Spreadtrum Communications
3. [R1-2309089](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309089.zip) Remaining issues on Rel-18 Multi-cell scheduling vivo
4. [R1-2309136](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309136.zip) Maintenance of Multi-cell PUSCH/PDSCH scheduling with a single DCI ZTE
5. [R1-2309171](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309171.zip) On Rel-18 MC-DCI scheduling Nokia, Nokia Shanghai Bell
6. [R1-2309306](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309306.zip) Remaining issues on Multi-cell scheduling with single DCI LG Electronics
7. [R1-2309391](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309391.zip) Remaining Issues on multi-cell PUSCH/PDSCH scheduling with a single DCI Samsung
8. [R1-2309432](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309432.zip) Discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI xiaomi
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10. [R1-2309623](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309623.zip) Remaining issues for multi-cell PUSCH/PDSCH scheduling with a single DCI OPPO
11. [R1-2309642](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309642.zip) Remaining issues on multi-cell PUSCH/PDSCH scheduling with a single DCI Fujitsu
12. [R1-2309685](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309685.zip) Remaining issues on multi-cell PUSCH/PDSCH scheduling with a single DCI CMCC
13. [R1-2309698](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309698.zip) Remaining issues on Rel-18 multi-cell scheduling Lenovo
14. [R1-2309709](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309709.zip) Remaining issues on multi-cell PUSCH/PDSCH scheduling ETRI
15. [R1-2309847](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309847.zip) On remaining issues for Rel-18 multi-cell scheduling Apple
16. [R1-2309875](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309875.zip) Remaining detail on multi-cell scheduling with a single DCI ITRI
17. [R1-2309972](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2309972.zip) On maintenance for multi-cell scheduling with a single DCI MediaTek Inc.
18. [R1-2310010](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2310010.zip) Remaining Issues on multi-cell PUSCH/PDSCH scheduling with a single DCI Langbo
19. [R1-2310047](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2310047.zip) Maintenance on multi-cell PUSCH/PDSCH scheduling with a single DCI NTT DOCOMO, INC.
20. [R1-2310097](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2310097.zip) Maintenance for single DCI scheduling multiple cells Ericsson
21. [R1-2310156](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114b\Docs\R1-2310156.zip) Multi-cell PUSCH/PDSCH scheduling with a single DCI Qualcomm Incorporated

# List of agreements:

## Agreements made in RAN1#109-e

**Agreement**

Agree the following terminologies ONLY for convenience of discussion:

* DCI format 0\_X is used for scheduling multiple PUSCHs on multiple cells with one PUSCH per cell
* DCI format 1\_X is used for scheduling multiple PDSCHs on multiple cells with one PDSCH per cell.

The above does not imply introducing new DCI format(s) at this point.

**Agreement**

* Different TBs are scheduled on different cells by DCI format 0\_X.
* Different TBs are scheduled on different cells by DCI format 1\_X.

**Agreement**

* Fallback DCI (i.e., DCI formats 0\_0 and 1\_0) does not support multi-cell scheduling.

**Agreement**

* The DCI for multi-cell scheduling is monitored only in USS set.

**Agreement**

* PDSCH cannot be scheduled by DCI format 0\_X.
* PUSCH cannot be scheduled by DCI format 1\_X.

**Agreement**

* All the co-scheduled cells by a DCI format 1\_X and the scheduling cell are included in the same PUCCH group.
* FFS: All the co-scheduled cells by a DCI format 0\_X and the scheduling cell are included in the same [cell or PUCCH group].

**Agreement**

* DCI format 0-X/1-X on a scheduling cell can be used to schedule PUSCHs/PDSCHs on multiple cells including the scheduling cell.
* DCI format 0-X/1-X on a scheduling cell can be used to schedule PUSCHs/PDSCHs on multiple cells not including the scheduling cell.

**Agreement**

* For a UE, the maximum number of cells scheduled by a DCI format 0\_X can be same or different to the maximum number of cells scheduled by a DCI format 1\_X.

**Working Assumption**

* All HARQ-ACK codebook types (Type-1/2/3) are applicable when multi-carrier PDSCH scheduling is configured.

**Agreement**

* One value for the maximum number of co-scheduled cells by a DCI format 0\_X in Rel-18 is selected from {3, 4, 8}.
* For a UE, the maximum number of co-scheduled cells by a DCI format 0\_X can be smaller than or equal to the maximum number supported in Rel-18.

**Agreement**

* One value for the maximum number of co-scheduled cells by a DCI format 1\_X in Rel-18 is selected from {3, 4, 8}.
* For a UE, the maximum number of co-scheduled cells by a DCI format 1\_X can be smaller than or equal to the maximum number supported in Rel-18.

**Agreement**

* **(Working assumption)** DCI format 0\_X/1\_X is a new DCI format for multi-cell scheduling
* DCI format 0\_X can be used for single cell PUSCH scheduling.
* DCI format 1\_X can be used for single cell PDSCH scheduling.
* FFS: UE monitors one of or both multi-cell scheduling DCI and legacy single cell scheduling DCI for a scheduled cell.

**Agreement**

* DCI format 0-X/1-X can be transmitted on PCell.
* DCI format 0-X/1-X can be transmitted on a SCell at least when the DCI format 0-X/1-X does not schedule PUSCH/PDSCH on PCell.
* FFS whether a DCI format 0-X/1-X can be transmitted on an SCell if the DCI format 0-X/1-X schedules PUSCH/PDSCH on PCell.

**Agreement**

Further study DCI size budget including below options for multi-cell scheduling DCI:

* Option 1: Existing DCI size budget is maintained per scheduled cell.
  + Alt 1-1: DCI size budget is maintained via DCI size alignment and DCI size budget of DCI format 0\_X/1\_X is counted for each of the co-scheduled cells.
  + Alt 1-2: DCI size budget is maintained via configured size for multi-cell scheduling DCI and DCI size budget of DCI format 0\_X/1\_X is counted for each of the co-scheduled cells.
  + Alt 1-3: DCI size budget is maintained via DCI size alignment and DCI size budget of multi-cell scheduling DCI is counted only in one scheduled cell.
* Option 2: Existing DCI size budget is not necessarily maintained per scheduled cell.
  + Alt 2-1: DCI size budget of multi-cell scheduling DCI is counted only in one scheduled cell.
  + Alt 2-2: DCI size budget of multi-cell scheduling DCI is not counted per serving cell and not considered in the related serving cell specific DCI size alignment procedure, e.g., for K co-scheduled cells, gNB guarantee the total budget of 3\*K DCI sizes is not exceeded.
  + Alt 2-3: voiding the “3+1” limit for multi-cell scheduling
  + Alt 2-4: the DCI size budget for DCI size alignment can be separately configured for each cell
  + Alt 2-5: DCI size budget of the scheduling cell can be increased to account for the DCI format for multi-cell scheduling. Accordingly, the DCI size budget of a scheduled cell can be reduced.
* Other options/alternatives could be considered.

**Agreement**

Further study BD/CCE counting for multi-cell scheduling DCI based on below options:

* Alt 1: counted on each co-scheduled cell
* Alt 2: counted only in one scheduled cell
* Alt 3: scaled down to each of co-scheduled cell according to the number of co-scheduled cells
* Alt 4: counted as part of the scheduling cell instead of each scheduled cell
* Alt 5: scaled down to each of scheduled cells excluding scheduling cell
* Alt 6: counted on each co-scheduled cell excluding scheduling cell
* Other alternatives could be considered.

**Agreement**

For multi-cell scheduling, the co-scheduled cells are indicated by DCI format 0\_X/1\_X. At least the following options are considered:

* Option 1: An indicator in the DCI points to one row of a table defining combinations of scheduled cells.
  + The table is configured by RRC signaling.
  + FFS: Separate tables can be configured for multi-cell PDSCH scheduling and multi-cell PUSCH scheduling.
* Option 2: An indicator in the DCI is a bitmap corresponding to a set of configured cells that can be scheduled by the DCI 0\_X/1\_X
  + FFS: Separate sets of configured cells for multi-cell PDSCH scheduling and multi-cell PUSCH scheduling.
* Option 3: using existing field (e.g., CIF, FDRA) to indicate whether one or more cells are scheduled or not
* Other options are not precluded.
* Note: It does not preclude other DCI information fields (e.g., BWP) to be jointly indicated by the indicator of the co-scheduled cells.

**Agreement**

For design of multi-cell scheduling DCI, companies are encouraged to consider following types of DCI fields:

* Type-1 field: A single field indicating common information to all the co-scheduled cells or separate information to each of co-scheduled cells via joint indication or an information to only one of co-scheduled cells
* Type-2 field: Separate field for each of the co-scheduled cells, or each sub-group comprising one or more co-scheduled cells where a single field is commonly applied to the co-scheduled cells belonging to a same sub-group
* Type-3 field: Common or separate to each of the co-scheduled cells or to each sub-group.
  + FFS: whether it is dependent on explicit configuration or implicit condition (e.g., intra or inter band CA, FR1 or FR2).
* Other types are not precluded.

## Agreements made in RAN1#110

**Agreement**

All the co-scheduled cells by a DCI format 0\_X and the scheduling cell are included in the same PUCCH group.

**Agreement**

Confirm below working assumption reached in RAN1#109e meeting.

* **(Working assumption)** DCI format 0\_X/1\_X is a new DCI format for multi-cell scheduling

**Working Assumption**

For a cell within a set of cells which can be co-scheduled by a DCI format 0\_X/1\_X, support monitoring the DCI format 0\_X/1\_X and legacy single cell scheduling DCI format(s) from a same scheduling cell.

* The DCI format 0\_X/1\_X and the legacy DCI format(s) can be monitored simultaneously.
  + FFS: whether monitoring of the DCI format 0\_X/1\_X and the legacy DCI format(s) is supported for one, a subset, or all cells within the set of cells.
* FFS: number of different DCI sizes for 0\_X/1\_X and for legacy DCI formats
* FFS: whether to support a subset or all legacy DCI format(s) to be monitored with DCI 0\_X/1\_X

**Working Assumption**

* The maximum number of co-scheduled cells by a DCI format 1\_X in Rel-18 is 4.
* The maximum number of co-scheduled cells by a DCI format 0\_X in Rel-18 is 4.
* FFS: The maximum number of configurable cells for co-scheduling

**Agreement**

For discussing field design of DCI format 0\_X/1\_X which schedules more than one cell, reformulate the types of DCI fields as below:

* Type-1 field:
  + Type-1A field: A single field indicating common information to all the co-scheduled cells
  + Type-1B field: A single field indicating separate information to each of co-scheduled cells via joint indication
  + Type-1C field: A single field indicating an information to only one of co-scheduled cells
* Type-2 field: Separate field for each of the co-scheduled cells
* Type-3 field: Common or separate to each of the co-scheduled cells, or separate to each sub-group, dependent on explicit configuration.
  + Note: One sub-group comprises a subset of co-scheduled cells where a single field is commonly applied to the co-scheduled cell(s) belonging to a same sub-group.
* Note: Handling of any parameters applicable to multi-cell scheduling where corresponding fields are not included in DCI format 0\_X/1\_X (if any) will be separately discussed.

**Agreement**

* For DCI format 1\_X/0\_X which can schedule more than one cell,
* Type-1 fields at least include below:
  + Type-1A:
    - Identifier for DCI formats
    - Downlink assignment index
    - TPC for scheduled PUCCH
    - PUCCH resource indicator
    - PDSCH-to-HARQ timing indicator
    - One-shot HARQ-ACK request
* Type-2 fields at least include below:
  + New data indicator per TB
  + Redundancy version per TB
* FFS: Other fields to be included in DCI format 1\_X/0\_X and which type of the fields belongs to.
* FFS: size for each field

**Agreement**

* When UE detects a DCI format 1\_X scheduling a set of PDSCHs, the UE provides corresponding HARQ-ACK information in a PUCCH transmission within UL slot , where is a number of slots and is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format and is the last UL slot overlapping with the DL slot for the reference PDSCH reception for slot-based PUCCH or an UL slot overlapping with the end of the reference PDSCH reception in DL slot for sub-slot based PUCCH.



* FFS details of reference PDSCH

**Agreement**

* For Type-2 HARQ-ACK codebook, two sub-codebooks are generated with a first sub-codebook comprising HARQ-ACK information bits for PDSCH(s) scheduled by DCI(s) with each scheduling a single cell and a second sub-codebook comprising HARQ-ACK information bits for PDSCH(s) scheduled by DCI(s) with each scheduling more than one cell.
* Separate DAI counting for DCI(s) with each scheduling a single cell and DCI(s) with each scheduling more than one cell.
* FFS whether a DCI scheduling more than one cell is associated with the first sub-codebook or the second sub-codebook when the number of cells with actual PDSCH reception due to collision with semi-static TDD DL/UL configuration is one.
* Type-2 HARQ-ACK codebook is generated by concatenating the first sub-codebook and the second sub-codebook.
* If at least one cell of the set of cells which can be co-scheduled by a DCI format 1\_X is configured with maximum 2 codewords per PDSCH without spatial bundling,
  + FFS: the number of HARQ-ACK information bits for each DCI format 1\_X that schedules more than one cell;
* Otherwise, the number of HARQ-ACK information bits for each DCI format 1\_X that schedules more than one cell is equal to N, where N is the maximum number of cells which can be co-scheduled by a DCI format 1\_X in the PUCCH group for the UE.
* HARQ-ACK information bits for co-scheduled PDSCHs by a DCI format 1\_X is ordered based on serving cell indices associated with co-scheduled PDSCHs.
* HARQ-ACK bundling across co-scheduled cells is not supported for multi-cell scheduling.

**Agreement**

* UE does not expect to be configured both CBG-based PDSCH/PUSCH transmission and the multi-cell PDSCH/PUSCH scheduling on the same or different cells within a same PUCCH group.

**Agreement**

* At least cases 1-1 and 1-2 on SCS are supported:
* Case 1-1: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells including the scheduling cell and same SCS is used among all the co-scheduled cells including the scheduling cell.
* Case 1-2: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells not including the scheduling cell and same SCS is used among all the co-scheduled cells which may be same or different to the SCS of the scheduling cell.
* Case 1-3: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells including the scheduling cell and different SCS is used among the co-scheduled cells including the scheduling cell.
* Case 1-4: A DCI format 0-X/1-X on a scheduling cell can schedule multiple cells not including the scheduling cell and different SCS is used among the co-scheduled cells.
* FFS: Whether Case 1-3 or 1-4 is additionally supported.

## Agreements made in RAN#97

**Conclusion:**

* Deprioritize any optimization for unlicensed spectrum operation for designing the multi-cell PUSCH/PDSCH scheduling in Rel-18.
* Enhanced Type-2 HARQ-ACK codebook is not supported for the multi-cell PUSCH/PDSCH scheduling in Rel-18.
* Type-1 HARQ-ACK codebook is supported only for the case where co-scheduled cells by a DCI format 1\_X have same SCS/carrier type/duplex mode in Rel-18.
* Additional restriction(s) can be discussed in RAN1
* Configuring more than one scheduling cell for DCI format 0\_X/1\_X for each scheduled cell is not supported for the multi-cell PUSCH/PDSCH scheduling in Rel-18.

**Conclusion:**

* Followings are excluded from multi-cell PDSCH/PUSCH scheduling in Rel-18.
* SCell schedules multiple cells including P(S)Cell
* Different SCS among co-scheduled cells
* Different carrier type (licensed or unlicensed, FR1 or FR2-1 or FR2-2) among co-scheduled cells
* Configuration of both multi-cell PDSCH/PUSCH scheduling and multi-TRP for a scheduled cell
* Support for any sidelink scheduling

**Conclusion:**

* Following is excluded from multi-cell PDSCH/PUSCH scheduling in Rel-18.
* PCell schedules multiple cells by DCI format 0\_X/1\_X when a sSCell is configured to schedule PCell

## Agreements made in RAN1#110bis

**Agreement**

Confirm the following working assumption reached in RAN1#110 meeting.

**Working Assumption**

* The maximum number of co-scheduled cells by a DCI format 1\_X in Rel-18 is 4.
* The maximum number of co-scheduled cells by a DCI format 0\_X in Rel-18 is 4.
* FFS: The maximum number of configurable cells for co-scheduling

**Agreement**

At least the following fields are excluded from DCI format 1\_X/0\_X:

* CBGTI
* CBGFI
* PDSCH group index
* New feedback indicator
* Number of requested PDSCH group(s)
* Sidelink assignment index
* Second TPC command for scheduled PUSCH
* Second SRS resource indicator
* Second Precoding information
* Second PTRS-DMRS association
* Second TPC command for scheduled PUCCH

**Agreement**

For DCI format 1\_X/0\_X, Type-1 fields at least include the following:

* Priority indicator
* Indicator of co-scheduled cells
* beta offset indicator
* CSI request
* UL-SCH indicator
* FFS: ChannelAccess-CPext

**Agreement**

Confirm below working assumption reached in RAN1#110 meeting with revision.

**Working Assumption**

* For any cell within a set of cells which can be co-scheduled by a DCI format 0\_X/1\_X, RAN1 specification supports monitoring the DCI format 0\_X/1\_X and DCI format 0\_0/1\_0, 0\_1/1\_1, and/or 0\_2/1\_2 (if supported by the UE), if configured from a same scheduling cell.
* The DCI format 0\_X/1\_X and the DCI format 0\_0/1\_0/0\_1/1\_1/0\_2/1\_2 can be monitored simultaneously.
* Note: This does not mean a UE is required to support number of BDs/CCEs beyond the Rel-17 limits (i.e., and ) for PDCCH candidates for each scheduled cell.

**Agreement**

For a set of cells co-scheduled by a DCI format 0\_X/1\_X, time domain resource allocations for the set of cells are ~~jointly~~ indicated by a single TDRA field in the DCI format 0\_X/1\_X.

* Separate {SLIV, mapping type, scheduling offset K0 (or K2)} is indicated for each of co-scheduled PDSCHs/PUSCHs.
* FFS details of the TDRA table design

**Agreement**

Confirm below working assumption:

**Working Assumption**

HARQ-ACK codebook types (Type-1, Rel-15 Type-2, Rel-16 Type-3, Rel-17 Type-3) are applicable when multi-cell PDSCH scheduling is configured.

**Working Assumption**

For a set of cells which is configured for multi-cell scheduling,

* Existing DCI size budget is maintained on each cell of the set of cells.
* DCI size of DCI format 0\_X/1\_X is counted on one cell among the set of cells.
  + FFS which cell DCI size of the DCI format 0\_X/1\_X is counted on.
* BD/CCE of DCI format 0\_X/1\_X is counted on one cell among the set of cells.
  + FFS which cell BD/CCE of the DCI format 0\_X/1\_X is counted on.
* Search space of DCI format 0\_X/1\_X is configured on one cell of the set of cells and associated with the search space of the scheduling cell with the same search space ID.
  + FFS which cell the SS of the DCI format 0\_X/1\_X is configured on.
* FFS: How to address Rel-17 BD/CCE limit for any given cell (operating the feature under Rel-17 BD/CCE limit)
* Note: This does not mean a UE is required to support number of BDs/CCEs beyond the Rel-17 limits (i.e., and ) for PDCCH candidates for each scheduled cell.

**Agreement**

* UE does not expect to be configured both multi-PDSCH scheduling and multi-cell PDSCH scheduling on the same or different cells within a same PUCCH group.

**Agreement**

* For Type-2 HARQ-ACK codebook, if at least one cell of a set of cells which can be co-scheduled by DCI format 1\_X is configured with maximum 2 codewords per PDSCH without spatial bundling, the number of HARQ-ACK information bits for each DCI format 1\_X that schedules more than one cell of the set of cells is equal to M, where M is the maximum number of TBs which can be co-scheduled by a DCI format 1\_X in the PUCCH group for the UE.

**Agreement**

* For Type-2 HARQ-ACK codebook, a DCI format 1\_X scheduling more than one cell is associated with the second sub-codebook when the number of cells with actual PDSCH reception due to collision with semi-static TDD DL/UL configuration is one.
* If a UE is scheduled by a DCI format 1\_X to receive PDSCH over multiple cells, and if tdd-UL-DL-ConfigurationCommon, or tdd-UL-DL-ConfigurationDedicated, indicates that, for a cell from the multiple cells, at least one symbol from a set of symbols where the UE is scheduled PDSCH reception in the cell is an uplink symbol, the UE does not receive the PDSCH in the cell.
* If a UE is scheduled by a DCI format 0\_X to transmit PUSCH over multiple cells, and if tdd-UL-DL-ConfigurationCommon, or tdd-UL-DL-ConfigurationDedicated, indicates that, for a cell from the multiple cells, at least one symbol from a set of symbols where the UE is scheduled PUSCH transmission in the cell is a downlink symbol, the UE does not transmit the PUSCH in the cell.

## Agreements made in RAN1#111

**Proposal 2-1 rev3:**

Confirm the RAN1#110bis-e working assumption with the following changes:

**Working Assumption**

For a set of cells which is configured for multi-cell scheduling,

* Existing DCI size budget is maintained on each cell of the set of cells.
* DCI size of DCI format 0\_X/1\_X is counted on one cell among the set of cells.
  + DCI size of the DCI format 0\_X/1\_X is counted on the reference cell.
* BD/CCE of DCI format 0\_X/1\_X is counted on one cell among the set of cells.
  + BD/CCE of the DCI format 0\_X/1\_X is counted on the reference cell.
* Same reference cell is used for both DCI format 0\_X and DCI format 1\_X.
* The reference cell is
  + the scheduling cell if the scheduling cell is included in the set of cells and search space of the DCI format 0\_X/1\_X is configured only on the scheduling cell;
  + one cell of the set of cells which search space of DCI format 0\_X/1\_X is configured on and associated with the search space of the scheduling cell with the same search space ID if search space of the DCI format 0\_X/1\_X is configured on the cell in addition to the scheduling cell.
    - It is up to gNB on which cell the SS of the DCI format 0\_X/1\_X is configured on.
* To address Rel-17 BD/CCE limit for any given cell (operating the feature under Rel-17 BD/CCE limit)
  + For the reference cell, a total number of configured BD/CCEs for both DCI formats 0\_X/1\_X and legacy DCI formats (if configured) does not exceed the Rel-17 limits.
  + For other cells in the sets of cells, Rel-17 limits for PDCCH/DCI monitoring and BD/CCE counting rules for legacy DCI formats (not including DCI formats 0\_X/1\_X) apply
* ~~Note: This does not mean a UE is required to support number of BDs/CCEs beyond the Rel-17 limits (i.e., and ) for PDCCH candidates for each scheduled cell.~~

**Agreement**

For a set of cells which is configured for multi-cell scheduling, up to 4 cells within the set of cells are supported.

* A DCI format 0\_X/1\_X can schedule PUSCH(s)/PDSCH(s) on a combination of co-scheduled cells among the same set of cells.

**Agreement**

For DCI format 1\_X/0\_X,

* Type-1 fields at least include below:
  + ChannelAccess-Cpext
  + TDRA
* Below fields are agreed to be supported for DCI format 0\_X/1\_X. FFS: Whether the fields are type1, type2, type configurable, or omitted. FFS: details on the fields (e.g. length, which legacy configurations are applicable), other fields.
  + HARQ process number
  + MCS (FFS: potential compression scheme)
  + Bandwidth part indicator
  + Frequency domain resource assignment (FFS: potential compression scheme)
  + VRB-to-PRB mapping
  + PRB bundling size indicator
  + Rate matching indicator
  + ZP CSI-RS trigger
  + Antenna port(s)
  + Transmission configuration indication
  + DMRS sequence initialization
  + Frequency hopping flag
  + TPC command for scheduled PUSCH
  + Precoding information and number of layers
  + PTRS-DMRS association
  + SRS request
  + SRS resource indicator
  + SRS offset indicator
  + PTRS-DMRS association
  + Open-loop power control parameter set indication
  + UL/SUL indicator

Note: RAN1 strives to minimize the number of fields which are type configurable.

**Agreement**

For monitoring PDCCH candidates for a set of cells which is configured for multi-cell scheduling, the n\_CI in the search space equation is determined by a value configured for the set of cells by RRC signaling.

Agreement

The types for below fields in DCI format 1\_X are listed ([R1-2212924](file:///D:\RAN1\RAN1%23112\tdocs\FL%20summary\R1-2212924.zip)):

|  |  |  |
| --- | --- | --- |
| **Field** | **Type** | **Details (for information only)** |
| HARQ process number | Type 2 | Details in Section 7.1.1 |
| MCS | Alt 1: Type 2 (without compression) | Details in Section 7.1.2 |
| BWP indicator | Type 1A | Details in Section 7.1.3 |
| FDRA | Type 2   * Further consider larger RBG granularity than existing maximum specified or configured value for RA type 0 * Use large RBG-based RIV for RA type 1 based on R16 configurable granularities for DCI format 1\_2 | Details in Section 7.1.4 |
| VRB-to-PRB mapping | Type 1A | Details in Section 7.1.5 |
| PRB bundling size indicator | Type 1A | Details in Section 7.1.6 |
| Rate matching indicator | Type 1B (up to 4 bits) | Details in Section 7.1.7 |
| ZP CSI-RS trigger | Type 1B (up to 3 bits) | Details in Section 7.1.8 |
| Antenna port(s) | Configurable between Type 1A and Type 2 | Details in Section 7.1.9 |
| TCI | Type 1B (up to 4 bits) | Details in Section 7.1.10 |
| DMRS sequence initialization | Type 1A | Details in Section 7.1.11 |
| SRS request | Type 1B (up to 4 bits) | Details in Section 7.1.12 |
| SRS offset indicator | Type 1B (up to 3 bits) | Details in Section 7.1.13 |

This does not imply that payload of DCI can be larger than what is supported for polar code in Rel-17.

FFS: Details

**Agreement**

* The types for below fields in DCI format 0\_X are listed:

|  |  |  |
| --- | --- | --- |
| Field | Type | **Details (for information only)** |
| HARQ process number | Type 2 | Details in Section 7.2.1 |
| MCS | Alt 1: Type 2 (without compression) | Details in Section 7.2.2 |
| BWP indicator | Type 1A | Details in Section 7.2.3 |
| FDRA | Type 2   * Further consider larger RBG granularity than existing maximum specified or configured value for RA type 0 * Use large RBG-based RIV for RA type 1 based on R16 configurable granularities for DCI format 1\_2 | Details in Section 7.2.4 |
| Frequency hopping flag | Type 1A | Details in Section 7.2.5 |
| TPC command for scheduled PUSCH | Type 2 | Details in Section 7.2.6 |
| Open-loop power control parameter set indication | Type 1A | Details in Section 7.2.7 |
| Antenna port(s) | Configurable between Type 1A and Type-2 | Details in Section 7.2.8 |
| Precoding information and number of layers | Configurable between Type 1A and Type-2 | Details in Section 7.2.9 |
| PTRS-DMRS association | Type 2 | Details in Section 7.2.10 |
| DMRS sequence initialization | Type 1A | Details in Section 7.2.11 |
| SRS request | Type 1B (up to 4 bits) | Details in Section 7.2.12 |
| SRS resource indicator | Configurable between Type 1A and Type-2 | Details in Section 7.2.13 |
| SRS offset indicator | Type 1B (up to 3 bits) | Details in Section 7.2.14 |
| UL/SUL indicator | FFS | Details in Section 7.2.15 |

This does not imply that payload of DCI can be larger than what is supported for polar code in Rel-17.

FFS: Details

## Agreements made in RAN1#112

**Agreement**

For Type-2 HARQ-ACK codebook, for a set of cells which is co-scheduled by a DCI format 1\_X, the reference PDSCH to determine DAI counting is the PDSCH with smallest serving cell index among the set of co-scheduled cells.

**Agreement**

* For a set of cells which is co-scheduled by a DCI format 1\_X, the PDSCH with the smallest serving cell index among the set of co-scheduled cells is used to determine last DCI format for PUCCH determination among DCI formats within a same PDCCH MO.
* It is up to gNB implementation to resolve the last DCI format issue when both DCI format 1\_X and other DCI format 1\_0/1\_1/1\_2/1\_X are received in a same PDCCH monitoring occasion on a same scheduling cell for scheduling PDSCHs on same scheduled cell.

**Agreement**

For determining the timing of a PUCCH carrying HARQ-ACK information corresponding to a set of co-scheduled PDSCHs by a DCI format 1\_X, the reference PDSCH is the PDSCH ending last as indicated in the DCI format 1\_X among the set of co-scheduled PDSCHs.

**Conclusion**

Type-1 HARQ-ACK codebook is supported for multi-cell scheduling without K1 extension.

* UE expects HARQ-ACK information for all co-scheduled PDSCHs by DCI format 1\_X can be mapped in the Type-1 HARQ-ACK codebook.
* Type-1 HARQ-ACK codebook is not enhanced for Rel-18 multi-cell scheduling.

**Agreement**

For a set of cells which is configured for multi-cell scheduling using DCI format 0\_X/1\_X, a joint TDRA table is configured by RRC signaling for the set of cells with each row in the table containing TDRA indexes for all cells within the set of cells.

* TDRA field in the DCI format 0\_X/1\_X belongs to Type-1B field.
* TDRA field in the DCI format 0\_X/1\_X indicates a row from the joint TDRA table.
* TDRA index for a cell points to a corresponding TDRA in the TDRA table applicable for DCI format 0-1/1-1.

**Agreement**

CSI request in DCI format 0\_X belongs to Type-1C field.

* This field is applied to the cell with smallest serving cell index among the co-scheduled cells.

**Agreement**

UL-SCH indicator in DCI format 0\_X belongs to Type-1C field.

* This field is applied to the cell with smallest serving cell index among the co-scheduled cells.

**Agreement**

Enhanced Type-3 codebook indicator in DCI format 1\_X belongs to Type-1A field.

**Agreement**

HARQ-ACK retransmission indicator in DCI format 1\_X belongs to Type-1A field.

**Agreementl**

PUCCH Cell indicator in DCI format 1\_X belongs to Type-1A field.

**Agreement**

For a set of cells configured for multi-cell scheduling using DCI format 0\_X/1\_X,

* the size of a Type-1A field in the DCI format 0\_X/1\_X is determined as maximum field size of active BWP among all cells within the set of cells.
* the size of a Type-1B field in the DCI format 0\_X/1\_X is equal to ceiling(log2(N)), where N is the number of rows in RRC-configured table with each row containing multiple indexes for all cells within the set of cells.
  + The Type-1B field indicates one row of the configured table
  + The Type-1B index for a cell points to a corresponding index in a RRC configured table applicable for DCI format 0\_1/1\_1 or MAC CE activated values.
* the size of a per cell Type-2 field in the DCI format 0\_X/1\_X is determined based on active BWP for each cell.

**Agreement**

For a set of cells which is configured for multi-cell scheduling using DCI format 0\_X and DCI format 1\_X, support the following:

* If table defining combinations of co-scheduled cells for the set of cells is configured,
  + an indicator in the DCI is included and points to one row of the table.
  + The table is configured by RRC signaling for the set of cells.
    - Separate tables are configured for downlink scheduling and uplink scheduling
  + The size of the indicator is equal to ceil(log2(N)), where N is the number of rows in the table.
  + The max number of rows in the table is 16
  + The size of the per-cell Type 2 fields for each co-scheduled cell does not change according to the indicated co-scheduled cell combination
  + The payload size of DCI format 1\_X is derived by UE based on RRC configuration of the active BWP(s) of co-scheduled cell combinations within the set of cells.
    - The payload size of DCI format 1\_X is the same for the active BWP(s) of all the co-scheduled cell combinations and equal to the largest payload size among the active BWP(s) of all the co-scheduled cell combinations determined by the co-scheduled cell combination table.
  + The payload size of DCI format 0\_X is derived by UE based on RRC configuration of the active BWP(s) of co-scheduled cell combinations within the set of cells.
    - The payload size of DCI format 0\_X is the same for the active BWP(s) of all the co-scheduled cell combinations and equal to the largest payload size among the active BWP(s) of all the co-scheduled cell combinations determined by the co-scheduled cell combination table.
* Otherwise,
  + The UE determines the actually scheduled cell(s) based on the FDRA field of each cell of the set of cells.
    - For Type 0 FDRA, all 0s indicates the cell is not scheduled.
    - For Type 1 FDRA, all 1s indicates the cell is not scheduled.
  + The size of the Type 2 fields for each cell does not change according to actually co-scheduled cells.
  + The payload size of DCI format 0\_X is derived by UE based on RRC configuration of the active BWP(s) of all cells within the set of cells.
  + The payload size of DCI format 1\_X is derived by UE based on RRC configuration of the active BWP(s) of all cells within the set of cells.

**Agreement**

Following is supported in Rel-18 multi-cell scheduling

* A UE can be configured one or multiple sets of cells with each set configured for multi-cell scheduling using DCI format 0\_X/1\_X.
* Up to 4 sets of cells can be configured per PUCCH group.
* When multiple sets of cells are configured,
  + a cell in one set of cells can’t be included in another set of cells.
  + n\_CI value is independently configured for each set of cells.
  + reference cell for counting DCI size and BD/CCE of DCI format 0\_X/1\_X is independently determined for each set of cells.
  + search space configuration of DCI format 0\_X/1\_X is independently configured for each set of cells.
  + DCI size of DCI format 0\_X is independently determined for each set of cells.
  + DCI size of DCI format 1\_X is independently determined for each set of cells.
* The multiple sets of cells can be scheduled by DCI format 0\_X/1\_X from different scheduling cells.
* Up to N sets of cells can be configured and respectively scheduled by DCI format 0\_X/1\_X from a same scheduling cell.
  + The value of N is reported as UE capability.
  + An indicator is included in the DCI to indicate the scheduled set of cells,
    - The size of the indicator is equal to ceil(log2(N)), where N is the number of sets of cells.
  + Unique n\_CI value is configured for each set of cells.

**Agreement**

* A new RBG size configuration “Configuration 3” is added with the following values and only used for DCI format 0\_X/1\_X for RA type 0.
* RBG size is configured per BWP per cell.
* Independent RA type configuration is applied per BWP per cell for multi-cell scheduling DCI.

**Table 5.1.2.2.1-1 / Table 6.1.2.2.1-1: Nominal RBG size *P***

|  |  |  |  |
| --- | --- | --- | --- |
| **Bandwidth Part Size** | **Configuration 1** | **Configuration 2** | **Configuration 3** |
| 1 – 36 | *2* | 4 | 8 |
| 37 – 72 | 4 | 8 | 16 |
| 73 – 144 | 8 | 16 | 32 |
| 145 – 275 | 16 | 16 | 32 |

**Agreement**

DCI format 0\_X / 1\_X with CRC scrambled by C-RNTI and MCS-C-RNTI is supported.

**Agreement**

For a set of cells which is configured for multi-cell scheduling using DCI format 0\_X/1\_X, if DCI size budget on the reference cell can’t be maintained after performing Rel-17 DCI size alignment procedures for legacy DCI formats (after step 4C), UE applies zero padding to whichever of DCI formats 0\_X or 1\_X that has a smaller size to have equal size.

**Agreement**

* Separate search space sets for DCI format 0\_X/1\_X and legacy DCI formats are independently configured
* Separate search space sets for DCI format 0\_X and 1\_X can be independently configured

**Agreement**

If the UE is configured with two SRS resource sets with ‘codebook’ or ‘non-codebook’, a PUSCH scheduled by DCI format 0\_X is always associated with the first SRS resource set with ‘codebook’ or ‘non-codebook’.

**Conclusion**

PUSCH repetition Type B operation is not supported with DCI format 0\_X (i.e. UE cannot be configured with PUSCH repetition Type B applicable for DCI format 0\_1)

**Agreement**

New RRC parameter of RBG granularity for RA type 1 can be configured per BWP per cell for DCI format 0\_X/1\_X with same value range applicable for DCI 0\_2/1\_2.

**Agreement**

Size of RV field can be configured per BWP per cell for DCI format 0\_X/1\_X.

**Agreement**

Size of HPN field can be configured per BWP per cell for DCI format 0\_X/1\_X.

**Agreement**

Priority indicator in DCI format 0\_X belongs to Type-1A field.

* The indicated priority is applied to all the co-scheduled PUSCH(s)

Priority indicator in DCI format 1\_X belongs to Type-1A field.

* The indicated priority indicator is applied to the PUCCH.

RRC parameters is introduced to configure the presence of priority indicator in DCI format 0\_X/1\_X

* This parameter is per set of cells

**Agreement**

ChannelAccess-Cpext in DCI format 1\_X belongs to Type-1A field.

* The indicated channel access information is applied to the PUCCH and/or SRS (whichever is first).

ChannelAccess-Cpext-CAPC in DCI format 0\_X belongs to Type-1A field.

* The indicated code point is applied to all the co-scheduled PUSCHs and/or SRS (whichever is first) by DCI format 0\_X.

**Agreement**

Beta\_offset indicator in DCI format 0\_X belongs to Type-1A field.

* This field is applied to the scheduled PUSCH(s) where the UCI is multiplexed.

**Agreement**

Inclusion of SCell dormancy indication in DCI format 0\_X/1\_X is configurable

**Agreement**

Inclusion of PDCCH monitoring adaptation indication in DCI format 0\_X/1\_X is configurable

**Agreement**

Inclusion of minimum applicable scheduling offset indicator in DCI format 0\_X/1\_X is configurable