3GPP TSG RAN WG1 #118bis R1-240xxxx

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**Agenda item: 9.10.1**

**Source: Moderator (Nokia)**

**Title: Moderator summary #1 - Enabling TX/RX for XR during RRM measurements**

**Document for: Discussion and Decision**

# Introduction

The following objectives were agreed to be part of Rel19 WI on XR, XR (eXtended Reality) for NR Phase 3 [1]:

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| --- |
| - Specify support for multimodality in RAN for UL and DL [RAN3]:  NOTE: This is subject to alignment with SA2, e.g., if MMSID is not available from CN, then UE assistance information-based approach as an alternative. RAN#106 to check handling of uplink discard based on SA2/SA4 outputs on whether the corresponding information is available at the UE.  NOTE: Review in RAN#106 the conclusions in SA2 side (including MMSID delivery to RAN) to allocation for further TUs in RAN3 from Q1/25 onwards.  - Specify enhancements to enable transmission/reception in gaps/restrictions that are caused by RRM measurements (from inter-frequency RRM measurement gaps, or intra-frequency measurements, or other scheduling restrictions etc). [RAN1, RAN2, RAN4]  - Specify the corresponding measurement gap and scheduling restriction to enable the identified enhancements with RRM performance impact taken into consideration, work being triggered by LS. [RAN4]  - Specify Enhancements for support of UL scheduling to enable high XR capacity while meeting delay requirements/avoiding too late PDUs, as follows [RAN2]:  - Specify additional Logical Channel priority handling using delay/deadline information of packets;  - Specify enhanced DSR (Delay Status Report) reporting with multiple pairs of remaining time and buffer size for an LCG.  - Specify the following user plane enhancements [RAN2]:  - RLC re-transmission related enhancements for operation of RLC Acknowledged Mode (AM) with small packet delay budget.  - Extend Release 18 standalone mechanism to support NR-NR dual connectivity as follows [RAN3]:  - PDU set based handling;  - ECN marking;  - Burst Arrival Time reporting, if needed;  - PSI Discard coordination, if needed;  NOTE: No RAN2 impact from above items.  - Specify uplink congestion signalling [RAN2]:  - Specify in MAC layer XR rate control signalling over downlink per QoS flow/per DRB to enable faster source rate adaption to uplink congestion.  - Specify Core requirements related to the above objectives as necessary [RAN4]. |

According to the Work Item description [1], RAN1 shall carry the normative work for the following objective:

* Specify enhancements to enable transmission/reception in gaps/restrictions that are caused by RRM measurements (from inter-frequency RRM measurement gaps, or intra-frequency measurements, or other scheduling restrictions etc). [RAN1, RAN2, RAN4]

This document provides a summary of contributions submitted to RAN1#118bis under agenda item 9.10.1 Enabling TX/RX for XR during RRM measurements.

# Enabling TX/RX for XR during RRM measurements

## Details of Alt. 1-1 (Explicit indication by DCI)

### Companies proposals and observations

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| --- | --- |
| **Company** | **Proposals/Observations** |
| Apple | Proposal 1: To facilitate adaptation of legacy MGs, Network Controlled Small Gaps, MGs for multi-SIM, MGs for positioning with a unified signaling design, MGs can be indexed. A MG index set consists of one or more MG index, MGs referred by a MG index set can be skipped through a single NW indication. |
| CATT | Proposal 1: The 1-bit Tx/Rx indication should always present in the scheduling DCI, including DCI format x\_1/x\_2/x\_3.  Proposal 2: The default of 1-bit Tx/Rx indication should be set to “no cancellation”.  Proposal 3: The 1-bit Tx/Rx indication could be set at the time for measurement gap cancellation before the minimum time offset prior to MGs or scheduling restriction.  Proposal 4: If the running retransmission timer is overlapping with the MG or restriction occasion, the MG or the restriction occasion would be indicated “cancelation” by the 1-bit Tx/Rx indication.  Proposal 5: The 1-bit Tx/Rx indication would be with the default value “no cancellation” in the scheduling DCIs at the start of DRX ON in each C-DRX cycle.  Proposal 6: When the UE is indicated to skip the MG or scheduling restriction occasion in a given XR traffic arrival cycle, UE could also terminate or suspend the RRM cancelation behavior based on the following aspects:   * The XR transmission is completed a time offset prior to the start of upcoming measurement gap, which is enough for preparing the upcoming RRM measurement. * The XR transmission is not expected to be scheduled within the upcoming measurement gaps indicated by the Rel-17 PDCCH skipping indication. * UE receives the DRX command MAC CE a time offset prior to the start of upcoming measurement gap, which is enough for preparing the upcoming RRM measurement. * UE reports the CG-PUSCH TOs with the value of '1' via the UTO-UCI, in which the Tx/Rx are not collided with the upcoming measurement gap. |
| CMCC | Proposal 1: Regarding the DCI formats carrying the new one-bit field used for skipping indication, support DCI formats 0\_1 and 1\_1.  Proposal 2: Regarding the dynamic indication to enable Tx/Rx in particular gap/restriction that are caused by RRM measurements, support to introduce a new higher layer parameter which is used to enable the inclusion of the new one-bit field in DCI formats 0\_1 and 1\_1.  Proposal 3: Regarding the new one-bit field in DCI used for skipping indication, bit equal to 1 indicates the corresponding gap/restriction occasion is to be skipped while bit equal to 0 indicates the corresponding gap/restriction occasion is not to be skipped.  Proposal 4. The 1bit skipping indication applies to all overlapped gaps/restrictions simultaneously when multiple MG/SMTC configurations are configured to a UE. |
| Ericsson | Observation 1 The design alternatives should be assessed to decide for a baseline design approach that results in a feature providing improved performance with reasonable level of complexity.  Observation 2 Due to uncertainty in application packet arrival and size, as well as uncertainty in scheduling a transmission and/or its retransmission, a dynamic solution provides the network with the flexibility needed to improve XR capacity when a MG is required to enable UE measurements in a particular occasion or being skipped.  Observation 3 Any semi-static approach is simple from UE perspective but inefficient from the NW perspective. Due to the inbuilt uncertainty on the need for utilizing a MG for serving the traffic, determining a proper configuration/pattern/time window that meets the intended objectives is impractical and results in resource wastage and unnecessary complexity.  Observation 4 Explicit dynamic solution based on Alt. 1-1 provides the network with the flexibility needed to improve XR capacity while minimizing the specification impact.  Proposal 1 Confirm the Working assumption in RAN1#118 for supporting Alt. 1-1.  Proposal 2 Support Alt.1-1 for the DCI formats 0\_X/1\_X with X=0,1 and 2.  Proposal 3 Support Alt. 1-1 where the indication in the DCI format on a scheduling cell corresponds to the MG on the scheduling cell (i.e. Option 1).  Proposal 4 Support Alt. 1-1 where once an MG in indicated to be “skipped” by a scheduling DCI, it shall not be indicated to be “not skipped” by another scheduling DCI. |
| Fraunhofer IIS, Fraunhofer HHI | Proposal 1: The DCI can indicate the dynamic cancellation of only one MG occasion. This provides the scheduler sufficient flexibility needed to improve the XR capacity by dynamically adapting to the incoming data packets from the XR application.  Proposal 2: Once indicated as skipped, a MG occasion should remain consistently indicated as skipped.  Observation 1: Using one-bit signaling in the DCI to dynamically indicate the status of the earliest MG occasion starting after the ending symbol of the PDCCH carrying the bit-field may in some cases be ambiguous.  Proposal 3: The dynamic indication of an MG occasion which is to be skipped is provided explicitly in the DCI by the ID of the corresponding MG configuration (measGapId). The earliest MG occasion of this MG configuration starting after the ending symbol of the PDCCH carrying the DCI is to be skipped.  Proposal 4: The scheduling DCI formats x\_0, x\_1, and x\_2 (with x=0,1) can be used to dynamically indicate the skipping of a MG occasion. |
| Google | Proposal 2: Any gap/restriction occasion overlapping fully or partially with the time offset is not considered as the gap/restriction occasion indicated by the DCI.  Proposal 3: UE should not skip the measurement gap/restriction if the overlapping CG PUSCH occasion within the multi-PUSCH CG configuration is cancelled by the UTO-UCI  Proposal 5: Overriding skipping indication is permitted at least when the UE cancels a CG PUSCH overlapping with the measurement gap/restriction. |
| Huawei, HiSilicon | Proposal 1: For “Alt 1-1: Explicit indication by DCI to skip a particular gap/restriction”, support:   * This 1-bit field is included in DCI format 0\_1/1\_1, 0\_2/1\_2 and 0\_3/1\_3; * A bit value of ‘0’ indicates that the gap/restriction caused by RRM measurements is not skipped, and a bit value of ‘1’ indicates that the gap/restriction caused by RRM measurements is skipped. |
| InterDigital | Observation 1: Scheduling restrictions can have major impact on transmission/reception of XR data with tight delay budgets. Delaying the transmissions to after MG results in not meeting QoS and impacts capacity.  Observation 2: When there is an ongoing data Tx/Rx that may use only a subset of slots in a gap occasion, it can be useful to skip some slots at the beginning or end of the gap occasion rather than the entire gap occasion. Skipping some slots in between a gap occasion is not practical given the multiple times where RF retuning is involved  Proposal 1: Confirm working assumption to support explicit indication by DCI to skip a particular gap/restriction (Alt 1-1)  Proposal 2: Support the scheduling DCI formats 0\_1, 0\_3, 1\_1 or 1\_3 (as baseline) for explicity indicating to skip a particular gap/restriction  Proposal 3: Support DCI-based skipping that is configurable for a subset of MG configurations/restrictions (e.g. for concurrent gaps) |
| Lenovo | Proposal 1: A UE first applies measurement skipping DCI command before resolving collision amongst concurrent measurement gaps.  Proposal 2: Discuss whether time gap between DCI and earlier occasion of concurrent occasions needs to be larger than a minimum time (e.g., DCI processing time) to apply measurement occasion skipping prior to resolving collision amongst concurrent measurement gaps.  Proposal 3: DCI indication of skipping a measurement occasion cannot be overridden later.  Proposal 4: The bit in the DCI is used to indicate whether to skip the first gap/restriction occasion after a minimum time offset required between the last symbol of the last PDCCH candidate carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI. |
| LGE | Proposal 1: Consider the following options for gap/restriction skipping behavior in Alt. 1-1:   * + Option 1: (Uni-directional skipping) Once an MG is skipped, it cannot be re-enabled by subsequent indications   + Option 2: (Last DCI prioritization) Prioritize the last DCI received until the minimum time offset from the start of the corresponding skipped gap/restriction   Proposal 2: Support that DCI format indicates to skip a particular gap/restriction without PDSCH/PUSCH scheduling  Proposal 3: Support configuration for Alt. 1-1 that specifies applicable or protected gaps/restrictions |
| MediaTek | Proposal 4: Introduce a new single-bit DCI field. When MG skipping is enabled by RRC, the DCI field is present. When MG skipping is disabled by RRC, the DCI field is not present.  Proposal 5: Support both DL-scheduling DCI and UL-scheduling DCI.  Proposal 6: Support DCI formats 0\_1/1\_1 and 0\_2/1\_2. Do not support 0\_3/1\_3. |
| Meta | Proposal 1: Regarding DCI formats for triggering, 1\_1/0\_1 and 1\_2/0\_2 are both supported.  Proposal 2: Regarding DCI content, bit equal to 1 means gap/restriction occasion is skipped, bit equal to 0 means gap/restriction occasion is not skipped. |
| NEC | Proposal 1: confirm the working assumption in RAN1#118.  Proposal 2: support UE to ignore a skipping indication for a MG/restriction occasion if the measurement in this MG/restriction occasion is critical.  Proposal 3: if UE received a DCI which indicates to skip a MG/restriction occasion, UE does not expect to receive another DCI which indicates the MG/restriction occasion should not be skipped. |
| Nokia | Observation 1: RAN1 shall comply with conclusions/decisions from RAN4 on which gap/restriction types are applicable for skipping.  Observation 2: Explicit indication by DCI to skip a particular gap/restriction (Alt 1-1) is sufficiently flexible to cover all cases and it can be implemented to mimic the behaviour of other solutions. Therefore, additional solutions are not necessary for Release 19.  Proposal 1: Clarify the note from previous agreement as follows:   * Note: Minimum time offset(s) between the end of ~~[the first]~~ received dynamic indication and start of corresponding gap(s)/restriction(s) occasion that is going to be skipped shall be introduced.   Proposal 2: The term “first gap/restriction” refers to the first applicable gap(s)/restriction(s).  Proposal 3: For Alt 1-1: Explicit indication by DCI to skip a particular gap/restriction, it should be possible to configure the following scheduling DCI formats with a skipping indication bit included:   * DCI formats 1\_1 and 0\_1 as well as DCI formats 1\_2 and 0\_2   Proposal 4: For DCI content of Alt.1-1 the following is suggested:   * Bit equal to 1 means applicable gap/restriction occasion is skipped.   Proposal 5: Once the UE has received DCI indication to skip (bit set to 1) the next applicable measurement gap/restriction, UE does not expect the indication to be changed until time offset before the next applicable gap/restriction.  Proposal 6: The presence of skipping indication in supported DCI formats can be configured individually for each DCI format via a new higher layer parameter. |
| NTT DOCOMO | Proposal 1: DL scheduling DCI format (e.g. DCI format 1\_1/1\_2) and UL scheduling DCI format (e.g. DCI format 0\_1/0\_2) can be used for the dynamic indication.   * The 1 bit field presence in a DCI format is configured by RRC.   Proposal 2: UE doesn’t expect different indications for a same gap/restriction occasion. |
| OPPO | Proposal 1: Based on RAN1 #118 working assumption,   * A new field of one bit is introduced into DCI formats 0\_1/2/3 and 1\_1/2/3, and the presence of the new field configured by RRC per DCI format; * The first gap(s)/restriction(s) occasion is among the gap(s)/restriction(s) occasions that are eligible to be skipped, where the eligibility is subject to RAN4 discussion.   Proposal 2: How UE handles skipping of a single gap/restriction occasion based on the corresponding indications in multiple DCIs should be discussed, preferably with the following options:   * Option 1: If a UE receives at least one DCI indicating to skip a gap/restriction occasion, the UE skips the gap/restriction occasion. * Option 2: If a UE receives a DCI indicating to skip a gap/restriction occasion, the UE does not expect to receive a later DCI indicating no skipping of the same gap/restriction occasion and the UE skips the gap/restriction occasion. |
| Panasonic | Proposal 1: At least DCI formats 0\_2/1\_2 should support carrying MG skipping indication.  Proposal 2: A gNB should send DCIs with consistent MG skipping content corresponding to a single MG occasion. In particular, the gNB should not change the indication content for a MG occasion after indicating to skip the MG indication.  Proposal 3: The order of applying MG skipping indication and handling the MG collision should be defined. |
| Qualcomm | Proposal 1: Dynamic indication to enable Tx/Rx in a particular gap/restriction are based on DCI formats 0\_1 and 1\_1.  Proposal 2: RAN1 clarifies whether the UE follows the dynamic indication bit in a DCI format to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements if the DCI format does not schedule a PDSCH.  Proposal 3: When overlapping between gaps/restrictions that are caused by RRM measurements occurs, the dynamic indication to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements is applied after the overlapping is resolved.  Proposal 4: RAN1 does not assume all gap/restriction configurations and all gaps/restrictions within a same configuration are subject to the dynamic indication to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements. |
| Samsung | Proposal 1: Consider DCI format x\_1 and x\_2 for 1-bit indication to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements.  Proposal 2: Consider ‘1’ means “a particular gap/restriction is skipped” and ‘0’ means “a particular gap/restriction is not skipped”.  Proposal 3: The UE determines whether or not to skip a gap/restriction based on the value of the indication in the last DCI that applicable for the gap/restriction and the UE correctly receives. |
| Sony | Observation 1: UE has better knowledge, particularly for the UL traffic. Hence, UE assistance information could be beneficial in assisting gNB to allow XR traffic when there is a collision between XR traffic and RRM measurement.  Observation 2: UE assistance information indicating the number of gap(s) / restriction(s) that can be skipped during a configured RRM measurement is beneficial in the operation of XR transmission during RRM measurement.  Observation 3: Skipping RRM measurement may affect the quality and/or latency of the reported RRM measurement. It would be beneficial for gNB to know whether the RRM measurement has been compromised or not.  Proposal 1: Confirm the working assumption to support dynamic indication to enable Tx/Rx in particular gap/restriction that are caused by RRM measurements. The dynamic indication is an explicit indication by DCI to skip a particular gap/restriction.  Proposal 2: Support to introduce a new bit-field in the existing DCI format (e.g., DCI x\_1). |
| Spreadtrum Communications | Proposal 1: To address the ambiguity on the DCI indication in scenarios involving multiple configurations, two interpretations emerge, with a slight preference for Option 1:   * Option 1: The DCI indication is applicable to the first gap/restriction occasion after a minimum time offset, irrespective of which configuration it belongs to among the multiple MG configurations. * Option 2: The DCI indication is strictly confined to the first gap/restriction occasion after a minimum time offset, which belongs to a particular one among the multiple MG configurations.   Proposal 2: Study how to indicate the later gap/restriction in scenarios where overlapping occurs between two gaps/restrictions occasion when multiple configurations are activated.  Proposal 3: Considering the following details of DCI contents:   1. A value of 0 signifies that measurements are to be conducted during gaps/restrictions, whereas a value of 1 denotes Tx/Rx operations within these intervals, skipping the gap/restriction occasion. 2. Enable MG skipping enhancements through higher-layer RRC parameters, with DCI format 1\_1 or 0\_1 by default. 3. The availability of DCI formats 1\_2 or 0\_2 depends on the specific configuration of higher-layer RRC parameters. 4. When a gap/restriction occasion is indicated as “cancelled (1)” earlier, gNB is not allowed to be indicated as “NOT cancelled (0)” later; when a gap/restriction occasion is indicated as “NOT cancelled (0)” earlier, gNB is allowed to be indicated as “cancelled (1)” later. |
| TCL | Proposal 1. Confirming the working assumption, for solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements select the following option:   * Alt. 1: Dynamic indication to enable Tx/Rx in particular gap/restriction that are caused by RRM measurements.   + Alt 1-1: Explicit indication by DCI to skip a particular gap/restriction;     - Indication is included as part of scheduling DCI:       * Bit-field size is one bit;         + The bit in the DCI is used to indicate whether to skip the first gap/restriction occasion after a minimum time offset required between the last symbol of the PDCCH carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI.   Proposal 2: The current UE-specific DCI format (e.g. DCI format 0\_x/1\_x) can be used for dynamic indication to enable Tx/Rx within measurement gap(s)/restriction(s). |
| vivo | Proposal 1: To enable Tx/Rx in gaps/restrictions that are caused by RRM measurements with Alt. 1, DCI formats 1\_1 and 1\_2 are supported.   * The presence of the one-bit indication in different DCI formats is configured per DCI format. * FFS DCI formats 0\_1 and 0\_2.   Proposal 2: For a DCI indicating to skip a particular gap/restriction occasion, the DCI can indicate invalid FDRA without scheduling a PDSCH reception.  Proposal 3: When a UE is configured with multiple concurrent measurement gap configurations, if there are collided measurement gap occasions, the UE first solves collision among different measurement gap occasions as legacy, and DCI indication to enable Tx/Rx in a particular gap/restriction that are caused by RRM measurements is applied to a survived measurement gap occasion after collision handling.  Proposal 4: For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements, the bit in a DCI is used to indicate whether to skip the first skippable gap/restriction occasion after a minimum time offset required between the last symbol of the PDCCH carrying the DCI and the start of corresponding skipped gap/restriction occasion indicated by the DCI.   * FFS: how to determine whether an occasion is skippable or not |
| Xiaomi | Observation 3：The scheme based on dynamic indications does not align well with the target use case where non-integer periodic XR services do not align with integer periodic RRM..  Proposal 3：Support Alt 3-1 as the solution to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements. |
| ZTE | Observation 1: Multiple measurement gaps can be configured for one UE, including e.g., Rel-17 concurrent measurement gap.  Observation 2: In the scenario of multiple overlapped gaps/restrictions configured and activated for one UE, single bit indication may cause ambiguities on UE behaviors.  Proposal 1: For the scenario of single gap/restriction configured and activated for one UE, support the bit in the DCI is used to indicate whether to skip the first gap/restriction after a minimum time offset.  Proposal 2: In the scenario of multiple overlapped gaps/restrictions configured and activated for one UE, the 1-bit field in DCI signaling for the measurement gap can be down-selected in one of the following two ways:  • Option 1: The 1-bit field in DCI indicates to skip two conflicting measurement gap occasions simultaneously.  • Option 2: The 1-bit field in DCI indicates to skip the measurement gap occasion with high priority.  Proposal 3: Support indicating to skip measurement gap/restriction via non-fall back scheduling DCI, i.e., DCI format x\_1, x\_2, x\_3. |

### Moderator's summary of contributions

The following list summarizes details of Alt. 1-1 (Explicit indication by DCI) that companies provided in Tdocs submitted to RAN1#118bis:

**Scheduling DCI formats to include 1 bit indication field:**

* Support DCI formats 0\_0/1\_0: **Ericsson, Fraunhofer**
* Support DCI formats 0\_1/1\_1: **Ericsson, Fraunhofer, MediaTek, Meta, Nokia, NTT DOCOMO, Samsung, vivo** (FFS: 0\_1 and 0\_2), **CMCC, Qualcomm, CATT, Huawei, InterDigital, OPPO, TCL, ZTE**
* Support DCI formats 0\_2/1\_2: **Ericsson, Fraunhofer, MediaTek, Meta, Nokia, NTT DOCOMO, Samsung, vivo** (FFS: 0\_1 and 0\_2), **Panasonic, CATT, Huawei, OPPO, TCL, ZTE**
* Support DCI formats 0\_3/1\_3: **CATT, Huawei, InterDigital, OPPO, TCL, ZTE**
* Do not support DCI formats x\_3 (where x is 0 or 1): **MediaTek**

**Scheduling DCI formats that do not schedule data:**

RAN1 clarifies whether the UE follows the dynamic indication bit in a DCI format to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements if the DCI format does not schedule a PDSCH: **Qualcomm, vivo, LGE**

**Interpretation of 1-bit indication field in DCI:**

* Bit equal to 1 indicates the corresponding gap/restriction occasion is to be skipped: **CMCC, Huawei, Meta, Nokia, Samsung, Spreadtrum**
* Bit equal to 0 indicates the corresponding gap/restriction occasion is not to be skipped: **CMCC, Huawei, Meta, Samsung, Spreadtrum**
* The default of 1-bit Tx/Rx indication should be set to “no cancellation”: **CATT**
  + The 1-bit Tx/Rx indication would be with the default value “no cancellation” in the scheduling DCIs at the start of DRX ON in each C-DRX cycle: **CATT**
  + If the running retransmission timer is overlapping with the MG or restriction occasion, the MG or the restriction occasion would be indicated “cancelation” by the 1-bit Tx/Rx indication: **CATT**

**Changing the indication from “skipped” to “not skipped” and vice versa:**

* From “skipped” to “not skipped”:
* Once an MG is indicated to be “skipped” by a scheduling DCI, the MG shall not be indicated to be “not skipped” by another scheduling DCI: **Ericsson, Fraunhofer, Lenovo, NEC, Nokia, OPPO, Panasonic, Spreadtrum, LGE**
* Overriding skipping indication is permitted at least when the UE cancels a CG PUSCH overlapping with the measurement gap/restriction: **Google**
* The UE determines whether or not to skip a gap/restriction based on the value of the indication in the last DCI that applicable for the gap/restriction and the UE correctly receives (overriding is possible?): **Samsung, LGE**
* The XR transmission is completed a time offset prior to the start of upcoming measurement gap, which is enough for preparing the upcoming RRM measurement: **CATT**
* The XR transmission is not expected to be scheduled within the upcoming measurement gaps indicated by the Rel-17 PDCCH skipping indication: **CATT**
* UE receives the DRX command MAC CE a time offset prior to the start of upcoming measurement gap, which is enough for preparing the upcoming RRM measurement: **CATT**
* UE should not skip the measurement gap/restriction if the overlapping CG PUSCH occasion within the multi-PUSCH CG configuration is cancelled by the UTO-UCI: **CATT, Google**
* From “not skipped” to “skipped”:
  + When a gap/restriction occasion is indicated as “NOT cancelled (0)” earlier, gNB is allowed to be indicated as “cancelled (1)” later: **Spreadtrum**

**Configuration of one bit indication field in DCI formats:**

* Introduce a new higher layer parameter which is used to enable the inclusion of the new one-bit field in DCI: **CMCC, MediaTek, NTT DOCOMO**
* The presence of the new field is configured by RRC per DCI format: **Nokia,** **OPPO, Spreadtrum**
* 1 bit indication is always present in DCI formats: **CATT**

**Clarification of “first gap/restriction” that indication is referring to:**

* The first gap(s)/restriction(s) occasion is among the gap(s)/restriction(s) occasions that are eligible to be skipped, where the eligibility is subject to RAN4 discussion: **OPPO**
  + *Related to different types of gaps/restrictions that RAN4 is discussing*
* The term “first gap/restriction” refers to the first applicable gap(s)/restriction(s): **Nokia**
  + *Related to different types of gaps/restrictions that RAN4 is discussing*
* The first skippable gap/restriction (FFS: how to determine whether an occasion is skippable or not): **vivo**
  + *Related to the same configuration and some additional restrictions which gaps inside this configuration cannot be skipped based on UAI*

**Clarification of indication:**

* DCI-based skipping that is configurable for a subset of MG configurations/restrictions: **InterDigital**
* The DCI indication is applicable to the first gap/restriction occasion after a minimum time offset, irrespective of which configuration it belongs to among the multiple MG configurations: **Spreadtrum** (1st pref)
* The DCI indication is strictly confined to the first gap/restriction occasion after a minimum time offset, which belongs to a particular one among the multiple MG configurations: **Spreadtrum**
* The bit in the DCI is used to indicate whether to skip the first gap/restriction occasion after a minimum time offset required between the last symbol of the last PDCCH candidate carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI: **Lenovo**
* Indication in the DCI format on a scheduling cell corresponds to the MG on the scheduling cell: **Ericsson**

**Indicating MG configurations that can or cannot be skipped:**

* Index MG configuration, A MG index set consists of one or more MG index, MGs referred by a MG index set can be skipped through a single NW indication: **Apple**
* Indicate the MG ID: **Fraunhofer**
* The list of indices of gaps/restrictions to be applied or protected: **LGE**

**Clarify the note from previous agreement:**

Note: Minimum time offset(s) between the end of ~~[the first]~~ received dynamic indication and start of corresponding gap(s)/restriction(s) occasion that is going to be skipped shall be introduced: **Nokia**

**About working assumption on Alt. 1-1:**

* Confirm working assumption: **Ericsson, InterDigital, NEC, Sony, TCL**
* Further discuss the working assumption: **Apple**

### Discussion: Round #1

Moderator’s comments and recommendations:

There are several details that need to be discussed and decided for Alt. 1-1. A summary of companies views on the issues below can be found in Sec. 2.1.2.

**Scheduling DCI formats to include 1 bit indication field:**

A number of companies supported including 1 bit indication field to DCI formats x\_1/x\_2 (where x is 1 and 0).

Supporting these formats shall provide sufficient opportunities to indicate skipping of a gap/restriction. There are certain benefits of supporting x\_2 in addition to x\_1 since it can have a smaller DCI size based on configurations. Some companies did not support including the indication as part of DCI format x\_3 due to quite large size of this DCI format. Few companies proposed to change fallback DCI format; however, it is not recommended to include the indication to that format since DCI size shall be aligned across all UEs and be decodable in case device configurations is not clear at a gNB side.

Moderator’s recommendation is to support DCI formats x\_1/x\_2 for indication to skip gap/restriction caused by RRM measurements.

**Scheduling DCI formats that do not schedule data**

As mentioned by companies, there are scheduling DCIs that do not schedule data but used for other purposes e.g., SPS release, SCell dormancy, etc. Based on moderator’s understanding, if bit field is included in the DCI format x\_1/x\_2 UE shall consider that field regardless of the purpose of DCI. If companies see it beneficial, we can clarify this further that no special behavior is assumed in Rel19.

**Interpretation of 1-bit DCI field and changing the indication from “skip” to “do not skip” and vice versa:**

We shall clarify the meaning of a bit in a new bit field and possibility to change the indication for the same gap/restriction. Following similar principle for UTO-UCI, it is suggested once we indicate gap/restriction as “skipped” we do not change it to “not skipped”. However, changing from “not skipped” to “skipped” shall be supported since there might be multiple DCIs prior to gap/restriction and before minimum time offset, so gNB can indicate “skip” closer to gap/restriction.

Thus, the following is proposed based on companies’ input:

* Bit equal to 1 indicates the corresponding gap/restriction occasion is to be “skipped”. Once a gap/restriction is indicated to be “skipped” by a DCI, UE does not expect the gap/restriction to be indicated as ‘not skipped’ by another DCI.
* Bit equal to 0 indicates the corresponding gap/restriction occasion is to be “not skipped”. Once a gap/restriction is indicated to be “not skipped” by a DCI, the gap/restriction can be indicated to be “skipped” by another DCI.

**Configuration of one bit indication field in DCI formats**

Next, we shall decide how one bit indication is included in the DCI formats, i.e., one higher layer parameter to configure indication in all DCI formats supported to carry such indication or one higher layer parameter to configure indication per DCI format that supports such indication. It would be good to collect your views on possible way forward.

**Clarification of “first gap/restriction” that indication is referring to**

Last meeting we agreed on some details for Alt. 1-1, including the formulation: “The bit in the DCI is used to indicate *whether to skip the first gap/restriction occasion* after a minimum time offset required between the last symbol of the PDCCH carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI.”

As commented by various companies, RAN4 is currently working on types of gaps that can or cannot be considered for possible skipping. Therefore, it would be good to clarify this point in RAN1 that the first gap/restriction is among gap/restriction configuration that are allowed for skipping from RAN4 perspective.

**Clarification of indication:**

There were other points raised related to the indication that we can further clarify:

* The DCI indication is applicable to the first gap/restriction occasion after a minimum time offset, irrespective of which configuration it belongs to among the multiple MG configurations;
* The bit in the DCI is used to indicate whether to skip the first gap/restriction occasion after a minimum time offset required between the last symbol of the last PDCCH candidate carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI – *this is related to the case with PDCCH repetition.*
* Indication in the DCI format on a scheduling cell corresponds to the MG on the scheduling cell.

**Indicating MG configurations that can or cannot be skipped:**

There were contributions proposing a solution to indicate which gap configurations can or cannot be skipped e.g., using indexes of gaps. From moderator’s point of view, it is related to the discussion above on clarification of “first gap/restriction”. In RAN1 we need to clarify that we only refer to those gap/restriction configurations that can be potentially skipped as per RAN4 decision. It will be up to RAN4 to decide how to capture in specs which gap/restriction can or cannot be skipped. We can have a separate discussion on that to clarify our way forward.

**Clarify the note from previous agreement:**

Another point that shall be considered is the square brackets in the notes from earlier agreement: “Note: Minimum time offset(s) between the end of [the first] received dynamic indication and start of corresponding gap(s)/restriction(s) occasion that is going to be skipped shall be introduced”.

Since we already agreed that there is a minimum time offset between indication and gap/restriction, the [the first] in the note above is no longer needed and we can remove it.

**About working assumption on Alt. 1-1:**

Some companies suggested confirming working assumption on Alt. 1-1. RAN4 just received RAN1 LS with the working assumption, it would be good to give them time to discuss it. We can come back to that discussion later this week if RAN4 makes progress on that topic.

**Please, provide your view (in the table below) regarding the following questions:**

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| **Q1:** Do you agree with the following proposals? Please, feel free to suggest modifications if necessary.  **Proposal 2.1.1**  For Alt 1-1: explicit indication by DCI to skip a particular gap/restriction, one bit indication is included as part of DCI formats 0\_1/1\_1 and 0\_2/1\_2.  **Proposal 2.1.2**  For Alt 1-1: explicit indication by DCI to skip a particular gap/restriction:   * Bit equal to 1 indicates the corresponding gap/restriction occasion is to be “skipped”. Once a gap/restriction is indicated to be “skipped” by a DCI, UE does not expect the gap/restriction to be indicated as ‘not skipped’ by another DCI. * Bit equal to 0 indicates the corresponding gap/restriction occasion is to be “not skipped”. Once a gap/restriction is indicated to be “not skipped” by a DCI, the gap/restriction can be indicated to be “skipped” by another DCI.   **Proposal 2.1.3**  Clarify the note from previous agreement as follows:   * Note: Minimum time offset(s) between the end of ~~[the first]~~ received dynamic indication and start of corresponding gap(s)/restriction(s) occasion that is going to be skipped shall be introduced.   **Q2:** Would you like to clarify the following: “UE follows the indication bit in a scheduling DCI format (e.g., 1\_1/1\_2) to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements if the scheduling DCI format does not schedule data and used for other purposes, e.g., SPS release, SCell dormancy, etc.”?  **Q3:** For configuration of one bit indication to “skip/not skip” in DCI formats, please indicate your preferred option:   * **Option 1:** One higher layer parameter to configure indication in all DCI formats supported to include such indication. * **Option 2:** One higher layer parameter to configure indication per DCI format supporting such indication.   **Q4:** Do you agree to further clarify “first gap/restriction” as “first applicable/eligible/etc gap/restriction”? It would be up to RAN4 to define the applicability/eligibility/etc of the gap/restriction (they are currently discussing types of gaps that can or cannot be skipped).  **Proposal 2.1.4**  The first gap/restriction occasion is among those types of gap/restriction configurations that are eligible to be skipped, where the eligibility is subject to RAN4 discussion.  **Q5:** Please, share your view about further clarification (in *italic*) related to the indication raised by companies and indicate whether you agree to further clarify it (proponents, please feel free to further clarify the motivation from additional clarification):   1. The DCI indication is applicable to the first gap/restriction occasion after a minimum time offset, *irrespective of which configuration it belongs to among the multiple gap/restriction configurations*; 2. The bit in the DCI is used to indicate whether to skip the first gap/restriction occasion after a minimum time offset required *between the last symbol of the last PDCCH candidate* carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI; 3. Indication in the DCI format *on a scheduling cell corresponds to the MG on the scheduling cell*.   **Q6:** Do you agree to leave the decision on how to indicate which gap/restrictions configurations can or cannot be skipped up to RAN4?  **Q7:** Please, share your view related to a way forward with working assumption for Alt. 1-1.  **Q8**: Any other details for Alt. 1-1 that need to be clarified? |

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| **Company** | **Answers/Comments** |
| Qualcomm | Q1:  Proposal 2.1.1:  DCI formats 0\_2/1\_2 were originally specified for URLLC data scheduling. If DCI formats 0\_2/1\_2 are to be used to carry the gap/restriction skipping indication, can the proponents clarify whether the DCI format 0\_2/1\_2s are meant to be used to schedule XR data or just to carry the skipping indication but not necessarily schedule XR data?  Proposal 2.1.2:  RAN1 has only discussed how to skip a configured gap/restriction for UE Tx/Rx, but has not discussed whether an early indication to skip a gap can be reverted to not skipped. This can be indicated by the following sentence in the working assumption.  "Alt. 1: Dynamic indication to enable Tx/Rx in particular gap/restriction that are caused by RRM measurements..."  We are fine with Proposal 2.1.2 in general. It is more challenging for the UE to revert from "skipped" to "not skipped". For this case, a separate minimum time offset that is larger than that for indicating a configured gap to "skipped" needs to be defined. Having said this, we think the “corresponding gap/restriction occasion” for a DCI format including the 1 bit can be different depending on bit value.  Proposal 2.1.3:  Together with the working assumption, "the first" may have indicated that once a gap/restriction is indicated to be "skipped", it does not matter what the bit value is in the subsequent DCIs and these DCIs can be ignored. Then, this has implied proposal 2.1.2. Based on this, we think "the first" does not need to be removed.  Q2:  Yes, we think this should be clarified so that there is no ambiguity in UE implementation. I.e., whether value of the 1 bit in this DCI format should be ignored by the UE or the UE also follows the bit value even it does not schedule the PDSCH. If the DCI format is followed by the UE, it provides additional opportunities for network to indicate skipped gaps/restrictions. This also implies that a DCI format that indicates skipped gap/restriction does not necessarily schedule the XR data.  Q3:  We think option 2 is a better.  Q4  Proposal 2.1.4:  Yes, we agree with the proposal. At least in RAN1 discussion we do not assume all configurations of gaps/restritions due to RRM measurement or all gaps/restrictions in a configuration are subject to skipping.  Q5:  1.  We can confirm this understanding once Proposal 2.1.4 is confirmed first. I.e., the DCI indication is applicable to the first “skippable” gap/restriction occasion after a minimum time offset *irrespective of which configuration it belongs to among the multiple gap/restriction configurations*;  2.  If the key point of this clarification is "last PDCCH candidate", it depends on Proposal 2.1.2. We do not think this needs to be separately discussed. If the key point of this clarification is "the last symbol", this is included in the following agreement and is up to RAN4 discussion.  Agreement  If Alt. 1 from RAN1#117 agreement is supported, minimum time offset(s) X between indication to skip and skipped measurement occasion is up to RAN4 to discuss and decide on particular value(s).  In either case, we do not think this clarification needs to be discussed separately.  3.  We support this proposal. RAN1 has not studied and discussed the necessity for gap skipping for CA case. For CA, the multiple carriers should provide enough resources for prompt XR data transfer within the PDB and there is no need to skip gaps/restrictions. It is even fine to us to restrict the feature of DCI indicated gap/restriction skipping to SC.  Q6:  Yes, we agree with this. It should be also up to RAN4 whether any gap/restriction of a gap/restriction configuration can or cannot be skipped. Based on this, the conclusion can be:  leave the decision on how to indicate which gap/restrictions configurations and which gap/restrictions of a gap/restriction configuration can or cannot be skipped up to RAN4  Q7:  Working assumption was made because companies wanted to check with RAN4 first for issues of the DCI based indication for gap skipping. RAN4 has not really discussed this yet. Therefore, we think RAN1 does not need to confirm the working assumption in this meeting. |
| InterDigital | **Q1:**  Proposal 2.1.1:  Using DCI format x\_1 for indicating skipping of a gap occasion makes sense given its usage for single cell scheduling. However, it is not clear to us the need to also support format x\_2 for indicating gap skipping.  Proposal 2.1.2:  Fine with the proposal.  Proposal 2.1.3:  Fine to drop ‘the first’ from the note, although it does seem to be related to proposal 2.1.2.  **Q2:**  Generally fine with the understanding that the UE follows the configured gap-skipping indication regardless of the purpose and what the other bits indicate in the DCI format.  **Q3:**  Option 2  **Q4:**  Generally agree that the discussion on eligibility of which of the gap/restriction configurations are skippable is up to RAN4. However, it may be useful to clarify the need for proposal 2.1.4, before we wait for RAN4 conclusion. Additionally, since it is possible that the different eligible gap/restriction configurations may be configured with different priority values, it may be useful to discuss/clarify whether the skipping is applied on the first gap/restriction occasion regardless of priority of the configuration or the priority is considered before skipping. |
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## Concurrent measurement gaps

### Companies proposals and observations

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| **Company** | **Proposals/Observations** |
| CMCC | Proposal 4. The 1bit skipping indication applies to all overlapped gaps/restrictions simultaneously when multiple MG/SMTC configurations are configured to a UE. |
| Lenovo | Proposal 1: A UE first applies measurement skipping DCI command before resolving collision amongst concurrent measurement gaps. |
| OPPO | Proposal 4: The execution order between R17/18 collision handling for gaps/restrictions caused by RRM measurements and R19 enabling Tx/Rx in gaps/restrictions should be further studied. |
| Panasonic | Proposal 3: The order of applying MG skipping indication and handling the MG collision should be defined. |
| Qualcomm | Proposal 3: When overlapping between gaps/restrictions that are caused by RRM measurements occurs, the dynamic indication to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements is applied after the overlapping is resolved. |
| Spreadtrum Communications | Proposal 2: Study how to indicate the later gap/restriction in scenarios where overlapping occurs between two gaps/restrictions occasion when multiple configurations are activated. |
| vivo | Proposal 3: When a UE is configured with multiple concurrent measurement gap configurations, if there are collided measurement gap occasions, the UE first solves collision among different measurement gap occasions as legacy, and DCI indication to enable Tx/Rx in a particular gap/restriction that are caused by RRM measurements is applied to a survived measurement gap occasion after collision handling. |
| ZTE | Observation 1: Multiple measurement gaps can be configured for one UE, including e.g., Rel-17 concurrent measurement gap.  Observation 2: In the scenario of multiple overlapped gaps/restrictions configured and activated for one UE, single bit indication may cause ambiguities on UE behaviors.  Proposal 2: In the scenario of multiple overlapped gaps/restrictions configured and activated for one UE, the 1-bit field in DCI signaling for the measurement gap can be down-selected in one of the following two ways:  • Option 1: The 1-bit field in DCI indicates to skip two conflicting measurement gap occasions simultaneously.  • Option 2: The 1-bit field in DCI indicates to skip the measurement gap occasion with high priority. |

### Moderator's summary of contributions

**Concurrent measurement gaps:**

* 1 bit applies to all overlapped gaps/restrictions: **CMCC, ZTE**
* UE first applies measurement skipping DCI command before resolving collision amongst concurrent measurement gaps: **Lenovo**
  + Whether time gap between DCI and earlier occasion of concurrent occasions needs to be larger than a minimum time: Lenovo
* The dynamic indication to enable Tx/Rx in a particular gap/restriction that is caused by RRM measurements is applied after the overlapping is resolved: **Qualcomm, vivo, ZTE**
* Further discuss and decide on the order of applying skipping: **OPPO, Panasonic, Spreadtrum**

### Discussion: Round #1

Moderator’s comment and recommendation:

RAN4 is discussing what types of gaps shall be considered in this work item. Type 2 gaps that allows for multiple concurrent gaps is still under debate whether or not it will be considered for potential skipping. From moderator point of view, it is premature to discuss the potential collision resolution in RAN1 given no decision about supporting such type in RAN4 has been taken. Moderator proposes to wait for RAN4 decision on types of gaps and thus postponing this discussion.

**Please, provide your view (in the table below) regarding the following question:**

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| **Q1:** Do you agree with moderator’s recommendation? If not, please share an alternative way forward. |

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| **Company** | **Answers/Comments** |
| Qualcomm | Q1:  Yes, we can wait until RAN4 made the decision. |
| InterDigital | Fine with moderator’s recommendation |
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## Partial skipping

### Companies proposals and observations

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| **Company** | **Proposals/Observations** |
| InterDigital | Proposal 4: Support partial skipping of a gap/restriction with the skipping indication in DCI |
| LGE | Proposal 6: Support slot-level cancelling/skipping gaps/restrictions that are caused by RRM measurements to enable Tx/Rx |
| MediaTek | Proposal 3: Do not support partial skipping. |
| Nokia | Proposal 7: Partial skipping of gap/restrictions caused by RRM measurements is not supported in Release 19. |
| NTT DOCOMO | Proposal 3: Not support the case where an occasion of gap/restrictions caused by RRM measurements are cancelled/skipped partially. |
| OPPO | Proposal 3: It is not supported in R19 XR to partially cancel/skip an occasion of gaps/restrictions caused by RRM measurements. |
| Sony | Proposal 3: Support partial skipping of gap(s)/restriction(s) to allow more scheduling opportunities. |
| Xiaomi | Observation 1：The scheduling of UEs with higher capabilities can be expedited as they are able to complete their RRM measurements earlier.  Observation 2：The enhancement of system scheduling efficiency can be achieved by effectively reducing the idle time of UEs caused by RRM measurement, particularly in scenarios with low system resource occupancy rate.  Proposal 1：Relevant reporting and processing mechanisms for mitigating UEs idle time caused by RRM measurements could be deliberated in RAN1.  Proposal 2：Partial cancellation or skipping of gaps or restrictions caused by RRM measurements could be futher discussed in RAN1. |
| ZTE | Proposal 4: The case where an occasion(s) of gap/restrictions that are caused by RRM measurements are cancelled/skipped partially should not be excluded.  Proposal 5: RAN1 continues to discuss and decide whether or not to introduce the case where an occasion(s) of gap/restrictions that are caused by RRM measurements are cancelled/skipped partially in the SMTC or NCSG. |

### Moderator's summary of contributions

A number of companies expressed their view related to partial skipping. The views are summarized below.

**Support partial skipping**: InterDigital, LGE, Sony, Xiaomi, ZTE

* If the UE perform transmission / reception for such short period then in practice, the UE can still continue to perform RRM measurement for the remaining measurement gap: **Sony, Interdigital, LGE**
* In some scenarios scheduling restriction is only for SSB symbols: **ZTE**

**Do not support partial skipping**: MediaTek, Nokia, NTT DOCOMO, OPPO

* Large RAN4 impact, RAN4 needs complicated study that how to treat MG length: **NTT DOCOMO**
* Due to high RAN4 workload for the full skipping (necessary RRM requirements, minimum DCI processing time for MG skipping, etc), partial skipping can be deprioritized for this feature: **MediaTek**
* can lead to big impacts to both specification and UE implementation: **OPPO**

### Discussion: Round #1

Moderator’s comment and recommendation:

We have an FFS point to further study partial skipping: “FFS: Whether or not/How to support of the case where an occasion(s) of gap/restrictions that are caused by RRM measurements are cancelled/skipped partially”.

Given that RAN1 selected a solution for full skipping, moderator’s recommendation is to discuss this topic and decide whether to support partial skipping or not. Some companies support partial skipping as it gives more possibilities for measurements, other companies share their concerns about complexity of such behavior and not clear scenarios where measurements can be conducted taken into account the RF re-tuning time, etc. Benefits and drawbacks provided in companies contributions can be found in Section 2.3.2. To facilitate the discussion, please share your view related to that topic.

**Please, provide your view (in the table below) regarding the following question:**

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| **Q1:** Please, share your view related to partial skipping support, i.e., do you support it or not, details of solution if you support partial skipping, etc. |

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| **Company** | **Answers/Comments** |
| Qualcomm | We do not support partial skipping for Rel-19 because it introduces too much impact to the specification and UE implementation. |
| InterDigital | We are supportive of partial skipping in a limited sense, assuming that skipping here does not imply doing data Tx/Rx in the middle of a gap occasion.  In scenarios where there is an ongoing data Tx/Rx that may use only some of the beginning slots in a long gap occasion (e.g. 6ms), it can be useful for XR data to skip such slots at the beginning of the gap occasion rather than the entire gap occasion. Spec impact is expected to be marginal anyways as partial skipping can be accommodated within the ongoing discussion on DCI-based skipping. For example, upon receiving the DCI format with the skipping indication the UE may assume the corresponding gap is skipped partially when the scheduled DL/UL resources use only some slots overlapping with the skipped gap occasion at the beginning of gap occasion. Skipping some symbols/slots in the middle of a gap occasion is not practical given multiple times where RF retuning is involved. |
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## Other types of solutions

### Companies proposals and observations

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| **Company** | **Proposals/Observations** |
| Google | Proposal 1: Support Option 1 for dynamic scheduling and Option 2 for configured grant.  Proposal 4: The skipping of measurement gaps/restrictions could be activated/deactivated per Configured Grant configuration |
| MediaTek | Observation 1: Network-controlled solutions are suitable from the perspective of XR traffic arrival characteristics while UE-triggering based solutions are suitable from the perspective of satisfying measurement requirements.  Proposal 1: Consider UE-triggering based solutions for measurement occasion skipping. At least, UE triggering solutions should be considered based on measurement report triggering on the condition that serving cell measurements are below or above a threshold (e.g., event-A2). |
| Nokia | Proposal 8: Other solutions than Explicit indication by DCI to skip a particular gap/restriction (Alt 1-1) are not necessary for Release 19. |

### Moderator's summary of contributions

The views related to additional solutions are summarised below.

* The skipping of measurement gaps/restrictions could be activated/deactivated per Configured Grant configuration: **Google**
* Support Option 1 for dynamic scheduling and Option 2 for configured grant: **Google**
* Consider UE-triggering based solutions for measurement occasion skipping: **MediaTek**
* UE triggering solutions should be considered based on measurement report triggering on the condition that serving cell measurements are below or above a threshold (e.g., event-A2): **MediaTek**
* Other solutions than Explicit indication by DCI to skip a particular gap/restriction (Alt 1-1) are not necessary for Release 19: **Nokia**

### Discussion: Round #1

Moderator’s comment and recommendation:

We have an FFS point related to solutions other than network triggered solutions to enable Tx/Rx of gaps/restrictions caused by RRM measurements. There was a proposal to consider UE triggering solution when UE indicates to gNB it does not need a measurement occasion. Another proposal is related to different solutions to dynamic grant and configured grant scenarios. The latter seems to be related to the network-based solutions that we have already selected.

The moderator’s recommendation is to discuss and decide whether solutions other than network triggered solutions are needed.

**Please, provide your view (in the table below) regarding the following question:**

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| **Q1:** Do you support other types of solutions to enable Tx/Rx in gaps/restrictions caused by RRM measurements to be specified in Release 19? Please, elaborate your answer, including why other solutions are necessary/not necessary, details of the proposed solutions, etc. |

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| **Company** | **Answers/Comments** |
| Qualcomm | Benefit of DCI based indication of gap/restriction skipping only shows up for dynamically scheduled XR data with jittering and uncertain packet size. For periodic traffic with fixed packet size, predetermined arrival time and tight PDB, the DCI based solution introduces overhead without clear benefit. For this, we think the semi-static solution for SPS and CG based XR data transmission can be considered in Rel-19. |
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## Other issues

### Companies proposals and observations

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| **Company** | **Proposals/Observations** |
| Apple | Proposal 2: If dynamic signaling based design is adopted, lead time for dynamic skipping is 5 ms after the end of the PDCCH containing a DCI containing a dynamic measurement skipping indication.  Proposal 3: If dynamic signaling based design is adopted:  when a slot is designated as not a “valid downlink slot” due to overlap with a configured measurement gap occasion, and that measurement gap occasion is skipped due to RRM measurement adaptation for XR, for the basic UE feature supporting RRM measurement adaptation, the slot is not converted into a “valid downlink slot” and the slot may be eligible to be designated as “valid downlink slot” subject to additional UE capability.  Proposal 4: RAN1 takes time to evaluate the working assumption reached at RAN1 #118 and should not rush to confirmation of the working assumption. |
| Fraunhofer IIS, Fraunhofer HHI | Observation 2: RAN2 has an ongoing Study Item on AI/ML for mobility in NR, one of the objectives of which is to evaluate potential benefits and gains of RRM measurement prediction.  Observation 3: RRM measurements prediction can be used by the UE in MGs/restrictions which have been deactivated to enable transmissions/receptions for XR traffic instead of performing the actual measurements. |
| LGE | Proposal 4: Introduce dynamic or semi-static time offset indication mechanisms to enhance the feasibility of gap/restriction skipping in Alt. 1-1.  Proposal 5: Support to configure the searchspace which is required to be monitored only when there is an upcoming gap/restriction that are caused by RRM measurements. |
| MediaTek | Proposal 2: Wait for RAN4 progress and response before further discussing UE assistance information. |
| Sony | Proposal 4: Support UE Assistance Information (UAI) indicating the gNB on the MG(s) to be skipped by the UE. |
| TCL | Proposal 3: Re-use the current processing timeline for PDSCH or PUSCH as the minimum time gap between the end of the skipping command and the start of the skipped measurement occasion.  Proposal 4：UE assistance information/indication to notify gNB whether enabling Tx/Rx for XR during RRM measurements restriction can be considered.  Proposal 5: Interaction between DRX and solutions to enable Tx/Rx during measurement restrictions can be studied. |
| vivo | Proposal 5: Enhancement on enabling Tx/Rx in gaps/restrictions that are caused by RRM measurements outside DRX active time is not considered in R19. |

### Moderator's summary of contributions

There are few additional issues raised by companies in their contributions. Please, find the list that summarises these issues below.

**Issue 1: Valid downlink slot:**

* When a slot is designated as not a “valid downlink slot” due to overlap with a configured measurement gap occasion, and that measurement gap occasion is skipped, do not change to “valid downlink slot”: **Apple**

**Issue 2: Interaction with DRX:**

* Interaction between DRX and solutions to enable Tx/Rx during measurement restrictions can be studied: **TCL**
* Enhancement on enabling Tx/Rx in gaps/restrictions that are caused by RRM measurements outside DRX active time is not considered in R19: **vivo**

**Issue 3: Search space for DCI with indication to skip/not to skip:**

* Configure the searchspace which is required to be monitored only when there is an upcoming gap/restriction that are caused by RRM measurements: **LGE**

**Issue 4: Timeline discussion:**

* If dynamic signaling based design is adopted, lead time for dynamic skipping is 5 ms after the end of the PDCCH containing a DCI containing a dynamic measurement skipping indication: **Apple**
* Re-use the current processing timeline for PDSCH or PUSCH: **TCL**
* Introduce dynamic or semi-static time offset indication mechanisms: **LGE**

**Issue 5: UAI:**

* Support UE Assistance Information (UAI) indicating the gNB on the MG(s) to be skipped by the UE: **Sony**
* Wait for RAN4 progress and response before further discussing UE assistance information: **MediaTek**
* UE assistance information/indication to notify gNB whether enabling Tx/Rx for XR during RRM measurements restriction can be considered: **TCL**

### Discussion: Round #1

Moderator’s comments and recommendations:

**Issue 1:** During RAN1#116 an agreement was made, saying: when an occasion(s) of gaps/restrictions that are caused by RRM measurements are cancelled/skipped fully, UE is assumed to receive/transmit in the gaps/restrictions that are caused by RRM measurements as it would without any (measurement etc. related) gaps/restrictions that are caused by RRM measurements. From moderator’s point of view, issue 1 (please see above for the exact description) is related to that agreement and according to that agreement “not valid downlink slot” will become valid as the operation would be as there were no gap/restriction.

**Issue 2**: Interaction with DRX. Currently it is not clear whether there is a need to do something with DRX operation. It is also under RAN2 domain, we can deprioritize this topic in RAN1.

**Issue 3**: Is related to extra monitoring occasion for PDCCH carrying indication to skip prior to measurement occasion.

**Issue 4 and 5** (time offset value and UAI) were already discussed in RAN1 and it is up to RAN4 to continue the discussion, no additional information has been received in RAN1 so far.

**Please, share your view (in the table below) related to the following questions:**

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| **Q1:** Please, share your view related to Issues 1-3. Particularly:   * For issue 1, do you agree that according to RAN1 earlier agreement, “not valid downlink slot” will become “valid” when gap/restriction is skipped? * For issue 2, do you see anything that needs to be clarified in RAN1 regarding interaction with DRX? * For issue 3, do you see a need to consider extra monitoring occasion for PDCCH carrying indication to skip, e.g., before each measurement occasion?   **Q2:** Do you agree with moderator’s recommendations for Issues 4-5?  **Q3**: Do you see any other issues that need to be discussed? |

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| **Company** | **Answers/Comments** |
| Qualcomm | Q1:  For Issue 1, does the spec mean the slot remains "not valid" if we do not make any further conclusion? We think it is not good to draw a universal conclusion without looking at the specific cases related to "valid downlink slot" and "not valid downlink slot". The DCI based gap skipping is a dynamic mechanism. If we make the conclusion as recommended by the moderator, the dynamic indication is propagated to use cases where "valid downlink slot" and "not valid downlink slot" are involved. This may cause additional timeline issues and should be checked case by case.  For Issue 2, we think the DCI based gap skipping indication at least applies to gaps/restrictions within the CDRX active. Whether it is applicable to outside CDRX active time, it may depend on whether the target use case only includes dynamically scheduled XR data or also includes semi-persistent or periodic XR data. If it does not apply to semi-persistent or periodic XR data, there seems no need to skip gaps/restrictions outside CDRX active time. This depends on whether semi-persistent and periodic data can be configured to semi-statically override gap/restrictions in issue 1. Based on this, we think Issue 2 can be discussed after Issue 1.  For Issue 3, we prefer not to define the gap skipping indication dedicated PMOs to cause additional UE PDCCH decoding efforts.  Q2:  We agree with moderator’s recommendations for Issue 4 and 5. |
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# Offline sessions

## Offline session

# Proposals for online sessions

## Online session

# Agreements

## RAN1#116

**Agreement**

Consider at least solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements.

* FFS: Other types of solutions.
* Whether or not/how to account for any UE assistance information/indication in addition to other information available at the network

**Agreement**

From RAN1 perspective, when an occasion(s) of gaps/restrictions that are caused by RRM measurements are cancelled/skipped fully, UE is assumed to receive/transmit in the gaps/restrictions that are caused by RRM measurements as it would without any (measurement etc. related) gaps/restrictions that are caused by RRM measurements.

* FFS: Whether or not/How to support of the case where an occasion(s) of gap/restrictions that are caused by RRM measurements are cancelled/skipped partially

**Agreement**

For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements consider the following alternatives or combinations for further down-selection:

* Alt. 1: Dynamic indication to enable Tx/Rx in particular gap(s)/restriction(s) that are caused by RRM measurements.
  + FFS: details
* Alt. 2: Semi-persistent solution to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements.
  + FFS: details
* Alt. 3: Semi-static solution to enable TX/RX in gaps/restrictions that are caused by RRM measurements.
  + FFS: details
* Alt. 4: Dynamic solution to adapt/change gap/SMTC configuration to enable TX/RX in gaps/restrictions that are caused by RRM measurements.
  + FFS: details
* Alt. 5: Rule-based solution to enable TX/RX in gaps/restrictions that are caused by RRM measurements:
  + FFS: details

Companies are encouraged to use the EVM in TR38.835 if they are submitting simulation results.

Working Assumption

RAN1 aims to develop/identify solution(s) to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements agnostic in RAN1 normative work to types of gaps/restrictions that are caused by RRM measurements.

Note: UE features related to the developed solution(s) is a separate discussion.

## RAN1#116-bis

**Agreement**

For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements consider the following alternatives or combinations for further down-selection:

* Alt. 1: Dynamic indication to enable Tx/Rx in particular gap(s)/restriction(s) that are caused by RRM measurements.
  + FFS: **Alt 1-1**: Explicit indication by DCI to skip a particular gap(s)/restriction(s);
  + FFS: **Alt 1-2**: Explicit indication by DCI to indicate a time window where to skip a particular gap(s)/restriction(s);
  + FFS: **Alt 1-3**: Implicit indication by DCI scheduling a transmission/reception overlapping with a gap(s)/restriction(s) to skip the gap(s)/restriction(s);
  + FFS: DCI format, DCI content, DCI bit-field size;
  + FFS: Whether indication is for one or more occasions;
  + FFS: How to consider time offset between the end of received dynamic indication and start of gap(s)/restriction(s) occasion that is going to be skipped.
* Alt. 2: Semi-persistent solution to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements.
  + FFS: **Alt 2-1**: gNB sends a skipping activation command, UE will skip gaps/restrictions until de-activation command is received.
  + FFS: **Alt 2-1a**: gNB sends an activation command to enable pre-configured gap(s)/restriction(s), UE will skip gap(s)/restriction(s) after de-activation command is received.
  + FFS: **Alt 2-2**: RRM measurement adaptation is applied to all MG configurations/scheduling restrictions due to all SMTC configurations, or is applied to selected MG configuration(s) and/or scheduling restrictions due to selected SMTC configuration(s) and is conducted in a time-window, and time-windows are derived from a semi-persistent ~~configuration~~ activation for their periodicity, offset and duration.
  + FFS: **Alt 2-3**: Activate/de-activate one or more of pre-configured pattern(s) via MAC-CE to indicate occasions where Tx/Rx is prioritized over gap(s)/restriction(s);
  + FFS: Details of activation/deactivation MAC-CE command
  + FFS: How to consider time offset between activation/deactivation command and start of gap(s)/restriction(s) occasion that is going to be skipped.
* Alt. 3: Semi-static solution to enable TX/RX in gaps/restrictions that are caused by RRM measurements.
  + FFS: **Alt 3-1**: Configure a pattern(s) via RRC to indicate occasions where to skip gaps/restrictions;
    - FFS: Details of pattern
  + FFS: **Alt 3-2**: Gaps/restrictions skipping is applied to all MG configurations/scheduling restrictions due to all SMTC configurations / RRM measurements, or is applied to selected MG configuration(s) and/or scheduling restrictions due to selected SMTC configuration(s) / RRM measurement(s) and is conducted in a time-window, and time-windows are derived from a semi-static configuration for their periodicity, offset and duration.
  + FFS: **Alt 3-3**: Gaps/restrictions that are caused by RRM measurements are skipped if collided with particular semi-statically pre-configured Tx/Rx occasions.
  + FFS: **Alt. 3-4**: Gaps/restrictions that are caused by RRM measurements are skipped based on semi-statically configured priority information for particular semi-statically pre-configured Tx/Rx and/or particular gaps/restrictions.

**Agreement**

Confirm the working assumption from RAN1 #116 with updates:

* RAN1 aims to develop/identify solution(s) to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements agnostic in RAN1 normative work to types of gaps/restrictions that are caused by RRM measurements.
  + It is up to RAN4 to discuss which type of gaps/restrictions caused by RRM measurements can be cancelled/skipped
  + Note: UE features related to the developed solution(s) is a separate discussion

**Agreement**

RAN1 continues to discuss and decide whether or not to introduce new UE assistance information for solution(s) to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements. At least the following UE assistance information is considered for further study:

* FFS: UE assistance information related to measurement occasions:
  + FFS: The number of needed measurement gaps/SMTC with restrictions within a time period;
  + FFS: The maximum number or ratio of MGs/SMTC with restrictions that can be skipped within a time period;
  + FFS: The number of required SSBs within a time period;
  + FFS: The number of consecutive RRM measurements that can be skipped;
  + FFS: The maximum interval between two consecutively reserved gap/restriction occasions for RRM measurements;
  + FFS: The patterns of gap(s)/restriction(s) where skipping is feasible or acceptable;
* FFS: UE assistance information related to channel conditions:
  + FFS: RSRP is below/above search threshold (s-MeasureConfig);
* FFS: UE assistance information related to traffic:
  + FFS: PSI (PDU set importance);
* FFS: UE assistance information related to UE mobility:
  + FFS: L3 parameters related to mobility, e.g., static or not

Companies are encouraged to provide additional details (e.g. how often the UE assistance info is provided, timing, applicable scenarios, performance gains, etc) on their preferred scheme.

Note: From specification point of view, there is no mandated gNB behavior in response to any of the UE assistance information.

RAN1 to make decision, from RAN1 perspective, in RAN1#117 on the support of UE assistance information.

## RAN1#117

**Agreement**

For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements, select one or combination among only Alt1 and Alt3 from RAN1#116bis.

**Conclusion**

RAN1 does not further discuss new UE assistance information related to channel conditions, traffic, UE mobility.

Proposal 2.1.2-v7

For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements consider the following alternatives or combinations for further down-selection:

* Alt. 1: Dynamic indication to enable Tx/Rx in particular gap(s)/restriction(s) that are caused by RRM measurements.
  + FFS: **Alt 1-1**: Explicit indication by DCI to skip a particular gap(s)/restriction(s);
    - Indication is included as part of scheduling DCI:
      * FFS: Bit-field size is one bit;
      * FFS: Bit-field size is >1 bit;
    - Note: Minimum time offset(s) between the end of [the first] received dynamic indication and start of corresponding gap(s)/restriction(s) occasion that is going to be skipped shall be introduced.
  + FFS: **Alt 1-2**: Explicit indication by DCI to indicate a time window where to skip a particular gap(s)/restriction(s);
    - Note: Minimum time offset between the end of received dynamic indication and start of gap(s)/restriction(s) occasion in time window that is going to be skipped shall be introduced.
  + FFS: **Alt 1-3**: Implicit indication by DCI scheduling a transmission/reception overlapping with a gap(s)/restriction(s) to skip the gap(s)/restriction(s);
    - Note: Minimum time offset between the end of received dynamic indication and start of gap(s)/restriction(s) occasion that is going to be skipped shall be introduced.
  + FFS: DCI format, DCI content, DCI bit-field size;
  + FFS: Whether indication is for one or more occasions;
  + FFS: How to consider time offset between the end of received dynamic indication and start of gap(s)/restriction(s) occasion that is going to be skipped.
* Alt. 3: Semi-static solution to enable TX/RX in gaps/restrictions that are caused by RRM measurements.
  + FFS: **Alt 3-1**: Configure a pattern(s) via RRC to indicate occasions where to skip gaps/restrictions;
    - FFS: Details of pattern:
      * FFS: Pattern is based on periodicity, offset and duration;
      * FFS: Pattern is based on a bitmap;
    - FFS: whether a pattern is applied to all or subset of configured MG configurations/scheduling restrictions.
  + FFS: **Alt 3-3**: Gaps/restrictions that are caused by RRM measurements are skipped if collided with particular semi-statically pre-configured Tx/Rx occasions.
  + FFS: **Alt. 3-4**: Gaps/restrictions that are caused by RRM measurements are skipped based on semi-statically configured priority information for particular semi-statically pre-configured Tx/Rx and/or particular gaps/restrictions.

**Conclusion**

There is no consensus in RAN1 to support UE assistance information related to measurements occasions. The reason for this situation is lack of consensus on the need/feasibility for UAI and lack of technical understanding on issues outside of RAN1 expertise (e.g. impact of RRM measurement performance). It is up to other working groups to trigger further work in RAN1 on UE assistance information.

Proposal 2.3.3-v4:

RAN1 agrees to send an LS to RAN4 (CC: RAN2) to convey the following information about UE assistance information (including the conclusion on UAI):

|  |  |
| --- | --- |
| **1. Overall Description:**  RAN1 discussed UE assistance information related to measurements occasions and related to channel conditions, traffic, UE mobility. The following agreement and conclusions were agreed:   |  | | --- | | **Agreement**  RAN1 continues to discuss and decide whether or not to introduce new UE assistance information for solution(s) to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements. At least the following UE assistance information is considered for further study:   * FFS: UE assistance information related to measurement occasions:   + FFS: The number of needed measurement gaps/SMTC with restrictions within a time period;   + FFS: The maximum number or ratio of MGs/SMTC with restrictions that can be skipped within a time period;   + FFS: The number of required SSBs within a time period;   + FFS: The number of consecutive RRM measurements that can be skipped;   + FFS: The maximum interval between two consecutively reserved gap/restriction occasions for RRM measurements;   + FFS: The patterns of gap(s)/restriction(s) where skipping is feasible or acceptable; * FFS: UE assistance information related to channel conditions:   + FFS: RSRP is below/above search threshold (s-MeasureConfig); * FFS: UE assistance information related to traffic:   + FFS: PSI (PDU set importance); * FFS: UE assistance information related to UE mobility:   + FFS: L3 parameters related to mobility, e.g., static or not   Companies are encouraged to provide additional details (e.g. how often the UE assistance info is provided, timing, applicable scenarios, performance gains, etc) on their preferred scheme.  Note: From specification point of view, there is no mandated gNB behavior in response to any of the UE assistance information.  RAN1 to make decision, from RAN1 perspective, in RAN1#117 on the support of UE assistance information.  **Conclusion**  RAN1 does not further discuss new UE assistance information related to channel conditions, traffic, UE mobility.  **Conclusion**  There is no consensus in RAN1 to support UE assistance information related to measurements occasions. The reason for this situation is lack of consensus on the need/feasibility for UAI and lack of technical understanding on issues outside of RAN1 expertise (e.g. impact of RRM measurement performance). It is up to other working groups to trigger further work in RAN1 on UE assistance information. |   Particularly, it was discussed whether impact on RRM performance from skipping measurement occasions may be reduced if UE sends additional information:   * Information about the maximum number of MGs/SMTC with restrictions that can be skipped within a time period. * Information about the patterns of gap(s)/restriction(s) where skipping is feasible or acceptable.   **2. Actions:**  **To RAN4:**  **ACTION:** RAN1 kindly asks RAN4 to consider the above information into account and decide whether or not to introduce any UE assistance information related to measurement occasions. |

Final LS in R1-2405736.

## RAN1#118

**Agreement**

For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements select one among the following options:

**Option 1: Support Alt. 1-1:**

* Alt. 1: Dynamic indication to enable Tx/Rx in particular gap(s)/restriction(s) that are caused by RRM measurements.
  + **Alt 1-1**: Explicit indication by DCI to skip a particular gap(s)/restriction(s);
    - Indication is included as part of scheduling DCI:
      * FFS: Bit-field size is one bit;
      * FFS: Bit-field size is >1 bit;
    - Note: Minimum time offset(s) between the end of [the first] received dynamic indication and start of corresponding gap(s)/restriction(s) occasion that is going to be skipped shall be introduced.
  + FFS: DCI format, DCI content, DCI bit-field size;
  + FFS: Whether indication is for one or more occasions;
  + FFS: How to consider time offset between the end of received dynamic indication and start of gap(s)/restriction(s) occasion that is going to be skipped.

**Option 2: Support Alt. 3-1:**

* Alt. 3: Semi-static solution to enable TX/RX in gaps/restrictions that are caused by RRM measurements.
  + **Alt 3-1**: Configure a pattern(s) via RRC to indicate occasions where to skip gaps/restrictions;
    - FFS: Details of pattern:
      * FFS: Pattern is based on periodicity, offset and duration;
      * FFS: Pattern is based on a bitmap;
    - FFS: whether a pattern is applied to all or subset of configured MG configurations/scheduling restrictions.

**Agreement**

If Alt. 1 from RAN1#117 agreement is supported, minimum time offset(s) X between indication to skip and skipped measurement occasion is up to RAN4 to discuss and decide on particular value(s).

**Working Assumption**

For solutions based on triggering/enabling by network signaling to enable Tx/Rx in gaps/restrictions that are caused by RRM measurements select the following option:

* Alt. 1: Dynamic indication to enable Tx/Rx in particular gap/restriction that are caused by RRM measurements.
  + **Alt 1-1**: Explicit indication by DCI to skip a particular gap/restriction;
    - Indication is included as part of scheduling DCI:
      * Bit-field size is one bit;
        + The bit in the DCI is used to indicate whether to skip the first gap/restriction occasion after a minimum time offset required between the last symbol of the PDCCH carrying the DCI format and the start of corresponding skipped gap/restriction occasion indicated by the DCI.

Send an LS to RAN4 to inform them of the above working assumption and ask them if there is any issue with it. Final LS in R1-2407561.

# References

|  |  |  |
| --- | --- | --- |
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| 1. [R1-2408256](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_118b/Docs/R1-2408256.zip) | Enabling TX/RX for XR during RRM measurements | TCL |
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