**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 2nd round discussion on 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.

For the second round discussion,

* Companies are invited to comment on proposals tagged ‘[2RD]’ **before 8/19 UTC 20:00.** We will further discuss ones with good chance for agreement in RAN1 email reflector before GTW session on 8/20.

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.

|  |
| --- |
| **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. |
| Intel | Alt1 | We do not support duplicate functionality of paging DCI by PEI. Indication by Paging DCI for the considered contents seems sufficient. Since the common understanding is that network is not expected to send L1 availability indication frequently and typical paging probability is low, additional power saving gain of indication by PEI over paging DCI is not expected to be significant.  Regarding the question, we think availability indication can be transmitted using reserved bits in paging DCI, and need not depend on short message/scheduling exist or not, i.e., legacy paging functionality remain unimpacted. |
| Ericsson | Alt-1 | We support to confirm the original WA.  The availability indication is present in the Paging PDCCH when it contains at least one of short message and scheduling information.  We would be OK to not allow only L1 availability indication in the PDCCH i.e. if the Paging PDCCH does not contain short message or scheduling information. |
| Qualcomm | Alt-1 | Paging PDCCH based TRS availability indication should be used even if PEI is configured, to not couple the two features. |
| Huawei, HiSilicon |  | We share similar view as ZTE and Nordic. The two issues of Issue 2.1-1 and Issue 2.1-2 are closely related. They should be discussed and confirmed together.  We can accept the confirmation of the whole working assumption. |
| Lenovo, Motorola Mobility | Alt-1 | UE shall assume CSI-RS/TRS is unavailable if UE does not receive paging DCI. |
| DOCOMO | Alt1 | We support to confirm the original. |
| Apple | Alt2 | We think TRS availability indication should be carried in PEI is PEI is configured, due to the most up-to-date indication provided by PEI and the associated UE power saving gain. |
| vivo | Alt-1 | Indication of TRS without short message or scheduling information is allowed. NW can avoid sending L1 availability indication without short MSG and scheduling by implementation. |
| Xiaomi |  | First of all, we think that the original working assumption is OK and should be confirmed.  Then maybe the Alt1/2 could be further discussed after PEI design is more clear in next meeting.  For the question, we think it might be implemented by gNB and should not be confined with SM or SI in paging PDCCH. |
| LG |  | We have similar view with Nordic, ZTE, and Huawei.  We prefer to confirm original WA. |
| MTK |  | Similar to ZTE’s view, we prefer to confirm the whole WA.  To help the progress, we suggest to further clarify whether NW can only use paging DCI if PEI is configured. In our view, PEI is sufficient to indicate the available TRS/CSI-RS. Only use paging DCI when the PEI is not configured. |
| Nokia | Alt1/original | We would support confirming the original. |
| SONY | Alt 1 | We support to confirm the original working assumption (as agreed in the previous meeting). |
| CMCC | Alt 1 | Support to confirm the original one |
| IDCC | Alt1/original |  |
| Panasonic | Alt-1 |  |

#### 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. |
| Ericsson | Alt-1 | We support to confirm the original WA. |
| Qualcomm | Alt-2 | Anything related to PEI should be postponed after PEI signling dowselection is done. |
| Huawei, HiSilicon | Alt-1 and agreed with Alt.1 of issue 2.1-1 as a whole package | First, we think that Issue 2.1-1 and Issue 2.1-2 are closely related issues. The were agreed as a package for working assumption. To combine the supporing companies of Issue 2.1-1 and Issue 2.1-2, majority companies actually prefer agree the whole package of working assumption.  If PEI is not allowed to indicate the availability of TRS, UE shall always need to receive paging PDCCH no matter PEI indicates there is paging or not. Then the power saving benefit of PEI would be significantly impacted. |
| Lenovo, Motorola Mobility | Alt-1 |  |
| DOCOMO | Alt1 | We support to confirm the original. |
| Apple | Alt-1 |  |
| vivo | Alt-2 | We can deprioritize PEI based availability until agreements are made in AI 8.7.1.1. |
| Xiaomi | Alt-2 | Similar as 2.1-2, we should confirm the original WA fisrt for progress.  PEI design is not clear yet, so PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UE can be open to further discussion, that is Paging PDCCH based availability indication should be prioritied. |
| LG |  | We have similar view with Nordic, ZTE, and Huawei.  We prefer to confirm original WA. |
| MTK |  | Same view as that in issue 2.1-1. |
| Nokia | Alt-1/Original | We also would support confirming the original working assumption. Also in our paper we showed the cost of not supporting the L1 availability indication in PEI to the PEI power saving gain. |
| SONY | Alt-2 | PEI is another feature. At least, we have similar view as QC that we can discuss it after PEI signal down-selection is completed. |
| CMCC | Alt 1 | Support to confirm the original one |
| IDCC | Alt1 |  |
| Panasonic | Alt-1 |  |

#### 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. |
| Ericsson | Alt 2 | Alt 2 is sufficient and better from overhead perspective.  Regarding Alt 1, if the L1-based availability indication is disabled, UE cannot be informed of availability, in which case there is no need to configure TRS/CSI-RS occasion(s). |
| Qualcomm | FFS | There is a dependency on SIB based availability indication based on presence or absence of the TRS configuration. |
| Huawei, HiSilicon | Alt2 | For Alt.1, the 1-bit indication provide no benefit and flexibility. If gNB does not want to provide assistance TRS for IDLE/INACTIVE UEs, the gNB just does not configure related parameters of SIB-X, which means that no TRS occasion is configured. This method can implement the function of ‘1-bit in SIB-X’, and reduce the signaling overhead at the same time. |
| Lenovo, Motorola Mobility | Alt-1 | Alt-1 can reduce L1 signaling overhead, in case gNB would transmit TRS/CSI-RS on all of the configured occasions without dynamic change. |
| DOCOMO | Not alt 1 | We have same view as ZTE.  It’s not clear for us that need of dedicated enable/disable signaling of L1 based availability indication. |
| Apple | Alt1 |  |
| vivo | Alt-1 | If SIB based availability is supported, one bit can be configured with the TRS/CSI-RS occasions to indicate whether UE need to monitor L1 availability indication for the TRS resource.  Does Alt-2 mean UE can only obtain the availability through L1 indication, and SIB based availability is not supported? |
| Xiaomi | FFS | L1 based availability indication of TRS/CSI-RS occasions for idle/inactive UEs is agreed for some frequently availability changing case,, where L1 based availability indication can be considered as default signaling. Wether SIB based signaling can be enabled/disabled to be FFS. |
| LG | FFS | This issue can be discussed after we decide whetehr the SIB based signaling supported or not. |
| Nokia | FFS | We think that enabling /disabling should be associated to the configuration of the L1 availability indication e.g. number of bits used and related field configuration. |
| SONY | Alt 2 | We prefer Alt-2. Alt-2 can be seen as implicit indication (We do not need to provide explicit activation/deactivation for L1-based signalling). |
| CMCC | Alt 1 |  |
| IDCC | Alt1 |  |
| Panasonic | Alt-1 |  |

### 2.1.2 <Summary of 1st round discussion>

Issue 2.1-1: support paging PDCCH based availability indication

|  |  |  |
| --- | --- | --- |
| **Question:** Whether or not allow availability indication only in paging PDCCH without short message and/or scheduling information? | Opt-1: gNB is not allowed to send availability without scheduling information and/or short message | CATT, Ericsson |
|  | Opt-2: gNB is allow to not to send availability without scheduling information [by implementation] | OPPO, Samsung |
|  | Opt-3: gNB is allow to send availability without scheduling information | Samsung , vivo |

**Table 2.1.2-1: Summary of 1st round discussion on Issue 2.1-1**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt-1: Confirm the following WA:   * Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs. | CATT, Sharp, OPPO, Spreadtrum, Samsung, Intel, Ericsson, Qualcomm, Lenovo, Motorola Mobility, DOCOMO, vivo, sony, Panasonic, IDCC **(14)** |
| 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 | TCL, Samsung, Apple **(3)** |
| Alt-3: Confirm the following WA  **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** | Nordic, ZTE, Sanechips, Huawei, HiSilicon, MTK, LG, Nokia, CMCC, IDCC, Apple **(11)** |

No objection to support paging PDCCH based availability indication, but there are still many concerns about PEI based signaling. For the benefit of progress, it’s necessary to discuss the two methods separately. Proposal 2.1-1 is drafted based on majority view to support Alt1. PEI based signalling is discussed in next sub-section, and is not precluded.

For the details regarding whether or not to allow availability indication only in paging PDCCH without short message and/or scheduling information, only a few companies provide views. So, the details are captured as FFS points.

|  |
| --- |
| **Proposal 2.1-1**  **Confirm the following WA:**   * **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.** * **FFS: whether or not allow availability indication in paging PDCCH without short message and/or scheduling information** * **FFS: how to reuse reserved bits in paging DCI format, e.g. reserved bits in short message or other reserved bits.** |

Issue 2.1-2: support PEI based availability indication

**Table 2.1.2-2: Summary of 1st round discussion on Issue 2.1-2**

|  |  |
| --- | --- |
|  | **Companies** |
| 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. | TCL, Spreadtrum, Nordic, Ericsson, Lenovo, Motorola Mobility, DOCOMO, Apple, IDCC, Panasonic **(10)** |
| 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. | CATT, Sharp, Samsung, Intel, Qualcomm, vivo, Xiaomi, Sony **(8)** |
| Alt-3: Confirm the following WA  **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** | ZTE, Sanechips, Huawei, HiSilicon, LG, MTK, Nokia, CMCC, Apple **(9)** |

According to the summary in Table 2.2.2-2, (5) Companies cannot agree to confirm the WA to support PEI based signaling method, due to following concerns, s.t.

* no need to couple PEI and availability indication features.
* additional power saving gain of indication by PEI over paging DCI is not expected to be significant
* anything related to PEI should be postponed after PEI singling down-selection is done.

For the sake of time, proposal 2.1-2 based on Alt2 is suggested for further discussion in this meeting.

|  |
| --- |
| **Proposal 2.1-2**  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. |

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

|  |  |
| --- | --- |
| **Question/Concern** | **Response** |
| [Ericsson]: if the L1-based availability indication is disabled, UE cannot be informed of availability, in which case there is no need to configure TRS/CSI-RS occasion(s). | [FL]: based on the comments from comapines supporting Alt1, if the L1-based availability indication is disabled, the presence of the configuration of the TRS/CSI-RS occasion is used as SIB-based availability indication. |
| [Sharp] determined by whether the SIB-based availability indication is supported and whether it coexistences with L1 based availability indication | [FL] We can clarify the dependence on SIB based availability indication for Alt1. The purpose is to capture all possible altearntives for now, and do down-selection in next meeting, At least one solution is needed to complete the design of L1 based avaiblity indication. |
| [QC] There is a dependency on SIB based availability indication based on presence or absence of the TRS configuration. |
| [TCL] Need to determine whether to consider any signaling type (L1 /SIB based) as default singling first |
| [Xiaomi] Wether SIB based signaling can be enabled/disabled to be FFS. |
| [LG] This issue can be discussed after we decide whetehr the SIB based signaling supported or not. |
| [Vivo] Does Alt-2 mean UE can only obtain the availability through L1 indication, and SIB based availability is not supported? | [FL] Not necessary. But, that’s one possible use case. Alterantively, both SIB-based and L1 based indication is supported simultentously. |
|  |  |

**Table 2.1.2-3: Summary of 1st round discussion on Issue 2.1-3**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| 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. | CATT, Samsung, Lenovo, Motorola Mobility, CMCC, Apple, vivo, IDCC, Panasonic **(10)** | ZTE, Sanechips, DOCOMO **(3)** |
| 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 | Ericsson, Huawei, HiSilicon, Sony **(4)** |  |
| Alt3: L1 based availability indication of TRS/CSI-RS occasions for idle/inactive Ues can be enable/disabled based on whether or not corresponding DCI fields is configured. | Nordic, Nokia **(2)** |  |
| Alt4: FFS | Sharp, TCL, Qualcomm, ZTE, Sanechips, DOCOMO, Xiaomi, LG **(8)** |  |

According to the summary in Table 2.1.2-3, the views are still divergent. Since this issue is not critical as others, we can capture all possible alternatives and do down-selection in next meeting.

For Alt1, some clarification based on comments from CATT/ Qualcomm are added to address the concerns on Alt1. Alt3 is added based on preference from Nordic/Nokia.

|  |
| --- |
| **Proposal 2.1-3**  L1 based availability indication of TRS/CSI-RS occasions for idle/inactive UEs can be enable/disabled based on one of the following alternatives, down-select in RAN1#106b-e meeting:   * Alt1: a binary bit configured in SIB-X. if the L1-based availability indication is disabled, the presence of the configuration of the TRS/CSI-RS occasion is used as SIB-based availability indication. * Alt2: presence/absence of the configuration of TRS/CSI-RS occasions * Alt3: whether or not corresponding DCI fields is configured * Other alternative is not precluded |

### 2.1.3 <2nd round discussion>

The following proposal is drafted based on the summary of 1st round discussion in Section 2.1.2.

|  |
| --- |
| **[2RD]Proposal 2.1-2 (v0)**  Prioritize Paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues   * Discuss PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs after L1 of signal/channel of PEI is confirmed. |

Please provide your views whether or not to support **Proposal 2.1-1**. If not, why? Any suggestion or modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y/N)** | **Comments** |
| LG | N | In case of PDCCH based PEI, it is not difficult to convey TRS/CSI-RS availability indication. We already discuss this issue in the previous RAN1 meeting and made working assumption that PDCCH based PEI can be supported for availability indication when PDCCH based PEI is supported.  Also, there are some proposals in 8.7.1.1 that conveying UE subgroup indication using DCI format 1\_0 with CRC scrambled by P-RNTI(paging DCI). Note that reserved bits in paging DCI may not enough to convey both UE subgroup index and TRS/CSI-RS indication. So, we would like to check first how many bits are required for TRS/CSI-RS indication and whether the paging DCI can be used for UE subgroup indication or not. |
| Sharp | Y |  |
| TCL | Y | This proposal is one part of WA in the previous meeting, and we clearly support both paging PDCCH and PEI based availability indication, but for the sake of progress we are fine to support this proposal. |
| vivo | Y |  |
| MTK | N | This proposal is not necessary. Based on the WA, we can already discuss paging PDCCH first, and then PEI. |
| Xiaomi | Y | Or confirm the WA. |
| OPPO | Y |  |
| Nordic | N | We disagree with any prioritization; we can continue working based on WA. Discussing this is waste of 3GPP air time. |
| DOCOMO | N | We have same view as MTK. We don’t need to repeat this discussion again. |
| Huawei, HiSilicon | N | The whole working assumption needs to be confirmed as whole package or we can leave it as working assumption to continue our work. |
| CMCC | N | Not need this proposal, just confirm the original WA. |
| ZTE, Sanechips | N | It does not make any sense to repeat the same discussion again and again, the availability carried by paging DCI only would defeat the PS gain from PEI.  We disagree with the prioritization, we can continue our work according to the original WA. |
| Nokia | N | We have similar view as MediaTek and other companies. |
| CATT | Y | The power saving gain from TRS/CSI-RS is achieved based on its persistently available to allow UE waking up later. The L1 based indication of TRS/CSI-RS availability would not change frequently in order to achieve UE power saving. The availability indication at the paging DCI would be sufficient to have the flexibility but less overhead. There is no result showing the benefit of including availability indication in PEI |
| Apple | N | The proposal is not necessary. The WA is sufficient already to carry on further work in RAN1. We feel it is not an efficient use of time to discuss this proposal. |

## 2.2 Indication content

In RAN1#105-e meeting, the following agreement were made regarding the indication content for L1 based availibity ccasionn 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 ccasion(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)  Nokia: Network configurable grouping. |
| Alt-3: Yes, QCL information indicated/updated by the L1 availability indication. | Xiaomi, Nokia(PEI) | 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. |
| Intel | Alt2, Alt4 | Alt2 allows for optimizing overhead, such as in low mobility scenarios. Whereas, Alt4 makes more sense when considering mobility, i.e., same information is repeated over different beams. Hence, we may also need to look into number of bits that can be allocated for this indication. |
| Ericsson | Alt-2 with modifications | Grouping should be supported – otherwise it leads to very restricted availability indication in multi-beam operation. For example, it should also be possible to indicate availability for all the configured resource sets (regardless of QCL reference), which can be be achieved via grouping. |
| Qualcomm | Alt-4 |  |
| Huawei, HiSilicon | Alt-1 and Alt-4 | We feel that Alt.1 and Alt.4 are not exclusive. When multiple resources are grouped, a number of companies propose to group the TRS resources with same QCL source together. So Alt-1 is a natural way to do this, at least for FR1.  If companies concern on the L1 singalling overhead for FR2, we can further discuss, e.g. grouping the TRS resources assicated with a group of SSB indexes as a resource group to be indicated by one bit in the bitmap.  We share the same view as MTK and Sony that the indication content should include the availability information for different beam directions. IDLE/INACTIVE Ues can move to different beam’s coverage, indicating only the TRS occasions with the same QCL reference will prohibit IDLE/INACTIVE Ues to get power saving gain. |
| Lenovo, Motorola Mobility | Alt-2 or Alt-4 | For Alt-2, it is allowed that Gnb does not transmit TRS for a certain beam.  For Alt-4, this may have the benefits of cross-beam combination and the UE may be able to evaluate and select the best beam. |
| Apple | Alt-1 or Alt-2 | It seems to us that Alt-1 and Alt-2 are the same (or at least very similar). Some clarification would be helpful.  Alt-3 is not clear to us. |
| Vivo |  | The TRS availability is indicated in beam selective manner can be achieved by associating the multiple resources to one bit in a bitmap through proper NW configuration. No need to mandate NW to provide the availability in beam selective manner. |
| Xiaomi | FFS | We think the alterntives are related to the configuration of TRS resources |
| LG | Alt-2 for PEI,  Alt-4 for Paging PDCCH | To reduced the overhead of PEI, we can considere beam-selectivity manner for availability indicdation. Note that UE does not need to monitor all PDCCH monitoring occasions within a PO. For power saving efficiency, UE may choose the best beam direction(s) for paging PDCCH monitoring, and same principle can be applied to the PEI.  Meanwhile, in case of paging PDCCH based availability indication, the best beam direction(s) can be changed during a DRX cycle. Thus, it would be better reusing Rel-15 multi-beam transmission strategy. |
| MTK | Alt-2 or Alt-4 | We can be flexible with either option.  Alt-4 allows UE to perform beam-wise combining, while Alt-2 can achieve the most compact information. |
| Nokia | Alt-2 (for Paging DCI) and Alt3 (for PEI) with some modifications | For paging DCI based indication we think that network configurable grouping should be considered. The grouping should not be restricted to signals only having the same QCL source, but up to network configuration.  In terms of Alt-3, the one bit indication in case of Type2-PDCCH CSS is sharing Type0-PDCCH CSS is needed as the paging DCI associated to different SSBs can be sent in same time location, hence the availability cannot be distinquished purely based on ‘presence’ of the signal. It is not strictly about adjusting the QCLsource, but removing the ambiquity. |
| SONY | Alt-4 | The motivation is to re-use the existing TRS for connected mode Ues (introduced in Rel-15). Hence, we basically reuse Rel-15 multi-beam transmission. |
| CMCC | Alt-4 | It’s up to UE to receive which beam(s) for PO PDCCH in TS 38.304. “In multi-beam operations, the UE assumes that the same paging message and the same Short Message are repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the paging message and Short Message is up to UE implementation.”  As the TRS avability informatin indication, it should be same across beams which is aligned with current Pgaing PDCCH reception if it is carried in Paging PDCCH. |
| IDCC | Alt4 | Agree with CMCC. |
| Panasonic | Alt-4 | Grouping by high layer is possible for any case no matter beam operation is used or not. So better to consider a unified manner. |

#### 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. |
| Ericsson | FFS | Depends on higher layer configuration e.g. if beam grouping is supported or as discussed in Issue 2.2-1. |
| Qualcomm | Alt-1 |  |
| Huawei, HiSilicon | Alt-2 | We are not sure what is the relationship of this discussion and the proposal of L1 indication in a window. In our understanding, six companies supports the window based L1 indication to just indicate related TRS occasions which is helpful for power saving. there is no need to indicate the L1 availability which is not helpful for power saving. So, we can add ‘Huawei, HiSilicon’ to Alt-2.  It is important to reduce the signaling overhead for L1 signaling since multiple TRS resources can be configured for IDLE/INACTIVE UEs, while the number of available bits in paging PDCCH and PEI is limited. |
| Lenovo, Motorola Mobility | Alt-1 |  |
| Apple |  | This seems to be related to issue 2.2-1. The intention needs to be further clarified. |
| vivo |  | The bitmap in paging DCI can provide the availability of all the TRS resources with L1 availability. |
| Xiaomi | FFS | The intention here is not clare to us. |
| LG | Alt-2 for PEI  Alt-1 for Paging PDCCH | As we commented our paper, availability indication using PEI would be usefule for the corresponding PO monitoring. So, availability assumption between PEI and associated PO is enough for achieving power saving gain.  Meanwhile, in case of paging PDCCH based availability indication, TRS cannot be used for PDCCH decoding at the same PO. Instead, it would be useful for the PEI and/or paging PDCCH/PDSCH decoding for the next DRX cycle(s). Also, it is common understanding that periodic TRS for connected mode UE will be provided for idle/inactive mode UEs. Thus we don’t see any motivation to restrict availabile resources for TRS reception. |
| MTK | Alt-1 | We support Alt-1. To minimize the impact to legacy paging DCI, up to 3 RS patterns can be configured. |
| Nokia | FFS | If grouping is configured, the availability indication via bit map would apply to the group of resources. |
| SONY | Alt-2 | There could be multiple TRS configurations. The availability also indicates the active/selected TRS configuration that occupy certain RS resources. |
| CMCC | Alt 1 |  |
| IDCC | Alt1 |  |
| Panasonic |  | Both options can be supported based on the high layer configuration. |

#### 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. |
| Intel | Alt1 |  |
| Ericsson | Alt-1 | Alt 1 can have lower overhead.  Regarding maximum number of configured resources per availability indication, it should also be possible to indicate availability for all the configured resource sets (regardless of QCL reference) via single indication. |
| Qualcomm | Alt-1 | This is aligned with Alt-1 for Issue 2.2-2 |
| Huawei, HiSilicon | Alt1 | Since multiple TRS resources can be indicated as a group, and one bit in bitmap can correspond to one group of TRS resource(s). We don’t see obvious benefits to use ‘codepoint’ manner. |
| Lenovo, Motorola Mobility | Alt-1 or Alt-2 |  |
| Apple | Alt-1 | Our preference is Alt-1, assuming only the same-beam TRS availability indication is signaled.  This is very related to the decisions we make for issue 2.2-1/2.2-2. Depending on how the signaling is done, how grouping is done and how beams are handled, the signaling design consideration may be different. |
| Vivo | Alt-1 |  |
| Xiaomi | Alt-1 | Bitmap is more clear to use here. |
| LG | Alt 1 | We prefer Alt 1. But we also fine with further discussion. |
| MTK | Alt-2 | Based on our view in issue 2.2-3, up to three codepoints are preferred. |
| Nokia | Alt1(for paging DCI) | For paging DCI based indication bit field would be preferable together with NW configured grouping (associated to the bits) |
| CMCC | Alt 1 |  |
| IDCC | Alt1 |  |
| Panasonic |  | We should address firstly maximum number of configured RS resources and also possible grouping of the RS resources. |

### 2.2.2 <Summary of 1st round discussion>

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

|  |  |
| --- | --- |
| **Questions/Concerns** | **Response** |
| [ZTE, Apple]: what’s the difference between Alt1 and Alt2. | [FL]: Both Alt1 and Alt2 consider configuring of a RS resource set per QCL assumption. However, Alt2 considers L1 signaling only indicates availability information for resources from a single RS resource set, where the RS resource set has the same QCL reference as the L1 signaling. |
| [Nokia] For paging DCI based indication we think that network configurable grouping should be considered. The grouping should not be restricted to signals only having the same QCL source, but up to network configuration. | [FL] Alt2 specifically requires the same QCL reference for L1 based avability indication and RS resources to be indicated. Can you clarify how alt2 works if the grouping should not be restricted to signals only having the same QCL source?  How to group is for sure open, but this proposal focus on multi-beam operation related issue. Grouping can be discussed in Issue 2.2-3. |
| [Nokia] In terms of Alt-3, the one bit indication in case of Type2-PDCCH CSS is sharing Type0-PDCCH CSS is needed as the paging DCI associated to different SSBs can be sent in same time location, hence the availability cannot be distinquished purely based on ‘presence’ of the signal. It is not strictly about adjusting the QCLsource, but removing the ambiquity. | [FL]In that case, the legacy rule, i.e. Alt-4, can be reused. QCL reference will be configured in SIB-X either per resource or pre a RS set. |

**Table 2.2.2-1: Summary of 1st round discussion on Issue 2.2-1**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt-1: Yes, by a bitmap, where each bit corresponds to the assistance TRS(s) that are QCLed with the same associated SSB index. | TCL, ZTE, Sanechips, Huawei, HiSilicon, Apple, [vivo] **(7)** |
| Alt-2: Yes, L1 availability indication only indicates availability/unavailability information for resources with the same QCL reference | Sharp, OPPO, Nordic, [ZTE, Sanechips], Intel, Ericsson, Apple, MTK, Nokia (not restricted to same QCL reference), LG **(11)** |
| Alt-3: Yes, QCL information indicated/updated by the L1 availability indication. |  |
| Alt-4: No, same TRS/CSI-RS availability indication in multi-beam operation | CATT, Samsung, Intel, Qualcomm, Huawei, HiSilicon, MTK, Sony, CMCC, IDCC, Panasonic, LG **(12)** |
| FFS | Xiaomi **(1)** |

Companies support ‘beam selective manner’ (Alt-1 or Alt-2) are based on motivations, including

* to reduce L1 signaling overhead
* UE only need to care about the TRSs with the same QCL reference for a special PO

Companies doesn’t support ‘beam selective manner’ (Alt-4) provide justifications, s.t.

* UE needs to get availability information of RS resources for all beam direction after long deep sleep to achieve power saving gain.

Based on the comments from HW, Alt1 is more about configuration/signaling overhead reduction. It can be combined with Alt4 to achieve ‘beam-selective manner’. So, Alt1 and Alt4 is combined in the Alt2 of following proposal.

The following proposal is drafted to capture all possible alternatives to support multi-beam operation of the L1 based availability indication. The down-selection could depend on the choose of L1 signaling method.

|  |
| --- |
| **Proposal 2.2-1**  **Support at least one of the following alternatives**   * **Alt1:  a L1 availability indication occasion provides availability/unavailability information only for RS resources with the same QCL reference as the L1 availability indication occasion.** * **Alt2: a L1 availability indication occasion can provide availability/unavailability information for RS resources with different QCL references as the L1 availability indication occasion**   + **FFS whether or not the RS resources indicated in each occasion can be configured per QCL reference.**   **Note: a L1 availability indication occasion is a configured monitoring occasion of the L1 signal/channel to provide the availability indication.** |

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

|  |  |
| --- | --- |
| **Questions/Concerns** | **Response** |
| [HW]:We are not sure what is the relationship of this discussion and the proposal of L1 indication in a window | [FL]: In my understanding, Alt2 requires association between configured RS resources and a PO. For the discussion about a window, it can be applied on top of this proposal, where UE monitors resources within the window. |
| [Sharp, Ericsson, Nokia]: Depends on higher layer configuration e.g. if beam grouping is supported or as discussed in Issue 2.2-1. | [FL] The purpose for this issue is to discuss whether the indication is for all RS reosurces common to all UEs or part of RS resources associated with a PO per UE group. Whether all RS resources are all resources configured in SIB-X or associated with a beam direction is not a concern here. |
| [Apple, Xiaomi]: The intention needs to be further clarified. |
| [Panasonic] Both options can be supported based on the high layer configuration. |  |
| [Sony] There could be multiple TRS configurations. The availability also indicates the active/selected TRS configuration that occupy certain RS resources. | [FL] Yes, the key is whether the candidate RSs to be selected include all configured RS resources or only some of the RS resources. |
|  |  |

**Table 2.2.2-2: Summary of 1st round discussion on Issue 2.2-2**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt-1: for all configured RS resource | CATT, OPPO, Nordic, Samsung, ZTE, Sanechips, Qualcomm, Lenovo, Motorola Mobility, vivo, MTK, CMCC, LG, IDCC |
| Alt-2: for some configured RS resources, e.g. indicated in a paging cycle to group of UE for the next paging cycle | TCL, Huawei, HiSilicon, Sony, LG |
| FFS | Sharp, Ericsson, Nokia, xiaomi |

The majority support Alt-1. But there is a concern, i.e. whether Alt1 is for all configured RS resources in SIB-X or all configured RS resources per beam direction. However, the main discussion point for this issue is whether the indication is for RS resources common to all UEs or per UE group, e.g. associated with a PO. So, proposal 2.2-2 is drafted based on majority view to support common indication to all idle/inactive UEs.

|  |
| --- |
| **Proposal 2.2-2**  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the availability/unavailability information are for RS resources applicable to all idle/inactive UEs. |

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 2.2.2-3: Summary of 1st round discussion on Issue 2.2-3**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt-1: Bitmap, to indicate TRS resources usage of up to [X] TRS sets/groups. | Sharp, TCL, OPPO, Spreadtrum, ZTE, Sanechips, Intel, Ericsson, Qualcomm, Huawei, HiSilicon, Lenovo, Motorola Mobility, Apple, vivo, Nokia(for paging DCI), CMCC, Xiaomi, LG, IDCC |
| Alt-2: X codepoints, to indicate TRS resources usage of up to X TRS sets/groups | CATT, TCL, Nordic, Samsung, Lenovo, Motorola Mobility, MTK |

|  |  |
| --- | --- |
| **Questions/Concerns** | **Response** |
| [Panasonic]: We should address firstly maximum number of configured RS resources and also possible grouping of the RS resources. | [FL]: maximum number of configured RS resources and grouping of the RS resources are in the discussion scope here. It should be jointly considered with bitmap or codepoint design. |
|  |  |

Proposal 2.2-3 is drafted based on the majority view to support Alt-1. The bitmap size can be FFS. X = 1 is not precluded to address the preference from CATT.

|  |
| --- |
| **Proposal 2.2-3**  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, where each bit is associated with at least one resource/configuration or a set/group of resources.   * The bitmap is up to X bits. * FFS X, X = 1 is not precluded. |

### 2.2.3 <2nd round discussion>

The following proposals are drafted based on the summary of 1st round discussion in Section 2.2.2.

|  |
| --- |
| **[2RD]Proposal 2.2-2 (v0)**  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the availability/unavailability information are for RS resources applicable to all idle/inactive UEs. |

Please provide your views whether or not to support **Proposal 2.2-2**. If not, why? Any suggestion or modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y/N)** | **Comments** |
| LG |  | For paging PDCCH based availability indication, it seems fine for us, but needs further clarification.   * Since we have sepreated discussion that whether the SIB based availabilitiy indication is supported or not, “RS resources applicable to all idle/inactive mode UEs” should be explained more clearly. For me, this proposal seems like even the RS resources whose availability is indicated via SIB signaling can be controlled by L1 based signaling.   For PEI based availability indication, we would like to clarify our understanding.   * If this proposal includes beam selectivity manner, we are not convinced with this option. As we commented before, our preference is that PEI indicating availability of TRS occasion(s) which have same QCL assumption. We need to discuss this issue further. * If this proposal includes concept of window, e.g. duration before the associated PO, we do not prefer this option. |
| Sharp |  | We don’t sure what means “the availability/unavailability information are for RS resources applicable to all idle/inactive UEs”? For example, if an indication is carried in a paging PDCCH, only specific UEs who monitor the PO will read the information. Does it mean it is not applicable to all UEs? |
| TCL | Y | We are fine with the intention of this proposal, but we suggest some minor changes in wording of the proposal as below.  **[2RD]Proposal 2.2-2 (v0)**  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the availability/unavailability information indicates ~~are for~~ those RS resources which are applicable to the ~~all~~ idle/inactive UEs. |
| vivo | Y |  |
| MTK | N | Are the indicated RS resources reasonably constraint to the RS resources in validity  time? If this is the case, the proposal should be revised. |
| Xiaomi | Y |  |
| OPPO |  | Is the intention that all the UE per beam share the same RS indication?  If yes, the proposal shall be revised to reflect this. |
| Nordic | Y | Applicability may be ambiguous, we prefer word “configured”  which are applicable to the ~~all~~ idle/inactive UEs -> which are configured for the idle/inactive UEs |
| DOCOMO |  | It is not clear to us that what “the availability/unavailability information are for RS resources applicable to all idle/inactive UEs” indicates. Could you clarify this intention? |
| Huawei, HiSilicon |  | We are a little bit confused by the proposal. How to understand RS applicable to all IDLE/inactive UEs?  If the availability indication is carried by paging DCI in PO1, are the indicated available RS considered as applicable or not applicable to the IDLE mode UEs in PO2?  We need further clarification before further comment and decision. |
| CMCC |  | Need more clarification, we think the same TRS/CSI-RS availability indication are transmitted in multi-beams |
| ZTE, Sanechips |  | We are also confused about the original intention of this proposal.  (1)What is “RS resources applicable to all idle/inactive UEs.”?  (2) Is there any connection with the following proposals discussed in the email thread? According to my understanding, the **Proposal 2.2-2 i**s exclusive with the following alt1, as the proposal 2.2-2 implies the availability indication is applied to all the configured RS to idle/inactive state UE, while the following alt1 includes RS with the same QCL reference.  Clarification is appreciated.  Besides, regarding the following alt1, it requires UE to detect L1 availability indication in all the beam directions (monitoring occasions) to obtain the full picture of RS availability/un availability with all beam directions, which is more power consuming, hence, alt2 is preferred.  Proposal 2.2-1 (v1)  Support at least one of the following alternatives          Alt1:  a L1 availability indication occasion provides availability/unavailability information only for RS resources with the same QCL reference as the L1 availability indication occasion.          Alt2: a L1 availability indication occasion can provide availability/unavailability information for RS resources with ~~different~~ QCL references not confined to ~~as~~ the L1 availability indication occasion  ~~o   FFS whether or not the RS resources indicated in each occasion can be configured per QCL reference.~~  Note: a L1 availability indication occasion is a ~~configured monitoring occasion of the~~ L1 signal/channelmonitoring occasion (e.g. a paging PDCCH monitoring occasion) to provide the availability indication. |
| Nokia | N/Maybe | I would also like to get some clarification to the intent of the proposal.  From network perspective, e.g. via L1 indication in paging DCI, network can provide the ‘presence’ indication to sub-set of UEs by sending the indication only in certain PO. Again, from network perspective, the availability assumption would then apply to those resources indicated by the L1 availability indication, with in the time frames related to the PO where this was indicated. |
| CATT | Y | Since IDLE/Inactive UEs could not be UE-specific configured with the TRS/CSI-RS resource, the availability indication of TRS/CSI-RS resource should be to all TRS/CSI-RSUEs. |
| Apple | Y | Availability indication is a broadcast information, and it should be applicable to all the UEs that receive the availability indication. |

|  |
| --- |
| **[2RD]Proposal 2.2-3 (v0)**  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, where each bit is associated with at least one resource/configuration or a set/group of resources.   * The bitmap is up to X bits. * FFS X, X = 1 is not precluded. |

Please provide your views whether or not to support **Proposal 2.2-3**. If not, why? Any suggestion or modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y/N)** | **Comments** |
| LG | Y for paging PDCCH | We are fine with paging PDCCH based availability indication.  However, we need more discussion for PEI base availability indication. We have not decided yet how to configure resource set/group. As we commented before, beam selectivity can be considered for PEI based availability indication, so this proposal seems premature and requires more details on configuration method of reserouce set/group. |
| Sharp | Y |  |
| vivo | Y |  |
| MTK | Conditional Support | X should be no larger than 3, since we should be carefully occupied the reserved bits in paging PDCCH. |
| Xiaomi | Y |  |
| OPPO | Y |  |
| Nordic | Conditionally | Same comment as MTK. Some max X should be agreed |
| Huawei, HiSilicon | Y | @LG,  In our view, even if beam selectivity is used, TRS resource associated with the same beam can be also configured as a group of resources. So it seems this does not exclude the beam selective manner of indication. Or you have some other considerations? |
| CMCC | Y |  |
| ZTE, Sanechips | Y |  |
| CATT | N | We would like to clarify what more than one TRS/CSI-RS resources are used in the assumption. We don’t see the need of more than one TRS/CSI-RS resource for each beam in a cell. In multi-beam operation, each beam has associated TRS/CSI-RS resource. Since IDLE/Inactive UE would not know which beam it will be under after deep sleep, the TRS/CSI-RS availability should be the same for all beam. Thus, we believe 1 bit is sufficient and don’t see the need to have bitmap. |
| Apple |  | We are not against the principle in general, but we feel the discussion may not be in the right order. The current proposal could be too broad to cover anything.  In our view, we should first (1) clarify the definition of resource/configuration. We have raised the issue a few time but there is no clarification for it yet. E.g. whether we intend to reuse CSI-RS resource set for a TRS configuration here. To us, we should not do this because the unnecessary overhead is too large. We should define a new TRS configuration signaling. Depending on the decision, a resource may mean a CSI-RS resource or a TRS resource (2 or 4 CSI-RS resources); (2) discuss the max # of TRS configurations. This affects what should be considered in the design.  We can always say that the grouping can be configured to reduce the overhead. But considering an example with 64 beams, with one TRS configuration for each beam. The availability of each TRS configuration should be independent depending on whether there are connected UEs in each beam. We do not see a good basis to perform grouping and use a single bit to indicate the availability for the group.  Therefore, we would appreciate some examples regarding what kind of grouping is being considered.  One possible way forward is to agree on one bit per TRS configuration first (this should be supported at least for small number of TRS configurations, FR1 or small # of beams), and the grouping can be further discussed once we get more clarity on the related issues. |

## 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 ignalling 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, Apple |  |
| For PEI based only | CMCC, Apple |  |
| Opt-3: Include in the L1 based availability indication | | LG, Ericsson, Sony | 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, Apple | 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 onfiguration 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). |
| Intel | Option 1 (Configured by higher layer)  Duration (Option 1, 2, 3)  Start from time of indication, Opt-1 |  |
| Ericsson | Opt-3 (Indicating validity via L1) is first preference | Configuring multiple validity timers and indicating the used validity timer via L1 based availability indication allows better flexibility in indicating different timescales of availability.  Regarding candidate duration, we prefer Opt-1 although we would like to check if this refers to default paging cycle so that Ues have same understanding of the duration of the cycle length/availability. We do not support Opt-3 as it implies an always-ON TRS from NW perspective.  Reference point : UE can assume availability from the time/Paging cycle in which it receives the indication. |
| Qualcomm | Opt-3 | The TRS is valid as long as it is indicated by availability indication signaling. Given the TRS is reused from a connected mode UE, its presence/absence wont be aligned with idle/inactive UE’s PO pattern. |
| Huawei, HiSilicon | (Opt-1 and Opt-2) or Opt-5 (i.e. Support, FFS details, there is a typo in the proposal) | We think the four options seems not the same level concept. Option 1 and Option 3 are the signaling method of validity time. However, Option 2 is another level concept.  First, we’d like to support Opt-2. It is only the TRS resources located within a window before the PO that is useful for the Ues associated with the PO. By defining the window, on the one hand, less resources are indicated in L1 signaling, and thus the signaling overhead is reduced (more details please see our reply under Issue 2.2.2-2). On the other hand, Gnb can only pay attention to the TRS resources within the window, which is friendlier for Gnb implementation.  Second, we also support Opt-1. Opt-1 is how the validity time is configured, and it is not exclusive with Opt.2.  The related discussion may also depend on the progress of L1 based signaling, e.g. paging DCI based indication and PEI based indication. So, we somehow also agree with Opt.5 that the validity time is needed but should be discussed when other topics are clearer. |
| Lenovo, Motorola Mobility | Option 2 (window before a PO) | Here, our understanding on the question is the validity time of L1 based availability indication, not the validity time of TRS configurations. The L1 based availability indication before a PO should be valid at least until the end of a current paging cycle (for PEI based indication) and until the end of a next paging cycle (for paging DCI based indication). |
| DOCOMO | Option 1 (Configured by higher layer) |  |
| Apple | Option 1/3/4 (validity time)  Option 1 (reference point) |  |
| vivo | Opt-3 null/infinity | One entry, in the supported validity time durations, which provides availability without restricted by certain time duration, should be supported, and UE does not change the assumption of availability unless new indication received.  When the TRS availability does not change frequently, the additional overhead for the L1 availability indication is limited. |
| Xiaomi | Option ½ | Option2 can be a futher optimization based on option 1. |
| LG | Signaling: Opt-3  Duration: Opt-1 / 4  Starting: Opt-1 | For the signaling method, dynamic indication can provide more NW scheduling flexibility.  For the duration, we think default paging cycle or modification period can be used. However, for the PEI based availability indication Option-4 is preferred. |
| MTK | Opt 1 (for non-PEI based signaling);  Opt 2 (for PEI based signaling) | It is relevant to the signaling method. If PEI is used to signal the availability indication, Opt-2 is preferred.  If PEI is not used, the validty time can be configured by higher layer. And the duration of validty time can be configured as N paging cycle. (Opt-1 in candidate duration)  The starting points of both Opts are from the time of indication/configuration. |
| Nokia | Opt-1 | We think that one validity timer (as a function of few paging cycles) would be most straight forward and most easily aligned among UE and network. UE should be able to assume ‘presence’ immediately after the corresponding L1 availability indication, and the expiry of the availability would be aligned to the (UE specific) paging cycle.  As we have the TRS occassioon configuration that determines the time occasions when TRS are available we don’t think w eneed additional ‘time window’ such as proposed in Opt-2.  If infinite availability time wants to be supported, this should be considered via SIB based availability rather than L1 availability. |
| SONY | Opt-3 | The timer is indicated in L1 signalling |
| CMCC | Opt 1 and Opt 2 |  |
| Panasonic | Opt 1 & 3 | High layer may configure a more static value or a set of values to choose by L1 indication. |

### 2.3.2 <Summary of 1st round discussion>

**Table 2.3.2-1: Summary of 1st round discussion on Issue 2.3**

|  |  |
| --- | --- |
|  | **Companies** |
| Opt-1: Configured by higher layer | CATT, Sharp, TCL, Spreadtrum, Samsung, ZTE, Sanechips, Intel, Huawei, HiSilicon, DOCOMO, Apple, MTK, Nokia, CMCC, Xiaomi, Panasonic **(17)** |
| Opt-2: A window before a PO | OPPO, Spreadtrum, Nordic, Huawei, HiSilicon, Lenovo, Motorola Mobility, MTK, CMCC, Xiaomi, Apple **(12)** |
| Opt-3: Include in the L1 based availability indication | Ericsson, Qualcomm, , Sony, vivo(null/infinity), LG, Panasonic **(6)** |
| Opt-4: TRS without validity time limitation should be supported | Apple (until the next TRS availability indication) |
| Opt-5: Support, FFS details | Huawei, HiSilicon, Apple **(3)** |

No objection to support validity time. But the views for detailed solutions are not aligned yet. The following proposal is to sync views for the all possible alternatives first. We can do down-selection in the futher.

|  |
| --- |
| **Proposal 2.3**  **L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive Ues is valid for a time duration starting from a reference point, where**   * **the time duration can be determined based on at least one or more alternatives from the following:**   + **Alt-1: configured by higher layer**   + **Alt-2: a predefined/configured window**   + **Alt-3: included in the availability indication**   + **Alt-4: to be configured as an indication periodicity during which the availability status is the same**   + **A combination of alternatives or other alternatives is not precluded.** * **the reference point can be determined as at least one or more alternatives from the following:**    + **Alt-1: start of next PO or DRX cycle**   + **Alt-2 time location where UE receives the indication**   + **Alt-3: start of paging cycle where UE receive the indication**   + **Other alternatives is not precluded.** |

# 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 hether 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 ignallin, 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 ignalling 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**. |
|  |  |

### 3.1<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 ignalling 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 |
| Intel | Alt1, Alt2, Alt-3 |  |
| Ericsson | Alt 5 | We do not support SIB based signaling for availability indication.  We do not see the need for a duplicated solution since there is already L1-based availability indication via Paging DCI, and via PEI-DCI. With suitable validity timer settings, longer durations of availability can be indicated with these schemes.  Since Ues can enter and leave connected mode, the NW can transmit or omit (in a dynamic manner relative to SI change rate) the TRS in potential TRS occasions depending on whether there are connected mode Ues being served or not. However, if the NW uses SIB for availability indication, whenever it wants to turn ON/OFF TRS, then the content of SIB changes, and the NW has to start a SI update procedure.  Every time there is a change in TRS availability, it leads to an SI update procedure, increasing both UE power consumption and NW power consumption. This will impact all Ues including legacy Ues (that do not support this TRS feature).  Alternative then for the NW is to send less frequent SI updates even if there is no connected UE at a time in the cell. As such, the NW must keep the TRS transmissions ON for a long time even if no connected UE is using it, which in turn means an “always ON” TRS which is not inline with the note in WID. |
| Huawei, HiSilicon | Alt-5 | See no need to support SIB based indication. |
| Lenovo, Motorola Mobility | Alt2 is preferred, but Alt1 is acceptable. |  |
| DOCOMO | Alt 5 | SIB based ignallin is duplicate solution if validity timer for Paging DCI signaling is introduced, and informing availability of TRS by SIB affects legacy UE and Rel-17 UE in terms of power consumption due to the waste SIB update procedure. |
| Apple |  | We support SIB-based indication in general. We think e.g. 1-bit indication in SIB-x is sufficient to differentiate SIB-based and L1-based indication, but we are open to consider other alternatives also. |
| Vivo | Alt 2 | Whether the availability of the TRS follows L1 indication or SIB, it can be indicated together with the configuration for the TRS resource.  For TRS with SIB based availability, the availability of these TRS resources are updated only through SI update mechanism. |
| Xiaomi | Alt2 | Alt2 is more flexiable. |
| MTK | Alt-5 | We don’t support SIB based signaling for TRS/CSI-RS availability information. From the view of proponents for SIB-based ignallin, it can be utilized when TRS/CSI-RS availability information is updated infrequently. However, L1-based indication can also support infrequent upate of TRS/CSI-RS availability information. It is not necessary for using SIB based signaling. |
| Nokia | Alt-3 | We think (as expressed) that in some scenarios SI based availability information is preferred to L1 availability indication. We do not prefer to use SI update based method (such as Alt-1) to adjust the presence/absence due to the implied cost (of SI update procedure) |
| SONY | Alt.5 (Deprioritized) | We consider L1 signalling is sufficient. SIB-based may be added to complement L1 signalling. |
| CMCC | Alt 1 |  |
| IDCC | Alt5 |  |
| Panasonic | Alt-1 | In our understanding, Alt 1 is based on the legacy UE ignalli in a way that the presence of the TRS configuration on SIB but without L1 indication means the TRS is available, and vice versa. If TRS is not configured, it is not available. |

#### Issue 3-2: FFS whether and how SIB based ignalling and L1 based ignalling 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, Nokia |  |
| 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 ignallin, 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 ignallin 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 ignallin. |
| 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 |
| Intel | Alt4, Alt5, Alt6 |  |
| Huawei, HiSilicon | Alt. 1 | See our comments for Issue 3-1. |
| Apple | Alt-1 | We do not see it is very necessary to support the simultaneous configuration of both, even though we think SIB-based signaling itself is useful. |
| Vivo | Alt-2 | For each TRS resource, SIB based signaling and L1 signaling can not be indicated simultaneously. NW can indicate whether the availability follows the L1 indication together with the configuration for the resource in SIB.  For TRS with SIB based availability, i.e. without L1 indication, the availability of these TRS resources are updated only through SI update mechanism. |
| Xiaomi | Alt-5 | If the answer of issue 3-1 is yes, alt-5 is preferred. |
| LG | Alt-2 | We do not have strong view on SIB based signaling, but we prefer Alt-2 if it is supported. |
| MTK | Alt-1 | We support Alt-1 to avoid the problem of handling different configuration from SIB and L1 based indication. |
| Nokia | Alt-1 | We think that SI based availability information would be needed only when the availability is static, and L1 indication is not therefore needed. |
| SONY | Alt.4, Alt.5 | We prefer L1-based indication only. Alt4 and 5 are for the case when SIB is supported (in addition to L1-based). |
| CMCC | Alt 4 |  |
| Panasonic | Alt 1 |  |

### 3.2<Summary of 1st round discussion>

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

**Table 3.2-1: Summary of 1st round discussion on Issue 3.1**

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Companies** |
| Alt1 | Yes, based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X | CATT, TCL, Spreadtrum, Samsung, Intel, Lenovo, Motorola Mobility, CMCC, Panasonic **(9)** |
| Alt2: | Yes, configurable in SIB\_X | TCL, Intel, Lenovo, Motorola Mobility, vivo, Xiaomi **(7)** |
| Alt3 | Yes, in static manner via SI without SI update and physical layer presence/availability indication | Intel, Nokia **(2)** |
| Alt4 | Yes, FFS details | Sharp, Samsung **(2)** |
| Alt5 | No, or deprioritize | OPPO, Nordic, ZTE, Sanechips, Ericsson, Huawei, HiSilicon, DOCOMO, MTK, SONY, IDCC **(11)** |
| Others | 1-bit indication in SIB-x is sufficient to differentiate SIB-based and L1-based indication | Apple |

|  |  |
| --- | --- |
| **Index** | **Concerns to support SIB based signaling** |
| C1 | **Unclear of the benefits/use case that cannot achieved by L1 based indication**  [ZTE, Sanechips, Ericsson ]: the benefit of SIB based solution is unclear. We do not see the need |
| C2 | **Cost of SI update procedure**  [Ericsson] a change in TRS availability, it leads to an SI update procedure, increasing both UE power consumption and NW power consumption. This will **impact all Ues** including legacy Ues (that do not support this TRS feature) |
| C3 | **‘Always on’ signal**  [Ericsson] for the NW is to send less frequent SI updates even if there is no connected UE at a time in the cell. As such, the NW must keep the TRS transmissions ON for a long time even if no connected UE is using it, which in turn means an “always ON” TRS |

Many comapines show concerns on the cost of SI update procedure to support SIB based indication, Alt2 seems to be unacceptable in this regard. However, motivation of Alt1 & Alt3 are more about indicating static available TRS resources to avoid L1 signalling overhead. So, the following proposal is drafted based on Alt1 and Alt3.

|  |
| --- |
| **Proposal 3-1**  Support SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues at least in static manner, where   * the configuration of the TRS/CSI-RS occasion(s) in SIB\_X indicates all static available RS resources, * no SI update procedure to adjust the availability information |

### 3.3 <2nd round discussion>

The following proposals are drafted based on the summary of 1st round discussion in Section 3.2.

|  |
| --- |
| **[2RD] Proposal 3-1 (v0)**  Support SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues at least in static manner, where   * the configuration of the TRS/CSI-RS occasion(s) in SIB\_X indicates all static available RS resources, * no SI update procedure to adjust the availability information |

Please provide your views whether or not to support **Proposal 3-1**. If not, why? Any suggestion or modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y/N)** | **Comments** |
| LG | N | If I understand correctly, there are only two companies who support providing static TRS availability configuration in system information. We are fine to further discuss on semi-static availability indication using SIB, but static TRS seems “always on signal” for us.  Also, the second sub-bullet seems like not aligning with our previous decision that “It is RAN1 understanding that existing SI update procedure is used for SIB based signalling” |
| Sharp |  | The first bullet should be clarified if it is only applied for the cases of non- coexistence with L1indication .  The second bullet is not clear how to update the configuration, and the SIBx update procedure should be determined by RAN2 |
| TCL | Y | We support this proposal |
| vivo |  | The SI update procedure can update the configurations provided by SIB in current mechanism, and should also include the parameters for static TRS configured by SIB. Hence, the second sub-bullet is not needed. |
| MTK | Y (with revision) | May compromise to the following revision:  Support SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive Ues ~~at least~~ in static manner when L1 based availability indication is not configured, where   * the configuration of the TRS/CSI-RS occasion(s) in SIB\_X indicates all static available RS resources, * ~~no SI update procedure to adjust the availability information~~ |
| Xiaomi |  | Can we confine gNB behavior as the 2nd sub bullet, which is the current mechanism in specification?  Even if we can, our concern on the other hand is that network may choose not to configure such shared TRS to idle/inactive UE from the implementation point of view since static manner obviously increase network power consumption.  We suggest we discuss L1 indication in the first place, FFS static manner later. |
| OPPO | N | How to make sure there is static RSs?  We think this proposal doesn’t reflect the majority view in the 1st round. |
| Nordic |  | Below aspect is not specifiable in our opinion, if this option is available then it can be misused. -> resulting in large UE power consumption   * no SI update procedure to adjust the availability information   However, if this is possible to specify somehow, then are OK |
| DOCOMO |  | It’s not clear for us about ‘no SI update procedure to adjust the availability information’. Could you clarify about that?  In my understanding, it seems to conflict with our previous agreement. “Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signaling.” |
| Huawei, HiSilicon | N | According to the WID, always-on RS is not required. So we cannot agree on any ‘static’ manner.  It seems even Alt.1 does not mean it is static. |
| CMCC |  | Same concern as DOCOMO |
| ZTE, Sanechips | N | See our comments in the 1st round. |
| Nokia | Y (with revision) | Similarly, as raised by MediaTek, we would also think that it would be preferable to focus to the case that L1 availability indication is not configured to avoid any confusion on the availability state.  As pointed by others, it might be good to provide some clarification what is meant with static available resources. One interpretation would be that TRS occasion configuration without L1 availability, would imply ‘always-on’. While that could be one option, it seems bit too restrictive.  The second sub bullet could be adjusted to the form that it is assumed by RAN1 that existing SI update procedure is used, as raised by DOCOMO. E.g. “Existing SI update procedure is used to adjust the information” |
| CATT | Y (with revision) | We agree with MediaTek’s proposed revision. The SIB update function should not be excluded. |
| Apple |  | The current proposal is unclear to us. What does “static” manner mean? If it is indicated in SIB-x, isn’t it correct that SIB update procedure would automatically apply? |

# 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 onfiguration 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. |
| Intel | Alt-1 |  |
| Ericssons | Alt-1 |  |
| Qualcomm | Alt-2 |  |
| Huawei, HiSilicon | Alt-1 |  |
| Lenovo, Motorola Mobility | Alt1 |  |
| DOCOMO | Alt-1 |  |
| Apple |  | We would like a clarification first. Do all the companies here assume that we directly reuse the CSI-RS resource set configuration signaling (which uses 2 or 4 CSI-RS resources for TRS)? This creates significant signaling overhead, which is a big issue for SIB. We think we should define a separate TRS configuration to minimize the overhead. |
| Vivo | Alt-1 |  |
| Xiaomi | Alt-2 |  |
| LG | Alt-1 |  |
| MTK | Alt 1 | To reduce the configuration overhead, we support Alt-1. |
| Nokia | Different approaches could be considered for FR1 and FR2 | We think that we could consider different approaches for FR1 and FR2 to limit the overhead. In FR1 it would be possible to configure the QCL source per resource (i.e. TRS) allowing different number of resource to be assigned to SSBs, while for FR2 it would reduce the configuration overhead if resource ID (max. 64) would also indicate the corresponding SSB, limiting the configuration to one per SSB. Note that it would not be necessary to configure resources for all SSBs |
| CMCC | Alt 2 |  |
| IDCC | Alt2 |  |
| Panasonic | Alt-2 | The RS configuration for QCL can just follow the legacy signaling structure. |

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. |
| Intel | Alt2 |  |
| Ericsson | Alt-2.1 |  |
| Qualcomm | Alt-2.1 | Maybe our proposal is a little unclear, but should be counted under Alt-2.1. |
| Huawei, HiSilicon | Alt1 | According to our understanding, a UE can use a RS with QCL typeC only for coarse T/F tracking, while the UE can use a RS with QCL typeA for fine T/F tracking.  We are not sure how to understand Alt.2-2. Some further clarification is expected. |
| Lenovo, Motorola Mobility | Alt-2.1 |  |
| DOCOMO | Alt2 |  |
| Apple | Alt-2.1 |  |
| vivo | Alt-2 | The QCL source, SSB index, need to be explicitly indicated for TRS resource. While for the QCL type, explicit indication can be avoided. UE assumes type-C, and type-D when applicable, QCLed with SSB by default. |
| Xiaomi | Alt-2.1 |  |
| LG | Alt-2 |  |
| MTK | Alt-2 | Support Alt-2.2: w/ explicit indication in higher layer configuration. |
| Nokia | Alt-2.1 | In the spirit of the earlier agreement to consider TRS based configuration, we think the same QCL rule should apply. |
| SONY | Alt-2.1 |  |
| CMCC | Alt-2.1 |  |
| Panasonic | Alt-2.1 |  |

### <Summary of 1st round disucsion>

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

**Table 4.1.2-1: Summary of 1st round discussion on Issue 4.1-1**

|  |  |
| --- | --- |
|  | **Support Companies** |
| Alt-1:configured per RS resource set | CATT, TCL, OPPO, Spreadtrum, Nordic, ZTE, Sanechips, Intel, Ericssons, Qualcomm, Huawei, HiSilicon, Lenovo, Motorola Mobility, DOCOMO, Vivo, LG, MTK **(18)** |
| Alt-2: configured per RS source configuration, same as Rel-15/16 | Samsung, Xiaomi, CMCC, IDCC, Panasonic **(5)** |
| Alt-3: be associated with the configuration order of the resources | Sharp **(1)** |
| define a separate TRS configuration to minimize the overhead. | Apple: |
| Different approaches could be considered for FR1 and FR2 | Nokia: |

The majority support Alt1 to configure QCL reference per a set of RS resources, for the benefit to reduce configuration overhead. There is a concern about corresponding L1 availability ndication. The availability for RS resources with same QCL reference can be different according to the status in connencted mode. To support Alt-1, it requires L1 avaability indication in beam selective manner as we discussed for Issue 2.2-1.

@Apple, I think the majority assume different configuration from legacy configuration of NZP-CSI-RS resource set. But, the main discussion here is hether to configure the QCL information per a set of RS resources.

The following proposals are drafted to clarify corresponding L1 avaability indication method.

|  |
| --- |
| **Proposal 4.1-1a**  Each RS resource set is configured to be QCLed with one SSB index, and a bit/codepoint in a L1 availability indication provides availability/unavailability information for a RS resource from a RS resource set.  **Proposal 4.1-1b**  Each RS resource set is configured to be QCLed with one SSB index, and a bit/codepoint in a L1 availability indication provides availability/unavailability information for a RS resource set.  **Proposal 4.1-1c**  Each RS resource is configured to be QCLed with one SSB index, and a bit/codepoint in a L1 availability indication provides availability/unavailability information for a RS resource set.  Note: A RS resource set is a set of RS resoruces configured with one or more common parameters, e.g. ID, and etc. |

Issue 4.1-2: FFS: QCL type

**Table 4.1.2-2: Summary of 1st round discussion on Issue 4.1-2**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Descriptions | **Support Companies** | |
| Alt1 | configurable  - FR1: either ‘typeA’ or ‘typeC’;  - FR2: either ‘typeA+D’ or ‘typeC+D’. | Huawei, HiSilicon | |
| Alt2.1 | Reuse Rel-16 QCL rule, i.e. ‘QCL-TypeC’ or ‘QCL-TypeD’ when applicable   * No explicit indication in higher layer configuration | Sharp, OPPO, Samsung, ZTE, Sanechips, Ericsson, Qualcomm, Lenovo, Motorola Mobility, Apple, vivo, Xiaomi, Nokia, SONY, CMCC, Panasonic | Nordic, TCL, Intel, DOCOMO, LG |
| Alt2.2 | Reuse Rel-16 QCL rule, i.e. ‘QCL-TypeC’ or ‘QCL-TypeD’ when applicable   * w/ explicit indication in higher layer configuration | CATT, MTK |

The majority support reusing Rel-15/16 rule, where only ‘QCL-C’ and ‘QCL-D’ can be used for TRS, and no explicit ndication is needed as QCL-D is only applicable for FR2.

|  |
| --- |
| **Proposal 4.1-2**  For a RS resources configured for TRS/CSI-RS occasion(s) for idle/inactive Ues, a quasi co-location type can be determined as one of the following:   * ‘typeC’ with an SS/PBCH block for FR1, * ‘typeD’ with an SS/PBCH block for FR2. |

### <2nd round disucsion>

The following proposals are drafted based on the summary of 1st round discussion in Section 4.1.2.

|  |
| --- |
| **[2RD]**  **Proposal 4.1-1a**  Each RS resource set is configured to be QCLed with one SSB index, and a bit/codepoint in a L1 availability indication provides availability/unavailability information for a RS resource from a RS resource set.  **Proposal 4.1-1b**  Each RS resource set is configured to be QCLed with one SSB index, and a bit/codepoint in a L1 availability indication provides availability/unavailability information for a RS resource set.  **Proposal 4.1-1c**  Each RS resource is configured to be QCLed with one SSB index, and a bit/codepoint in a L1 availability indication provides availability/unavailability information for a RS resource set.  Note: A RS resource set is a set of RS resoruces configured with one or more common parameters, e.g. ID, and etc. |

Please provide your views about which variant (a, b, or c) of **Proposal 4.1-1** you support. Any suggestion or modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(a, b, or c)** | **Comments** |
| LG | Support b | In terms of signaling overhead point of view, option b is preferable. But we are open to discuss further. |
| Sharp | b | Proposal 4.1-1b seems to be more efficient. |
| TCL | b | variant b seems more comprehensive than the other two variants |
| vivo | b | Since TRS is a CSI-RS resource set with CSI-RS resources with common parameters, it is nature that the QCL information and availability is provided at least per resource set. |
| MTK | b | Proposal 4.1-1b is efficient for periodic TRS. |
| Xiaomi | b | 4.1-1b is more efficient compared with the other two optioins. |
| OPPO | b | To save signaling overhead |
| Nordic | b |  |
| DOCOMO | b |  |
| Huawei, HiSilicon |  | We are fine to agree the firat part of a or b, i.e. “Each RS resource set is configured to be QCLed with one SSB index”. However, the second part is not really the configuration issue of QCL. Regarding how 1 bit of L1 signalling map to a RS resource set(s), it would be related with Issue 2.2-1: FFS whether and how to indicate the ‘availability’ in beam selective manner. For example, one bit can map to multiple resource sets of multiple SSBs in FR2 to resolve overhead issue.  Therefore, we suggest to agree the first part. And pending on the second part which could be discussed in Issue 2.2-1. |
| CMCC | b |  |
| Nokia | c (with modifications) | The intent of proposals 4.1-1a, 4.1-1b and 4.1-1c seems to be to use ‘RS-ResourceSet’ as a grouping mechanism, to enable grouping different ‘RS-Resources’, which have some common parameters.  In proposals 4.1-1a and 4.1-1b all the ‘RS-Resources’ would have a common QCL source, as the QCL source is set by ‘RS-ResourceSet’.  Now if I understand the proposal correctly, in proposals 4.1-1a and 4.1-1b, if each ‘RS-ResourceSet’ is mapped to one bit in e.g. the 6 bits in paging DCI, we could only provide L1 availably indication for TRS occasions for 6 SSBs. It would also mandate one group to contain only ‘RS-Resources’ with same QCL, which is not problem if we have sufficient information field size to separate the indications.  For this reason, we would prefer proposal 4.1-1c.  Also, while I fully support the methods to reduce the overhead, I would propose to modify the note as follows:  “Note: A RS resource set is a set of RS reso~~r~~urces can be configured with one or more common parameters, e.g. ID, and etc”  For FR1 the overhead is not an issue, and finally the methods to reduce the overhead (on top of the minimum set of parameters agreed by RAN1) is up to RAN2. |
| CATT | N | Since IDLE/Inactive UEs would move among beams within a cell, UE would need to know whether TRS/CSI-RS availability for all beams within a cell in order to determine to wake up early or not. 1-bit is sufficient to indicate the availability of all TRS/CSI-RS resources. |
| Apple |  | Thanks the moderator for responding to our question. The main issue we have with the proposal is that we do not know what a RS resource is, and what a RS resource set is, if we do not know how we intend to define the signaling. Leaving out the detailed signaling, for a TRS configuration (with 2 or 4 OFDM symbols), does it correspond to a RS resource or a RS resource set? Without the common understanding on the terminology, the proposal is too vague. |

|  |
| --- |
| **[2RD] Proposal 4.1-2 (v0)**  For a RS resources configured for TRS/CSI-RS occasion(s) for idle/inactive Ues, a quasi co-location type can be determined as one of the following:   * ‘typeC’ with an SS/PBCH block for FR1, * ‘typeD’ with an SS/PBCH block for FR2. |

Please provide your views whether or not to support **Proposal 4.1-2**. If not, why? Any suggestion or modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y/N)** | **Comments** |
| LG | Y |  |
| Sharp | Y |  |
| vivo |  | In our understanding, the QCL type between TRS and SSB should be type-C for FR1, and type-C+ type-D for FR2, rather than only type-D QCL for FR2.  We suggest to revise the proposal, and simply say ‘the same QCL type as that in rel-15/16’, or copy the text in current spec. |
| MTK | Y | For the sake of progress, we can accept this proposal. |
| Xiaomi | Y |  |
| OPPO | Y |  |
| Nordic | Y, but | just a technical question, isn’t it so that before MSG4 SSB serves also like TYPE-A source for PDCCH/PDSCH? Idle TRS is new signal before MSG4, similar should apply? |
| DOCOMO |  | We can’t set ‘typeC+D’ regarding the QCL type between TRS and SSB for FR2? If so, we would like to get clarification about it. |
| Huawei, HiSilicon |  | The proposal is not correct. Type D only cannot help the time/frequency tracking. Type C and Type D can be assumed simultaneously. Maybe we should decide whether QCL type of assistance TRS needs to be configured or not.  We still think it is better to support the configuration of Type A between SSB and assistance TRS to enable better synchronization if configured. |
| ZTE, Sanechips |  | We have the same understanding with vivo. |
| CATT | Y |  |

## 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 onfiguration index is one of the configuration parameters. How to determine the details of onfiguration 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 (PEI) |
| 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 |
| Intel | Alt-2 |  |
| Ericsson |  | Discuss after further progress on detailed configuration. |
| Qualcomm | Alt-3 |  |
| Huawei, HiSilicon | Alt-1 | In legacy NR system, the configuration index can be derived based on the order of the configuration in a ‘list’. So we don’t think it needs explicit configuration.  Similar view with ZTE. |
| Lenovo, Motorola Mobility | Alt 2 | A configuration index can be same as an SSB index for a QCL source. |
| DOCOMO | Alt-3 |  |
| Apple | Alt-3 |  |
| Xiaomi | Alt-3 |  |
| LG | Alt-3 |  |
| Nokia |  | Please see our responce in Table 4.1.1-2 |
| SONY | Alt-2 |  |
| CMCC | Alt-3 |  |
| Panasonic | Alt 2 |  |

### <Summary of 1st round disucsion>

**Table 4.2.2-1: Summary of 1st round discussion on Issue 4.2**

|  |  |
| --- | --- |
|  | **Companies** |
| Alt-1: no need | Huawei, HiSilicon |
| Alt-2: per resource set | Intel, Samsung, [ZTE, Sanechips], Lenovo, Motorola Mobility, SONY, Panasonic |
| Alt-3: postpone, | Sharp, Ericsson, Qualcomm, DOCOMO, Apple, LG, CMCC |
| Alt-4: based on QCL source | Nokia (PEI) |
| Alt-4: associated with SSB/paging occasion(s) | CATT, TCL |

Let’s postpone discussion on this issue as many companies suggested.

## 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 onfiguration index is one of the configuration parameters. How to determine the details of onfiguration 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. |  |
| Intel | Alt-3 | Up to RAN2 |
| Ericsson |  | RAN1 should discuss the information that is necessary to convey the potential TRS resources,including any common configuration parameters, based on Alt 1/3/7.  Detailed RRC design can be left to RAN2. |
| Qualcomm | Alt-7 | With redundant parameters removed |
| Huawei, HiSilicon | **For the question raised by moderator:**  Alt-2 | The issue of exceeding the maximum SIB size has been analyzed in several contributions, and many companies agree that this issue exists. We are not sure which company has concern on whether the issue exists.  So we think we should continue discuss this issue from RAN1 perspective. |
| Lenovo, Motorola Mobility | Alt 2 |  |
| DOCOMO |  | As mentioned by Ericsson and Huawei, RAN1 should discuss the necessary information for TRS to slove the issue of exceeding the maximum SIB size |
| Apple |  | We would like to repeat the clarification question we asked above: do most companies here assume that we directly reuse the CSI-RS resource set configuration signaling (which uses 2 or 4 CSI-RS resources for TRS)? This creates significant signaling overhead, which is a big issue for SIB. We think we should define a separate TRS configuration to minimize the overhead.  Another possible way to move forward is that we identify the parameters needed for TRS configurations and leave it to RAN2 to design/optimize the signaling. |
| Vivo | Alt-3 | The detailed signaling design is up to RAN2 discussion. |
| Nokia | Alt-3 | We think that RAN1 should focus to identify which parameters are needed (in general) and also that which parameters can be common (maybe but not mandatorily), and provide the information to RAN2. RAN2 can further consider the need and methods to reduce the overhead. |
| SONY | Alt-7 | TRS for inactive/idle mode Ues should re-use the TRS for connected mode Ues (Hence, reuse the existing configuration). |
| CMCC | Alt 1, Alt 3 |  |
| Panasonic | Alt 4 and 7 |  |

# 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. |
| Qualcomm | Issue-2, 3 |  |
| Huawei, HiSilicon | Issue-3 | OK to send LS but can discuss the detailed content of LS. |
| LG | Issue-3, Issue-5, issue-6 | Issue-5 should be discussed and determined. Since the TRS transmission is a new type of reference signal for Idle/Inacitve mode UE, how to handle overlap with PDSCH transmission shall be discussed. |
| MTK | Issue-2 | The issue can be solved if the validity time is supported.  There are two cases that may take application delay into consideration, e.g., RS On-to-Off and Off-to-On. For On-to-Off, UE will assume there is no available TRS/CSI-RS at configured occasion(s) after the expiration of validity time. For RS Off-to-On, it can be up to UE implementation to determine the required time for TRS/CSI-RS usage.  Therefore, the application delay is not needed. |
| Nokia | Issue-3, Issue-6 | Issue-1: We think that this configuration is addressed to IDLE/Inactive UEs and CONNECTED mode UEs should ignore it and follow the dedicated configurations.  Issue-2/-4: As the L1 availability indication/TRS occasion configuration does not relate to any UE behaviour visible to network, there is no need to consider this.  Issue-3: With the progress regarding the parameters, we could consider send LS to RAN2  Issue-5: While this could be discussed, it should be clear that al IDLE/Inactive mode UEs cannot be assumed to be aware of the TRS occasion, thus same assumption as in Rel-15/16 should be respected. As commented in Issue-1, CONNECTED mode UEs should respect their dedicated configuration. |

# 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 |