3GPP TSG-RAN WG2 Meeting #116bis-e R2-22xxxx

**Online, 17th Jan – 25th Jan 2022**

Source: CATT

Title: Summary of 8.9.2.2 TRS/CSI-RS for idle/inactive (CATT)

Agenda Item: 8.9.2.2

Document for: Discussion and Decision

# Introduction

This contribution provides a summary of the contributions posted at RAN2#116bis-e under the agenda item 8.9.2.2 and suggests some associated proposals.

# Discussion

## 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:

|  |  |
| --- | --- |
| 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.

In summary, Rapporteur suggests discussing the following points:

**Proposal 1: RAN2 discusses the following points:**

**1) If the L1-based availability indication is enabled,**

**a) should a UE acquiring SIB-X consider a configured TRS/CSI-RS as “unavailable” or “available until it receives a L1-based availability indication?**

**b) should SIB-based availability indication be supported on top of L1-based availability indication?**

**2) If the L1-based availability indication is disabled, confirm the legacy SIB-based availability indication can be reused, i.e. the default state of a TRS/CSI-RS configuration included in SIB-x is “available”**

**3) Should alternate SIB-based approaches be explored e.g. static TRS availability configuration in system information, e.g. in a form of a time table?**

### 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.

|  |
| --- |
| * 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. |

|  |  |  |
| --- | --- | --- |
| Source | Related proposals | |
|  | |  |

**Proposal 2: RAN2 to discuss whether there is a need to indicate the TRS/CSI-RS availability in Idle/Inactive when releasing the UE to Idle/Inactive in the RRCRelease message.-**

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

In last RAN2 e-meeting, it was agreed:

|  |
| --- |
| * 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:

|  |  |
| --- | --- |
| 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:

|  |
| --- |
| **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, we propose that RAN2 continues discussing it further.

**Proposal 3: RAN2 to discuss whether there is a need to enable / disable the TRS/CSI-RS L1 based availability mechanism by broadcast signalling.**

### Explicit parameter or implicit determination of N

According to the updated RAN1 LS [11], a new parameter *indBitID* is introduced to indicate the index of the associated bit in TRS availability indication field in DCI for each TRS resource set. The range of *indBitID* is {0,1, 2, …, N-1}. And there is a NOTE for the parameter:

|  |
| --- |
| • Note: It is left to RAN2 decision on whether explicit parameter is used for N or it can be implicitly determined by the TRS resource set configurations. |

Companies’ views are summarized in the table below:

|  |  |
| --- | --- |
| Source | Related proposals |
| Xiaomi [2] | Proposal 1 The number of bits in the TRS/CSI-RS availability indication field can be implicitly determined by the number of TRS resource set groups in the configuration by SIB-X. |
| CATT [7] | Proposal 1: 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. |

According to the two tdocs, we propose:

**Proposal 4: 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.**

## TRS/CSI-RS and eDRX UEs

In last meeting, the following conclusion was made on TRS/CSI-RS with eDRX.

|  |
| --- |
| =>Postpone further discussion on TRS/CSI-RS applicability for eDRX UEs. Can consider later |

### Applicability of TRS/CSI-RS for eDRX UEs

Clearly the first question is to check if TRS/CSI-RS is applicable to eDRX UEs.

Companies’ views are summarized in the table below:

|  |  |
| --- | --- |
| Source | Related proposals |
| OPPO [1] | Proposal 1 TRS/CRI-RS also apply to eDRX UEs. |
| Xiaomi [2] | “In last meeting, RAN2 also discussed the case that TRS/CSI-RS applying for e-DRX users. We do think that a UE configured with e-DRX can benefit from this.” |
| Sharp[6] | Proposal 1: TRS/CSI for idle/inactive can be used when eDRX for idle/inactive is configured. |
| CATT [7] | Proposal 4: TRS/CSI-RS mechanism should be used for both DRX and eDRX UEs. |

According to the Tdocs, at least companies support TRS/CRI-RS for idle/inactive can be applied to eDRX UEs.

**Proposal 5: RAN2 confirm TRS/CSI-RS for idle/inactive can be applied to eDRX UEs.**

### Solutions enabling TRS/CSI-RS applicability to eDRX UEs

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:

|  |  |
| --- | --- |
| 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 3-1: Extending the use of the RAN1-agreed L1 availability indicator [1][7]

- Option 3-2: 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]

**Proposal 6: RAN2 to discuss which option is adopted when TRS/CRI-RS is applied to eDRX UEs:**

**- Option 1: No need to introduce standardized solution for TRS/CRI-RS for eDRX UEs**

**- Option 2: Separate TRS/CSI-RS resources for eDRX and DRX**

**- Option 3: Use separate TRS/CSI-RS availability indications for DRX and eDRX UEs**

**- Option 3-1: Extending the use of the RAN1-agreed L1 availability indicator**

**- Option 3-2: Using a reserved bit in the Short Message**

**- 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**

**- 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.**

## Sizing and segmentation of new SIB-X

In last RAN2 e-meeting, it was agreed:

|  |
| --- |
| * 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:

|  |  |
| --- | --- |
| 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.

**Proposal 7: RAN2 discuss:**

* **Wait for additional RAN1 feedback, before finalizing aspects on SIB-X sizing, segmentation etc. or**
* **Decide now that segmentation of the new SIB is needed, or**
* **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.**

## Others

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

Companies’ views are summarized in the table below:

|  |  |
| --- | --- |
| 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:

|  |
| --- |
| * 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:

|  |
| --- |
| * 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:

|  |  |
| --- | --- |
| 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:

|  |  |
| --- | --- |
| 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. |

# Conclusion

Below are easier agreements:

**Proposal 4: 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.**

**Proposal 5: RAN2 confirm TRS/CSI-RS can be applied to eDRX UEs.**

Try to agree proposals, may need some discussion:

**Proposal 1: RAN2 discusses the following points:**

**1) If the L1-based availability indication is enabled,**

**a) should a UE acquiring SIB-X consider a configured TRS/CSI-RS as “unavailable” or “available” until it receives a L1-based availability indication?**

**b) should SIB-based availability indication be supported on top of L1-based availability indication?**

**2) If the L1-based availability indication is disabled, confirm the legacy SIB-based availability indication can be reused, i.e. the default state of a TRS/CSI-RS configuration included in SIB-x is “available”**

**3) Should alternate SIB-based approaches be explored e.g. static TRS availability configuration in system information, e.g. in a form of a time table?**

**Proposal 2: RAN2 to discuss whether there is a need to indicate the TRS/CSI-RS availability in Idle/Inactive when releasing the UE to Idle/Inactive in the RRCRelease message.-**

**Proposal 3: RAN2 to discuss whether there is a need to enable / disable the TRS/CSI-RS L1 based availability mechanism by broadcast signalling.**

**Proposal 6: RAN2 to discuss which option is adopted when TRS/CRI-RS is applied to eDRX UEs:**

**- Option 1: No need to introduce standardized solution for TRS/CRI-RS for eDRX UEs**

**- Option 2: Separate TRS/CSI-RS resources for eDRX and DRX**

**- Option 3: Use separate TRS/CSI-RS availability indications for DRX and eDRX UEs**

**- Option 3-1: Extending the use of the RAN1-agreed L1 availability indicator**

**- Option 3-2: Using a reserved bit in the Short Message**

**- 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**

**- 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.**

**Proposal 7: RAN2 discuss:**

* **Wait for additional RAN1 feedback, before finalizing aspects on SIB-X sizing, segmentation etc. or**
* **Decide now that segmentation of the new SIB is needed, or**
* **Send to 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.**

# 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 Mobile Softwar
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)