**3GPP TSG RAN WG1 #106-e** **R1-210XXXX**

**e-Meeting, Aug 16th – 27th, 2021**

**Agenda Item:** 8.7.1.2

**Source:** Moderator (Samsung)

**Title:**  Moderator summary for TRS/CSI-RS occasion(s) for idle/inactive UEs

**Document for:** Discussion/Decision

# Introduction

This document provides the summary of contributions [1] – [24] submitted to agenda item 8.7.1.2, and discussion in the following email thread on TRS/CSI-RS occasions for idle/inactive UEs during RAN1 #106-e meeting.

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| [106-e-NR-R17-PowSav-02] Email discussion regarding TRS/CSI-RS occasions for idle/inactive UEs – Qiongjie (Samsung)   * 1st check point: 8/19 * 2nd check point: 8/24 * Final check: 8/27 |

Companies are invited to provide comments to questions/alternatives/proposals drawn based on the FL summary using this document.

For phase I discussion before 1st check point on 8/19, companies are requested to provide views for **<1st round discussion> in Section 2, 3, 4 5 by 8/17 UTC 01:00 am.** We will refine proposals based on that, and further discuss potential proposals before GTW session on Wednesday, 8/18.

The issues in this document are color coded with High Priority or Medium Priority.

# L1 based Availability Indication

## 2.1 Signalling method

In RAN1#105-e meeting, the following working assumption were made to support both paging DCI and PDCCH based PEI based signaling for availability indication of TRS/CSI-RS occassion(s) to idle/inactive UEs.

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| --- |
| **Working assumption:**  Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.  Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.   * FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB |

The following proposals related to the signalling method were made in contributions [1] - [24] for RAN1 #106e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | ***Confirm the working assumption, i.e.***   * ***Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.*** * ***Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.***   + ***FFS how to enable/disable L1 based availability indication configurable by SIB***   ***The L1 based availability indication for a TRS resource is enabled/disabled implicitly by the presence/absence of the configuration of the TRS resource in SIB.*** |
| TCL | **Proposal 1:** **Support L1 signaling (Paging PDCCH based and PEI based) for availability indication of TRS/CSI-RS occasions to the idle/inactive UEs.**   * **P-PDCCH based Indication can be used when a UE is paging in contiguous way in successive POs** * **PEI base Indication can be used when a UE is paging in non-contiguous way in successive POs**   **Proposal 4: For enabling/disabling of SIB based and L1 based signaling of TRS availability indication, the following procedure can be considered:**   * **Alt1: SIB based signaling can be considered as default signaling and L1 based signaling can be enabled/disabled.** * **Alt2: L1 based signaling can be considered as default signaling and SIB based signaling can be enabled/disabled.** * **Alt3: No default signaling is considered, and a NewBitField of size one bit in the SIB\_X can be used to enable/disable both SIB based and L1 based signaling.** |
| ZTE | **Proposal 1: Confirm the following working assumption.**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.**  **FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB.** |
| vivo | ***Proposal 2:*** *Confirm the following part of the WA made in RAN1#105e*   * *Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.* |
| Spreadtrum | ***Proposal 1: Confirm the working assumption that “Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs”.***  ***Proposal 2: Confirm the working assumption that “Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected”.*** |
| Sony | **Proposal 1: Confirm the working assumption on support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Proposal 2: The availability indication can be explicitly informed using one or some of these reserved bits in paging DCI.** |
| Samsung | **Proposal 1: Confirm the WA to support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Proposal 2: Deprioritize supporting PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.** |
| CATT | ***Proposal 8: Paging DCI based availability indication should be supported at least for the case when PEI is not configured.***  ***Proposal 10:*** ***An 1-bit explicit indication of enable/disable L1 signaling for TRS/CSI-RS availability indication can be configured together with TRS/CSI-RS resource configuration in SIB-X.*** |
| Nordic | ***Proposal-1:*** *A gNB may configure X codepoints, up to [8], each codepoint indicating validity/invalidity for subset of configured iTRS resource sets.*   * *validity/invalidity is indicated for a pre-configured period of time (e.g. 10s) from the time of indication.*    + *FFS: different validity/invalidity periods for different UE groups* * *DCI field is present in Paging Early indication PDCCH (if configured), otherwise in Paging DCI.* |
| Lenovo | **Proposal 4: For L1 based signalling for the availability indication of TRS/CSI-RS at the configured occasion(s),**   * **A bitfield for indicating availability of TRS on configured TRS occasions within a DRX cycle can be configured in a DCI format including PEI for the DRX cycle.** * **Paging DCI of a current DRX cycle can include TRS availability information for a following DRX cycle.**   **Proposal 6: Support a TRS transmission mode that UE may assume that TRS are present on all configured TRS occasions, in order to reduce DCI signalling overhead.** |
| OPPO | ***Proposal 4: Implicit method to enable/disable L1 based availability indication shall be supported.***   * ***Presence of the configuration of TRS/CSI-RS occasions or the grouping of TRS/CSI-RS occasions can implicitly indicate that L1 based availability indication is enabled*** |
| Qualcomm | **Proposal 2: Confirm the working assumption from RAN1-105e to use the paging PDCCH to carry the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs**   * **By the unused and/or reserved bits in the paging DCI** * **This includes cross-slot scheduling paging PDCCH as PEI.**   **Proposal 3: If PEI is configured, PEI can be used to indicate the UE to decode paging PDCCH to read the TRS availability information**   * **If PEI is based on sequence, use one sequence to indicate whether TRS availability is provided in paging PDCCH** * **If PEI is based on PDCCH, PDCCH can carry the same information as paging PDCCH** |
| CMCC | **Proposal 1. Confirm the following working assumption:**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.**   * **FFS how to enable/disable L1 based availability indication configurable by SIB**   **Proposal 2. Don’t allow indicating the availability of TRS/CSI-RS only in paging DCI without short message and/or scheduling information.**  **Proposal 3. If PDCCH-based PEI is configured by SIB, the availability indication is carried in PDCCH-based PEI, else, the availability indication is carried in paging PDCCH.** |
| LG | **Proposal 1: Confirm the working assumption.**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.**  **• FFS whether and how to enable/disable L1 based availability indication configurable by SIB** |
| MediaTek | **Proposal 1: Confirm the following working assumption for TRS/CSI-RS availability information:**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.**   * **FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB** |
| Intel | **Proposal 1: Prioritize paging PDCCH based availability indication signaling design.** |
| Panasonic | **Proposal 1: Confirm the working assumption to support both PEI and paging based signaling for TRS/CSI-RS availability indication.** |
| DOCOMO | **Proposal 2: Only Paging DCI and/or paging early indication should be adopted to indicate the availability of TRS/CSI-RS for idle/inactive mode UE.**  **Proposal 4: When PEI is adopted to indicate the availability of TRS/CSI-RS for idle/inactive mode UE, UE behaviour should be considered whether or not to use TRS/CSI-RS for time/frequency tracking when UE can’t detect PEI.** |
| Xiaomi | ***Proposal 3: At least Paging DCI or PDCCH based available/unavailable indication is preferred.*** |
| Ericsson | **Proposal 1** **Support L1-based TRS availability indication with associated validity time via a bitfield in Paging DCI.** |
| Nokia | **Proposal: Support paging DCI based and PEI based beam specific aperiodic L1 availability indication.** |

### 2.1.1 <1st round discussion>

According to the proposals in contributions [1] - [24] submitted to AI 8.7.1.2, three are three open issues regarding L1 based signaling methods for availability indication of TRS/CSI-RS occassion(s) to idle/inactive UEs.

* Issue 2.1-1: support paging PDCCH based availability indication.
* Issue 2.1-2: support PEI based availability indication
* Issue 2.1-3: FFS how to enable/disable L1 based availability indication configurable by SIB

#### Issue 2.1-1: support paging PDCCH based availability indication

**Table 2.1.1-1: Views for Issue 2.1-1**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Motivations** |
| Yes, or confirm WA | Huawei, HiSilicon, TCL, ZTE, Vivo, Spreadtrum, Sony, Samsung, CATT, Nordic, Lenovo, Qualcomm, CMCC, LG, MediaTek, Intel, Panasonic, DOCOMO, Xiaomi, Ericsson, Nokia (21) | should be supported at least for the case when PEI is not configured. |
| No |  |  |

According to the views summarized in Table 2.1.1-1, there is a consensus to support paging PDCCH based signaling at least for the case when PEI is not configured.

In addition, some companies proposed more details for supporting paging PDCCH based signaling, including

* [Sonly, Qualcomm, Intel]: by the unused and/or reserved bits in the paging DCI
* [CMCC]: don’t allow indicating the availability of TRS/CSI-RS only in paging DCI without short message and/or scheduling information.

For the 1st round discussion on Issue 2.1-1, the following alternatives can be considered as potential way forward.

Alternatives 2.1.1-1:

* Alt-1: Confirm the following WA:
* Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.
* Alt-2: Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.at least when PEI is not configured
  + FFS the case when PEI is configured, e.g. using paging PDCCH, PEI, or a combination of PEI and paging PDCCH
* Question: Whether or not allow availability indication only in paging PDCCH without short message and/or scheduling information?

Companies are invited to provide comments for Alternatives 2.1.1-1 in the table below, such as alternative to support and reasons, reply to the question, additional details to consider, other alternative if any, and etc.

**Table 2.1.1-2: 1st round discussion on Issue 2.1-1:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-1 | We don’t see the need of non-scheduling DCI for dynamic TRS/CSI-RS availability indication at Paging PDCCH |
| Sharp | Alt-1 | Support for Paging PDCCH as the baseline. If PEI is configured, it can be used to indicate the presence of a paging PDCCH with TRS indication |
| TCL | Support Alt2 | We prefer Alt2, as it focus on supporting both paging PDCCH based availability Indication and PEI based availability indication. Alt1 targets supporting of paging PDCCH based availability indication only. |
| OPPO | Alt-1 | Confirm at least the 1st part of the WA in last meeting.  For case there is no scheduling or short message, gNB is allowed not to send paging DCI. When no indication is received by the UE, the UE shall assume there is no additional RS. |
| Spreadtrum | Alt-1 |  |
| Nordic | Alt-1, with condition | if agreed together with Alt 1 in 2.1.1.2 |
| Samsung | Alt1 or Alt2 | Either one is OK. Alt-2 is slightly better as it has more information for moving forward.  For the question, we think gNB should have the flexibility to transmit the availablity indication any time as needed. The availability can be transmitted at least without scheduling information. For the short message, it depends on whether or not we use reserved bits in short message. It can be discussed after we determine the # of bits needed for the availability indication. |
| ZTE, Sanechips |  | We should confirm the original WA, instead of the listed alternatives.  **Working assumption:**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.**   * **FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB**   The listed alternatives had been discussed in the last meeting, but there is no consensus, we don’t think we need to repeat the discussion again.  It should be noted that if the availability indication is carried by paging DCI not PEI, UE has to detect SSB and PO for availability indication in each paging cycle, the power saving gain brought by PEI is completely defeated by the paging DCI based solution!!!  Hence, we cannot accept the listed alternatives, we should confirm the original WA. |

#### Issue 2.1-2: support PEI based availability indication

**Table 2.1.1-3: Views for Issue 2.1.-2**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Motivations or Details** |
| Yes, or confirm WA | Huawei, HiSilicon, TCL, ZTE, Spreadtrum, Nordic, Lenovo, CMCC, LG, MediaTek, Panasonic, DOCOMO, Xiaomi, Nokia (13) | * Higher power saving gain than paging PDCCH based signaling * PEI based signaling and paging PDCCH signaling can be used to for availability indication associated with different validity time: * [TCL]: P-PDCCH based indication can be used when a UE is paging in contiguous way in successive POs, PEI base Indication can be used when a UE is paging in non-contiguous way in successive POs * [Lenovo]: PEI based indication for current DRX cycle, paging PDCCH based indication for following DRX cycle |
| A combination of PEI and paging PDCCH based signaling | Qualcomm | If PEI is configured, PEI can be used to indicate the UE to decode paging PDCCH to read the TRS availability information   * If PEI is based on sequence, use one sequence to indicate whether TRS availability is provided in paging PDCCH * If PEI is based on PDCCH, PDCCH can carry the same information as paging PDCCH |
| Deprioritize | Samsung, Intel | * Clear design for PEI is not established yet * Limited gain over paging PDCCH based solution w/ large spec efforts * Concerns to couple PEI and availability indication |

According to Table 2.1.1-3, (13) companies propose to support PEI based signaling or confirm WA from last meeting. One company [12] proposed to support a combination of PEI and paging PDCCH based signaling. Two companies [7] [16] proposed to deprioritize supporting PEI based signaling and prioritize paging PDCCH based availability indication.

In addition, some companies proposed more details for supporting PEI based signaling, including

* [CMCC]: If PDCCH-based PEI is configured by SIB, the availability indication is carried in PDCCH-based PEI, else, the availability indication is carried in paging PDCCH.
* [DOCOMO]: When PEI is adopted to indicate the availability of TRS/CSI-RS for idle/inactive mode UE, UE behaviour should be considered whether or not to use TRS/CSI-RS for time/frequency tracking when UE can’t detect PEI.

For the first round discussion on Issue 2.1-2, the following alternatives can be considered as potential way forward.

Alternatives 2.1.1-2:

* Alt-1: Confirm the following WA
  + Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.
* Alt-2: Prioritize Paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs
  + FFS PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs after L1 of signal/channel of PEI is confirmed.

Companies are invited to provide comments for Alternatives 2.1.1-2 in the table below, such as alternative to support and reasons, additional details to consider, other alternative if any, and etc.

**Table 2.1.1-4: 1st round discussion on Issue 2.1-2**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-2 | We don’t see the need of using PEI for TRS/CSI-CS availability indication. |
| Sharp | Alt-2 | Paging PDCCH should be prioritized for UEs which may not support both two features |
| TCL | Alt1 | We prefer alt1 |
| Spreadtrum | Alt-1 |  |
| Nordic | Alt 1 |  |
| Samsung | Alt-2 | We have concern about coupling PEI and availability indication features. The availability indication is for idle mode RS resources configured in SIB, which is cell-specific. But, the PEI is for UE group specific paging message.   * For the benefit of simplicity, gNB only need to provide common availability information for all configured RS resources, UE can choose to receive any TRS resource based on its preference and timeline. * Also, the assistance RS can be used not only before paging PDCCH reception, for example for idle mode SDT. |
| ZTE, Sanechips |  | We should confirm the original WA, instead of the listed alternatives.  **Working assumption:**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.**   * **FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB**   The listed alternatives had been discussed in the last meeting, but there is no consensus, we don’t think we need to repeat the discussion again.  It should be noted that if the availability indication is carried by paging DCI not PEI, UE has to detect SSB and PO for availability indication in each paging cycle, the power saving gain brought by PEI is completely defeated by the paging DCI based solution!!!  Hence, we cannot accept the listed alternatives, we should confirm the original WA. |

#### Issue 2.1-3: FFS how to enable/disable L1 based availability indication configurable by SIB

**Table 2.1.1-5: Views for Issue 2.2-3**

|  |  |  |
| --- | --- | --- |
|  | | Companies |
| Yes | 1-bit in SIB-X | TCL, CATT, [TCL] |
| No, no need | Enabled/disabled implicitly  -e.g. presence of the configuration of TRS/CSI-RS occasions;  -e.g. L1 based availability indication is considered as default signaling, and SIB based signaling can be enabled/disabled | Huawei, HiSilicon, [TCL], OPPO |

For the 1st round discussion on Issue 2.1-3, the following alternatives can be considered as potential way forward.

Alternatives 2.1.1-3:

* Alt1: L1 based availability indication of TRS/CSI-RS occasions for idle/inactive UEs can be enable/disabled based on a binary bit configured in SIB-X
* Alt2: L1 based availability indication of TRS/CSI-RS occasions for idle/inactive UEs can be enable/disabled based on presence/absence of the configuration of TRS/CSI-RS occasions

Companies are invited to provide comments for Alternatives 2.1.1-3 in the table below, such as alternative to support/FFS, additional details to consider, other alternative if any, and etc.

**Table 2.1.1-6: 1st round discussion on Issue 2.1-3**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support/FFS)** | **Comments** |
| CATT | Alt1 | An explicit 1-bit indication in SIB-X would allow the network to minimize the L1 signaling when the TRS/CSI-RS information are semi-statically configured and would not change dynamically. |
| Sharp | FFS | It is determined by whether the SIB-based availability indication is supported and whether it coexistences with L1 based availability indication |
| TCL |  | Before selection of any alt in this issue, it is necessary to clarify whether to consider any signaling type (L1 /SIB based) as default singling for TRS availability indication or not. In our view, if no default signaling is considered then explicit enabling/disabling, e.g. 1 bit in SIB-X can be used to enable/disabled L1 based or SIB based signaling. If L1 based signaling is considered as default signaling, then implicit enabling/disabling i.e. alt2 is preferred. |
| Nordic | None of above | Preferred condition is “if DCI field is configured” |
| Samsung | Alt 1 | This should be discussed no matter SIB based signaling is supported or not. Alt1 provides more flexibility to gNB for using the L1 based singling. |
| ZTE, Sanechips | Not alt 1 | There is no need of dedicated enable/disable signaling for the L1 based solution. Other solutions can be further discussed. |

## 2.2 Indication content

In RAN1#105-e meeting, the following agreement were made regarding the indication content for L1 based availibity indicaiton of TRS/CSI-RS occasion(s) to idle/inactive UEs.

|  |
| --- |
| Agreement:  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availability/unavailability information for configured RS resources using a bitmap or codepoint   * e.g. using bitmap, where each bit is associated with at least one resource/configuration or a set/group of resources * e.g. a codepoint to indicate a state of availability/unavailability for all or some of configured RS resources * FFS maximum number of configured RS resources per physical layer availability indication to support. * FFS whether availability/unavailability information is for all or some of configured RS resources |

The following proposals related to the indication content were made in contributions [1] - [24] for RAN1 #106e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | 1. ***Bitmap is the baseline for availability indication, where each bit indicates a RS or a group of RS.*** 2. ***Support to indicate the availability of assistance TRS occasion(s) per beam direction by a bitmap, where each bit corresponds to the assistance TRS(s) that are QCLed with the same associated SSB index.*** |
| TCL | **Proposal 6: Availability of a set/group of multiple TRS/CSI-RS can be indicated in a paging cycle to the UE or group of UE for the next paging cycle, which may reduce the availability indication overhead of L1 signaling.** |
| ZTE | **Proposal 3: Bitmap should be used to indicate the TRS availability/unavailability information.**  **Proposal 4: The maximum number of CSI-RS/TRS resources should be sufficient to support multi-beam operation with a maximum of 64 beams.**  **Proposal 5: Each bit in the bitmap can be used to indication the availability/unavailability indication for a TRS resource set.** |
| Vivo | ***Proposal 3:*** *Availability/unavailability information is indicated using a bitmap, where each bit is associated with at least one TRS resource set based on SIB configuration.* |
| Spreadtrum | ***Proposal 4: Availability/unavailability information using bitmap, where each bit is associated with at least one resource/configuration or a set/group of resources, should be supported.*** |
| Sony | **Proposal 4: For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, use a bitmap / codepoint to indicate availability/unavailability information for all or some of configured RS resources.**  **Proposal 5: Indication the ‘availability’ of TRS/CSI-RS occasions in beam selective manner is not supported.** |
| CATT | ***Proposal 9: The availability indication should be one bit or one code point to indicate all TRS/CSI-RS resources within a cell. UE could not assume any TRS/CSI-RS resource if the availability indication is only indicated the selected TRS/CSI-RS resources within a cell.*** |
| Nordic | ***Proposal-1:*** *A gNB may configure X codepoints, up to [8], each codepoint indicating validity/invalidity for subset of configured iTRS resource sets.*   * *validity/invalidity is indicated for a pre-configured period of time (e.g. 10s) from the time of indication.*    + *FFS: different validity/invalidity periods for different UE groups* * *DCI field is present in Paging Early indication PDCCH (if configured), otherwise in Paging DCI.* |
| OPPO | ***Proposal 1: Availability/unavailability information is for all configured RS resources using a bitmap.***   * ***each bit is associated with one resource or a set/group of resources***   ***Proposal 5: Beam level indication shall be supported for TRS/CSI-RS availability.*** |
| Qualcomm | **Proposal 4: For an idle/inactive UE that newly camped on the cell, availability/unavailability** **of a TRS/CSI-RS that is indicated before the UE camped on the cell is unknow to the UE. In this case, the UE assumes the TRS/CSI-RS is not transmitted.**  **Proposal 5: For availability/unavailability** **information provided by a physical layer availability indication for TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs**   * **First preference based on Alt. 1: The indication is self-contained. Availability and unavailability information for all the configured RS resources is transmitted using a bitmap** * **Second preference based on Alt. 2: Use codepoint to indicate one or more resource/configuration indices that correspond to the available RS resources.** |
| MediaTek | Proposal 5: UE assumes the same TRS/CSI-RS availability indication in multi-beam operation. |
| Intel | **Proposal 2: Support availability/unavailability information for configured RS resources using a bitmap**   * **Each bit can be associated with at least one resource/configuration or a set/group of resources.** * **Reserved bits in paging DCI can be used for availability indication** |
| Panasonic | **Proposal 2: Before agreeing on the signaling details, the maximum number of TRS configurations supported by TRS/CSI-RS occasion(s) should be agreed first. This has direct impact on the overhead reduction for L1 signaling design, i.e. whether to use bitmap or codepoint.**  **Proposal 5: To use codepoint to indicate TRS resources usage of up to 8 TRS sets. To use bitmap to indicate TRS resources usage of up to 4 TRS sets.** |
| Apple | **Proposal 5: When the availability indication is carried in a DCI, it only carries the information for TRS/CSI-RS configuration(s) that correspond to the same beam as the DCI.**  **Proposal 6: When the availability indication is carried in a DCI, a bitmap is used to carry the availability indication, with one bit per TRS configuration in the same beam.** |
| Sharp | **Proposal 5: The physical layer indication only indicates availability/unavailability commands for the resources with the same QCL reference** |
| InterDigital | **Proposal 2: Availability is indicated using a bitmap where each bit is associated to a group of (including one) resources.** |
| Xiaomi | ***Proposal 4: QCL information update by L1 indication can also be supported.*** |
| Ericsson | **For L1-based TRS availability indication via Paging DCI, the bitfield within the paging DCI is explicitly configured using a start and length field (Details FFS) with maximum 6 bits in the DCI.**  **For L1-based TRS availability indication via Paging DCI, a codepoint/bitmap based approach is used to indicate TRS availability of different resources and/or for different validity timer values.**   * 1. **The number of resource sets per availability indication can be up to 64.**   **For L1-based TRS availability indication via Paging DCI, support beam selective TRS availability indication, i.e., if UE detects Paging DCI in a beam X, the availability bitfield in the Paging DCI is associated to a group of beams corresponding to beam X.**   * 1. **Grouping is configured via higher layers (Details FFS)** |
| Nokia | **Proposal: For indicating the availability indication in paging DCI via the [6] bits use network configurable grouping to establish mapping between indication and active TRS resource set(s). For PEI, consider using QCL relation of PEI (based on monitoring occasion) with 1 bit availability indication and 1 bit to identify the possible QCL sources (in case of Type2-PDCCH CSS is sharing Type0-PDCCH CSS).** |
|  |  |

### 2.2.1 <1st round discussion>

According to the proposals in contributions [1] - [24] submitted to AI 8.7.1.2, three are three issues regarding indication content for explicit availability indication of TRS/CSI-RS occassion(s) to idle/inactive UEs.

* Issue 2.2-1: FFS whether and how to indicate the ‘availability’ in beam selective manner
* Issue 2.2-2: FFS whether availability/unavailability information is for all or some of configured RS resources
* Issue 2.2-3: FFS maximum number of configured RS resources per physical layer availability indication to support, and corresponding signalling details, e.g. using bitmap or codepoints.

#### Issue 2.2-1: FFS whether and how to indicate the ‘availability’ in beam selective manner

**Table 2.2.1-1: Summary of views in Contributions [1]-[24] for Issue 2.2-1**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Other details** |
| Alt-1: Yes, by a bitmap, where each bit corresponds to the assistance TRS(s) that are QCLed with the same associated SSB index. | Huawei, HiSilicon, | TRS configuration is per beam direction |
| Alt-2: Yes, L1 availability indication only indicates availability/unavailability information for resources with the same QCL reference | Apple, OPPPO, Ericsson, Nokia, Sharp | Ericsson: Grouping is configured via higher layers (Details FFS) |
| Alt-3: Yes, QCL information indicated/updated by the L1 availability indication. | Xiaomi, Nokia | Xiaomi: QCL information update by L1 indication can also be supported  Nokia: 1 bit to identify the possible QCL sources (in case of Type2-PDCCH CSS is sharing Type0-PDCCH CSS). |
| Alt-4: No, same TRS/CSI-RS availability indication in multi-beam operation | MediaTek, Sony, CATT | -Reuse Rel-15 multi-beam transmission |

For the 1st round discussion on Issue 2.2-1, companies are invited to provide comments for the Alts in above Table 2.2.1- 1, such as Alt(s) to support and reasons, additional details to consider, other alternative if any, and etc.

**Table 2.2.1-2: Discussion on Issue 2.2-1**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-4 | IDLE/Inactive UE would not know which beam (SSB) it is under after long deep sleep. In order to achieve UE power saving, TRS/CSI-RS resource should be same for all beams within a cell. If not TRS/CSI-RS resource availability is different among beams within a cell, UE need to wake up early and could not assume TRS/CSI-RS available to achieve power saving. |
| Sharp | Alt-2 | UE only need to care about the TRSs with the same QCL reference for a special PO, alt2 makes full use of the bit space of the L1 signal |
| TCL | At1 |  |
| OPPO | Alt-2 | To save the overhead |
| Nordic | Alt 2 |  |
| Samsung | Alt-4 | In practice, it’s necessary and beneficial for idle/inactive UEs to do beam sweeping for receving the assistant RS resources. After beam-sweeping of the assistant RS resources, UE can then decodes PDCCH or PDSCH in the beam direction has the best performance. |
| ZTE, Sanechips | Alt1+alt 2 | More clarification about the difference between alt1 and alt2.  To reduce signaling overhead, each bit in the bitmap should be used to indicate availability indication for a resource set, and all the resource within the resource set has the same QCL information.  Hence, in our understanding, Alt1+alt 2 can works for our intention. |

#### Issue 2.2-2: FFS whether availability/unavailability information is for all or some of configured RS resources

**Table 2.2.1-3: Summary of views in contributions [1] – [24] for Issue 2.2-2**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Motivations** |
| Alt-1: for all configured RS resource | OPPO, Qualcomm, vivo, [Sony], CATT, |  |
| Alt-2: for some configured RS resources, e.g. indicated in a paging cycle to group of UE for the next paging cycle | TCL, [Sony] | -may reduce the availability indication overhead of L1 signaling. |

For the 1st round discussion on Issue 2.2-2, companies are invited to provide comments for the Alts in above Table 2.2.1- 3, such as Alt(s) to support and reasons, additional details to consider, other alternative if any, and etc.

**Table 2.2.1-4: Discussion on Issue 2.2-2**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-1 | IDLE/Inactive UE would not know which beam (SSB) it is under after long deep sleep. In order to achieve UE power saving, TRS/CSI-RS resource should be same for all beams within a cell. If not TRS/CSI-RS resource availability is different among beams within a cell, UE need to wake up early and could not assume TRS/CSI-RS available to achieve power saving. |
| Sharp | FFS | The question is not clear enough; it should wait for the answer to the last question. E.g. the all configured resources are all resources configured in SIBx or it only includes the resources associated with an indication occasion? |
| TCL | Alt2 | Alt2 may allow the network to indicates UE only those RS resources which can be used for synchronization purposes and thus it will reduce the availability indication overhead. |
| OPPO | Alt -1 | All RS per beam |
| Nordic | Alt -1 | All resource per corresponding beam if more than one allowed. |
| Samsung | Alt -1 | The available RS resources are shared from connected mode. There is no association between the available RS resources and UE groups in reality. So Alt2 doesn’t make sense.  Also, idle/inactive mode UE should have the flexibility to receive any of the available RS resources according to its preferences and implementation. No need to restrict the use case to paging reception only. For example, UE may use it before SDT in idle mode. |
| ZTE, Sanechips | Alt-1 | For alt-1, the signaling overhead can be also reduced by grouping some TRS resource into a resource set. |

#### Issue 2.2-3: FFS maximum number of configured RS resources per physical layer availability indication to support and corresponding signaling details, e.g. using bitmap or codepoints

**Table 2.2.1-5: Summary of views in Contributions [1] - [24] for Issue 2.2-3**

|  |  |
| --- | --- |
|  | Companies: values for X |
| Alt-1: Bitmap, to indicate TRS resources usage of up to [X] TRS sets/groups. | Huawei, HiSilicon, ZTE, Vivo, Spreadtrum, OPPO, Qualcomm, Intel, Panasonic:4, Apple, InterDigital, Ericsson:6, [Nokia]:6 |
| Alt-2: X codepoints, to indicate TRS resources usage of up to X TRS sets/groups | CATT:1,  Nordic:[8], Panasonic:8, Ericsson:64 |

For the 1st round discussion on Issue 2.2-3, companies are invited to provide comments for the Alts in above Table 2.2.1- 5, such as Alt(s) to support and reasons, additional details to consider, other alternative if any, and etc.

**Table 2.2.1-6: Discussion on Issue 2.2-3**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-2 | Only one TRS resource for all beam at each cell. |
| Sharp | Alt1 | A bitmap is more flexible to indicated each resource/set ‘s status |
| TCL | Support Alt1 & Alt2 | We support both alt1 and alt2. |
| OPPO | Alt-1 | A bitmap is more flexible |
| Spreadtrum | Alt-1 | For using bitmap, each bit from the bitmap can be associated with a set/group of resources. It is a flexible way. |
| Nordic | Alt-2 | Codepoints have enough flexibility if resources per beam are indicated. |
| Samsung | Alt-2 | Given the same # of bits, Alt2 can provide more combinations of available TRS sets/groups. |
| ZTE, Sanechips | Alt-1 | For indication with bitmap, each TRS resource set can be enabled / disabled separately, there would be multiple active resource sets at the same time, which is beneficial to UE PS. |

## 2.3 Validity time

According to previous FL summary [25], we briefly discussed three alternatives about the validity time for L1 based availability indication in RAN1 #105e meeting. As mentioned in [HW, TCL, Samsung], the main motivations is to reduce L1 signalling overhead for availability indication. The availability of assistance TRS is assumed to be the same during an indicated time period before expiration of corresponding timer.

In [25], the L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs is valid for a time duration that can be determined based on at least one or more alternatives from the following:

* Alt-1: Configured by higher layer
* Alt-2: A window before a PO
* Alt-3: Included in the availability indication
* A combination of alternatives is not precluded.

The following proposals related to the validity time of the availability indication were made in contributions [1] – [24] for RAN1 #106e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | 1. ***Support to indicate the availability of assistance TRS in a window before the PO for both paging DCI based availability indication and PEI based availability indication.*** 2. ***At least for paging DCI based availability indication, an indication period is introduced during which the availability of assistance TRS is assumed to be the same.*** 3. ***Indication period is several default paging cycle length, which is common to all Ues and can avoid different understanding among Ues paged on the same PO.*** 4. ***The length of the indication period can be configured to one default paging cycle or configured as N default paging cycles.*** |
| TCL | **Proposal 5: Include the configuration of IndicationCycle in the *DownlinkConfigCommonSIB*, similar to the paging cycle, to reduce the availability indication overhead of L1 signaling.** |
| Vivo | ***Proposal 4:*** *TRS without validity time limitation should be supported, in addition to the configurations with validity time.*   * *The candidate duration values for validity time can be {N1, N2, … Nx, Null} paging cycles;* * *For TRS without validity time limitation, e.g., the duration of validity time is configured as ‘NULL’, if UE detects L1 signaling indicate TRS available, UE does not change the assumption of TRS availability unless receiving new L1 signaling indicate TRS unavailable.* |
| Spreadtrum | ***Proposal 5: The validity time for paging PDCCH based availability indication should be supported.***  ***Proposal 6: The validity time for PEI based availability indication should also be supported.*** |
| Sony | **Proposal 3: Support to provide additional availability information (e.g. availability duration, which active TRS/CSI-RS are currently available).** |
| Samsung | **Proposal 5: L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive Ues is valid for a time duration configured by higher layer**   * **FFS L1 based signalling of the valid time duration.** |
| Nordic | ***Proposal-1:*** *A gNB may configure X codepoints, up to [8], each codepoint indicating validity/invalidity for subset of configured iTRS resource sets.*   * *validity/invalidity is indicated for a pre-configured period of time (e.g. 10s) from the time of indication.*    + *FFS: different validity/invalidity periods for different UE groups* * *DCI field is present in Paging Early indication PDCCH (if configured), otherwise in Paging DCI.* |
| Lenovo | **Proposal 5: gNB can configure a validity time interval for a TRS configuration. Upon expiry of the validity time, UE assumes that previous TRS configuration is unavailable.** |
| OPPO | ***Proposal 3: DCI in previous paging cycle can be used to indicate whether there is RS for the current paging cycle or Paging DCI in previous PO can be used to indicate whether there is RS for current PO.*** |
| CMCC | **Proposal 6. For paging PDCCH based availability indication, the validity time is configured by higher layer.**  **Proposal 7. For PEI based availability indication, the validity time is a window before the PO which associated with the PEI.** |
| LG | **Proposal 2: The L1 based signaling can indicate available duration for the TRS/CSI-RS occasion(s).**  **- FFS: Details including the length of duration and its indication method** |
| MediaTek | **Proposal 3: Further study the following alternatives for the validity time of TRS/CSI-RS availability indication at the configured occasion(s) to idle/inactive Ues.**   * **Alt 1: Configured by higher layer** * **Alt 2: A window before a PO** |
| Intel | **Proposal 3: Support higher layer configuration of validity time duration for availability indication.** |
| Panasonic | **Proposal 6: Validity period needs to be defined for L1 availability/unavailability indication of TRS/CSI-RS occasion(s) for IDLE/INACTIVE Ues.** |
| Apple | **Proposal 2: For PEI based availability indication of TRS occasions, the availability indication is valid until the end of the current PO.**  **Proposal 3: For paging PDCCH based availability indication of TRS occasions, the duration for which the availability indication remains valid is configurable, with one of the values being infinity. It should be valid at least until the end of the next PO.**  **Proposal 7: When a TRS configuration is indicated as available, the idle/inactive Ues assumes that only a certain number of TRS occasion(s) before a PO is available.** |
| InterlDigital | **Proposal 3: Validity time of the availability indication is configured by higher layers.** |
| DOCOMO | **Proposal 1: The validity timer of the availability of TRS/CSI-RS should be supported.**   * **When the availability is informed e.g., by paging PDCCH, the timer (re)starts, and then after the timer expires, i.e., the availability indication has not been received for the timer period, the UE assumes no TRS/CSI-RS can be obtained.** * **The time period can be configured, e.g., via SIB.** |
| Xiaomi | ***Proposal 5: A predefined window before each PO can be configured for network power saving.*** |
| Ericsson | **For L1-based TRS availability indication via Paging DCI, higher layers can configure multiple validity time value(s) and the applied validity time value is indicated via Paging DCI.** |
| Nokia | **Proposal: Support L1 availability indication that indicates the availability for a time duration, where the time duration is set by configurable validity timer. After the timer has expired, UE should assume that the TRS are no longer available.** |

### 2.3.1 <1st round discussion>

According to the proposals in contributions [1] – [24] submitted to AI 8.7.1.2, there are strong interests to support validity time for explicit availability indication of TRS/CSI-RS I(s) to idle/inactive Ues. The main issue is to determine the details or down-select alterantives for FFS.

* Issue 2.3-1: how to determine validity time of TRS/CSI-RS availability indication at the configured occasion(s) to idle/inactive Ues

#### Issue 2.3: how to determine validity time of TRS/CSI-RS availability indication at the configured occasion(s) to idle/inactive Ues

**Table 2.3.1-1: Summary of views in contributions [1] – [24] for Issue 2.3**

|  |  |  |  |
| --- | --- | --- | --- |
|  | | **Companies** | **Other details** |
| Opt-1: Configured by higher layer | | TCL, Samsung, Nordic, Lenovo, CMCC, Intel, Apple (paging PDCCH based), InterlDigital, DOCOMO, Nokia | .- |
| Opt-2: A window before a PO | For PEI and paging DCI based | Huawei, HiSilicon, Xiaomi |  |
| For PEI based only | CMCC, Apple |  |
| Opt-3: Include in the L1 based availability indication | | LG, Ericsson | higher layers can configure multiple validity time value(s) and the applied validity time value is indicated via Paging DCI. |
| Opt-4: TRS without validity time limitation should be supported | | Vivo | For TRS without validity time limitation, if UE detects L1 signaling indicate TRS available, UE does not change the assumption of TRS availability unless receiving new L1 signaling indicate TRS unavailable. |
| Opt-4: Support, FFS details | | Spreadtrum, Sony, MediaTek, Panasonic |  |

Companies also proposed to consider **candidate duration** for the validity time, including

* Opt-1: N paging cycles
  + Huawei, HiSilicon, Vivo
* Opt-2: N s., e.g. 10s
  + Nordic
* Opt-3: Null/ infinity
  + Vivo, Apple
* Opt-4: the end of the current PO
  + Apple (for PEI based)

In addition, there are some proposals about determining the **reference/starting point** for the indicated validity time.

* Opt-1: from the time of indication
  + Nordic, Apple (PEI based)
* Opt-2: start of next DRX cycle
  + OPPO

For the 1st round discussion on Issue 2.3, companies are invited to provide comments for i) the options in above Table 2.3.1- 1, such as option(s) to support, additional details to consider, other option, and etc; ii) **candidate duration** and **reference/starting point** associated with preferred options in Table 2.3.1-1.

**Table 2.3.1-2: Discussion on Issue 2.3**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option(s)**  **(Support)** | **Comments** |
| CATT | Opt-3 null/infinity | UE power saving is achieved by persistent present of TRS/CSI-RS resource. The shorter the validity time, the less the UE power saving gain. Since we have L1-based signaling for availability indication, no validity time is needed to specify. |
| Sharp | Opt- 1 with modification for candidate duration  Opt- 1 for reference/starting point | For Opt-1 on candidate duration, the paging cycle may have a different value for different UE, “N default paging cycle” may be proper.  Opt-3 will introduce an always-on signal, that is not in compliance with the WID’s objective, and if a UE miss an indication, it will not be able to update the status correctly for a long time  For reference/starting point, opt-1 can be applied for both paging PDCCH or PEI based indication |
| TCL | Option 1 | Configured by higher layer |
| OPPO | Opion 2 |  |
| Spreadtrum | Opt-1(Configured by higher layer) and Opt-2(A window before a PO) | In order to reduce the signaling overhead of the network, the validity time should be supported for TRS/CSI-RS availability indication. The validity time for the availability indication can be multiple paging cycles. Furthermore, during the validity time for the availability indication, UE can determine whether the TRS/CSI-RS in the window before a PO is valid based on the availability indication(PEI/Paging DCI). Therefore, in our view, Opt-1 can work together with Opt-2 to reduce the overhead of the network. |
| Nordic | Option 2 | We could be fine also with Option 1, but then there must be some reference cycle defined. For option 2, gNB just indicates duration from corresponding group’s paging frame |
| Samsung | **Signaling method:** Option 1  **Candidate duration**: Option 1, 2, 3  **reference/starting point:** start of current DRX cycle. | Higher layer configuraiton of the validity time is sufficient. More candidate durations can be considered, including null/infinity.  The reference/starting point should be common to all UEs. We sugget to start of current DRX cycle as Opt-3. In practice, gNB transmits the avaiablity indication after they are used for connected mode UEs. |
| ZTE, Sanechips | opt-1 | If the validity time of TRS/CSI-RS availability indication is needed, we prefer the validity time is configurable (opt-1). |

# SIB based availability indication

In RAN1#105-e meeting, we made the following agreement related to SIB based availibity ndication of TRS/CSI-RS occasion(s) to idle/inactive Ues.

|  |
| --- |
| Agreement:  Further study supporting SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues at least based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X in case L1 based availability indication is not configured.   * FFS whether and how SIB based signaling and L1 based signaling can be configured simultaneously |

The following proposals related to the SIB based availability indication were made in contributions [1] – [24] for RAN1 #106e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | 1. ***No SIB based availability indication is supported for availability indication of TRS/CSI-RS occasions for idle/inactive Ues.*** |
| TCL | **Proposal 2: Support SIB based signaling for availability indication of TRS/CSI-RS occasions to the idle/inactive Ues.**  **Proposal 3: SIB based singling and L1 based signaling can be configured simultaneously through SIB\_X or Pre-Configuration.** |
| ZTE | **Proposal 2:** **The SIB-based signaling for indication of TRS occasion availability is not needed if L1-based signaling indication is configured.** |
| Vivo | ***Proposal 5:*** *SIB based TRS avsilsbility update can be supported.*   * *It is up to RAN2 to decide whenther the same SI update mechanism is reused.*   ***Proposal 6:*** *NW can configure a subset of TRS with SIB based availability indication, and the remaining TRS resource with L1 based availability indication in the TRS resource allocation.*   * *For TRS resource configured with L1 availability signalling, UE follows the availability provided in the L1 signaling.* |
| Spreadtrum | ***Proposal 3: SIB based signaling and L1 based availability indication of TRS/CSI-RS can be configured simultaneously.*** |
| Samsung | **Proposal 3: Support SIB based signalling for availability information of TRS/CSI-RS occasions for idle/inactive Ues as a default mode when L1 based signalling is not configured or expires.**  **Proposal 4: Same availability information of TRS/CSI-RS occasions for idle/inactive Ues can be provided in both SIB based signalling and L1 based signalling.**   * **Note: SI update notification in paging PDCCCH is not needed for updating of the availability information in SIB if the availability information in SIB duplicates with the availability information in L1 based signalling.** |
| CATT | ***Proposal 6:*** ***The availability of TRS/CSI-RS at a given cell should be indicated to the UE by SIB-based signaling, which is indicated by the presence/absence of TRS/CSI-RS configuration in the SIB-X.*** |
| CMCC | **Proposal 4. Supporting SIB based signalling for availability information of TRS/CSI-RS occasions for idle/inactive Ues based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X in case L1 based availability indication is not configured.**  **Proposal 5. SIB based signaling provides availability indication for a default assumption of the availability information for all configured TRS/CSI-RS occasions, and L1 based signaling provide updates relatively to the default assumption.** |
| MediaTek | **Proposal 2: For TRS/CSI-RS availability information, SIB-based signalling and L1-based signalling cannot be configured simultaneously.** |
| Intel | **Proposal 4: Support SIB-based signaling for availability indication of TRS/CSI-RS occasions for idle/inactive Ues, at least in case L1-based availability indication is not configured.** |
| Apple | **Proposal 4: Support SIB-based availability indication of the TRS occasion(s). Do not support simultaneous configuration of SIB-based signaling and L1 signaling for availability indication.** |
| InterDigital | **Proposal 1: SIB-based signaling of availability indication is not supported.** |
| DOCOMO | **Proposal 3: SIB-based availability indication should be deprioritized until essential discussion is over.** |
| Xiaomi | ***Proposal 2: SIB based signaling and L1 based signaling can be configured simultaneously, in that case L1 based signaling can overwrite the SIB based signaling.*** |
| Nokia | **Proposal: Support indicating the availability in static manner via SI without SI update and physical layer presence/availability indication.**  **Proposal: Support providing static TRS availability configuration in system information, e.g. in a form of a time table**. |
|  |  |

### <1st round discussion>

According to the proposals in contributions [1] – [24] submitted to AI 8.7.1.2, three are two opening issues regarding SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues

* Issue 3-1: whether or how to support SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues
* Issue 3-2: FFS whether and how SIB based signaling and L1 based signaling can be configured simultaneously

#### Issue 3-1: whether or how to support SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues

**Table 3.1-1: Summary of views in contributions [1[ - [24] for Issue 3-1**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Motivations/other details** |
| Alt-1:Yes, based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X | Samsung, CATT, CMCC, Intel | -provide NW flexibility to reduce L1 signaling overhead  -used as default mode in case L1 based indication is not configured |
| Alt-2:Yes, configurable in SIB\_X | TCL, Vivo | - provide NW flexibility to reduce L1 signaling overhead |
| Alt-3:Yes, in static manner via SI without SI update and physical layer presence/availability indication | Nokia | - Support providing static TRS availability configuration in system information, e.g. in a form of a time table. |
| Alt-4 Yes, FFS details | Apple |  |
| Alt-5: No, or deprioritize | Huawei, HiSilicon, ZTE, InterDigital, DOCOMO |  |

According to the summary in Table 3.1-1, there are strong interests to support SIB based signaling for the availability indication

For the 1st round discussion on Issue 3-1, companies are invited to provide comments for the Alts in above Table 3.1- 1, such as Alt(s) to support and reasons, additional details to consider, other alternative if any, and etc.

**Table 3.1-2: 1st round discussion on Issue 3-1:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-1 | This is a legacy behavior of resource configuration for IDLE/Inactive UE |
| Sharp | Alt-4 | the details need study |
| TCL | Alt1 & Alt2 | Generally we support alt2 but also ok to support Alt-1: which is based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X |
| OPPO | Alt-5 | See no strong need to support SIB based indication. |
| Spreadtrum | Alt-1 |  |
| Nordic | Alt-5 |  |
| Samsung | Alt-1 or Alt-4 | SIB based signaling is beneficial and necessary for gNB to balance power saving gain and L1 signaling overhead. Alt-1 is the simplest way to support SIB based solution. We are also open to study other alterantives for SIB based siganlign. |
| ZTE, Sanechips | Alt-5 | The L1-based solution can provide both long term indication and short term indication.  The SIB based solution requires SIB update procedure, where UE needs to detect paging DCI for SIB update, DL assignment for SIB scheduling, SIB message, which is more power consuming for both gNB and UE, and also cost more resource overhead.  Hence, the benefit of SIB based solution is unclear |

#### Issue 3-2: FFS whether and how SIB based signaling and L1 based signaling can be configured simultaneously

**Table 3.1-3: Summary of views in contributions [1] – [24] for Issue 3-2**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Other details/Motivations** |
| Alt-1: No | MediaTek, Apple |  |
| Alt-2: yes, NW can configure a subset of TRS with SIB based availability indication, and the remaining TRS resource with L1 based availability indication in the TRS resource allocation. | vivo | For TRS resource configured with L1 availability signalling, UE follows the availability provided in the L1 signaling. |
| Alt-3: yes, same availability information of TRS/CSI-RS occasions for idle/inactive UEs can be provided in both SIB based signalling and L1 based signalling | Samsung | - SI update notification in paging PDCCCH is not needed for updating of the availability information in SIB if the availability information in SIB duplicates with the availability information in L1 based signalling. |
| Alt-4: yes, SIB based signaling provides availability indication for a default assumption of the availability information for all configured TRS/CSI-RS occasions, and L1 based signaling provide updates relatively to the default assumption**.** | CMCC |  |
| Alt-5: yes, L1 based signaling can overwrite the SIB based signaling | Xiaomi |  |
| Alt-6: yes, FFS details | Spreadtrum |  |

For the 1st round discussion on Issue 3-2, companies are invited to provide comments for the Alts in above Table 3.1- 3, such as Alt(s) to support/FFS, additional details to consider, other alternative if any, and etc.

**Table 3.1-4: 1st round discussion on Issue 3-2:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt(s)**  **(support/FFS)** | **Comments** |
| CATT | Alt-5 | SIB-based signaling is for semi-statically configured TRS/CSI-RS resource. If L1-based signaling is enabled for a given cell, L1-based signaling would indicate the availability dynamically and over-write the SIB-based signaling. |
| Sharp | FFS | We slightly prefer alt-2 |
| TCL | Alt3 | We prefer alt3 |
| Samsung | Alt3 or Alt 6 | SIB based signaling and L1 based signaling can be configured simultaneously to explore benefits to both gNB and UE. We are open to discuss all possible alterantives. |
| ZTE, Sanechips | Alt-1 | The L1-based solution can provide both long term indication and short term indication.  The SIB based solution requires SIB update procedure, where UE needs to detect paging DCI for SIB update, DL assignment for SIB scheduling, SIB message, which is more power consuming for both gNB and UE, and also cost more resource overhead.  Hence, the benefit of SIB based solution is unclear |

# Configurations

## QCL information

In RAN1#105-e meeting, we made the following agreement related to configuration of QCL information for TRS/CSI-RS occasion(s) to idle/inactive Ues.

|  |
| --- |
| Agreement:  The QCL information of TRS/CSI-RS occasion(s) for idle/inactive Ues is indicated as a SSB index in range of 0 to 63.   * FFS: how the QCL information can be configured, e.g. per RS resource set or per configuration * FFS: QCL type, which is predetermined |

The following proposals related to the configuration of QCL information were made in contributions [1] – [24] for RAN1 #106e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | 1. ***The QCL information is configured per resource set.*** 2. ***The QCL type for TRS in IDLE/INACTIVE mode is configurable***    * ***In FR1, a TRS is QCLed with an SSB with respect to either ‘typeA’ or ‘typeC’;***    * ***In FR2, a TRS is QCLed with an SSB with respect to either ‘typeA+D’ or ‘typeC+D’.*** |
| ZTE | **Proposal 6: The QCL information of TRS occasion is indicated per RS resource set.**  **Proposal 7: The QCL type of TRS occasion is determined according to Rel-15/16 specification.** |
| vivo | ***Proposal 1:*** *TRS resource set configured for idle/inactive Ues can be type-C or type-D qualsi co-located with SSB, and the QCL information of the TRS can be configured per resource set.* |
| Samsung | **Proposal 7: Support QCL information configured per RS resource for TRS/CSI-RS occasion(s) for idle/inactive Ues, and QCL-typeD for FR2, ‘ QCL-typeC’ for FR1.** |
| CATT | ***Proposal 3: QCL information configuration of TRS for idle/inactive UE should be configured at least per CSI-RS resource set.***  ***Proposal 4: For TRS/CSI-RS occasion(s) configured for idle/inactive mode, UE shall expect that a TCI-State indicates QCL-Type C and QCL-Type D with SS/PBCH block.*** |
| Lenovo | **Proposal 2: QCL information for TRS configured for idle/inactive Ues is indicated per TRS resource set.**  **Proposal 3: A TRS resource set ID explicitly indicates an SSB index as a QCL source of the TRS resource set.** |
| Qualcomm | **Proposal 1: Reuse Rel-16 QCL rule with SSB as the QCL source for periodic TRS configured to inactive/idle Ues.** |
| Panasonic | **Proposal 4: In maximum, 8 sets of TRS configurations, where each configuration can support up to 8 SSB beams, can be supported in SIB. We are also open to discuss lower number.** |
| Sharp | **Proposal 3: The indication of QCL information can be associated with the configuration order of the resources**  **Proposal 4: The QCL type of TRS/CSI-RS occasion reference signal for idle Ues should take ‘QCL-TypeC’ or ‘QCL-TypeD’ as the default** |
| InterlDigital | **Proposal 4: QCL information is provided per RS resource for TRS/CSI-RS occasion(s).** |
| Xiaomi | ***Proposal 1: QCL information with overhead reduction can be explicitly configured per RS resource and QCL type should be predetermined*** |
| Ericsson | 1. QCL information of TRS/CSI-RS occasions is configured per resource set. |
|  |  |
|  |  |

### <1st round discussion>

According to the proposals in contributions [1] – [24] submitted to AI 8.7.1.2, three are two open issues regarding configuration of QCL information for TRS/CSI-RS occasion(s) to idle/inactive Ues.

* Issue 4.1-1: FFS: how the QCL information can be configured, e.g. per RS resource set or per configuration
* Issue 4.1-2: FFS: QCL type

Issue 4.1-1: FFS: how the QCL information can be configured, e.g. per RS resource set or per configuration

**Table 4.1.1-1: Summary of views in contributions [1] – [24] for Issue 4.1-1**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Motivations/Details** |
| Alt-1:configured per RS resource set | Huawei, HiSilicon, ZTE, vivo, CATT, Lenovo, Sharp, Ericsson | --to reduce configuration overhead. |
| Alt-2: configured per RS source configuration, same as Rel-15/16 | Samsung, Panasonic, InterlDigital, Xiaomi | - reuse Rel-15 configuration  - [Panasonic]: 8 sets of TRS configurations, where each configuration can support up to 8 SSB beams |
| Alt-3: be associated with the configuration order of the resources | Sharp | -to reduce configuration overhead.  E.g. the first CSI-RS/TRS resource is associated with the first active SSB index as default, then one bit for each CSI-RS/TRS resource is set to indicate if the associated SSB index is the same or different from the previous resource’s. If it is indicated as different, UE can use the next active SSB index as the association source for the resource. |

For the 1st round discussion on Issue 4.1-1, companies are invited to provide comments for the Alts in above Table 4.1.1- 1, such as Alt to support, additional details to consider, other alternative if any, and etc.

**Table 4.1.1-2: 1st round discussion on Issue 4.1-1:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-1 | Each TRS/CSI-RS resource set is configured to be QCL with one SSB index. |
| Sharp | Alt-3 | It only costs one bit for each RS resource/set which is more efficient than configuring a 6bits SSB index for each RS within the limited size of the SIBx |
| TCL | Alt1 | We prefer alt1 |
| OPPO | Alt-1 | To save the signaling overhead |
| Spreadtrum | Alt1 |  |
| Nordic | Alt1 |  |
| Samsung | Alt-2 | The avaiablity state for each TRS/CSI-RS resource is independent, depending on the status in connected mode. If we configure the RS resoruces set per QCL assumption, gNB may need to indicate both the set ID and resource ID in the avaiablity indication. So, we prefer to use the same configuraiton as for connected mode, where the QCL information is provided per RS resource. |
| ZTE, Sanechips | Alt-1 | To reduce signaling overhead, alt-1 is preferred. |

Issue 4.1-2: FFS: QCL type

|  |
| --- |
| * **In section 5.1.5 of TS 38.214**   For a periodic CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*, the UE shall expect that a TCI-State indicates one of the following quasi co-location type(s):  - ‘typeC’ with an SS/PBCH block and, when applicable, ‘typeD’ with the same SS/PBCH block, or  - ‘typeC’ with an SS/PBCH block and, when applicable, ‘typeD’ with a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, |

**Table 4.1.1-3: Summary of views in contributions [1] – [24] for Issue 4.1-2**

|  |  |  |
| --- | --- | --- |
|  | | **Companies** |
| Alt-1: configurable  - FR1: either ‘typeA’ or ‘typeC’;  - FR2: either ‘typeA+D’ or ‘typeC+D’. | | Huawei, HiSilicon |
| Alt-2: Reuse Rel-16 QCL rule, i.e. ‘QCL-TypeC’ or ‘QCL-TypeD’ when applicable | Alt-2.1: no explicit indication in higher layer configuration | ZTE, Samsung, Sharp, Xiaomi |
| Alt-2.2: w/ explicit indication in higher layer configuration | Vivo, CATT, Qualcomm |

For the 1st round discussion on Issue 4.1-2, companies are invited to provide comments for the Alts in above Table 4.1.1- 3, such as Alt to support, additional details to consider, other alternative if any, and etc.

**Table 4.1.1-4: 1st round discussion on Issue 4.1-2:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-2 | UE would detect SSB before TRS/CSI-RS in multi-beam configuration. The QCL-TypeC or QCL-TypeD needs to configured for TRS/CSI-RS to associate with a SSB index |
| Sharp | Alt-2.1 | The TRS may be shared with connected UEs and it should align with the rules for TRS in R15/16 |
| TCL | Alt2 |  |
| OPPO | Alt-2.1 |  |
| Nordic | Alt 2 |  |
| Samsung | Alt-2.1 | Our understanding is ‘QCL-TypeC’ is applicable to FR1, and ‘QCL-TypeD’ is applicable to FR2. So, no need to explicitly configure a TCI-state to indicate a QCL-Type in SIB-X. |
| ZTE, Sanechips | Alt-2.1 | According to current spec, the SSB can be only QCL-ed with TRS with QCL-C or QCL-D. And QCL-D is only applicable for FR2. Hence, we think explicit indication is not needed. |

## 4.2 Configuration index

In RAN1 #105-e, we made the following agreement regarding the configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs. It shows configuration index is an open issue for FFS.

|  |
| --- |
| Agreement:  Configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs include:   * periodicityAndOffset {10, 20, 40, 80} ms * frequencyDomainAllocation for row1 with applicable values from {0, 1, 2, 3} to indicate the offset of the first RE to RE#0 in a RB * FFS Configuration index   + details,     - E.g. Per resource or resource set or group of resource sets     - E.g. explicit or implicit indication based on QCL source |

The following proposals related to the configuration index were made in contributions [1] – [24] for RAN1 #106-e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | 1. ***The configuration of assistance TRS for IDLE/INACTIVE UEs does not include configuration index.*** |
| CATT | ***Proposal 2: TRS/CSI-RS configuration for Idle/Inactive mode should be associated with SSB/paging occasion(s) to achieve good power saving gain with low SIB*** ***signaling overhead***. |
| Intel | **Proposal 5: Configuration index is explicitly signaled where index is per resource set.** |
| Sharp | **Proposal 1: The definition of “Configuration index” can wait until the organization of TRS resources in SIB is clear** |
| Nokia | **Proposal: The configuration of TRS to the IDLE/INACTIVE mode UEs needs to support independent configuration for each broadcast/SSB beam.** |
|  |  |
|  |  |

### 4.2.1 <1st round discussion>

According to the proposals in contributions [1] – [24] submitted to AI 8.7.1.2, there are proposals to support configuraiton index is one of the configuration parameters. How to determine the details of configuraiton index is still an open issue.

* Issue 4.2: FFS Details of configuration index

Issue 4.2: FFS: details of configuration index

**Table 4.2.1-1: Summary of views in contributions [1] – [24] for Issue 4.2**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt-1: no need | Huawei, HiSilicon |
| Alt-2: per resource set | Intel |
| Alt-3: postpone | Sharp |
| Alt-4: based on QCL source | Nokia |
| Alt-4: associated with SSB/paging occasion(s) | CATT |

For the 1st round discussion on Issue 4.2, companies are invited to provide comments for the Alts in above Table 4.2.1- 1, such as Alt to support, additional details to consider, other alternative if any, and etc.

**Table 4.2.1-2: 1st round discussion on Issue 4.2**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-4 | UE would detect SSB before TRS/CSI-RS in multi-beam configuration. The QCL-TypeC or QCL-TypeD needs to configured for TRS/CSI-RS to associate with a SSB index |
| Sharp | Alt-3 |  |
| TCL | Alt4 |  |
| Nordic | Depends | On how many resource per beam are allowed. |
| Samsung | Alt-2 | Avaaiblity indication in L1 siganling can be provided per resource set or group of multiple resource sets. |
| ZTE, Sanechips |  | Same with legacy configuration |

## 4.3 Configuration overhead reduction

According to previous FL summary [25], we briefly discussed the following three alternatives about method of configuration overhead reduction for L1 based availability indication in RAN1 #105e meeting, including

* Alt1: The common configuration parameter per RS resource set, or group of sets
* Alt2: gNB provides a ‘reference configuration’, and each configured resource can have a ‘delta-configuration’ compared with the reference one
* Alt3: Predefine or fix a part of TRS parameters in specification
* Alt4: Number of RS resources/configurations be minimized
* Alt5: Configure TRS/CSI-RS SMTC, e.g. similar as SMTC for mobility
* Alt6: TRS/CSI-RS configuration for Idle/Inactive mode should be associated with SSB/paging occasion(s)

The following proposals related to the configuration overhead reduction were made in contributions [1] – [24] for RAN1 #106e meeting.

|  |  |
| --- | --- |
| Huawei, HiSilicon | 1. ***The following ways can be used to reduce signaling overhead for the TRS resource configuration***    * ***Alt1: The common configuration parameter per RS resource set, or group of sets***    * ***Alt2: gNB provides a ‘reference configuration’, and each configured resource can have a ‘delta-configuration’ compared with the reference one*** |
| ZTE | **Proposal 8: A default value should be applied if the corresponding parameter is not configured for RRC idle/inactive UE.**  **Proposal 9: Some parameters, such as startingRB and nrofRBs, can be jointly indicated to reduce signaling overhead.** |
| CATT | ***Proposal 1: TRS/CRS-RS resource/resource set configuration should meet the requirement of SIB message size limit.***  ***Proposal 2: TRS/CSI-RS configuration for Idle/Inactive mode should be associated with SSB/paging occasion(s) to achieve good power saving gain with low SIB*** ***signaling overhead***.  ***Proposal 5: The following procedure can be used for TRS/CSI-RS occasion(s) configuration:***  ***Step1) predefined parameters******of TRS/CSI-RS resource grid;***  ***Step 2) SIB indicate parameters details; including***   * ***QCL assumption of the configured TRS/CSI-RS resources associated with a SSB;*** * ***Code points mapping of availability/not availability for a given TRS resources.***   ***Step 3) To derive TRS occasion(s) according to predefined rule and parameters provided by step1 and step 2.*** |
| Nordic | ***Proposal-2****: Consider configuring predefined TRS pattern to reduce CSI-RS resource-specific overhead to zero bits.* |
| Lenovo | **Proposal 1: Support following methods to reduce the TRS configuration signalling overhead:**   * **Update a subset of parameters of TRS configuration** * **Based on configuration parameters of one NZP-CSI-RS resource of an NZP-CSI-RS resource set, a UE derives configuration parameters of remaining NZP-CSI-RS resources of the NZP-CSI-RS resource set** |
| Panasonic | **Proposal 3: Supported number of TRS configurations in SIB should be minimized, for both operations with and without beam sweeping.** |
| Apple | **Proposal 1: A TRS configuration for idle/inactive UEs further includes the number of slots, which indicates 1 or 2 slots for the TRS configuration.**   * **Further signaling overhead reduction/optimization (e.g. introducing common parameters) can be considered.** |
| Sharp | **Proposal 2: TRS resources configuration can be compressed by packaging and bundling parameters** |
| DOCOMO | **Proposal 5: The common configuration parameter among RS resource sets, or groups of sets should be supported to reduce the SIB overhead for TRS/CSI-RS for idle/inactive mode UE.** |
| Ericsson | 1. In cases where there is no SI size limitation issue (e.g. FR1), support reuse of existing periodic TRS configuration(s) for TRS occasion provisioning. 2. In cases where resulting SIB size is deemed excessive (e.g. FR2 or FR1 with many beams), support grouping of common parameters within a TRS resource set, and across configured TRS resource sets.    1. Details FFS (E.g. such as frequencyDomainAllocation, nrofRBs, and startingRB). |
| Nokia | **Proposal:** **When informing TRS occasions for the IDLE/INACTIVE mode UEs, parameters ‘nrofPorts’, ‘cdm-Type’ and ‘density’ in ‘CSI-RS-ResourceMapping’ can be omitted from the configuration and values assumed to be same as defined by specification TS38.214 for CSI-RS configured with ‘trs-info’.**  **Proposal:** **Following parameters can be assume to be same/common for RS resources in a slot for TRS configuration, or could be used to implicitly derive other parameter(s):**   * **’row1’, ‘startingRB’ and ‘nrofRBs’are common/same for both TRS symbols in a slot, thus would be provided only once per slot (RS resource set).** * **‘CSI-ResourcePeriodicityAndOffset’, or similar IE would need to be provided only once for TRS symbols in same slot, or in two consecutive.** |
|  |  |

### 4.3.1 <1st round discussion>

According to the proposals in contributions [1] – [24] submitted to AI 8.7.1.2, there are proposals to support configuraiton index is one of the configuration parameters. How to determine the details of configuraiton index is still an open issue.

* Issue 4.3: whether or how to reduce configuration overhead

Issue 4.3: whether or how to reduce configuration overhead

**Table 4.3.1-1: Summary of views in contributions [1] – [24] for Issue 4.3**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt1: The common configuration parameter per RS resource set, or group of sets | Huawei, HiSilicon, Apple, DOCOMO, Ericsson, Nokia |
| Alt2: gNB provides a ‘reference configuration’, and each configured resource can have a ‘delta-configuration’ compared with the reference one | Huawei, HiSilicon, Lenovo |
| Alt3: Predefine or fix a part of TRS parameters in specification | ZTE, Nordic, Nokia |
| Alt4: Number of RS resources/configurations be minimized | Panasonic |
| Alt5: TRS/CSI-RS configuration for Idle/Inactive mode should be associated with SSB/paging occasion(s) | CATT |
| Alt6: packaging and bundling parameters | Sharp  ZTE: Some parameters, such as startingRB and nrofRBs, can be jointly indicated to reduce signaling overhead. |
| Alt7: reuse of existing periodic TRS configuration(s) | Ericsson: In cases where there is no SI size limitation issue (e.g. FR1), |

In [8], one company also propose that TRS/CRS-RS resource/resource set configuration should meet the requirement of SIB message size limit.

For the 1st round discussion on Issue 4.3, the following alternatives can be considered as potential way forward.

* Alt-1: send LS to RAN2 to check if there is a SIB message size limit to support the configuration of TRS/CRS-RS resource/resource to idle/inactive UEs.
* Alt-2: discuss all potential alternatives for configurations overhead reduction based on Table 4.3.1-1, and do down selection in next meeting
* Alt-3: up to RAN2 decision

Companies are invited to provide comments for the above Alts as WF, such as alternative to support, additional details to consider, other alternative if any, and etc.

**Table 4.3.1-2: 1st round discussion on Issue 4.3:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt**  **(support)** | **Comments** |
| CATT | Alt-3 | Let RAN2 decides the configuration |
| Sharp | Alt-6 | Some parameters can be packet into a group, and related resources can be bundled into one info element  Regarding the alt2, based on the PER(X6911) rules, each optional element will be applied one bit in the head of the coding stream to indicated the absence/presence of the elements, so a method with delta-configuration cannot save bits if there are numerous parameters for one resource |
| TCL | Alt1 |  |
| Noridic | Alt 1 and Alt3 | having common common parameters is a key way to reduce overhead. With Alt 3, it would be possible to reduce per-resource overhead to 0. |
| Samsung | Alt-3 |  |
| ZTE, Sanechips | Alt-1,3,6. |  |

# Others

In addition to the three main topics in Section 2-4, some other issues or design aspects have been discussed by a few companies, and the corresponding proposals are captured below.

|  |  |
| --- | --- |
| Vivo | ***Proposal 7:*** *Further clarification is needed on whether and how RRC connected UE would handle the TRS configured for idle/inactive UEs, and following options can be considered.*   * *Opt-1: Assume the same availability as that defined for idle/inactive UEs.* * *Opt-2: Ignores configuration by provided SIB and the availability indication in paging PDCCH.* |
| Spreadtrum | ***Proposal 7: UE assumes a L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs takes effects once received.*** |
| Sony | **Proposal 7: In addition to SIB, support TRS/CSI-RS configuration via other high-layer signaling (e.g., dedicated RRC, RRC release message, etc.).** |
| Samsung | **Proposal 6: Send LS to RAN2 to report RAN1 progress on supporting TRS/CSI-RS occasions for idle/inactive UEs, including**   * **configuration parameters and corresponding applicable values needed,** * **RAN1’s understanding of reusing Rel-15 configuration of NZP-CSI-RS resources, and** * **SIB based availability indication if supported.** |
| Nordic | ***Proposal-3:*** *For the case when TRS periodicity is larger than SSB cycle, consider delaying UE’s PF from nominal position to frame after TRS, in order to facilitate power saving.* |
| OPPO | ***Proposal 2: There shall be a time gap large enough between L1 signaling and TRS/CSI-RS.*** |
| LG | **Proposal 3: Study how to handle PDSCH REs overlap with TRS/CSI-RS occasion(s).** |
| MediaTek | **Proposal 4: For the availability indication of TRS/CSI-RS at the configured occasion(s), the application delay is not needed if validity time is supported.** |
| Apple | **Proposal 1: A TRS configuration for idle/inactive UEs further includes the number of slots, which indicates 1 or 2 slots for the TRS configuration.**   * **Further signaling overhead reduction/optimization (e.g. introducing common parameters) can be considered.** |
|  |  |

### 5.1 <1st round discussion>

According to the proposals in contributions [1] – [24] to AI 8.7.1.2, three are two issues regarding SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive UEs

**Table 5.1-1: Summary of other potential open issues proposed in contributions [1] – [24]**

|  |  |  |
| --- | --- | --- |
|  | **Companies** | **Details** |
| Issue-1:  clarify whether and how RRC connected UE would handle the TRS configured for idle/inactive UEs | vivo | * Opt-1: Assume the same availability as that defined for idle/inactive UEs. * Opt-2: Ignores configuration by provided SIB and the availability indication in paging PDCCH. |
| Issue-2: time gap between L1 signaling and TRS/CSI-RS. | Spreadtrum, OPPO, MediaTek | OPPO: There shall be a time gap large enough between L1 signaling and TRS/CSI-RS.  Spreadtrum: L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs takes effects once received.  MediaTek: not needed |
| Issue-3: Send LS to RAN2 to report RAN1 progress on supporting TRS/CSI-RS occasions for idle/inactive UEs | Samsung | Necessary information include   * configuration parameters and corresponding applicable values needed, * RAN1’s understanding of reusing Rel-15 configuration of NZP-CSI-RS resources, and * SIB based availability indication if supported. |
| Issue-4: For the case when TRS periodicity is larger than SSB cycle, consider delaying UE’s PF from nominal position to frame after TRS, in order to facilitate power saving. | Nordic |  |
| Issue-5: How to handle PDSCH REs overlap with TRS/CSI-RS occasion(s). | LG |  |
| Issue 6: configuration parameter of number of slots | Apple | 1 or 2 slots |

For the 1st round discussion on Issue 3-1, companies are invited to provide views about the other issues summarized in the above Table 5.1- 1, such as valid or not, whether to discuss in this meeting or for FFS, other details to consider, and etc.

**Table 5.1-2: 1st round discussion on Issue 5**

|  |  |  |
| --- | --- | --- |
| **Company** | **Issue(s)**  **(valid to discussion/FFS)** | **Comments** |
| Sharp | Valid and FFS: issue -1/ issue -2/issue-5  discuss : issue-6 | Issue-6 can be discussed with issue 4.3 on the configuration overhead reduction |
| Nordic | Issues 1,2,4,5,6 | Issue 6 should be as in legacy |
| Samsung | Issue-3, Issue-5, Issue 6 | For Issue 1, this feature is dedicated to idle/inactive UEs. So, connected UEs should ignore the corresponding configuraiton in SIB-X in general. No need to disucss it.  For issue 2, we think no need to support it. The discussion on validity time, such as the reference/starting point will clarify this issue.  For issue 4, enhancement of paging is out of scope for this AI. |
| ZTE, sanechips | Issue-3 | LS to RAN2 is needed. |

# References

[1] [R1-2106480](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106480.zip) Assistance RS occasions for IDLE/inactive mode Huawei, HiSilicon

[2] [R1-2106519](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106519.zip) TRS/CSI-RS occasions for IDLE/inactive mode TCL Communication Ltd.

[3] [R1-2106522](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106522.zip) TRS for RRC idle and inactive UEs ZTE, Sanechips

[4] [R1-2106607](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106607.zip) TRS/CSI-RS occasion(s) for idle/inactive UEs vivo

[5] [R1-2106709](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106709.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs Spreadtrum Communications

[6] [R1-2106816](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106816.zip) Considerations on TRS/CSI-RS occasion(s) for idle/inactive UEs Sony

[7] [R1-2106899](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106899.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs Samsung

[8] [R1-2106984](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2106984.zip) Configuration of TRS/CSI-RS for paging enhancement CATT

[9] [R1-2107045](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107045.zip) On TRS design for idle/inactive UEs Nordic Semiconductor ASA

[10] [R1-2107183](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107183.zip) Provision of TRS/CSI-RS for idle/inactive UEs Lenovo, Motorola Mobility

[11] [R1-2107254](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107254.zip) Further discussion on RS occasion for idle/inactive UEs OPPO

[12] [R1-2107357](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107357.zip) TRS/CSI-RS for idle/inactive UE power saving Qualcomm Incorporated

[13] [R1-2107415](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107415.zip) Discussion on TRS/CSI-RS occasion(s) for IDLE/INACTIVE-mode UEs CMCC

[14] [R1-2107454](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107454.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs LG Electronics

[15] [R1-2107520](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107520.zip) On TRS/CSI-RS occasion(s) for idle/inactive mode UE power saving MediaTek Inc.

[16] [R1-2107600](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107600.zip) On TRS/CSI-RS Ocassions for UE Power Saving Intel Corporation

[17] [R1-2107623](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107623.zip) Potential enhancements for TRS/CSI-RS occasion(s) for idle/inactive UEs Panasonic

[18] [R1-2107751](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107751.zip) Indication of TRS configurations for idle/inactive-mode UE power saving Apple

[19] [R1-2107798](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107798.zip) Discussion on TRS/CSI-RS occasions for idle/inactive UEs Sharp

[20] [R1-2107807](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107807.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs InterDigital, Inc.

[21] [R1-2107870](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107870.zip) Discussion on TRS/CSI-RS occasion for idle/inactive UEs NTT DOCOMO, INC.

[22] [R1-2107933](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107933.zip) On TRS/CSI-RS configuration and indication for idle/inactive UEs Xiaomi

[23] [R1-2107999](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2107999.zip) Provisioning TRS occasions to Idle/Inactive UEs Ericsson

[24] [R1-2108123](file:///C:\3gpp\Meetings\TSGR1\TSGR1_106-e\Docs\R1-2108123.zip) On RS information to IDLE/Inactive mode Ues Nokia, Nokia Shanghai Bell

[25] R1-2106117 Final summary for TRS/CSI-RS occasion(s) for idle/inactive UEs, Moderator (Samsung)

# Appendix: previous agreements

## RAN1#102-e

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| Agreements:   * New types/patterns of TRS/CSI-RS are not introduced specifically for idle/inactive mode UE.   Agreements:  The TRS/CSI-RS occasion(s) that may be for connected mode UEs can be shared to idle/inactive mode UEs.  -  Note: It is understood that gNB can potentially share the occasions to idle/inactive (which would just mean it up to NW whether to share or not share).  -  Note: It is understood that TRS/CSI-RS in the TRS/CSI-RS occasion(s) may or may not be transmitted.  -  Note: Always-on TRS/CSI-RS transmission by gNodeB is not required  -  At least TRS/CSI-RS occasion(s) corresponding to periodic TRS is supported  - FFS for other RS types  -  FFS: Whether UE blind detection is required or not.  Agreements:  Idle/inactive UE may use the TRS/CSI-RS occasion(s) that are shared to it for functionalities such as:  -           **AGC, time/frequency tracking**  -           **FFS: RRM measurement for serving cell, RRM measurement for neighbor cell, paging reception indication**  **Observation:**  It is up to gNB implementation whether or not to transmit a TRS/CSI-RS to idle/inactive UEs even when the TRS/CSI-RS is not needed by connected UEs (e.g., when there is a connected mode UE in a cell but the UE is no longer using the TRS/CSI-RS, or when there is no longer connected mode UE in a cell, etc.)  Agreements:  The configuration of TRS/CSI-RS occasion(s) for idle/inactive mode UE(s) is provided by higher layer signalling  -           FFS higher layer signalling candidates (e.g., SIB, dedicated RRC, RRC release message, etc.)  -           FFS for other signalling candidates (e.g., pre-configuration, etc.)  -           FFS for detailed configuration parameters (e.g., whether and how to reduce the signalling overhead for configuration, etc.)  Agreements:  Further study whether and how to inform the availability of TRS/CSI-RS to idle/inactive mode UE (implicitly or explicitly).  - Note: Availability corresponds to the information for whether TRS/CSI-RS is actually transmitted or not. |

## RAN1#103-e

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| Agreement:   * Functionality of RRM measurement for neighbour cell is not supported for TRS/CSI-RS for idle/inactive UE(s).   Agreements:   * SIB signalling provides the configuration of TRS/CSI-RS occasion(s) for idle/inactive UE(s).   + Up to RAN2 to decide which SIB is to be used.   + Whether or not to additionally support other high-layer signalling methods (e.g., dedicated RRC, RRC release message, etc.) is up to RAN2   Send an LS to RAN2 informing the above agreements, and   * To further add that RAN1 is working on the detailed physical layer design   Agreement:   * Aperiodic TRS and semi-persistent/aperiodic CSI-RS are not used as TRS/CSI-RS occasion(s) for idle/inactive UEs.   Agreements:   * Target sending an LS to RAN2 and RAN4 to ask whether it is feasible to allow a UE to use the potential TRS/CSI-RS occasion to enhance the SSB based IDLE/Inactive mode evaluations of the serving cell. (to also include agreements from last meeting) * Further discussion whether any additional information needs to be included in the LS or not, including potential re-wording of the leading sentence   Agreements:   * Discuss further based on the following alternatives and down-select at RAN1#104-e:   + Alt 1: The availability of TRS/CSI-RS at the configured occasion(s) is NOT informed to the UE.   + Alt 2: The availability of TRS/CSI-RS at the configured occasion(s) is informed to the UE.   + Alt 3. The conditional availability of TRS/CSI-RS at the configured occasion(s) is informed to the UE.     - The condition can be, e.g., existence of paging.   + Alt 4. Combination of the above alternatives.   + FFS for details   + FFS for UE behavior when the availability is not informed.   + Other techniques are not precluded.   + Companies encourage to provide sufficient information for the proposal, e.g.,     - how to achieve power saving gain     - how to minimize impact on NW   how to minimize extra UE implementation complexity   * + - feasibility check on sharing the TRS/CSI-RS between connected UEs and idle/inactive UEs   + Proposals should be consistent with the WID objective.   **Conclusion:**   * TRS/CSI-RS based PEI is discussed in AI 8.7.1.1. * PEI functionality is not further discussed under AI 8.7.1.2. * Note: This does not prevent to potentially use PEI to carry the indication for TRS/CSI-RS presence. |

## RAN1#104-e

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| Update on 1/28 email:  Agreements:  Configuration of TRS/CSI-RS occasion(s) for idle/inactive Ues include at least:   * powerControlOffsetSS, * scramblingID * firstOFDMSymbolInTimeDomain, * startingRB. * nrofRBs, * FFS other parameters * FFS applicable values   Agreements:  The SCS configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs can be discussed and down-selected from following alternatives at RAN1#105-e:   * Alt1: same as initial BWP * Alt2: configurable parameter   Agreements:  Multiple RS resources can be configured for TRS/CSI-RS occasion(s) for idle/inactive UEs.   * FFS details (including whether or not to restrict the RS to be TRS only)   Update on 1/31:  Agreements:  For a cell with TRS/CSI-RS occasions configured for IDLE/Inactive UEs, IDLE/Inactive UE’s assumption on the availability of TRS/CSI-RS at the configured occasion(s) is informed to the idle/inactive UE based on explicit indication.   * FFS details (e.g., the signalling, detailed information for the TRS/CSI-RS, etc.) * There is no intended blind detection of the presence/absence of TRS/CSI-RS at the UE side in this feature. That is, the UE assumes TRS/CSI-RS is not present if the network does not indicate it is available (or indicates it is unavailable).   **Conclusion**  From RAN1 perspective, there is no consensus on supporting RRM measurement for serving cell functionality for TRS/CSI-RS occasion(s) for idles/inactive UEs.  Agreements:  The configuration of the frequency location of TRS/CSI-RS occasion(s) for idle/inactive UEs are discussed and down-selected from following alternatives at RAN1#104bis-e:   * Alt-1: within initial DL BWP * Alt-2: is not restricted by initial BWP   + IDLE/INACTIVE mode UE is not expected to receive TRS/CSI-RS outside the initial DL BWP.   Agreements:  To study QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs from following alternatives:   * Alt-1: ~~TCI state~~ from higher layer configuration, e.g. qcl-InfoPeriodicCSI-RS * Alt-2: QCL assumptions associated with transmitted SSBs implicitly, e.g. similar to PDCCH monitoring in PO   + ~~FFS details~~ * FFS details * Other alternatives are not precluded   **Conclusion:**  Decide at RAN1#104b-e, whether or not to support periodic CSI-RS in addition to periodic TRS for TRS/CSI-RS occasion(s) for idle/inactive UEs. |

## RAN1#104b-e

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| Agreement:  SCS of TRS/CSI-RS occasion(s) for idle/inactive UEs is same as SCS of CORESET#0.  Agreement:  Support higher layer configuration of the QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs.   * FFS details of the QCL information, e.g. associated SSB index   Agreement:  IDLE/INACTIVE mode UE is not expected to receive TRS/CSI-RS outside the initial DL BWP.   * Configuration of the frequency location of TRS/CSI-RS occasion(s) for idle/inactive UEs is not restricted by initial BWP.   Working assumption:  Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.   * FFS details, including paging DCI and/or PEI for L1 based signaling * FFS SIB-based signaling/configuration   + Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signalling   To further check on 4/19  Agreement:  Configuration for TRS/CSI-RS occasion(s) for idle/inactive UEs is based on periodic TRS only, including following limitations   * Configuration parameters that are necessary to provide configuration of periodic TRS for idle/inactive UEs * Applicable values that are necessary to provide configuration of periodic TRS for idle/inactive UEs * If the configuration is provided, idle/inactive UEs can always implicitly assume that trs-info is configured.   + The parameter trs-info does not need to be provided in the configuration   Agreement:  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, one or more alternatives from the following can be supported:   * Alt1: Availability/unavailability information for all or some of configured RS resources using a bitmap or codepoint * e.g. using bitmap, where each bit ~~from a bitmap or a codepoint~~ is associated with at least one resource~~/configuration~~ or a set/group of resources * e.g. a codepoint to indicate a state of availability/unavailability for all or some of configured RS resources * Alt2: value or codepoint to indicate one or more resource/configuration indices that correspond to the available RS resources * FFS whether and how to indicate the ‘availability’ in beam selective manner. * Other alternatives are not precluded |

## RAN1#105-e

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| Agreement:  Confirm the following working assumption:  Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.   * FFS details, including paging DCI and/or PEI for L1 based signaling * FFS SIB-based signaling/configuration   + Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signalling     Agreement:  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availability/unavailability information for configured RS resources using a bitmap or codepoint   * e.g. using bitmap, where each bit is associated with at least one resource/configuration or a set/group of resources * e.g. a codepoint to indicate a state of availability/unavailability for all or some of configured RS resources * FFS maximum number of configured RS resources per physical layer availability indication to support. * FFS whether availability/unavailability information is for all or some of configured RS resources     Agreement:  Support applicable values for the following configuration parameters as below.   * powerControlOffsetSS: {-3, 0, 3, 6}dB * scramblingID: 0 to 1023 * firstOFDMSymbolInTimeDomain: 0 to 9   + firstOFDMSymbolInTimeDomain indicates first symbol in a slot, a second symbol in the same slot can be derived implicitly with symbol index as firstOFDMSymbolInTimeDomain+4 * startingRB: 0 to 274 * nrofRBs: 24 to 276     Agreement:  The QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs is indicated as a SSB index in range of 0 to 63.   * FFS: how the QCL information can be configured, e.g. per RS resource set or per configuration * FFS: QCL type, which is predetermined   **Working assumption:**  Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.  Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.   * FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB   Agreement:  Configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs include:   * periodicityAndOffset {10, 20, 40, 80} ms * frequencyDomainAllocation for row1 with applicable values from {0, 1, 2, 3} to indicate the offset of the first RE to RE#0 in a RB * FFS Configuration index   + details,     - E.g. Per resource or resource set or group of resource sets     - E.g. explicit or implicit indication based on QCL source   Agreement:  Further study supporting SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive UEs at least based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X in case L1 based availability indication is not configured.   * FFS whether and how SIB based signaling and L1 based signaling can be configured simultaneously |