3GPP TSG-RAN WG2 Meeting #117 R2-220xxxx

**Online, 21st Feb – 3rd Mar 2022**

Source: CATT

Title: Report of [Pre117-e][005][ePowSav] TRS / CSI-RS Open Issues Input (CATT)

Agenda Item: 8.9.3.1

Document for: Discussion and Decision

# Introduction

This contribution provides a summary of the following offline:

* [Pre117-e][005][ePowSav] TRS / CSI-RS Open Issues Input (CATT)

Deadline: Feb 14th, 2359 UTC.

The goal of this offline is to address the TRS/CSI-RS related open issues listed for pre-discussion in [R2-2201785](https://urldefense.com/v3/__https:/www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Inbox/R2-2201785.zip__;!!CTRNKA9wMg0ARbw!1LCy6UrajROmecUESVslqpUuFx0kVUDvl5mQNowCooiZUOP1K6oZNTyB4Rol0gFpZpnwlA$).

# Contact Points

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

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email Address** |
| CATT (Rapporteur) | Pierre Bertrand | pierrebertrand@catt.cn |
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|  |  |  |
|  |  |  |

# Discussion

As background, the following agreements were achieved in RAN2#116bis-e on TRS/CSI-RS::

|  |
| --- |
| * 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) * A UE which acquired SIB-X with a TRS/CSI-RS configuration but didn’t yet receive an associated L1-based availability indication considers the configured TRS/CSI-RS as FFS: “unavailable” or “available”. * R2 doesn't send an LS to R1 on SIB segmentation * [055] Indicating the TRS/CSI-RS availability in Idle/Inactive when releasing the UE to Idle/Inactive in the *RRCRelease* message is not pursued. * [055] RAN2 follows RAN1 agreement that if TRS resource is configured in SIB, L1 based availability indication is always enabled based on that configuration. * [055] RAN2 waits for RAN1 to finalize the contents of SIB-X before finalizing aspects on SIB-X sizing, segmentation etc |

## OI 2.1: RAN2 to confirm TRS/CSI-RS can be applied to eDRX UEs.

Rapporteur is a little confused with this OI, as there was an explicit agreement in last meeting (see above) that this is supported. So Rapporteur simply suggests to skip this OI and to stick to the RAN2 agreement.

## Whether / how to address the delay required for updating a TRS/CSI-RS configuration due to the eDRX acquisition period (1024 H-SFN)

In [14] this issue was discussed and several options were presented for addressing the delay required for updating a TRS/CSI-RS configuration due to the eDRX acquisition period (1024 H-SFN), including doing nothing (option 1). A clear outcome was that Option 2 (Separate TRS/CSI-RS resources for eDRX and DRX) got the least support and should therefore be removed. Then, we are left with 4 options, as listed below:

* Option 1: No need to introduce standardized solution for TRS/CRI-RS for eDRX UEs [8]
* Option 2: Use separate TRS/CSI-RS availability indications for DRX and eDRX UEs
  + Option 2-a: Extending the use of the RAN1-agreed L1 availability indicator [1][7]
  + Option 2-b: Using a reserved bit in the Short Message [7]
* Option 3: 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 4: 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].

*During offline [055] of RAN2#116bis-e, Rapporteur received several questions (offline) on how Option 2 and 3 really solve the problem. Therefore we attempt to clarify Network and UE behaviors with such options:*

RAN1 agreed the *validityDuration* is up to 512 default paging cycles. And a default paging cycle can be up to 256 radio frames. So the *validityDuration* is up to 512\*256\*10ms = 1310 s ~ 22 min. So in practice, an eDRX UE with an eDRX cycle > 22min that would receive a L1-based TRS/CSI-RS activation in its PTW of cycle #k would always consider that the TRS/CSI-RS is not available at the beginning of its next PTW (cycle #k+1). In other words, if TTRS is the *validityDuration* configured in the cell, then the TRS/CSI-RS is useless for such UEs with an eDRX cycle > TTRS (at most 22min), unless of course if it receives a new L1-based availability indication during the PTW (cycle #k+1), which would then be like some kind of re-activation for the rest of this PTW.

Then considering this limitation, the network can reach all concerned eDRX UEs in the first TTRS seconds of an acquisition period and send them either a L1-based TRS/CSI-RS eDRX-specific deactivation command (with Option 2) or only the SI change notification with *systemInfoModification-eDRX* (with Option 3). Following this, NW could send a legacy SI change notification to DRX UEs in the next modification period and apply the changes in the following modification period, which would not affect the eDRX UEs in the rest of the acquisition period. Doing so, the maximum delay of TRS resources (re)configuration for DRX UEs can be reduced to the *validityDuration* of the L1-based TRS/CSI-RS activation. That is at most ~22min instead of ~6hours. To recap, using Option 2 as an example, the following steps would be executed:

* Let’s assume (for simplicity) that the TRS/CSI-RS validity duration (TTRS) was started at the beginning of the eDRX acquisition period #k (for both DRX and eDRX UEs).
* During the eDRX acquisition period #k, the network sends SI change indication to eDRX UEs (*systemInfoModification-eDRX*)
* During the eDRX acquisition period #k, in the interval 0 – TTRS, the network sends eDRX-specific L1-based TRS/CSI-RS availability indication as “unavailable” to eDRX UEs.
* At the end of the interval 0 – TTRS, the network has reached all eDRX UEs with eDRX cycle < TTRS which, then, won’t use the TRS/CSI-RS in their following eDRX cycles of the acquisition period #k.
* Similarly, in absence of reactivation, eDRX UEs with eDRX cycle > TTRS see the TRS/CSI-RS de-facto unavailable in their following eDRX cycles of the acquisition period #k.
* Then, after interval 0 – TTRS (at most 22min), the network can reactivate the TRS/CSI-RS validity duration for DRX UEs with the DRX-specific L1-based availability indication and now send SI change indication to DRX UEs (*systemInfoModification*) in the very next SI modification period and update the TRS/CSI-RS configuration in the next SI modification period.

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

**Q1: Which of the above option do you support?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option(s) #** | **Comments** |
| Nokia, Nokia Shanghai Bell | Option 1 | No need to introduce standardized solution |
| Samsung | Option 1 |  |
| OPPO | Option 2 | 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. |
| Sharp | Option 4 | Suggest to split Option4 into 2 options, since the two parts are not necessary to be used together.  For the first part, the eDRX UE checks systemInfoModification by monitoring paging occasions and updates SIB-X based on the DRX SI modification method during PTW. It is different from legacy eDRX, but is the same as DRX UE.  For the second part, the eDRX UE can verify SIB-X’s validity upon waking up from eDRX to get latest SIB-X and to avoid measurement of unavailable TRS/CSI-RS.  The eDRX UE should not impact DRX UE to receive SI update and L1 availability. If eDRX UE thinks available TRS/CSI-RS occasions are unavailable, power is cost but paging message will not be missed. If eDRX UE thinks unavailable TRS/CSI-RS occasions are available, paging message may be missed. The latter one is use case needs to be solved. |

## OI 2.3: A UE which acquired SIB-X with a TRS/CSI-RS configuration but didn’t yet receive an associated L1-based availability indication considers the configured TRS/CSI-RS as [FFS: “unavailable” or “available”]

RAN1 confirmed that if a TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration. Then, 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 (if any)?

**Q2: Which of the above option (“unavailable” or “available”) do you support?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option(s) #** | **Comments** |
| Nokia, Nokia Shanghai Bell | “unavailable” | TRS/CSI-RS is targeted for CONNECTED mode UEs and IDLE/INACTIVE UEs cannot assume that TRS/CSI-RS is always available when configured. L1-based availability indication indicates whether and how long TRS/CSI-RS is available. This is according to RAN1 agreement: “if a TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration” i.e. L1 based availability indication is always configured together with TRS resource configuration. |
| Samsung | Unavailable |  |
| OPPO | Unavailable |  |
| Sharp | Unavailable |  |

## OI 2.4: Aspects on SIB-X sizing and segmentation: Can segmentation be avoided? If not, how to segment?

In RAN2#116bis e-meeting, it was agreed to wait for for RAN1 to finalize the contents of SIB-X before finalizing aspects on SIB-X sizing, segmentation etc (Section 3). RAN1 sent an updated parameter list in [15] that we took into account for updating the running 38.331 CR, which SIB-X and TRS aspects are provided in Annex, for reference. Based on this, the calculation of the maximum size of SIBx for TRS resource for idle/inactive UEs is shown below.

**Table 1 The size of SIBx for TRS resource for idle/inactive UEs**

|  |  |  |
| --- | --- | --- |
| **Parameters in SIBx** | **Value Range** | **Maximum Field Size (bits)** |
| trs-ResouceSetConfig-r17 | 64(maxNrofTRS-ResourceSets-r17)\*size of TRS-ResourceSetConfig-r17 | 5760(64\*90) |
| **>**TRS-ResourceSetConfig-r17 |  | 90 |
| >> nrofResource-r17 | {2,4} | 1 |
| >> powerControlOffsetSS-r17 | {-3, 0, 3, 6} | 2 |
| >> scramblingID-Info-r17 | scrambling ID of TRS with length of 10 bits.  One or more scrambling IDs is configured for a TRS resource set.  • If a single scrambling ID is configured, it applies to all the TRS resources.  • Otherwise, each TRS resource is provided with a scrambling ID. | 42(2+4\*10) |
| >> firstOFDMSymbolInTimeDomain-r17 | 0 to 9 | 4 |
| >> startingRB-r17 | 0 to 274 | 9 |
| >> nrofRBs-r17 | 24 to 276 | 9 |
| >> ssb-Index-r17 | 0 to 63 | 6 |
| >> periodicityAndOffset-r17 | Reuse the existing structure of CSI-ResourcePeriodicityAndOffset, with periodicity limited to {10, 20, 40, 80} ms. | 9(7+2) |
| >> frequencyDomainAllocation-r17 | {0, 1, 2, 3}. But in running 38.331 CR, the bit string for row1 is reused to indicate the offset of the first RE to RE#0 in a RB. | 4(may be 2) |
| >> indBitID-r17 | INTEGER (0..5) | 3 |
| >>extension marker ("...") |  | 1 |
| validityDuration-r17 | {1, 2, 4, 8, 16, 32, 64, 128, 256,512} | 4 |
| Two optional bits+ the optional field of lateNonCriticalExtension |  | 3 |
| Maximum size of total |  | **5767** |

As the maximum number of TRS resource sets configured by higher layer is 64, the maximum size for SIBx is 5767 bits. However, the maximum SI message size is 2976 bits.

There may be some space to compress the overhead of TRS configuration for idle/inactive UEs. For example:

* The bits for *frequencyDomainAllocation-r17* can be change to 2.
* The overhead for both *startingRB-r17* and *nrofRBs-r17* may be reduced if they can be coded together.
* Could there be some limitation on the number of TRS resource sets (possibly < 64) if each TRS resource is provided with a scrambling ID?

However, considering the large gap to fill to keep within 2976 bits, it seems the segmentation is unavoidable. Thus, we want to invite companies to confirm segmentation of SIBx cannot be avoided.

**Q3: Do you agree that segmentation of SIBx cannot be avoided?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Nokia, Nokia Shanghai Bell | Yes | Segmentation of SIBx cannot be avoided |
| Samsung | Yes |  |
| OPPO | Yes |  |
| Sharp | Yes |  |
|  |  |  |
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Then, we need to further discuss how to segment SIBx.

According to 38.331, segmentation has already been supported in SIB7 (an ETWS secondary notification), SIB8 (a CMAS notification), and SIB12 (NR sidelink communication configuration). With these SIBs, segment type (last segment or not) and segment number are introduced while a container is introduced to include a segment. The following is the structure of SIB12 as an example.

|  |
| --- |
| – *SIB12*  SIB12 contains NR sidelink communication configuration.  ***SIB12* information element**  -- ASN1START  -- TAG-SIB12-START  SIB12-r16 ::= SEQUENCE {  segmentNumber-r16 INTEGER (0..63),  segmentType-r16 ENUMERATED {notLastSegment, lastSegment},  segmentContainer-r16 OCTET STRING  }  SIB12-IEs-r16 ::= SEQUENCE {  sl-ConfigCommonNR-r16 SL-ConfigCommonNR-r16,  lateNonCriticalExtension OCTET STRING OPTIONAL,  ...  }  SL-ConfigCommonNR-r16 ::= SEQUENCE {  sl-FreqInfoList-r16 SEQUENCE (SIZE (1..maxNrofFreqSL-r16)) OF SL-FreqConfigCommon-r16 OPTIONAL, -- Need R  sl-UE-SelectedConfig-r16 SL-UE-SelectedConfig-r16 OPTIONAL, -- Need R  sl-NR-AnchorCarrierFreqList-r16 SL-NR-AnchorCarrierFreqList-r16 OPTIONAL, -- Need R  sl-EUTRA-AnchorCarrierFreqList-r16 SL-EUTRA-AnchorCarrierFreqList-r16 OPTIONAL, -- Need R  sl-RadioBearerConfigList-r16 SEQUENCE (SIZE (1..maxNrofSLRB-r16)) OF SL-RadioBearerConfig-r16 OPTIONAL, -- Need R  sl-RLC-BearerConfigList-r16 SEQUENCE (SIZE (1..maxSL-LCID-r16)) OF SL-RLC-BearerConfig-r16 OPTIONAL, -- Need R  sl-MeasConfigCommon-r16 SL-MeasConfigCommon-r16 OPTIONAL, -- Need R  sl-CSI-Acquisition-r16 ENUMERATED {enabled} OPTIONAL, -- Need R  sl-OffsetDFN-r16 INTEGER (1..1000) OPTIONAL, -- Need R  t400-r16 ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000} OPTIONAL, -- Need R  sl-MaxNumConsecutiveDTX-r16 ENUMERATED {n1, n2, n3, n4, n6, n8, n16, n32} OPTIONAL, -- Need R  sl-SSB-PriorityNR-r16 INTEGER (1..8) OPTIONAL -- Need R  }  SL-NR-AnchorCarrierFreqList-r16 ::= SEQUENCE (SIZE (1..maxFreqSL-NR-r16)) OF ARFCN-ValueNR  SL-EUTRA-AnchorCarrierFreqList-r16 ::= SEQUENCE (SIZE (1..maxFreqSL-EUTRA-r16)) OF ARFCN-ValueEUTRA  -- TAG-SIB12-STOP  -- ASN1STOP |

Rapporteur thinks the similar mechanism can be reused for segment of SIBx, i.e. segment type (last segment or not) and segment number are introduced while a container is introduced to include a segment.

**Q3: In order to support segment of SIBx, Do you agree segment type (last segment or not) and segment number are introduced while a container is introduced to include a segment?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Nokia, Nokia Shanghai Bell |  | No strong view how the segmentation is done. |
| Samsung | Yes | Ok to follow the existing approach |
| OPPO | Yes |  |
| Sharp | Yes |  |

# 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)
14. R2-2201918 Report of [055][ePowSav] TRS CSI-RS for idle inactive
15. R1-2200700 LS on updated Rel-17 NR higher-layers parameter list, RAN WG1

# Reference

#### *SIBx*

SIBx contains configurations of TRS resources for idle/inactive UEs.

Editor’s NOTE: RAN2 to wait for additional RAN1 feedback, before finalizing aspects on SIB-X sizing, segmentation etc.

*SIBx* information element

-- ASN1START

-- TAG-SIBx-START

SIBx-r17 ::= SEQUENCE {

trs-ResouceSetConfig-r17 SEQUENCE (SIZE (1..maxNrofTRS-ResourceSets-r17)) OF TRS-ResourceSet-r17 OPTIONAL, -- Need R

validityDuration-r17 ENUMERATED {1, 2, 4, 8, 16, 32, 64, 128, 256,512} OPTIONAL, -- Need S

lateNonCriticalExtension OCTET STRING OPTIONAL,

...

}

TRS-ResourceSet-r17 ::= SEQUENCE {

powerControlOffsetSS-r17 ENUMERATED{db-3, db0, db3, db6},

scramblingID-Info-r17 CHOICE {

scramblingIDForCommon-r17 ScramblingId,

scramblingIDperResourceListWith2-r17 SEQUENCE (SIZE (2)) OF ScramblingId,

scramblingIDperResourceListWith4-r17 SEQUENCE (SIZE (4)) OF ScramblingId,

...

},

firstOFDMSymbolInTimeDomain-r17 INTEGER (0..9),

startingRB-r17 INTEGER (0..maxNrofPhysicalResourceBlocks-1),

nrofRBs-r17 INTEGER (24..maxNrofPhysicalResourceBlocksPlus1),

ssb-Index-r17 SSB-Index,

periodicityAndOffset-r17 CHOICE {

slots10 INTEGER (0..9),

slots20 INTEGER (0..19),

slots40 INTEGER (0..39),

slots80 INTEGER (0..79)

},

frequencyDomainAllocation-r17 BIT STRING (SIZE (4)),

indBitID-r17 INTEGER (0..5),

nrofResource-r17 ENUMERATED{2,4},

...

}

-- TAG-SIBx-STOP

-- ASN1STOP

| *SIBx* field descriptions |
| --- |
| ***trs-ResouceSetConfig***  RS configuration of TRS occasion(s) for idle/inactive UE(s), in terms of a list of N>=1 NZP TRS resource set(s). The maximum number of TRS resource sets configured by higher layer is 64. If a TRS resource is configured, the L1 based availability indication is always enabled based on that configuration.  Editor Note: FFS: the number of configured TRS resource sets is not larger than the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 |
| ***TRS-ResourceSet***  Common configuration parameters for the TRS resource set. |
| ***validityDuration***  The valid time duration at least for a paging PDCCH based L1 availability indication, time unit is one default paging cycle. When the validity duration is not configured, UE assumes a default time duration to be 2 default paging cycle(s). |

| *TRS-ResourceSet* field descriptions |
| --- |
| ***firstOFDMSymbolInTimeDomain***  The index of the first OFDM symbol in the PRB used for TRS in a slot. The field indicates first symbol in a slot, a second symbol in the same slot can be derived implicitly with symbol index as firstOFDMSymbolInTimeDomain+4. |
| ***frequencyDomainAllocation***  Indicate the offset of the first RE to RE#0 in a RB in row1. |
| ***indBitID***  The index of the associated bit in TRS availability indication field in DCI. Each TRS resource set is configured with an ID i for the association with i-th indication bit in TRS availability indication field in DCI. |
| ***nrofRBs***  Number of PRBs across which corresponding TRS resource spans. |
| ***nrofResource***  Number of TRS resources for a TRS resource set. |
| ***periodicityAndOffset***  Periodicity and slot offset (slot) for periodicTRS. It is used to determine the location of the first slot of TRS resource set. The periodicity value *slots10* corresponds to 10 slots, value *slots20* corresponds to 20 slots, and so on. |
| ***powerControlOffsetSS***  Power offset (dB) of NZP CSI-RS RE to SSS RE. |
| ***scramblingID-Info***  One or more scrambling IDs are configured for a TRS resource set. If a common scrambling ID is configured, it applies to all the TRS resources within the TRS resource set. Otherwise, each TRS resource within the TRS resource set is provided with a scrambling ID. If the number of TRS resources for the TRS resource set is 2, *scramblingIDperResourceListWith2-r17* is configured, while *scramblingIDperResourceListWith4-r17* is configured for the case that the number of TRS resources for the TRS resource set is 4. |
| ***ssb-Index***  Index of reference SSB with which quasi-collocation information is provided as specified in TS 38.214 subclause 5.1.5. |
| ***startingRB***  PRB index where corresponding TRS resource starts in relation to common resource block #0 (CRB#0) on the common resource block grid. |

Editor’s NOTE: A UE which acquired SIB-X with a TRS configuration but didn’t yet receive an associated L1-based availability indication considers the configured TRS as FFS: “unavailable” or “available”