**3GPP TSG RAN WG1 #105-e** **R1-21XXXX**

**e-Meeting, May 10th – May 27th, 2021**

**Agenda Item:** 8.7.1.2

**Source:** Moderator (Samsung)

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

**Document for:** Discussion/Decision

# Introduction

In RAN1#104bis e-meeting for AI 8.7.1.2, a working assumption to support L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) for idle/inactive UEs was agreed. The next step is then to determine the details, such as L1 signal/channel designs, indication content, validity time, and etc. Also, it was agreed to support configuration for TRS/CSI-RS occasion(s) for idle/inactive UEs based on periodic TRS only. The remaining issues are to determine the details of configuration parameters and corresponding applicable values that are necessary to provide the periodic TRS for idle/inactive UEs.

This document provides the summary of the contributions for TRS/CSI-RS occasion(s) for idle/inactive UEs in Section 8.7.1.2. The proposes from submitted contributions are divided into the following topics:

* Topic #1. Availability indication
* Topic #2. Configuration details
* Topic #3: Others

The following email thread for TRS/CSI-RS occasion(s) for idle/inactive UEs is announced by Chairman in RAN1#105 e-meeting:

[105-e-NR-R17-PowSav-02] Email discussion regarding TRS/CSI-RS occasions for idle/inactive UEs – Qiongjie (Samsung)

* 1st check point: 5/21
* 2nd check point: 5/25
* Final check: 5/27

In the first round of the discussion before 1st check point, companies are requested to provide comments on the suggested proposals or discussion points highlighted in yellow under Section 2.1, 3.1, and 4.1.

# Topic #1: Availability indication

According to the following agreement in RAN1#104bis-e meeting, a working assumption has been agreed to support L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) for idle/inactive UEs. Details are open for further disucssion. For indication content, two alterantives were agreed for downselection.

|  |
| --- |
| 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, 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
 |

The following proposals regarding the availability indication are submitted in RAN1#105-e:

|  |  |
| --- | --- |
| ZTE [1] | **Proposal 1: Confirm the working assumption that supporting L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.****Proposal 2: The TRS availability indication should be carried by PEI.****Proposal 3: The TRS availability indication carried by paging DCI can be also considered in addition to PEI based solution.****Proposal 4: Alt1 with a bitmap can be used to indicate the availability/unavailability information for each configured TRS resource or resource set.****Proposal 5: An application delay can be considered at least in the case that TRS resource or resource set availability indication is updated.** |
| Huawei, HiSilicon[2] | 1. ***The validity time for PEI based availability indication is the time duration between the PEI and the associated PO.***
2. ***The validity time for paging DCI based availability indication is the time duration after the transmission of the paging DCI and before the next PO of the same UE.***
3. ***An indication periodicity is introduced which can be configured N paging cycles, during which the availability of assistance TRS is assumed to be the same.***
4. ***If indication periodicity is additionally configured, the validity time of availability indication is the same as the indication periodicity.***
5. ***Support indication of availability of assistance TRS before the start of PO through PEI and legacy paging DCI.***
6. ***Bitmap is the baseline for availability indication, where each bit indicates a RS or a group of RS.***
7. ***Support to indicate the availability of assistance TRS(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.***
8. ***Support to indicate the availability of assistance TRS in a window before the PO.***
 |
| TCL Communication Ltd[3] | **Proposal 1: Support Alt1; the explicit availability/unavailability information for all or some of the configured RS resources using a bitmap or codepoint.** **Proposal 2: Support the validity time for availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UE, and consider the following alternatives to measure the accurate validity time:****Alt1: Single timer based validity time mechanism** **Alt2: Dual timer based validity time mechanism****Proposal 3: Application delay can be considered based on the availability/unavailability status of TRS in the network as given below.*** **Application delay is necessary when the availability/unavailability status of TRS is changing**
* **Application delay is not necessary when the availability/unavailability status of TRS remains the same**

**Proposal 4: Beam selective transmission of TRS availability indication should be associated to the specific beams which are used to transmit the same TRS resources and TRS resources should be configured in beam specific manner for each SSB beams.** |
| Vivo[4] | ***Proposal 2:*** *The availability indication can be delievered at least through paging DCI.** *TRS availability indication through PEI also depends on the signal/channel design of PEI, and it can be discussed after the details are clear.*

***Proposal 3:*** *SIB based TRS avsilsbility update can be supported.** *It is up to RAN2 to decide whenther the same SI update mechanism is reused.*

*Proposal 4: UE assumes the TRS available before receiving signaling indicating the TRS as NOT available.****Proposal 5:*** *The L1 availability indication takes effect once it is received from UE perspective.* ***Proposal 6:*** *Availability/unavailability information for all or some of configured RS resources is indicated using a bitmap, where each bit is associated with at least one resource or a set/group of resources.* |
| Spreadtrum Communications[5] | ***Proposal 1: Confirm the working assumption on signalling method of availability indication of TRS/CSI-RS.******Proposal 2: The availability indication of TRS/CSI-RS in paging DCI or PEI DCI shall be supported.******Proposal 3: Availability/unavailability information for all or some of configured RS resources using a bitmap shall be supported.******Proposal 4: Validity time for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UE shall be supported.******Proposal 5: Application delay for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UE is not need, the availability indication becomes effective once received.*** |
| CATT[6] | ***Proposal 6: Working assumption that support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs should not be confirmed******Proposal 8: 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.******Proposal 9:*** ***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.***  |
| CMCC[7] | **Proposal 1. Both paging DCI and PEI can be considered as L1 based signaling for the availability indication of TRS/CSI-RS. SIB can be used to indicate which L1 based signalling to be used.****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. Support Alt1: Availability/unavailability information for all or some of configured RS resources using a bitmap.****Proposal 4. A pre-defined validity time can be considered for PEI based availability indication signalling, e.g., the time before the associated PO.****Proposal 5. Both pre-defined validity time and explicit validity time indication can be considered for paging DCI based availability indication signalling.** |
| Qualcomm Incorporated[8] | **Proposal 3: 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 4: 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: Availability and unavailability information for all the configured RS resources using a bitmap**
* **Second preference based on Alt. 2: Codepoint to indicate one or more resource/configuration indices that correspond to all the available RS resources.**
 |
| OPPO[9] | ***Proposal 1: Paging DCI or PEI can be used to indicate the availability of TRS/CSI-RS.******Proposal 2: At least paging DCI shall be used for TRS availability indication.******Proposal 3: When PEI is configured for idle/inactive UEs, PEI can alternatively be used (e.g., based on network’s configuration) for TRS availability indication.******Proposal 5: 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***
 |
| Intel[10] | **Proposal 2: Support paging DCI as the L1 indication for availability indication update*** **SIB provides a default value**
* **Upon receiving change indication by L1, UE assumes the newly indicated availability characteristic**
* **UE can be configured to switch back to default value upon expiry of a timer**

**Proposal 3: Support availability/unavailability information for all or some of configured RS resources using a bitmap or codepoint.** |
| Apple[11] | **Proposal 3: Support PEI (if PDCCH is adopted for PEI), paging DCI, and SIB-based signaling to carry the availability indication of the TRS occasion(s).****Proposal 4: 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 5: 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.****Proposal 6: 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.** |
| Sony[12] | **Proposal 1: Availability information of TRS/CSI-RS is signaled in the paging DCI.****Proposal 2: Support to provide additional availability information (e.g. availability duration, which active TRS/CSI-RS are currently available).****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 value or codepoint to indicate one or more resource/configuration indices that correspond to the available RS resources.****Proposal 5: Indication the ‘availability’ of TRS/CSI-RS occasions in beam selective manner is not supported.** |
| Samsung[13] | **Proposal 1: Support paging PDCCH based explicit availability indication of TRS/CSI-RS occasions for idle/inactive UEs.****Proposal 2: Whether or not to support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs should be discussed after the completion of L1 signal/channel design of PEI.****Proposal 3: Support SIB based availability indication of TRS/CSI-RS occasions for idle/inactive UEs. If the same availability indication is provided via L1 signal/channel, no need to provide SI update notification in paging PDCCH for the change of the availability indication.** **Proposal 4: Support indication of available TRS/CSI-RS resource set(s) for idle/inactive UEs. value or codepoint to indicate one or more resource/configuration indices that correspond to the available RS resources****Proposal 5: An 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 provided to UEs explicitly by SIB or L1 based availability indication.** |
| MediaTek[14] | **Proposal 1: Confirm the following working assumption to support L1-based signalling for TRS/CSI-RS availability indication.*** **Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.**

**Proposal 2: SIB-based signalling with existing SI update procedure is not supported for TRS/CSI-RS availability indication.****Proposal 3: If paging early indication (PEI) is configured, gNB indicates the TRS/CSI-RS availability information to idle/inactive mode UE(s) through PEI.****Proposal 4: UE assumes the same TRS/CSI-RS availability indication in multi-beam operation.****Proposal 5: for the availability indication of TRS/CSI-RS at the configured occasion(s), the application delay is not needed if validity time is supported.** |
| LG[15] | **Proposal 1: The availability of TRS/CSI-RS at the configured occasion(s) is informed to the idle/inactive UE at least by the PEI.****- FFS: whether to support indication using paging DCI** **Proposal 2: The L1 based signaling can indicate available duration for the TRS/CSI-RS occasion(s).** **- FFS: Details including the length of duration and its indication method**  |
| Panasonic[16] | **Proposal 1: Confirm the working assumption on L1 based signaling for TRS/CSI-RS availability indication. Both PEI and paging based signaling are supported.****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 detailed L1 signaling design.****Proposal 4: Validity period needs to be defined for L1 availability/unavailability indication of TRS/CSI-RS occasion(s) for IDLE/INACTIVE UEs.**  |
| Nokia, Nokia Shanghai Bell[17] | **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, e.g. in a form of a time table**.**Proposal: Physical layer indication should not increase the network overhead by requiring frequent/periodic signal transmission.****Proposal: Support paging DCI based and PEI based beam specific aperiodic availability indication with validity timer as an additional availability indication. The value of validity timer should be configurable by network**. |
| Xiaomi[18] | ***Proposal 2:***  ***Paging DCI or PDCCH based available/unavailable indication is preferred from the L1 point of view.******Proposal 3: Alt1 is preferred for the information provided by a physical layer availability indication of TRS/CSI-RS, and in addition QCL association may be updated in the same time.*** |
| Sharp[19] | **Proposal 3: Alt1 using a bitmap should be supported for availability/unavailability information for configured RS resources** **Proposal 4: The physical layer indication only indicates availability/unavailability commands for the resources with the same QCL reference** |
| NTT DOCOMO, INC[20] | **Proposal 1: 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.**

**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.** |
| InterDigital, Inc.[21] | **Proposal 1: Downselect between paging PDCCH or paging early indication for availability signaling after more progress is achieved in the design of the paging early indication.****Proposal 2: Availability is indicated using a bitmap where each bit associated to a group of (including one) resources.** **Proposal 3: SIB-based signaling of availability indication is not supported.** |
| Lenovo, Motorola Mobility[22] | **Proposal 5: Availability of TRS transmission is indicated in paging DCI or DCI carrying the PEI (if DCI based PEI is supported).** **Proposal 6: 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.** |
| Ericsson[23] | [Proposal 1 Support L1-based TRS availability indication with associated validity timer via a bitfield in Paging DCI.](#_Toc71665172)[Proposal 2 For L1-based TRS availability indication via Paging DCI, higher layers can configure multiple validity timer value(s) and the applied validity timer value is indicated via Paging DCI.](#_Toc71665173)[Proposal 3 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).](#_Toc71665174)[Proposal 4 For L1-based TRS availability indication via Paging DCI, a codepoint/bitmap based approach can be used to indicate TRS availability of different resources and/or for different validity timer values.](#_Toc71665175)[Proposal 5 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.](#_Toc71665176)[a. Grouping is configured via higher layers (Details FFS)](#_Toc71665177) |
| Nordic Semiconductor ASA[24] | ***Proposal-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, support** + *Alt1: Availability/unavailability information for a set of configured TRS resources is indicated in the PEI by a single bit.*
		- *The set of TRS resources is given by TRS resources associated to SSBs indicated in ssb-PositionsInBurst, unless configured by gNB otherwise.*
 |

## First round discussion

According to the contributions submitted in RAN1#105b-e, the proposals regarding availability indication of TRS/CSI-RS at the configured occasion(s) for idle/inactive UEs can be categorized into five aspects

* L1 based signaling
* SIB based signaling
* Indication content
* Validity time
* Application delay

### Issue 1-1: L1 based signalling

A remaining issue about L1 based signaling is whether or not to confirm the following working assumption from last meeting.

Only one company are not OK to confirm the working assumption. In [6], CATT raised following concerns:

1. When IDLE/Inactive UE moving to a new cell, L1 signaling of TRS/CSI-RS availability indication received from original cell is invalid.
2. L1 signaling has backward compatibility issues when DCI is used as the L1 signaling. For instance, the reserved bits in the paging DCI could wake up legacy UE without the need of receiving paging/SI update, which will cause additional power consumption of legacy UE.
3. It will be concatenated effects in limiting UE power saving gain and missing the paging message when L1 signaling is missed detected. Since the miss-detection occurs for IDLE/Inactive UE with L1 signaling, it will create misalignment between gNB and UE’s understandings on the availability of TRS/CSI-RS.

For 1), the availability indication from original cell will be invalid regardless of the signaling type when cell reselection occurs. This seems to be a common issue for any signaling type. When cell reselection happens, UE has to receive a new availability indication from the new cell, otherwise the UE cannot assume any availability by default. It’s possible that SIB based signaling could be better than L1 based signaling for this case, since UE receives L1 based signaling after SIB reception. However, the latency doesn’t seem to be a critical issue. Whether or not to further consider SIB based signaling is still open.

For 2), it’s not clear what’s the backward compatibility issue. The legacy UEs can ignore the reserved bits of paging PDCCH.

For 3), the impact of miss-detection of L1 based availability indication is still under discussion. For instance, many companies propose to support validity time for the availability indication. With validity time for L1 based availability indication, UE cannot assume any availability of TRS/CSI-RS when miss-detection happens.

Based on the analysis above, it’s suggested to consider the following proposal.

**Moderator proposal #1**

**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**

Please provide the detailed views in the following table, and comments to further address the concerns from CATT are welcome.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y or N)** | **Comments/Suggestions** |
|  |  |  |
|  |  |  |

In addition, there are many proposals discussing down selection from the two alternatives for L1 signaling based availability indication. The motivations and concerns for PEI based and paging PDCCH based signaling are summarized below.

|  |  |  |
| --- | --- | --- |
|  | **Motivations** | **Concerns** |
| **Alt 1: PEI** | * Low UE power consumption. UE can skip receiving paging DCI and paging PDSCH when there is no paging message for the UE.
 | * Feasibility depends on the signal/channel design of PEI
* Couples the PEI and idle/inactive TRS/CSI-RS features
 |
| **Alt2: paging PDCCH** | * Decouples PEI and idle/inactive TRS/CSI-RS features. It allows an inactive/idle mode UE to support the TRS/CSI-RS but not the PEI.
* Enough DCI bits to indicate the availability information,
 | * UE still needs to detect PO even when it is not paged, which will degrade the power saving gain
* May cause “always-on” signal if the paging DCI is transmitted each PO to indicate the TRS availability information.
 |

Companies’ views are summarized as follows:

* + **Alt1:** ZTE, Huawei, HiSilicon, Spreadtrum, CMCC, OPPO, Apple (if PDCCH based), MediaTek, LG, Xiaomi, Docomo, Lenovo(if PDCCH based) **(12)**
	+ **Alt2:** ZTE, Huawei, HiSilicon, Vivo, Spreadtrum, CMCC, Qualcomm, OPPO, Intel, Apple, Sony, Samsung, Xiaomi, Docomo, Lenovo, Ericsson **(16)**
	+ **Others:**
	+ **CATT**: 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-
	+ **CMCC**: SIB can be used to indicate which L1 based signalling to be used

The following proposal is suggested for discussion based on the summarized views above.

**Moderator proposal #2**

**Support at least paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**

* **Whether or not to support PEI based availability indication can be discussed after L1 signal/channel of PEI is confirmed**
* **FFS enable/disable the feature configurable by SIB**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y or N)** | **Comments/Suggestions**  |
|  |  |  |
|  |  |  |

### Issue 1-2: SIB based signalling

On the one hand, some companies [Vivo, CATT, Intel, Apple, Samsung, Nokia] propose to support SIB based signaling of the availability indications, which are beneficial for the following use cases:

* Reuse SI update mechanism for infrequent update.
* A default mode, and UE switches back to the default mode when L1 based availability indication expires
* Cell reselection

On the other hand, some companies [HW, Docomo, InterDigital] proposed to not support SIB based signaling of the availability indication due to the following concerns:

* Availability indication carried in SIB may introduce additional paging DCI transmission, which leads more resource overhead for frequent update of availability for assistance TRS.
* Restriction of the flexibility of using TRS send for connected UEs.

For SIB based signaling, there are proposals to further clarify the details, s.t.

* Alt1: the availability of TRS/CSI-RS at a given cell should be informed to the UE by the present/not present of SIB-X TRS/CSI-RS configuration [CATT].
* Alt2: static TRS availability configuration, e.g. in a form of a time table [Nokia].

In addition, there are some proposals regarding the SI update mechanism associated with SIB-based signaling.

* It is up to RAN2 to decide whether the same SI update mechanism is reused [vivo]
* without SI update [Samsung, Nokia]

To conclude, it seems SIB based signaling and L1 based signaling have different suitable use cases. It’s beneficial to consider both of them. So, it’s suggested to further discuss SIB based signaling based on the following proposal.

**Moderator proposal #3**

**Support SIB based signaling for availability indication of TRS/CSI-RS occasions for idle/inactive UEs.**

* **FFS details,**
	+ **E.g. whether and how SIB based signaling and L1 based signaling can be supported simultaneously**
	+ **E.g. whether or not to provide SI update notification**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y or N)** | **Comments/Suggestions**  |
|  |  |  |
|  |  |  |

### Issue 1-3: Indication content

For the details of information of the availability indication, the following two alternatives were provided in last RAN1 meeting.

* Alt1: Availability/unavailability information for all or some of 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
* Alt2: value or codepoint to indicate one or more resource/configuration indices that correspond to the available RS resources

One remaining issue about the indication content is down-select from alternatives for determining the actual information carried in the L1 based signaling. Companies’ views are summarized as follows:

|  |  |  |
| --- | --- | --- |
|  | **Motivations** | **Others** |
| **Alt 1** | * More flexibility

There can be multiple active resources or resource sets simultaneously, which provides more TRS occasions and is beneficial to UE power saving in the case of varied SNR condition or UE with different capabilities | * Alt1-1: indicate the availability of TRS resources in a window before an PO to reduce signaling overhead
	+ Huawei, HiSilicon, TCL
* Alt1-2: one bit or one code point to indicate all TRS/CSI-RS resources within a cell
	+ CATT
 |
| **Alt2** | * Lower signaling overhead.

Alt 2 only indicates identities for configured RS resources that are available, while the RS resources are that are not available can be derived by UE implicitly | * UE still needs to detect PO even when it is not paged, which will degrade the power saving gain
* May cause “always-on” signal if the paging DCI is transmitted each PO to indicate the TRS availability information.
 |

Companies’ views are summarized as follows:

* + **Alt1:** ZTE, Huawei, HiSilicon, TCL, vivo, Spreadtrum, CATT, CMCC, Qualcomm, OPPO, Intel, Apple, Xiaomi, Sharp, InterDigital, Ericsson **(16)**
	+ **Alt2:** Sony, Samsung **(2)**
	+ **Others:**
	+ **Panasonic**: 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 detailed L1 signalling design

As the majority supports Alt1, the following proposal based on the majority view is suggested for further discussion.

**Moderator 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, support availability/unavailability information for all or some of 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 availability indication to support.**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y or N)** | **Comments/Suggestions**  |
|  |  |  |
|  |  |  |

Also, there are many proposals to follow up the FFS point regarding whether and how to indicate the ‘availability’ in beam selective manner. The views are summarized as follows:

* + **Alt1:** Support to indicate the availability of assistance TRS(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
	+ Huawei, HiSilicon, Lenovo
	+ **Alt2:** The physical layer indication only indicates availability/unavailability commands for the resources with the same QCL reference
	+ TCL, Apple, Sharp, Ericsson
	+ **Alt3:** beam selective manner is not supported
	+ Sony
	+ MediaTek: introduce some restrictions on UE implementation.

Therefore, it’s suggested to discuss all potential alternatives and down-select if possible.

**Discuss whether and how to support L1 based signalling of the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UE in beam selective manner.**

* **Alt 1: To indicate the availability per beam direction by a bitmap, where each bit corresponds to the assistance TRS(s) that are QCLed with the same associated SSB index**
* **Alt2: The physical layer indication only indicates availability/unavailability commands for the resources with the same QCL reference**
* **Alt3: Beam selective manner is not supported.**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Alternative to support** | **Comments** |
|  |  |  |
|  |  | . |

### Issue 1-4: Validity time

There are many proposals regarding how to determine a validity time for an availability indication, such that a UE can be provided with a time duration in which an availability indication is assumed to be valid, otherwise the UE may assume an availability indication is always valid before the UE receives another or the next availability indication.

The alternatives to support validity time are summarized as follows:

* + **Alt1: configured by higher layer, e.g. N paging cycles**
	+ Huawei, HiSilicon, [spreadtrum], CMCC, Samssung, Docomo, Lenovo
	+ **Alt2: A window before a PO. e.g. Time duration between the end of L1 signal/channel carries the availability indication and the start of an associated PO.**
	+ Huawei, HiSilicon, CMCC
	+ **Alt3: Included in the availability indication, and multiple validity timer value(s) can be configured as candidates**
	+ Huawei, HiSilicon, CMCC Sony, Samssung, LG, Panasonic, Nokia, Ericsson

As the majority are positive to support the validity time for L1 signaling based availability indication. The following proposal is suggested for discussion.

**Moderator 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 that can be determined based on one or more alternatives from the following:**

* **Alt 1: configured by higher layer**
* **Alt 2: a window before a PO.**
	+ **E.g. Time duration between the end of L1 signal/channel carries the availability indication and the start of an associated PO.**
* **Alt3: Included in the availability indication.**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y/ N)** | **Comments/Suggestions** |
|  |  |  |
|  |  |   |

### Issue 1-5: Application delay

There are some proposals about whether or not to introduce an application delay to determine when an L1 based availability indication can take effect. The views are summarized as follows:

* + **Alt1:** Need when availability indication indicates change of availability/unavailability status for the relevant RS resources
	+ ZTE, TCL
	+ **Alt1:** No need. L1 based availability indication takes effect once received.
	+ Vivo, spreadtrum
	+ **MediaTek**: If the validity time is supported, only RS Off-to-On can happen because 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.

Based on the summary above, no much interests for introducing application delay. Therefore, it’s suggested to consider the following proposal based on the view that no applicable delay is needed.

**Moderator proposal #6**

**A 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.**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y or N)** | **Comments/Suggestions** |
|  |  |  |
|  |  |  |

## First round discussion summary

# Topic #2. Configuration Details

According to the following agreements from RAN1#104e meeting, it has been agreed to support configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs include at least powerControlOffsetSS, scramblingID, firstOFDMSymbolInTimeDomain, startingRB, and nrofRBs, But the corresponding applicable values have no been confirmed yet. Based on the agreement from last meeting, we only need to support the configuration parameters and corresponding applicable values that are necessary to provide configuration of periodic TRS for idle/inactive UEs. Furthermore, how to configure the QCL information for multiple RS resources for TRS/CSI-RS occasion(s) for idle/inactive UEs are open for FFS.

|  |
| --- |
| In RAN1#104-e: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

In RAN1#104b-eAgreement: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: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
 |

The following proposals regarding details of configuration are submitted in RAN1#105-e:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ZTE [1] | **Proposal 6: The QCL information of TRS for idle/inactive UE is associated with SSB.****Proposal 7: Reducing signaling overhead should be taken into consideration when configuring TRS related parameters.**

|  |  |
| --- | --- |
| **parameters** | Applicable values |
| powerControlOffsetSS /dB | Ex. {-3, 0, 3, 6} |
| scramblingID | Ex. 0 to 1023 |
| firstOFDMSymbolInTimeDomain | Ex. 0 to 9 |
| startingRB | Ex. 0 to 274 |
| nrofRBs | INTEGER (24..maxNrofPhysicalResourceBlocksPlus1) |

 |
| Huawei, HiSilicon[2] | 1. ***For the configurable parameters in Table 2, the value range for*** ***CONNECTED mode*** ***can be used as the baseline.***
2. ***gNB configures the associated SSB index as the QCL information.***
3. ***Further discuss the TRS occasion in slot-level granularity to be configured relative to PO.***
4. ***The following way can be used to reduce signaling overhead for the TRS resources within a resource set***
	* ***Option 1: The parameters with the same value can be configured only once instead of multiple times.***
	* ***Option 2: gNB provides a ‘reference configuration’, and each configured resource can have a ‘delta-configuration’ compared with the reference one.***

**Table 2 The related parameters of TRS for IDLE/INACTIVE mode UEs**

|  |  |
| --- | --- |
| **Parameter** | **Note** |
| powerControlOffsetSS | Configured by gNB |
| scramblingID | Configured by gNB |
| firstOFDMSymbolInTimeDomain | Configured by gNB |
| startingRB | Configured by gNB, not restricted by initial BWP |
| nrofRBs | Configured by gNB, not restricted by initial BWP |
| QCL | Configured by gNB |
| SCS | Not configured, the same as the SCS of CORESET #0 |
| Trs-info | Not configured, implicitly assumed to be configured |
| frequencyDomainAllocation{row1, row2, row4, others} | Not configured, it is row1 by default. |
| nrofPorts | Not configured, single port is assumed. |
| cdm-Type | Not configured, single port is assumed. |
| periodicityAndOffset | FFS |

 |
| TCL Communication Ltd[3] | **Proposal 5: Include the configuration of IndicationCycle in the *DownlinkConfigCommonSIB*, similar to the paging cycle, to reduce the availability indication overhead.** **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.** **Proposal 7: Study the configuration of multiple TRS/CSI-RS SMTC window to reduce the configuration overhead.** |
| Vivo[4] | ***Proposal 1:*** *TRS resources configured for idle/inactive UEs can be type-C or type-D qualsi co-located with SSB, and the QCL information of the TRS resource can be optionally configured.* |
| Spreadtrum Communications[5] |  |
| CATT[6] | ***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 3: QCL information configuration of TRS for idle/inactive UE should be configured per CSI-RS resource set.*** ***Proposal 4: QCL information of TRS/CSI-RS occasion(s) should be explicitly indicated to be associated with SSB ID by SIB-X for IDLE/Inactive UEs.******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.*** |
| CMCC[7] |  |
| Qualcomm Incorporated[8] | **Proposal 1: Clarify whether value range of the configuration parameter for TRS can be extended when the TRS is configured to idle/inactive mode UEs.****Proposal 2: Reuse Rel-16 QCL rule with SSB as the QCL source for periodic TRS configured to inactive/idle UEs.** |
| OPPO[9] | ***Proposal 4: QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs is derived from higher layer configuration, e.g., qcl-InfoPeriodicCSI-RS.*** * ***qcl-InfoPeriodicCSI-RS shall refer to a SSB index***
 |
| Intel[10] | **Proposal 1:*** **In addition to the parameters agreed in RAN1-104e and 104bis-e, the following parameters can be included in TRS/CSI-RS configuration**
	+ **Repetition**
	+ **periodicityAndOffset**
	+ **frequencyDomainAllocation**
	+ **Availability indication**
 |
| Apple[11] | **Proposal 1: The QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs is indicated as a SSB index.****Proposal 2: Use the TRS configuration parameters in Table 1 as the starting point. Further signaling overhead reduction/optimization can be considered.****Table 1 TRS configuration parameters**

|  |  |
| --- | --- |
| **TRS configuration parameters** | **Value Range** |
| TRS configuration index | 0 to (max # of TRS configurations – 1) |
| Frequency domain allocation | {0, 1, 2, 3}For TRS, this can be simplified to the offset for the TRS REs in a RB. |
| firstOFDMSymbolInTimeDomain | 0 to 9 |
| startingRB | Can reuse the existing range: 0 to 274 |
| nrofRBs | Can reuse the existing range: 24 to 276 |
| powerControlOffsetSS | Reuse the existing range: {-3, 0, 3, 6} dB |
| scramblingID | Reuse the existing range: 0 to 1023 |
| periodicityAndOffset | Can reuse the existing structure of CSI-ResourcePeriodicityAndOffset, with periodicity limited to {10, 20, 40, 80} ms. |
| QCL information | 0 to 63, indicating the QCLed SSB index |
| Number of slots for TRS | {1, 2} |

 |
| Sony[12] | **Proposal 3: Support providing multiple TRS/CSI-RS configurations to idle/inactive UEs.** |
| Samsung[13] | **Proposal 6: Support applicable values of {db-3, db0, db3, db6} for *powerControlOffsetSS* of TRS/CSI-RS occasion(s) for idle/inactive UEs.****Proposal 7: Support a length of 10bits for *scramblingID* of TRS/CSI-RS occasion(s) for idle/inactive UEs**.**Proposal 8: Support value in range of 0 to 13 for *firstOFDMSymbolInTimeDomain*** **of TRS/CSI-RS occasion(s) for idle/inactive UEs**,**Proposal 9: Support applicable value for startingRB in range of (0..*maxNrofPhysicalResourceBlocks*-1), and applicable values for nrofRBs in range of (24, *maxNrofPhysicalResourceBlocksPlus1*). for TRS/CSI-RS occasion(s) for idle/inactive UEs**.**Proposal 10: Support the following fixed configuration for TRS/CSI-RS occasion(s) for idle/inactive UEs**:* **nrofPorts of 1,**
* **no cdm-type**
* **density of three**

**Proposal 11: Support periodicityAndOffset with applicable values of {4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 160, 320, 640} slots for TRS/CSI-RS occasion(s) for idle/inactive UEs.****Proposal 12: QCL information is provided per RS resource for TRS/CSI-RS occasion(s) for idle/inactive UEs, where the QCL information includes reference signal of a SSB and a qcl-type from { typeA, typeB, typeC, typeD }.**  |
| MediaTek[14] | **Proposal 6: Use Table 1 as the starting point for the discussion of applicable values for TRS configurations.****Table 1: Applicable values for the parameters**

|  |  |
| --- | --- |
| **Parameters** | **Value range** |
| powerControlOffsetSS | {-3, 0, 3, 6} dB |
| scramblingID | 0 to 1023 |
| firstOFDMSymbolInTimeDomain | Limit to {0, 1, …, 9} according to TS38.214 Section 5.1.6.1.1 |
| startingRB | 0 to 274 |
| nrofRBs | 24 to 276 |
| periodocityAndOffset | Limit to {10, 20, 40, 80} according to TS38.214 Section 5.1.6.1.1 |
| qcl-InfoPeriodicCSI-RS | Limit to {0, 1, …, 63} for SSB index |
| frequencyDomainAllocation | The value range can be {0, 1, 2, 3} to indicate the offset of the first RS RE to RE#0 in a RB |

 |
| LG[15] |  |
| Panasonic[16] | **Proposal 3: Supported number of TRS configurations in SIB should be minimized, for both operations with and without beam sweeping.** |
| Nokia, Nokia Shanghai Bell[17] | **Proposal: The configuration of TRS to the IDLE/INACTIVE mode UEs needs to support independent configuration for each broadcast/SSB beam.****Proposal:** W**hen 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):*** **‘firstOFDMSymbolInTimeDomain’ would need to be provided only once for symbols in a slot, and location of the second symbol can be derived from it.**
	+ **Note: if number of consecutive slots (1 or 2) is indicated separetly, in case of two (consecutive) slots, the symbol locations are same in both slots.**
* **’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 slots and only periods of {10,20,40,80} slots need to be supported.**

**Proposal:** **Configure the QCL information for each RS resource for IDLE/INACTIVE mode explicitely e.g. via SSB index.**  |
| Xiaomi[18] | ***Proposal 1: The QCL*** ***information configuration of TRS/CSI-RS occasion(s) associated with SSB indices for idle/inactive UEs should be supported.*** |
| Sharp[19] | **Proposal 1: The NZP-CSI-RS-Resource configuration for power-saving needs reconstruction to accommodate the size limitation of SIB****Proposal 2: SSB index could be used as QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs** |
| NTT DOCOMO, INC[20] | **Proposal 3: The common configuration parameter per RS resource set, or group of sets should be supported to reduce configuration overhead by SIB.** |
| InterDigital, Inc.[21] |  |
| Lenovo, Motorola Mobility[22] | **Proposal 1: Support following methods to reduce the TRS configuration signalling overhead:*** **Predefine or fix a part of TRS parameters in specification**
* **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**

**Observation 2: QCL indication methods in Rel-15/16 NR may not be directly applicable for TRS configured for idle/inactive UEs.****Proposal 2: QCL information for TRS configured for idle/inactive UEs is indicated per TRS resource set.****Proposal 3: Consider following QCL indication methods for TRS configured for idle/inactive UEs:** * **Alt 1: based on TRS resource set ID**
* **Alt 2: based on a bitmap of a length same as the maximum number of SSBs per half frame. Each configured TRS resource set is sequentially mapped to a bit with value ‘1’ and a corresponding SSB index.**
* **Alt 3: based on a SSB index provided in the configuration.**

**Proposal 4: Support following TRS transmission modes:*** **Mode 1: UE may assume that TRS are present on all configured TRS occasions**
* **Mode 2: UE shall further check availability of TRS on configured TRS occasions**
 |
| Ericsson[23] |  [Proposal 6 QCL information of TRS occasions (provided to idle/inactive UEs) should be associated with SSB indices.](#_Toc71665178)[Proposal 7 In cases where there is no SI size limitation, support reuse of existing periodic TRS configuration(s) for TRS occasion provisioning.](#_Toc71665179)[Proposal 8 In cases where resulting SIB size is deemed excessive, support grouping of common parameters within a TRS resource set, and across configured TRS resource sets.](#_Toc71665180)[a. Details FFS (E.g. such as frequencyDomainAllocation, nrofRBs, and startingRB).](#_Toc71665181) |
| Nordic Semiconductor ASA[24] | ***Proposal-1:*** *TRS are configured 5ms or 10ms before paging frame/half-frame.* * *supported periodicities are thus 5ms (half-frame) and 10ms (frame)*

***Proposal-3:*** *iTRS shall overlap with* * *All RBs of 24- and 48-RB CORESET#0*
* *48 contiguous RBs of 96-RB CORESET#0*

***Proposal-4:*** *TCI-state ID points to a SS/PBCH block index only [0-63].* * *UE assumes QCL-TypeC' with the SS/PBCH block and, when applicable, 'QCL-TypeD' with the same SS/PBCH block*

***Proposal-5:*** *For iTRS, support configuration of row1 of frequencyDomainAllocation* ***Proposal-6:*** *After all parameters necessary for iTRS are identified, study further how to reduce configuration overhead for iTRS resources.* |

## First round discussion

Based on the contributions submitted in RAN1#105b-e, the proposals regarding configuration details of TRS/CSI-RS occasion(s) for idle/inactive UEs can be categorized into five aspects

* Applicable values for supported parameters
* Other parameters
* Details of QCL information
* Methods for configuration overhead reduction

### Issue 2-1: Applicable values for supported parameters

The proposals regarding applicable values for supported parameters are summarized as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **powerControlOffsetSS** | **scramblingID** | **firstOFDMSymbolInTimeDomain** | **startingRB** | **nrofRBs,** |
| ZTE | {-3, 0, 3, 6} | . 0 to 1023 | 0 to 9 | (24..maxNrofPhysicalResourceBlocksPlus1) |  |
| Huawei, HiSilicon | same range of that for CONNECTED mode | same range of that for CONNECTED mode | same range of that for CONNECTED mode | same range of that for CONNECTED mode | same range of that for CONNECTED mode |
| Apple | {-3, 0, 3, 6} | 0 to 1023 | 0 to 9 | 0 to 274 | 24 to 276 |
| Samsung  | {-3, 0, 3, 6} | 0 to 1023 | 0 to 13 | 0..maxNrofPhysicalResourceBlocks-1 | 24, maxNrofPhysicalResourceBlocksPlus1 |
| MediaTek | {-3, 0, 3, 6} dB | 0 to 1023 | {0, 1, …, 9} | 0 to 274 | 24 to 276 |

Based on the above views, the following proposal is suggested for further discussion.

**Moderator proposal #7**

**Support applicable values for the following configuration parameters as below.**

* **powerControlOffsetSS: {-3, 0, 3, 6}dB**
* **scramblingID: 0 to 1023**
* **firstOFDMSymbolInTimeDomain: 0 to 9**
* **startingRB: 0 to 274**
* **nrofRBs: 24 to 276**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support** **(Y or N)** | **Comments/Suggestions** |
|  |  |  |
|  |  |  |

### Issue 2-2: Other parameters

There are proposals about other configuration parameters:

|  |  |
| --- | --- |
|  | **Views** |
| **periodicityAndOffset** | * + **Alt1: to support**
	+ Intel
	+ Apple, MediaTek, nokia: {10, 20, 40, 80} ms/slots:
	+ Samsung {4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 160, 320, 640} slots
	+ **Alt2: No need to support, TRS occasion in slot-level granularity to be configured relative to PO.**
	+ Huawei, HiSilicon, Nordic
 |
| **Repetition** | * + **Yes:** Intel
 |
| **frequencyDomainAllocation** | * + **Yes for row1**
	+ Intel, Nordic,
	+ MediaTek: {0, 1, 2, 3} to indicate the offset of the first RS RE to RE#0 in a RB
 |
| **TRS configuration index** | * + **Yes:** Panasonic, Sony, Apple
 |
| **Parameters assumed to be same as defined by specification TS38.214 for CSI-RS configured with ‘trs-info’, and omitted in the configuration*** ‘**nrofPorts’, ‘cdm-Type’, ‘density’,‘CSI-RS-ResourceMapping’**
 | * + **Supported:** Nokia
 |

Therefore, the following proposal is provided for discussion:

**Discuss whether to support additional configuration parameters of TRS/CSI-RS occasion(s) for idle/inactive UEs, including, and applicable values if supported:**

* **periodicityAndOffset,**
* **repetition**
* **frequencyDomainAllocation**
* **configuration index**
* **parameters assumed to be same as defined by specification TS38.214 for CSI-RS configured with ‘trs-info’, and omitted in the configuration, including**
	+ **‘nrofPorts’, ‘cdm-Type’, ‘density’, ‘CSI-RS-ResourceMapping’**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support****(Y or N)** | **Comments/Suggestions** |
|  |  |  |
|  |  |  |

### Issue 2-3: Details of QCL information

According to the contributions submitted to this meeting, the proposals regarding the details of QCL information are summarized as follows.

|  |  |
| --- | --- |
| **Views** | **Supported companies** |
| QCL information is indicated as an SSB index, e.g. 0-63 | ZTE, Huawei, HiSilicon, CATT, QC, OPPO, Apple, Samsung, MediaTke, Nokia, Xiaomi, sharp, Ericsson, Nordic |
| QCL information configuration of TRS for idle/inactive UE should be configured per CSI-RS resource set. | CATT, Lenovo |
| The configuration of TRS to the IDLE/INACTIVE mode UEs needs to support independent configuration for each broadcast/SSB beam. | Nokia |
| UE assumes QCL-TypeC' with the SS/PBCH block and, when applicable, 'QCL-TypeD' with the same SS/PBCH block  | Nordic |

According to the above views, the following proposal is suggested for further discussion.

**Moderator proposal #8**

**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**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Support****(Y or N)** | **Comments/Suggestions** |
|  |  |  |
|  |  |  |

### Issue 2-4: Methods for configuration overhead reduction

According to the contributions submitted to this meeting, the following alternatives are proposed to reduce configuration overhead for TRS/CSI-RS occasion(s) for idle/inactive UEs.

|  |  |
| --- | --- |
| **Alternative** | **Supported companies** |
| Alt1:.The common configuration parameter per RS resource set, or group of sets | Huawei, HiSilicon, nokia, Docomo, Ericsson  |
| 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 | Lenovo |
| Alt4: Number of RS resources/configurations be minimized | Panosonic |
| Alt5: Configure TRS/CSI-RS SMTC, e.g. similar as SMTC for mobility | TCL |
| Alt6: TRS/CSI-RS configuration for Idle/Inactive mode should be associated with SSB/paging occasion(s)  | CATT |

Therefore, it’s suggested to discuss all potential alternatives for configuration overhead reduction and down-select if possible.

**Discuss the following alternatives to reduce configuration overhead for TRS/CSI-RS at the configured occasion(s) to the idle/inactive UE**

**To reduce configuration overhead for TRS/CSI-RS occasion(s) for idle/inactive UEs, one or more of the following alternatives can be supported:**

* **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)**

Please provide the detailed views in the following table.

|  |  |  |
| --- | --- | --- |
| **Company**  | **Alternative to support** | **Comments** |
|  |  |  |
|  |  | . |

## First round discussion summary

# Topic #3: Others

The following proposals in addition to the three topics above are submitted in RAN1#104b-e

|  |  |
| --- | --- |
| ZTE [1] |  |
| Huawei, HiSilicon[2] | 1. ***Send LS to inform RAN2 about the progresses and agreements in RAN1 and trigger the discussion in RAN2 on the issues of signaling design for assistance TRS configuration.***
 |
| TCL Communication Ltd[3] |  |
| Vivo[4] | ***Proposal 4:*** *UE assumes the TRS available before receiving signaling indicating the TRS as NOT available.* |
| Spreadtrum Communications[5] |  |
| CATT[6] | ***Proposal 1: TRS/CRS-RS resource/resource set configuration should meet the requirement of SIB message size limit.******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.*** |
| CMCC[7] |  |
| Qualcomm Incorporated[8] |  |
| OPPO[9] |  |
| Intel[10] |  |
| Apple[11] | **Proposal 6: 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.** |
| Sony[12] | **Proposal 6: In addition to SIB, support TRS/CSI-RS configuration via other high-layer signaling (e.g., dedicated RRC, RRC release message, etc.).**  |
| Samsung[13] | **Proposal 10: Support the following fixed configuration for TRS/CSI-RS occasion(s) for idle/inactive UEs**:* **nrofPorts of 1,**
* **no cdm-type**
* **density of three**
 |
| MediaTek[14] |  |
| LG[15] | **Proposal 3: Study how to handle PDSCH REs overlap with TRS/CSI-RS occasion(s).** |
| Panasonic[16] |  |
| Nokia, Nokia Shanghai Bell[17] |  |
| Xiaomi[18] |  |
| Sharp[19] |  |
| NTT DOCOMO, INC[20] |  |
| InterDigital, Inc.[21] |  |
| Lenovo, Motorola Mobility[22] |  |
| Ericsson[23] |   |
| Nordic Semiconductor ASA[24] | ***Proposal-3:*** *iTRS shall overlap with* * *All RBs of 24- and 48-RB CORESET#0*
* *48 contiguous RBs of 96-RB CORESET#0*
 |

## First round discussion

In the following table, please provide any suggestions on other topics to be discussed if any.

|  |  |
| --- | --- |
| **Company**  | **Comments** |
|  |  |
|  |  |
|  |  |

# Conclusion

In RAN1#105-e meeting, the following agreements are made.

Companies are encouraged to prepare next meeting to resolve remaining issues, including:

# References

[1] [R1-2104222](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104222.zip) TRS for RRC idle and inactive UEs ZTE, Sanechips

[2] [R1-2104252](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104252.zip) Assistance RS occasions for IDLE/inactive mode Huawei, HiSilicon

[3] [R1-2104308](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104308.zip) TRS/CSI-RS occasions for idle/inactive UE TCL Communication Ltd.

[4] [R1-2104372](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104372.zip) TRS/CSI-RS occasion(s) for idle/inactive UEs vivo

[5] [R1-2104433](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104433.zip) Consideration on TRS/CSI-RS occasion(s) for idle/inactive UEs Spreadtrum Communications

[6] [R1-2104533](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104533.zip) Configuration of TRS/CSI-RS for paging enhancement CATT

[7] [R1-2104623](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104623.zip) Discussion on TRS/CSI-RS occasion(s) for IDLE/INACTIVE-mode UEs CMCC

[8] [R1-2104683](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104683.zip) TRS/CSI-RS for idle/inactive UE power saving Qualcomm Incorporated

[9] [R1-2104788](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104788.zip) Further discussion on RS occasion for idle/inactive UEs OPPO

[10] [R1-2104917](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104917.zip) Discussion on TRS/CSI-RS Design in idle/inactive mode Intel Corporation

[11] [R1-2105117](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105117.zip) Indication of TRS configurations for idle/inactive-mode UE power saving Apple

[12] [R1-2105175](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105175.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs Sony

[13] [R1-2105322](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105322.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs Samsung

[14] [R1-2105387](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105387.zip) On TRS/CSI-RS occasion(s) for idle/inactive mode UE power saving MediaTek Inc.

[15] [R1-2105435](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105435.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs LG Electronics

[16] [R1-2105475](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105475.zip) Potential enhancements for TRS/CSI-RS occasion(s) for idle/inactive UEs Panasonic

[17] [R1-2105506](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105506.zip) On RS information to IDLE/Inactive mode Ues Nokia, Nokia Shanghai Bell

[18] [R1-2105574](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105574.zip) On TRS/CSI-RS configuration and indication for idle/inactive UEs Xiaomi

[19] [R1-2105639](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105639.zip) Discussion on TRS/CSI-RS occasions for idle/inactive UEs Sharp

[20] [R1-2105709](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105709.zip) Discussion on TRS CSI-RS occasion for idleinactive UEs NTT DOCOMO, INC.

[21] [R1-2105743](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105743.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs InterDigital, Inc.

[22] [R1-2105771](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105771.zip) Provision of TRS/CSI-RS for idle/inactive UEs Lenovo, Motorola Mobility

[23] [R1-2105792](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105792.zip) Provisioning of TRS occasions to Idle/Inactive UEs Ericsson

[24] [R1-2105887](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105887.zip) On TRS design for idle/inactive UEs Nordic Semiconductor ASA

# Summary of Agreements

## RAN1#102-e

|  |
| --- |
| 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

|  |
| --- |
| 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

|  |
| --- |
| 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

|  |
| --- |
| 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 4/19Agreement: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
 |