3GPP TSG-RAN WG2 Meeting #116bis-e R2-220xxxx

**Online, 17th Jan – 25th Jan 2022**

Source: CATT

Title: Report of [AT116bis-e][055][ePowSav] TRS/CSI-RS for idle/inactive

Agenda Item: 8.9.2.2

Document for: Discussion and Decision

# Introduction

This contribution provides a summary of the following offline:

* [AT116bis-e][055][ePowSav] TRS/CSI-RS for idle/inactive (CATT)

Scope: Based on on-line agreements, attempt further progress off-line

Intended outcome: Report, with Agreements (and-or Open Issues).

Deadline: Tue W2.

# Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| --- | --- | --- |
| **Company** | **Name** | **Email Address** |
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# Discussion

In the GTW session on ePowSav, the following agreements were achieved:

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| * The number of bits N in the bitmap used for L1 availability indication is derived implicitly from the number of different values of *indBitID*. There is no need for an explicit parameter. * RAN2 confirm TRS/CSI-RS can be applied to eDRX UEs. * Confirm that there will be no particular mechanism for availability indication based on SIB (beyond the presence of the RS configuration) |

## TRS/CSI-RS availability indication

### Support of SIB-based indication of TRS/CSI-RS availability

The following FFS was left after RAN2#116-e post meeting offline discussion [077] on 38.304 Running CR (vivo).

Editor’s NOTE: FFS on 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.

Companies’ views are summarized in the table below and discussed further down [13]:

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| --- | --- |
| Source | Related proposals |
| Xiaomi [2] | Proposal 2 The TRS/CSI-RS availability is assumed to be ‘unavailable’ when UE has not received the TRS/CSI-RS availability indication upon getting the TRS/CSI-RS configuration. |
| vivo [3] | Proposal 4: The legacy SI update procedure can be reused if SIB based availability is supported.  Proposal 5: FFS how to monitor the TRS occasion when both L1 based availability and SIB based availability are supported. |
| ZTE [5] | Proposal 1: RAN 2 need wait for RAN1’s conclusion on their working assumption to decide whether SIB based availability indication for TRS resources shall be introduced or not. |
| CATT [7] | “Clearly, the presence/absence of a TRS/CSI-RS resource set is already implicitly supported by configuring only the available sets in the *trs-resourceSetlist*.” |
| LG Electronics Inc. [8] | Observation 1 Since the SI update is subject to the SI modification period, if the TRS/CSI-RS availability is indicated via SIB when the TRS/CSI-RS becomes available, the power saving using TRS/CSI-RS would be delayed until next SI modification period.  Proposal 1 Do not support the SIB based TRS/CSI-RS availability indication. |
| Nokia [12] | Proposal 3: Support providing static TRS availability configuration in system information, e.g. in a form of a time table. |

vivo supports SIB-based indication of TRS/CSI-RS availability, justified by the earlier RAN2 agreement that the legacy procedure shall be reused for updating the configuration of the TRS/CSI-RS, that is, once it is configured, assuming a TRS/CSI-RS is present is the normal behaviour of the legacy SI update procedure: “In our view, SIB based signaling for availability information can be achieved by legacy SI update procedure. When the new SIB-X contains idle/inactive TRS configuration(s), it means idle/inactive TRS is always valid and the supporting UEs may monitor the corresponding TRS occasions. If the network wants to disable the validity of idle/inactive TRS configuration, it could send paging to notify SI change, when UEs receives the updated SIB-X in which the idle/inactive TRS configuration is absent, it won’t monitor the idle/inactive TRS occasions”. This understanding is also captured by CATT in [7].

LGE has opposite view, arguing that “if the TRS/CSI-RS availability is indicated via SIB, network first needs to transmit the SI change notification to inform UE of that the SI will be updated at the next modification period, and then UE can receive the updated SI including the TRS/CSI-RS availability indication at the next modification period. Therefore, when the TRS/CSI-RS becomes ‘available’ from ‘unavailable’, UE cannot use the TRS/CSI-RS until the next modification period.”

Alternately, Nokia proposes to provide some static TRS availability configuration in system information, e.g. in a form of a time table, which then does not require any SI change notification to inform on the presence/absence of the TRS/CSI-RS.

ZTE [5] prefer to leave it to RAN1 to decide.

Now considering L1-based TRS/CSI-RS availability indication, vivo wonders how both schemes (L1-based and SIB-based) can work together (Proposal 5). For example, Xiaomi [2] raises the point of a UE acquiring a TRS/CSI-RS configuration in SIB-X without (yet) receiving the associated L1-based availability indication, e.g. upon cell selection (at power on), cell-reselection, or return from out of coverage. Xiaomi suggests that the default state of a TRS/CSI-RS configuration should be “unavailable”, arguing that if the UE missed a L1-based availability indication, it is safer to assume that the TRS/CSI-RS is absent in that case. But then, if the default status of a configured TRS/CSI-RS is “unavailable”, the simple legacy SIB mechanism cannot be reused to indicate if a configured TRS/CSI-RS is available or not.

Then in RAN2#116bis-e GTW online session we had the following agreement:

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| * Confirm that there will be no particular mechanism for availability indication based on SIB (beyond the presence of the RS configuration) |

After such agreement, it is Rapporteur’s understanding that proposals involving improvements for SIB-based availability indication e.g. in [12] are no longer pursued.

However, the issue raised in above contributions [2][3] on the default state (available/unavailable) of a TRS/CSI-RS configuration after a UE acquired SIB-X still needs to be resolved. As discussed in the summary [13], this may depend on whether L1 based availability indication is enabled/disabled.

As a recall, in RAN1#106bis-e meeting, the following working assumption was made:

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| **Working Assumption**  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration. |

As far as we know, RAN1 has still not confirmed/infirmed this WA so far, and Rapporteur suggests checking RAN2’s view about it in Section 3.1.3. In the meantime, to be exhaustive, Rapporteur proposes to consider both options (confirmed/infirmed) when discussing the above default state issue, which may also help concluding the L1 based availability indication issue.

Therefore, starting with the case where the L1-based availability indication is disabled, it seems straightforward in that case that the legacy SIB-based availability applies, i.e. the default state of a TRS/CSI-RS configuration included in SIB-x is “available”.

**Q1: If the L1-based availability indication is disabled, do you confirm the default state of a TRS/CSI-RS configuration included in SIB-x is “available”**

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| **Company** | **Yes/No** | **Comments** |
| CATT | Yes | This is the baseline and legacy behavior of a SIB configuration |
| Qualcomm | Yes | Agree with CATT |
| OPPO | No | According to RAN1 agreements, L1-based availability indication comes together with the TRS/CSI-RS configuration. We don’t need to discuss the case for L1-based availability indication being disabled. |
| Intel | No | Our understanding is that the above RAN1 WA will be confirmed. |
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**Summary**:

Then, the question is less obvious in case either the RAN1 WA is confirmed or the L1-based availability indication is enabled by configuration. As described in [2], a UE may acquire SIB-X and get aware of a TRS/CSI-RS configuration without receiving the associated L1-based availability mechanism, e.g. upon cell selection (e.g. upon power on), cell-reselection, or when returning from out of coverage. The question is then: should it assume the TRS/CSI-RS available or unavailable until it receives a corresponding L1-based availability indication?

**Q2: If the L1-based availability indication is enabled (or RAN1 WA is confirmed), should a UE which acquired SIB-X with a TRS/CSI-RS configuration but didn’t yet receive an associated L1-based availability indication, consider the configured TRS/CSI-RS as “unavailable” or “available”?**

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| **Company** | **Available/unavailable** | **Comments** |
| CATT | Unavailable | We agree with Xiaomi’s argument that the UE that acquired SIB-X may not have received the L1 availability indication yet, in which case the default behavior should be to consider that it is unavailable, waiting for the (next) L1 availability indication. |
| Qualcomm | Unavailable | If L1-based availability indication is configured/enabled, then SIB-X only provides configuration information and does not imply availability. Otherwise, we may run into the problem of mismatched indication between SIB and L1 indication. |
| OPPO | Unavailable | Agree with Qualcomm. |
| Intel | Unavailable |  |
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**Summary**:

### Support of unicast indication of TRS/CSI-RS availability

In [3] vivo suggests that the TRS/CSI-RS availability in Idle/Inactive can also be indicated when releasing the UE to Idle/Inactive. Arguing this can save unnecessary paging the UE to indicate the unavailability via L1-based indication. Note that RAN2 already had the following agreement, however the present proposal is not, in principle, conflicting with it as it does not discuss using dedicated signalling to carry additional TRS/CSI-RS configuration, but instead to carry availability information.

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| * R2 assumes that additional TRS/CSI-RS configuration by dedicated signalling is not supported. Can revisit e.g. based on R1 provided info if needed. |

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| Source | Related proposals |
| vivo[3] | Proposal 6: Potential options on dedicated signalling based availability are taken into account:  Option 1: *RRCRelease* message configures the availability information.  Option 2: *RRCRelease* message indicates the availability of the TRS configurations in connected mode. |

Rapporteur suggests checking companies’ views on this proposal:

**Q3: Is there a need to indicate the TRS/CSI-RS availability in Idle/Inactive when releasing the UE to Idle/Inactive in the *RRCRelease message*?**

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| **Company** | **Yes/No** | **Comments** |
| CATT | No | We think this is an optimization not essential at this late stage. |
| Qualcomm | No | Has limited use; relevant only for stationary UEs |
| OPPO | No | No need to consider this. |
| Intel | No | We see this as not essential |
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**Summary**:

### Enabling / disabling of the TRS/CSI-RS L1 based availability mechanism by broadcast signalling

In last RAN2 e-meeting, it was agreed:

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| * RAN2 assumes to support current RAN1 working agreement of L1 based signalling for TRS/CSI-RS availability indication. FFS whether it should be possible to enable / disable the TRS/CSI-RS L1 based availability mechanism by broadcast signalling. |

Companies’ views are summarized in the table below [13]:

|  |  |
| --- | --- |
| Source | Related proposals |
| vivo [3] | Proposal 3: If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration. |
| CATT [7] | Proposal 2: TRS/CSI-RS L1 based availability mechanism is enabled/disabled via broadcast signaling.  Proposal 3: RAN2 to choose, for RRC control of the TRS/CSI-RS L1 based availability mechanism, among:  • at cell level (in SIBx-r17)  • at TRS/CSI-RS resource set level (by making indBitID optional in TRS-ResourceSetConfig-r17) |
| LG Electronics Inc. [8] | Proposal 2 Do not support enabling/disabling the L1 based TRS/CSI-RS availability indication. |
| Nokia [12] | Proposal 1: It is possible to enable / disable the TRS/CSI-RS L1 based availability mechanism by broadcast signalling.  Proposal 2: TRS/CSI-RS configuration can be utilized by the UE without TRS/CSI-RS L1 based availability mechanism. |

Some companies [3][5] raise the point that in RAN1#106bis-e meeting, the following working assumption has been made:

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| **Working Assumption**  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration. |

They think RAN2 should keep in line with RAN1, hence they prefer not to introduce another explicit bit in SIB to enable the L1 based availability. But in [7][12] it is proposed to support enabling/disabling of the TRS/CSI-RS L1 based availability mechanism via broadcast signaling, arguing that this L1 based mechanism might be justified by the need to support both frequent and fast availability updates for some critical scenarios, but for scenarios where it is not needed, the network should not be mandated to make use of it if the broadcast signaling is sufficient. Considering there are different views and there are some concerns raised in last RAN2#116 e-meeting, and as mention in Section 3.1.1, RAN1 has still not confirmed/infirmed this WA so far, Rapporteur suggests checking RAN2’s view about it, with the following options:

* Option 1: Support enabling / disabling the TRS/CSI-RS L1 based availability mechanism by broadcast signaling (e.g. two stage-3 options are proposed in [7])
* Option 2: Not support enabling / disabling the TRS/CSI-RS L1 based availability mechanism by broadcast signaling (i.e. follow RAN1’s WA)
* Option 3: Wait for RAN1’s conclusion

**Q4: Which of the above option do you support?**

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| **Company** | **Option #** | **Comments** |
| CATT | 1 | After we agreed that the baseline and legacy SIB-based availability mechanism still holds, we think there is no reason to prevent from configuring the system to fall back to this simple way of configuring/enabling the TRS/CSI-RS for all cases where NW considers the L1-based availability indication is neither helpful nor necessary. |
| Qualcomm | 2 | Option 2 is more robust. |
| OPPO | 2 |  |
| Intel | 2 or 3 | We should follow the RAN1 working assumption. It is most likely that it will be confirmed this meeting. |
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**Summary**:

## TRS/CSI-RS and eDRX UEs

In RAN2#116bis-e GTW online session we had the following agreement:

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| * RAN2 confirm TRS/CSI-RS can be applied to eDRX UEs. |

Then [13] CATT [7] shows that a TRS/CSI-RS configuration update may require up to ~6 hours delay for all (DRX and eDRX) Idle/Inactive UEs in a cell to cope with largest agreed eDRX acquisition period (1024 H-SFN). However, there are different views whether this is a problem and how to resolve the problem and companies’ views are provided in the table below:

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| --- | --- |
| Source | Related proposals |
| OPPO [1] | Proposal 2: Do not introduce separate TRS/CSI-RS configuration in SIB for eDRX UEs, i.e., the same TRS/CSI-RS configuration is broadcasted for eDRX UEs and DRX UEs.  Proposal 3: Introduce separate TRS/CSI-RS availability indication for eDRX UEs.  Proposal 4: Send LS to RAN1 and ask RAN1 to work on the separate TRS/CSI-RS availability indication for eDRX UEs. |
| Xiaomi [2] | Proposal 3: The TRS/CSI-RS availability is assumed to be ‘unavailable’ when e-DRX UE missed the TRS/CSI-RS availability indication.  Proposal 4: The TRS/CSI-RS availability is assumed to be ‘unavailable’ for all the TRS resource set group(s) upon getting the TRS/CSI-RS configuration modification. |
| Sharp [6] | The UE can check *systemInfoModification* by monitoring UE’s paging occasions and update TRS/CSI-RS configuration based on the SI modification method for legacy DRX during PTW. And the UE can also check the validity of TRS/CSI-RS configuration before measuring TRS/CSI-RS  Proposal 2: RAN2 to discuss the methods which have no impacts on RAN1 for TRS/CSI-RS configuration modification for eDRX. |
| CATT [7] | Proposal 6: RAN2 to down-select a solution among:   * Separate TRS/CSI-RS resources for eDRX and DRX * Indicate whether current available TRS/CSI-RS is applicable to eDRX UEs. This can be via:   + Extending the use of the RAN1-agreed L1 availability indicator   + Using the reserved bit in the Short Message * eDRX UEs cannot use TRS/CSI-RS from the time they receive change notification for eDRX UEs to the time they receive the updated SI |
| LGE [8] | Observation 2 The problem that UE configured with eDRX uses outdated TRS/CSI-RS configuration doesn’t happen very often and can be solved by NW implementation.  Proposal 3 Do not specify the standardized solution to solve the problem that eDRX UE uses outdated TRS/CSI-RS configuration. |

In summary the possible options are:

* Option 1: No need to introduce standardized solution for TRS/CRI-RS for eDRX UEs [8]
* Option 2: Separate TRS/CSI-RS resources for eDRX and DRX [7]
* Option 3: Use separate TRS/CSI-RS availability indications for DRX and eDRX UEs
  + Option 3-a: Extending the use of the RAN1-agreed L1 availability indicator [1][7]
  + Option 3-b: Using a reserved bit in the Short Message [7]
* Option 4: eDRX UEs cannot use TRS/CSI-RS from the time they receive change notification for eDRX UEs to the time they receive the updated SI [2][7]
* Option 5: The UE can check *systemInfoModification* by monitoring UE’s paging occasions and update TRS/CSI-RS configuration based on the SI modification method for legacy DRX during PTW. And the UE can also check the validity of TRS/CSI-RS configuration before measuring TRS/CSI-RS [6].

Rapporteur suggests checking companies’ views on the various options discussed above:

**Q5: Which of the above option do you support?**

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| **Company** | **Option(s) #** | **Comments** |
| CATT | In preferred order:  3, 4, 2 | We think option 1 is overkill considering the huge delay.  Option 2 is the most flexible but also very resource-hungry and would require checking with RAN1.  Options 3-b and 4 do not require RAN1 involvement but the benefit of option 3 is that eDRX UEs can be told to ignore the TRS/CSI-RS only when the TRS/CSI-RS configuration change, whereas with option 4, any SI change notification (also for any other SIB but SIB-X) would prevent the eDRX UEs to use the TRS/CSI-RS.  Option 5 would require changing the basic principle of SI change for eDRX UEs (based on the *systemInfoModification-eDRX*) so we prefer to avoid this. |
| Qualcomm | Option 1 | Use of TRS/CSI-RS in RRC Idle/Inactive is optional and up to UE implementation. There is no need to specify normative behaviors for UE |
| OPPO | Option 3 | As we know, for eDRX UEs, an eDRX acquisition period is defined, and eDRX UEs use the eDRX acquisition period to acquire SI. This means that eDRX UEs may not track the exact SI change timely. Even though eDRX UEs may maintain different SI content than those DRX UEs, only one set of SI is broadcasted in the cell. We think this principle should be kept when considering TRS/CSI-RS applicable for eDRX UEs. So in our view, the same TRS/CSI-RS configuration can be used for eDRX UEs and DRX UEs.  To make TRS/CSI-RS work for idle mode UEs, network still needs to send availability indication. In current RAN1 design, TRS/CSI-RS availability indication is based on the latest TRS/CSI-RS configuration for DRX UEs. Even though a single set of TRS/CSI-RS configuration is broadcasted in the cell for eDRX UEs and DRX UEs, due to the long eDRX acquisition period, eDRX UEs may store different version of TRS/CSI-RS configuration than DRX UEs. This means that network cannot reuse the same availability indication for eDRX UEs, and should use a separate availability indication. So far, only L1-based availability indication is considered in RAN1 and therefore this new indication requires RAN1’s work. |
| Intel | Option 1 or 4 | Options 1 or 4 seems sufficient to us since the change of TRS/CSI-RS configuration should be quite rare. |
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**Summary**:

## Sizing and segmentation of new SIB-X

In last RAN2 e-meeting, it was agreed:

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| * RAN2 to wait for additional RAN1 feedback, before finalizing aspects on SIB-X sizing, segmentation etc. |

After RAN1#107-e, some progress was made in RAN1 on the SIB-X parameters, although there are still FFS to be finalized e.g. it is FFS if *scramblingID* is per TRS resource set, or per TRS resource. However some preliminary sizing is already possible. Companies’ views are summarized in the table below:

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| --- | --- |
| Source | Related proposals |
| vivo [3] | Proposal 1: Segmentation of the new SIB is needed.  Proposal 2: If scramblingID is per TRS resource set, then the TRS information only has common part. If scramblingID is per TRS resource, then the TRS information can be split common part and dedicated part. |
| Apple [4] | Observation 1: Based on the current sizing requirements, each TRS resource set needs at a very minimum 53 bits, excluding any future additional signalling overheads.  Observation 2: For 64 TRS resource sets (one resource set per beam for 64 beams), this amounts to 3392 bits  Observation 3: Physical layer limitation limits the maximum TBS of PDSCH assigned by a PDCCH with CRC scrambled by SI-RNTI to 2976 bits  Proposal 1: RAN2 to check the sizing aspect as described above and consider potential Segmentation aspect for SIB-X  Proposal 2: Define a hard segmentation mechanism for the newly proposed SIB-X. |

Considering current bits for TRS/CSI-RS configurations are not much bigger than the limitation for SI and it should be careful to introduce SI segmentation, we can send our concern to RAN1 and ask RAN1 to consider it. Therefore Rapporteur suggests discussing the following options:

* Option 1: Wait for additional RAN1 feedback, before finalizing aspects on SIB-X sizing, segmentation etc.
* Option 2: Decide now that segmentation of the new SIB is needed, or
* Option 3: Send RAN1 our concern on segmentation of SIB-x of TRS/CSI-RS for idle/inactive UEs and ask RAN1 to avoid it as much as possible.

Rapporteur suggests checking companies’ views on the various options discussed above:

**Q6: Which of the above option do you support?**

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| **Company** | **Option #** | **Comments** |
| CATT | 3 | We think we should always try to avoid segmenting SIBs and should check again with RAN1 first. |
| Qualcomm | Either 1 or 3 |  |
| OPPO | 3 |  |
| Intel | 3 | RAN1 is further discussing how to keep the size in check. Hence it would be good to check with RAN1. |
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**Summary**:

## Others [13]

### Dedicated signaling for additional TRS/CSI-RS configuration

Companies’ views are summarized in the table below:

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| Source | Related proposals |
| Ericsson[8] | Proposal 2: Dedicated signalling to provision TRS occasions to idle/inactive UEs is not supported in Rel-17. |

The issue was discussed in several meetings. And in last RAN2 e-meeting, it was agreed:

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| * R2 assumes that additional TRS/CSI-RS configuration by dedicated signalling is not supported. Can revisit e.g. based on R1 provided info if needed. |

Rapporteur thinks we don’t need to re-discuss it again.

### On-demand SI related improvements

The following was agreed in RAN2#116-e:

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| * The new SIB-X can be made on demand, and it is up to NW configuration. * There are no UE side impacts due to any additional NW side restriction on on-demand SIB-X. |

Companies’ inputs on this topic are summarized in the table below:

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| --- | --- |
| Source | Related proposals |
| Ericsson[8] | Proposal 3: Stop broadcasting the new (on-demand) SIB is left to NW implementation. |
| Nokia [12] | Proposal 4: On demand SI request for the SIB with TRS/CSI-RS information is restricted. Details FFS. |

It is Rapporteur’s understanding that Ericsson’s P3 is related to the 2nd agreement above and has no specification impact.

For Nokia’s proposal, the motivation is: “The TRS/CSI-RS configuration is cell specific and therefore a moving RRC Idle/Inactive UE could potentially request the configuration whenever it reselects to a new cell. If the UE is not likely to stay in the new cell for a long time period it would waste system resources (and UE energy) to trigger the on demand request of the SI containing the TRS/CSI-RS configuration”. It is Rapporteur’s understanding that this can be viewed as a specific optimization of the on-demand SI usage for TRS/CSI-RS. It is a new proposal and can be discussed with low priority in later meetings if time permits.

### RAN1-ish

Rapporteur thinks the below proposals belong to RAN1 and should not be discussed in RAN2:

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| Source | Related proposals |
| vivo [3] | Proposal 7: RAN2 to discuss whether TRS is available will impact the PEI-O location. |
| Ericsson [8] | Proposal 1: Which TRS configuration indicated in the new SIB to use is left to UE implementation. |
| Ericsson [8] | Proposal 5: It is up to the NW to configure TRS availability indication only in Paging DCI or PEI or in both. |

### Any urgent other issue

Rapporteur asks companies if there is any other urgent issue that needs to be discussed in this offline.

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| **Company** | **Issue description** |
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# Conclusion

# Reference

1. R2-2200240 , Discussion on TRS/CSI-RS applicability for eDRX UEs, OPPO
2. R2-2200466 , Discussion on TRS CSI-RS for RRC-IDLE and RRC-INACTIVE State UE, Beijing Xiaomi Communications
3. R2-2200593, Discussion on TRS CSI-RS in idle inactive mode, vivo
4. R2-2201204 , R17 NR UE Power Save SIB-X sizing aspects, Apple
5. R2-2201220, Further Consideration on TRS for Idle and Inactive UE, ZTE Corporation,Sanechips
6. R2-2201240, Discussion on TRS/CSI-RS and eDRX, Sharp
7. R2-2201270, TRS/CSI-RS for idle/inactive: leftover issues, CATT
8. R2-2201307, Discussion on TRS/CSI-RS for idle/inactive, LG Electronics Finland
9. R2-2201556, TRS exposure, Ericsson
10. R2-2200095 LS on updated Rel-17 LTE and NR higher-layers parameter list; RAN1
11. R2-2200091, LS on updated Rel-17 RAN1 UE features list for NR, RAN1
12. R2-2201497, Potential TRS/CSI-RS occasion(s), Nokia, Nokia Shanghai Bell
13. R2-2201677 Summary of 8.9.2.2 TRS/CSI-RS for idle/inactive (CATT)