**3GPP TSG RAN WG1 #107-e**  **R1-211XXXX**

**e-Meeting, November 11th – 19th, 2021**

**Agenda Item:** 8.7.1.2

**Source:** Moderator (Samsung)

**Title:**  Second round discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs

**Document for:** Discussion/Decision

# Introduction

This document provides summary of contributions [1-24] submitted to agenda item 8.7.1.2 for RAN1#107-e meeting. According to the proposals in contributions [1-24], the remaining issues for supporting TRS/CSI-RS occasion(s) for idle/inactive UEs can be divided into the following five parts, which are described in Section 2 to 6, respectively:

* Indication content for L1 availability indication
* Validity time for L1 availability indication
* Signaling methods for L1 availability indication
* Higher layer configurations of TRS/CSI-RS occasion(s)
* Others

Per chairman’s instruction, this document will be used for the following email discussion:

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| [107-e-NR-R17-PowSav-02] Email discussion regarding TRS/CSI-RS occasions for idle/inactive UEs – Qiongjie (Samsung)   * 1st check point: November 15 * Final check point: November 19 |

For the first round discussion, companies are required to comment on moderator proposals or questions tagged ‘**[1RD]**’ before 11/12 UTC 16:00**.**

For the second round discussion, please comment on moderator proposals/questions tagged ‘**[2RD]**’ before 11/15, Monday, UTC 21:00**.**

The issues in this document are color coded with High Priority or Medium Priority.

# 2 Indication content for L1 availabity indication

The following were agreed regarding the indication content for L1 based availability indication:

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| From RAN1#106bis-e:  **Agreement**  For L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availabilityinformation for configured RS resources using a bitmap. where each bit indicates whether associated TRS resource(s) are available.   * support L1 availability indication at an occasion can provide availability information RS resources with QCL references not confined to be the same as for the L1 availability indication occasion   + FFS associated TRS resource(s) per bit, e.g. a bit is associated with a TRS resource set   + Bitmap size is up to X bits     - X = [6] for paging PDCCH based L1 availability indication.     - FFS X for PEI DCI based L1 availability indication     - FFS details about how to configure the DCI field: e.g. start and length of bitmap (e.g. explicitly/implicitly configured) * for paging PDCCH based L1 availability indication, support L1 availability indication at an occasion can provide availability information for all configured RS resources   + FFS whether this needs to be supported regardless of the number of beams or for some configured RS resources * FFS: PEI DCI provides L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion * FFS: indication of unavailability |

In contributions [1-24], proposals related to indication content for L1 based availability indication are summarized in table below:

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| Huawei, HiSilicon | **Observation 5: For explicit configuration of association between an indication bit and the TRS resources set(s), it provide gNB with more flexibility with some signalling overhead:**  **Observation 6: Configuring the associated indication bit location in each TRS resource set in TRS-ResourceSetConfig would have smaller signalling overhead.**  **Proposal 6: For association between the indication bit and the configured TRS resource set(s) in TRS-ResourceSetConfig, introduce a parameter in each TRS resource set to indicate the indication bit location in the TRS availability indication field in paging DCI.**  **Proposal 7: It is supported that only the one indication bit, which is associated with the same QCL reference (SSB index) to be present in PEI DCI.**  **- The same association method between SSBs and an indication bit is applied to both paging DCI and PEI**  **Proposal 8: A mask window before the PO is supported, where paging DCI or PEI DCI based availability indication indicates the availability of TRS occasions which coincide the mask windows in the same modification period:**  **- The mask window before each PO is configured by an offset or defined in the specification;**  **- The bit length of the TRS availability indication field is the same as that when the time window is not configured.**  **Observation 8: Based on the agreement in RAN1#104, the availability state of ‘unknown’ is equivalent to ‘unavailable’.**  **Proposal 9: Each bit in the TRS availability indication field indicate ‘available’ or ‘unavailable’ for the associated TRS resource(s).** |
| ZTE,  Sanechips | **Proposal 1: The TRS/CSI-RS sets with different QCL references should be further grouped to reduce the signaling overhead of L1 availability indication.**  **Proposal 2: Each bit in the bitmap is associated with one or more TRS resource sets.**  **Proposal 3: The reserved bits in paging DCI are used for TRS availability indication. The bitmap size can be up to 6 bits.**  **Proposal 4: The TRS availability indication mechanism, bit size, and indication content for paging PDCCH and PEI should be the same.**  **Proposal 5: All the TRS resources should be indicated with L1 TRS availability information regardless of the number of beams.**  **Proposal 7: The length and start of the TRS availability indication can be implicitly derived and there is no need to introduce dedicated parameters.**  **Proposal 8: Indication of unavailability for TRS resource is needed to save network energy and resource overhead.** |
| Vivo | **Proposal 3: The bit field length for L1 availability indication is the number of groups configured for TRS resource set. The number of bits for the bitfield is up to 6, and the location can be**  **- Right after bitfield ‘TB scaling’ in paging DCI, and**  **- Right after ‘paging indication field’ in PEI.** |
| TCL | **Proposal 5: Consider similar bits’ size of paging PDCCH i.e. X = 6 bits for TRS availability indication field in PEI DCI.**  **Proposal 9: Availability of a set/group of multiple TRS/CSI-RS can be indicated in a paging cycle to the UE or group of UE for the next paging cycle, which may reduce the availability indication overhead of L1 signaling.** |
| Spreadtrum | **Proposal 4: For PEI DCI based L1 availability indication, L1 availability indication at an occasion can provide availability information only for RS resources with QCL references to be the same as for the L1 availability indication occasion.**  **Proposal 5: For paging PDCCH based L1 availability indication, the bitmap size is up to 6bits.** |
| CATT | **Proposal 5: 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.** |
| OPPO | **Proposal 3: up to 6 bits can be used in paging DCI.** |
| Sony | **Proposal 2: On paging PDCCH based L1 availability indication, the availability indication can be explicitly informed using one or more of the reserved bits in paging DCI.**  **Proposal 5: For paging PDCCH based L1 availability indication, support that L1 availability indication at an occasion can provide availability information for all configured RS resources and this needs to be supported regardless of the number of beams (e.g, the number of beams for SSB transmission).** |
| Intel | **Proposal 5: Support the following for using bitmap, at least in paging DCI based availability indication**  **• a bit is associated with a TRS resource set**  **• confirm size of bitmap X = 6**  **• Indication of “unavailability”** |
| Xiaomi | **Proposal 4: For L1 availability indication of TRS/CSI-RS, one bit is associated with one TRS resource set.**  **Proposal 6: For both paging DCI and PEI DCI based L1 availability indication of TRS/CSI-RS, bitmap size is 6 for licensed band and 6 or 8 for unlicensed band.**  **Proposal 7: For paging DCI based L1 availability indication of TRS/CSI-RS, bitmap field is located in the reserved bits field. And for PEI DCI based, bitmap field is located just after the subgrouping paging indication field.** |
| CMCC | **Proposal 3. For paging DCI based availability indication, the maximum 6 reserved bits are used to indicate the TRS/CSI-RS availability indication, which 1 bit associated with 1 TRS resource set in the order of configuration in the TRS resource set list.** |
| Panasonic | **Proposal 2: To extend the current agreement to support unavailability indication by the following:**   * **For L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availability and unavailability information for configured RS resources using a bitmap, where each bit indicates whether associated TRS resource(s) are available or not.**   **Proposal 3: If the bitmap length for the L1 TRS availability indication is not shorter than the number of configured TRS resource(s) in SIB, each bit is associated with a TRS resource. Otherwise, each bit corresponds a SIB-configured TRS resource group, whose QCL references are adjacent and associated with the QCL reference of the L1 indication occasion.** |
| Samsung | **Proposal 4: A bit in DCI field for TRS availability indication is associated with N>=1 TRS resource set, where**   * **N can be determined based on on the size of the DCI field, , and the number of configured TRS resource sets, ,** * **the (i+1)th bit is associated with ( +1)th TRS resource sets to ()th TRS resource sets if configured.**   **Proposal 5: The size of DCI field for TRS availability indication, N\_bits, can be configured by SIB with applicable values of 1 to 6.** |
| Apple | **Proposal 4: For paging PDCCH based availability indication, support bitmap-based indication for all the configured TRS resource sets, with one bit per TRS resource set, when there are up to 6 TRS resource sets configured**  **Proposal 5: For paging PDCCH based availability indication, support bitmap-based indication for only the configured TRS resource sets that correspond to the same beam as the paging PDCCH, with one bit per TRS resource set.**  **Proposal 6: For PEI based availability indication, support bitmap-based indication for only the configured TRS resource sets that correspond to the same beam as the paging PDCCH, with one bit per TRS resource set.**  **Proposal 9: 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, with the number being configurable.** |
| InterDigitial | **Proposal 1: One bit in the availability indication is associated to at least one TRS resource set.** |
| Sharp | **Proposal 3: Support bitmaps of up to 6 bits for paging PDCCH based L1 availability indication**  **Proposal 4:** **An indication ID can be introduced for each resource set to associate availability indication bit with CSI-RS resources**  **Proposal 5: Support PEI to provide availability indication for RS resources with QCL references to be the same** |
| LG | **Proposal 2: PEI DCI provides L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion**  **Proposal 3: Support using bits in a short message field in a paging DCI for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.**  **Proposal 4: Support L1 based availability indication at an occasion provides availability information for some configured RS resources.**  **o Allow allocating configured RS resources to each L1 based availability indication at an occasion differently** |
| Ericsson | **Proposal 4 For L1-based TRS availability indication via Paging DCI,**  **a. TRS resource sets can be grouped and there is one bit per group in the bitmap configured for DCI**  **b. A bit value“1” in the bitmap for a group indicates TRS is available for the TRS resources in the group for the configured validity time duration, and a bit value“0” is ‘reserved’**  **c. the bitfield within the DCI is explicitly configured using a start position within the DCI and a length field where length field indicates the number of the configured groups**  **d. Supported number of groups = [1..6]**  **e. When the number of groups is 1, then all configured TRS resources can be belong to the single group.**  **Proposal 5 For L1-based TRS availability indication via Paging DCI,**  **a. Support beam selective TRS availability indication, i.e., if UE detects DCI in a beam X, the availability bitfield in the DCI is associated to a group of beams corresponding to beam X.**  **b. A single bit in the DCI is configured for indicating beam-based grouping availability.**  **c. Beam-based grouping is configured via higher layers**  **Proposal 6 For supporting TRS availability in the PEI DCI, following is supported :**  **a. Configuration of the bitfield within the DCI via a start position within the DCI and a length field - can be different from Paging DCI**  **b. Configuration of validity time**  **c. Reference point is the SFN of the first PF associated with the current DRX cycle where UE receives the indication.**  **d. Configuration of grouping (if explicit) of TRS resource sets - can be different from Paging DCI**  **e. Beam-based grouping – grouping/indication mechanism is same as that for Paging DCI (if configured)** |
| Qualcomm | **Proposal 3: L1 availability indication information provided by PEI is not restricted to RS resources with QCL references to be the same as for the L1 availability indication occasion.**  **Proposal 4: If the number of configured TRS sets is larger than the number of bits (i.e., 6) in the L1 TRS availability indication signal, adopt one of the following two options**  **• Option 1: Network configures groups of TRS resource sets and use one bit in the DCI format for each group of TRS resource sets**  **• Option 2: For TRS resource sets that are not indicated by the L1 TRS availability indication signal, UE expects TRS resources of these TRS resource sets are always available.** |
| MediaTek | **Proposal 4: The bitmap size X of PEI can be same as the paging PDCCH.**  **Proposal 5: PEI DCI provides L1 availability indication information for RS resources with QCL references not confined to be the same as for the L1 availability indication occasion.**  Proposal 6: Due to limited number of reserved bits in paging PDCCH, support to provide the information only for some configured RS resources. |
| Nokia | **Observation: Following last meeting agreements it would seem that L1 availability indication bitmap could indicate availability for associated TRS resource set(s).**  **Proposal: Support network configurable association between L1 availability bits and TRS resource set(s).**  **Observation: Association of TRS resource set to bit(s) in L1 availability bitmap could be achieved by indicating the associated bitmap index as a part of the TRS resource set. Each association would require minimum 3 bits per TRS resource set, total of 192 for all 64 TRS resource sets.**  **Observation: Association of TRS resource set to bit(s) in L1 availability bitmap could be achieved by indicating for each L1 availability bit the associated TRS resource sets. Association of one TRS resource set would require 6 bits, resulting total 396 bits for 64 TRS resource sets.**  **Proposal: Bit of L1 availability bitmap indicates available ‘TRS group’. The group to which TRS resource set is associated is indicated as a part of the TRS resource set (i.e. bit/group index).**  **Observation: For L1 availability indication in PEI, QCL source of the physical layer indication could be used to determine to which TRS resources/sets the availability indication applies.**  **Proposal: For PEI, if searchSpaceSetZero is supported, two bits are used for L1 availability indication, where one bit indicates the availability of the TRS resource set based on the QCL source and another selects among the possible QCL sources. If only SS ID≠0, one bit indicating the availability for TRS resource set with same QCL source is supported.** |
| Nordic | **Proposal-3: In PEI, L1 availability indication at a monitoring occasion provides availability/unavailability information for RS resources, of the subset of iTRS resource set(s), having the same QCL reference as the monitoring occasion.**  **Proposal-4: Support configuration of one TRS resource set per transmitted SSB**  **• In Paging DCI**  **o In FR1, max bitmap size is 8bits**  ** gNB may configure which TRS resource set(s) are mapped to each bit**  **o In FR2, max bitmap size is 8bits**  ** gNB may configure which beam group(s) TRS resource sets are mapped to each bit**  **• In PEI**  **o 1bit indicates whether TRS resource set QCLed with CORESET/MO where PEI is received is available or not** |

According to the above proposals, the remaining issues related to indication content for L1 based availability indication of TRS/CSI-RS occasion(s) to idle/inactive UEs include:

* Issue 1-1: bit mapping, i.e. associated TRS resources set(s) per bit
* Issue 1-2: location and size of the TRS availability indication
* Issue 1-3: Indication of ‘unavailability’
* Issue 1-4: whether to support availability indication for partial configured TRS resources occasions

## 2.1 <1st round discussion>

Companies views for Issue#1-1/2/3/4 in contributions [1-24] are summarized in tables below:

**Issue 1-1: bit mapping, i.e. associated TRS resources set(s) per bit**

For paging PDCCH based signalling

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|  | **Descriptions** | **Support by** |
| Alt1 | A bit is associated with a group of N>=1 TRS resource sets | Huawei, HiSilicon, Sharp, Nokia, Ericsson, InterDigitial, Qualcomm, ZTE, Sanechips, Samsung **(10)** |
| Alt1-1: based on explicit configuration in TRS resource set, e.g. bit/group index | Huawei, HiSilicon, Sharp, Nokia, Ericsson, ZTE, Sanechips, |
| Alt1-2: implicated derived from the configuration of TRS resource sets | ~~ZTE, Sanechips,~~ Samsung |
| Alt2 | A bit is associated with a TRS resource set | Intel, Xiaomi, CMCC, Apple **(4)** |
| Alt3 | One bit for all TRS/CSI-RS resources | CATT, Apple, Ericsson **(3)** |
| Alt4 | support bitmap-based indication for only the configured TRS resource sets that correspond to the same beam as the paging PDCCH, |  |
| Alt4-1: with one bit per TRS resource set | Apple |
| Alt4-2: a single bit in the DCI is configured for indicating beam-based grouping availability | Ericsson |

For paging PEI based signalling

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|  | **Descriptions** | **Support** |
| Alt1 | Support PEI to provide availability indication for RS resources with QCL references to be the same | Spreadtrum, Sharp, LG, Huawei, HiSilicon, Nokiam Nordic, Aplple **(8)** |
| Alt1-1: one bit for all QCLed TRS resource sets | Huawei, HiSilicon, Nokiam Nordic |
| Alt1-2: one bit per TRS resource set. | Aplple |
| Alt2 | Same as paging PDCCH | ZTE, Sanechips, MediaTek, QC **(4)** |
| Alt3 | Configuration of grouping (if explicit) of TRS resource sets - can be different from Paging DCI | Ericsson |

**Issue 1-2: location and size of the TRS availability indication**

For paging PDCCH based signalling,

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|  | **Descriptions** | **Support** |
| Alt1 | Bitmap size up to 6 bits,   * explicit configured \* | Huawei, HiSilicon, Spreadtrum, OPPO, Intel, , Samsung\*, Sharp, Ericsson\* **(8)** |
| Alt1-1: reserved bits, e.g. Right after bitfield ‘TB scaling’ in paging DCI | ZTE, Sanechips, Vivo, Xiaomi, CMCC |
| Alt1-2: explicitly configured using a start position | Ericsson |
| Alt1-3: in short message | LG |
| Alt2 | Maximum size of 8 bit | Nordic |
| Alt2 | 1 bit | CATT |

For PEI PDCCH based signalling

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|  | **Descriptions** | **Support** |
| Alt1 | Bitmap size same as paging DCI | ZTE, Sanechips, TCL, Xiaomi, MediaTek **(5)** |
| Alt2 | one indication bit | Huawei, HiSilicon, spreadtrum **(3)** |

**Issue 1-3: whether and how to support indication of ‘unavailability’**

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|  | **Descriptions** | **Support** |
| Alt1 | Yes, “0” indicates “unavailability’” | Huawei, HiSilicon, ZTE, Sanechips, Intel, Panasonic (6) |
| Alt2 | No, value“0” is ‘reserved’ | Ericsson, Samsung (2) |

**Issue 1-4: whether to support availability indication for partial configured TRS resources occasions**

The following alternatives were proposed by companies to support availability indication for some of configured TRS resources, considering motivations, e.g.

* reduce the signaling overhead for TRS resources [HW, Apple, LG]
* due to limited number of reserved bits in paging PDCCH [MediaTek]

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|  | **Descriptions** | **Support** |
| Alt1 | A mask window before the PO is supported, where paging DCI or PEI DCI based availability indication indicates the availability of TRS occasions which coincide the mask windows | Huawei, HiSilicon |
| Alt2 | 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, with the number being configurable. | Apple |
| Alt3 | Support L1 based availability indication at an occasion provides availability information for some configured RS resources.   * o Allow allocating configured RS resources to each L1 based availability indication at an occasion differently | LG |

Based on the summary above, proposals 1-1, 1-2, 1-3 are drafted to address Issue 1-1/2/3, Issue 1-4 seems to be optimal feature, which is deprioritized in the first round discussion.

For paging PDCCH based availability indication, proposal 1-1 (v1) is drafted based on the the majority view to support

* bit mapping per a group of TRS resource sets
* bitmap size up to 6 bits
* use reserved bits in paging PDCCH, e.g. start from the first bit after scheduling information of PDSCH

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| **[1RD] Proposal 1-1 (v1)**  For paging PDCCH based L1 availability indication using a bitmap,   * bitmap size is up to 6 bits * a bit is associated with a group of TRS resource sets. The associated TRS resource sets for each bit can be based on one of the following alternatives down-selected in RAN1#107-e meeting:   + Alt1: explicit configuration of TRS resource set group, where     - each TRS resource set is configured with a group ID.     - the ith bit maps to ith TRS resource set group.     - the size of bitmap equals to the number of configured TRS resource set groups.   + Alt2: implicitly derived from the configuration of TRS resource sets, where     - All configured TRS resource sets are distributed into available bits according to the order of TRS resource sets     - the size of bitmap is configured explicitly by higher layer.   + Other alterantives are not precluded * start of the bitmap is the first bit of the reserved bits in paging PDCCH |

Please provide your views about **Proposal 1-1 (v1).** Y or N? Any modifications? Companies are also encouraged to down-select between Alt1 and Alt2.

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| **Company** | **Support**  **(Y or N,**  **Alt1 or Alt2)** | **Comments** | |
| TCL | Y, Alt1 | We are fine with this proposal and prefer Alt1. | |
| LG | Y, Alt 1 | Since, it seems like we are the only company who prefer using short message filed in addition to the reserved bits for the availability indication, we can compromise with majority view for the progress.  Among the candidates, we have no strong view but slightly prefer Alt 1 from the gNB scheduling flexibility point of view. | |
| ZTE,Sanechips | Y, Alt1 | We prefer Alt 1, which provides NW more scheduling flexibility with regard to, for example, how to group the RS resource sets according to the deployment scenarios. Our views in the summary section have been revised (highlights in red). | |
| Samsung | Y, Alt2 | We prefer Alt2 to reduce configuraoitn overheads. For the sake of progress, we are fine with Alt1 as a compromise if we are the only company prefers Alt2. | |
| OPPO | Y, Alt1 | We are fine with this proposal and prefer Alt1. | |
| Qualcomm | Y, Alt 1 | Alt 1 has the flexibility of network configuration without UE implementation overhead. It is also convenient to associate the group ID with the bit location in bitmap of the L1 availability signaling. | |
| Intel | Y, Alt1 |  | |
| Sharp | Y, Alt1 with midifications | | We can support Alt1 , and we think the first sub-bullet can be modified for the case that the group ID does not be configured directly to reduce the overhead., e.g. the lower bit can be the SSB index%2, the higher bits can be configured explicitly     * Alt1: explicit configuration of TRS resource set group, where   + each TRS resource set is associated with a group ID.   + the ith bit maps to ith TRS resource set group.   + the size of bitmap equals to the number of ~~configured~~ TRS resource set groups. |
| CMCC | Y, Alt1 |  | |
| Ericsson1 | Y with modifications Alt 1 | We suggest to capture the number of groups as an explicit parameter configured by higher layers, which seems to be needed for both Alt 1 and Alt 2. Then the group ID itself (for Alt 1) can be sized based on the number of configured groups. Suggeted update to first bullet is as follows.   * *Number of bits in the bitmap is configured by higher layers, and up to 6 bits in the bitmap are supported* | |
| Xiaomi | Y, Alt 1 |  | |
| Spreadtrum | Y, Alt1 |  | |
| DOCOMO | Y, Alt1 |  | |
| Panasonic | Y in principle | We are okay with the proposal in general. Just some clarification on the Alt2 that some rule on how TRS resource sets are distributed into available bits should also be defined. We would like to better understand the possible implicit rule. | |
| Nordic | Alt2 |  | |
| Nokia(1st round) | Y, alt1 | We also agree with the modification suggested by Ericsson for the configurability of the bitmap size. | |
| Huawei, HiSilicon | Y, wih modification on Alt.1 | We prefer the Alt.1.  However, we don’t see any need to introduce another level of concept of group index. We could directly use the indication bit index in the TRS availability field to finish the mapping/assocaiton. The concept of group is not needed to introduce complexity in spec and implementation. Similarly, the field size of TRS availability field can be configured or implicitly determined by the maximum configured bit index value.  We have the following proposed change:   * + Alt1: explicit configuration of association of a bit in TRS availability indication field with a group of TRS resource set ~~group~~, where     - each TRS resource set is configured to associated with a bit index in the TRS availability field~~group ID~~.     - ~~the ith bit maps to ith TRS resource set group.~~     - the size of bitmap is configured explicitly or implicitly determined by the maximum bit index configured~~equals to the number of configured TRS resource set groups~~. | |
| MTK | Y, Alt1 | We prefer Alt1. In Alt2, the beam index correlation may not represent the physical correlation, so a fixed rule may not fit all gNB implementation. | |
| Apple |  | Even though this is not our preference, we are fine to accept it given the majority support. But to clarify, is the following correct?   1. Each TRS resource set has to belong to one of the groups. 2. The paing DCIs on different beams carry exactly the same availability indication   We have slight preference for Alt 2 given the smaller overhead. Even though Alt 1 has the flexibility, it may not provide any real advantage. If each group has the same/similar number of TRS resource sets, Alt 1 can be achieved by Alt 2 by ordering the configuration properly. The advantage is not clear to have very uneven number of TRS resource sets in different groups because the gNB does not seem to have good criterion for efficient grouping. | |

For PEI PDCCH based availability indication, proposal 1-2(v1) is drafted based on the majority view to support PEI to provide availability indication for RS resources with QCL references to be the same. The details regarding bit mapping can be discussed after the decision on whether to support the multi-beam selective manner.

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| **[1RD] Proposal 1-2 (v1)**  PEI DCI provides L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion |

Please provide your views about **Proposal 1-2 (v1).** Y or N? Any modifications? Views about detailed bit mapping are also welcome.

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| **Company** | **Support**  **(Y or N)** | **Comments** |
| TCL | Y | We are fine with this proposal |
| LG | Y | We support the proposal. |
| ZTE,Sanechips | N | According to the guidance from RAN#93-e, the same mechanism/principle should be applied for both paging PDCCH and PEI. Therefore, the L1 indication method should be the same for both paging DCI and PEI. We think the proposal 1-2 (v1) is not consistent with the spirits of RAN-P agreements.  Furthermore, the following aspects should be considered.  (1)after UE wakes up from I-DRX off, the best beam pair may not the same as the previous paging cycle. If PEI only indicates the information with the same beam direction, UE needs to detect all the monitoring occasions for the full picture of availability indication, which is more power consuming.  (2)Similar with (1), if the PEI indicates “no paging message”, UE also needs to detect the PEI in all the occasions for the all the availability information as the best beam pair may change after a long sleep duration  (3)The TRS resources are shared from RRC connected state UEs, their beams directions may not be the same with PEI. It will be problematic for this one-to-one mapping indication method in this case. |
| vivo | N | Suggest to use the same mechanism as that defined for paging DCI. The same bitmap size and grouping mechanism can be resused for PEI for simplicity. |
| Samsung | N | We prefer same DCI design without duplicated spec efforts. |
| Qualcomm | N | There are two main concerns about the proposal. First, RAN#93 has concluded to use same principle/mechanism for paging PDCCH and PEI based L1 TRS availability indication. This proposal introduces a major difference between paging PDCCH and PEI based designs. Second, the proposal is against the regular procedure for UE beam management, ie., UE receives reference signal for the target beam before it can decode any channel on that beam. The proposal requires the UE to first receive a PDCCH for TRS availability then receive the TRS on same beam. This is not a realistic procedure for UE beam management. |
| Intel | N |  |
| Sharp | Y | We support the proposal. |
| CMCC | N |  |
| Xiaomi | N | Would like to have the same design as paging DCI |
| Spreadtrum | Y | For PEI DCI based L1 availability indication, the number of bits for L1 availability is not sufficient. Therefore, we prefer that PEI DCI provides L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion. |
| Apple | Y | We support the proposal. If it helps address other companies’ concern, we can in addition support the same mechanism as paging PDCCH.  Forcing to use the TRS resource set grouping concept for PEI largely removes the advantage of using PEI for availability indication. Once several TRS resource sets are grouped together, it becomes less likely for the gNB to indicate it as available. In addition, the UE knows the strongest beam(s) already when decoding PEI, so it is sufficient to know the TRS availability for that beam. |
| Panasonic | N | We do not support such strong restriction. |
| Nordic | Y | There is no problem with causality, if UE uses PEI information only when camping cell does not change. |
| Nokia(1st round) |  | It is not clear if the intention is to limit to one bit in PEI? Like noted, (if SS#0 is supported for PEI) for certain Type0-PDCCH multiplexing pattern1 configurations there would need to be additional indication for the QCL source to determine the available resources based on QCL. |
| Huawei, HiSilicon | We are fine with 1 bit indication. But need to reuse the same mapping method. | Firstly, we’d like to clarify that our preferred solution is to use one bit to indicate multiple SSB indexes/TRS resource sets. Note that the indicated TRS resources are not necessarily confined to be a single SSB index.  If we try to strive for the same design principle for PEI and paging DCI, it is better to use the same association relationship between one indication bit and the SSB indexes/TRS resource sets. However, introducing up to 6 bits for PEI may degrade the performance of PEI. Therefore we think it is a good balance to use a single bit in PEI to indicate a group of SSB indexes/TRS resource sets, while keeps the same association as that for paging DCI. |
| MTK | N | For the sake of progress, we support that PEI indication reuses the same indication as paging PDCCH. This proposal is an optimization for PEI indication.  Instead of limiting the configuration of PEI availability indication, we suggest to modify proposal 1-2 as the following:  **[1RD] Proposal 1-2**  PEI DCI provides L1 availability indication information ~~only~~ can be configured for RS resources with QCL references to be the same as for the L1 availability indication occasion |
| Lenovo/Motorola Mobility | N | It is preferred that PEI based availability indication is same as paging DCI based availability indication. |

For indication of ‘unavailability’, many companies haven’t provided views in their contributions yet. Two options based on the existing proposals are provided for disucsison and down-selection.

|  |
| --- |
| **[1RD] Proposal 1-3 (v1)**  Option a  Support indication of unavailability for L1 based availability indication using a bitmap, where value “0” for each bit indicates the associated TRS resource(s) are not available.  Option b  Indication of unavailability is not supported for L1 based availability indication using a bitmap, where value “0” for each bit is reserved. |

Please provide your views about **Proposal 1-3 (v1).** Which option do you support? Any modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Option a or b)** | **Comments** |
| TCL | Support option a | We prefer option a |
| LG | Option b | In my understanding, indicating “reserved” means that “no information”. So, UE will maintain its knowledge on the availability for the associated TRS resource(s) when the “reserved” is indicated by a bit in a bitmap. If I my understanding is correct, we prefer Option b. |
| ZTE, Sanechips | Option a | NW has the flexibility to switch off the TRS resource occasion according the objective in WID that “always-on” RS is not required. |
| vivo | Option a | If value ‘1’ indicates availability, it is nature that value ‘0’ means not available, or ‘can not assume available’.  Besides, indication of un-availability is also useful for options ‘sliding window’ issue exists when the validity time is configured, and if Alt-1/Alt-2 is selected when validity time is not configured. |
| Samsung | Option b | We think unavailability should be derived implicitly based on absence of availability indication, and is not limited by the valid duration. |
| OPPO | Option a | If we use a bitmap for the indication, and each bit corresponds to one TRS set, how some of bits can be reserved.  It shall be e.g., one if the TRS is present, or zero if the TRS is absent |
| Qualcomm | Option a | This also has a dependency on the validity duration design. For that we support the periodicity and offset based design with consistent indication within the duration. This mechanism does not restart the validity duration when a new L1 indication is received. In this case, unavailability can be directly provided by bit value “0”. |
| Intel | Option a | What is the benefit of not using one bit value? For a given L1 indication, some resource can be available, some may not be available. For those that are not available, it is natural to assume one bit value. |
| Sharp | Option a |  |
| CATT | Option a | We only support 1-bit indication of all TRS resource set within a cell with “0” being not avialble. |
| CMCC | Option a | It is much straightfaward using “1” as avaliabulity and “0” as unavailability. |
| Xiaomi | Option a | In fact we are not sure what option b means. |
| Spreadtrum | Option a |  |
| DOCOMO | Option a |  |
| Apple | Option b | We think Option b should be adopted for the cases where two DCIs indicating availability cover overlapping time duration.  If a TRS occasion is not indicated as available by any DCI, it is automatically considered as unavailable. |
| Panasonic | Option a |  |
| Nordic | Option a, but | if no indication received, TRS is not available. |
| Nokia(1st round) | Option b | This relates bit to the ‘inconsistency’ discussion, e.g. can NW change the bit from ‘0’ to ‘1’ e.g. middle of modification period/validity duration. If that is clarified, option a could be considered as well. |
| Huawei, HiSilicon | Option a | As analyzed in our contribution, the state ‘reserved’ may cause a UE cannot get the information on TRS availability for long time. |
| MTK | Option a | It should be clarified whether the word “reserved” in option b means that not guarantee the availability of TRS?  So far, we prefer option a because it provides a clearer information for UE. |
| Lenovo/Motorola Mobility | Option a |  |

## 2.2 <2nd round discussion>

Issue 1-1: bit mapping, i.e. associated TRS resources set(s) per bit for paging based avaability indication

**Summary on Proposal 1-1 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Y or N, Alt1 or Alt2)** | **Companies** |
| Y w/ Alt1 | TCL, LG, ZTE, Sanechips, OPPO, Qualcomm, Intel, Sharp, CMCC, Ericsson1, Xiaomi, Spreadtrum, DOCOMO, Nokia, Huawei, HiSilicon, MTK **(17)** |
| Y w/ Alt2 | Samsung, Nordic **(2)** |
| Y, | Panasonic |

Based on the feedback from the 1st round discussion, the majority support Alt1, while only 3 companies are interested in Alt2. For the sake of progress, let’s down-select Alt1.

The proposal is updated to integrate:

* modification on first bullet from Nokia/Ericsson, and
* modification of Alt1 from HW.

|  |
| --- |
| **[2RD] Proposal 1-1 (v2)**  For paging PDCCH based L1 availability indication using a bitmap,   * Number of bits in the bitmap ~~size~~ is configured by higher layers, and up to 6 bits in the bitmap are supported * a bit is associated with a group of TRS resource sets. The associated TRS resource sets for each bit can be based on one of the following alternatives down-selected in RAN1#107-e meeting:   + Alt1-1:explicit configuration of TRS resource set group, where     - each TRS resource set is configured with a group ID.     - the ith bit maps to ith TRS resource set group.     - ~~the size of bitmap equals to the number of configured TRS resource set groups.~~   + Alt1-2: explicit configuration of association of a bit in TRS availability indication field with a group of TRS resource set, where     - each TRS resource set is configured to associated with a bit index in the TRS availability field ~~group ID~~. * start of the bitmap is the first bit of the reserved bits in paging PDCCH |

**Please a) provide your preference for supporting Alt1-1 or Alt1-1 below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Alt 1-1 | Qualcomm, Samsung, ZTE, Sanechips, LGE, vivo,Xiaomi, Nokia2, DOCOMO, IDCC, CMCC, Lenovo/Motorola Mobility, CATT, Ericsson2,OPPO, Sony |
| Alt 1-2 | Sharp, Spreadtrum, Panasonic |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Function wise, Alt 1-1 more clearly reflects that multiple TRS resource sets can be associated with the same group and indicated by same bit in the bitmap. But Alt 1-1 and Alt 1-2 can work together by mapping goup to the bit in the bitmap. If so, the two Alternatives can be merged as one solution. |
| Samsung | The configuration of bitmap size doesn’t seem to be necessary. The bitmap size can be the maximum TRS resource set group supported. |
| ZTE, Sanechips | Agree with Samsung that it does not need to configure the bit size explicitly. Alt 1-1 is preferred. |
| LGE | Regarding the bitmap size indication, we have similar view with Samsung. If Alt 1-1 is supported, no expliciti indication for the bitmap size is needed. |
| MediaTek | We support Alt 1-1. Regarding the bitmap size, it corresponds to the number of TRS resource set group for Alt 1-1, and it suffices to define one of the bitmap size and the TRS resource set group size. |
| CATT | We would like to know how UE could know which TRS resource group it is under after wakeup from long sleep beside the solution only one group per cell. We would like to add that “FFS: How could more than one TRS resource set group per cell is configured to achieve UE power saving”. |
| Ericsson2 | Explicit indication of bitmap size reduces the “group ID” field size in the TRS resource set. For example, if 1 or 2 groups are configured, group ID field size would be 0 or 1 bit, respectively. |
| OPPO | Agree with Ericssion, it seems that the “group ID” field is not needed in the following proposal |
| Moderator | [2RD summary]  Based on the discussion so far, the proposal 1-1 can be further updated to:   * down-select Alt1-1 based on the majority view * clarify that the bitmap size is used to determine the applicable value for group ID field based on comment from Ericsson * extend the design to both paging PDCCH based and PEI based signaling as the majority support Option e for Question 1-2 (v2). For the sake of progress, we won’t discuss additional design of the indication content. * An FFS point is added as suggested by CATT.   **Proposal 1-1 (v3)**  For ~~paging PDCCH based~~ L1 availability indication using a bitmap,   * Number of bits in the bitmap, N, is configured by higher layers, and up to 6 bits in the bitmap are supported * a bit is associated with a group of TRS resource sets. The associated TRS resource sets for each bit can be based on ~~one of the following alternatives down-selected in RAN1#107-e meeting~~:   + ~~Alt1-1~~:explicit configuration of TRS resource set group, where     - each TRS resource set is configured with a group ID, with value from {0, …, N-1}.     - the ith bit maps to ith TRS resource set group.   + ~~Alt1-2: explicit configuration of association of a bit in TRS availability indication field with a group of TRS resource set, where~~     - ~~each TRS resource set is configured to associated with a bit index in the TRS availability field~~ * start of the bitmap is the first bit of the reserved bits in paging PDCCH * FFS: How could more than one TRS resource set group per cell is configured to achieve UE power saving |
| Apple | We are fine to accept Alt1-1 for paging PDCCH based availability indication. But we cannot accept that the same approach is also enforced for PEI based availability indication.  When the number of beams is large, providing availability indication per TRS resource set group greatly reduces the probability that the bit indicates available (because all the TRS resource sets within the group need to be available), which becomes very ineffective for UE power saving.  For paging PDCCH based availability indication, there is no good way around this problem, because we cannot predict which beam the UE would be in the next paging cycle.  But for PEI based availability indication, this is a problem we can avoid. The UE already knows which beam to use for decoding paging PDCCH/PDSCH, and the PEI on the same beam can provide the corresponding availability indication. This avoids the coarse granularity problem when using one bit per TRS resource set group.  Therefore we think there is strong technical argument to support a different approach for PEI based solution.  As a compromise, we can accept to support both options for PEI-based solution.  **Proposal 1-1 (v3) (Apple)**  For ~~paging PDCCH based~~ both paging PDCCH based and PEI based L1 availability indication using a bitmap, the following is supported:   * Number of bits in the bitmap, N, is configured by higher layers, and up to 6 bits in the bitmap are supported * a bit is associated with a group of TRS resource sets. The associated TRS resource sets for each bit can be based on ~~one of the following alternatives down-selected in RAN1#107-e meeting~~:   + ~~Alt1-1~~:explicit configuration of TRS resource set group, where     - each TRS resource set is configured with a group ID, with value from {0, …, N-1}.     - the ith bit maps to ith TRS resource set group.   + ~~Alt1-2: explicit configuration of association of a bit in TRS availability indication field with a group of TRS resource set, where~~     - ~~each TRS resource set is configured to associated with a bit index in the TRS availability field~~ * start of the bitmap is the first bit of the reserved bits in paging PDCCH * FFS: How could more than one TRS resource set group per cell is configured to achieve UE power saving   For PEI based L1 availability indication, it is additionally supported that L1 availability indication information is provided only for RS resources with QCL references to be the same as for the L1 availability indication occasion. |
| SONY | Our preference is Option 1-1. For clarity improvement, it should be written as follows:  each TRS resource set is configured with a**n** ~~group~~ ID |

Issue 1-1: bit mapping, i.e. associated TRS resources set(s) per bit for PEI based avaability indication

**Summary on Proposal 1-2 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Y or N)** | **Companies** |
| Y | TCL, LG, Sharp, Spreadtrum, Apple, Nordic **(6)** |
| N | ZTE, Sanechips, vivo, Samsung, Qualcomm, Intel, CMCC, Xiaomi, Panasonic, MTK **(10)** |

Reasons for N:

* proposal 1-2 (v1) is not consistent with the spirits of RAN-P agreements [ZTE, QC]
* after UE wakes up from I-DRX off, the best beam pair may not the same as the previous paging cycle. UE also needs to detect the PEI in all the occasions for the all the availability information as the best beam pair may change after a long sleep duration [ZTE]
* concerns on duplicated spec efforts [Samsung]
* the proposal is against the regular procedure for UE beam management, ie., UE receives reference signal for the target beam before it can decode any channel on that beam. [QC]

Reasons for Y:

* For PEI DCI based L1 availability indication, the number of bits for L1 availability is not sufficient. [Spreadtrum]
* Forcing to use the TRS resource set grouping concept for PEI largely removes the advantage of using PEI for availability indication. Once several TRS resource sets are grouped together, it becomes less likely for the gNB to indicate it as available. [Apple]
* In addition, the UE knows the strongest beam(s) already when decoding PEI, so it is sufficient to know the TRS availability for that beam. [Apple]

Additional comments:

* If it helps address other companies’ concern, we can in addition support the same mechanism as paging PDCCH. [Apple]
* It is not clear if the intention is to limit to one bit in PEI? Like noted, (if SS#0 is supported for PEI) for certain Type0-PDCCH multiplexing pattern1 configurations there would need to be additional indication for the QCL source to determine the available resources based on QCL.[Nokia]
  + **Moderator**: there is no intention to limit to just one bit. The details of bits is next step. The intention is to sync the view about the limitation of beam-selective first.
* to use one bit to indicate multiple SSB indexes/TRS resource sets [HW]

The majority are not OK with the proposal and prefer the PEI PDCCH based L1 availability indication to use the same indication content as paging PDCCH based availability indication in Proposal 1-1. It seems we are far from reaching consensus. So, all the options based on the input in 1st RD are provided for further check.

|  |
| --- |
| **[2RD] Question 1-2 (v2)**  Which option(s) are acceptable/unacceptable to you:   * **Option a (P1-1 v1):** PEI DCI provides L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion * **Option b (Apple):** For both PEI PDCCH based availability indication and paging PDCCH based availability indication, support L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion * **Option c (HW):** For PEI DCI provides L1 availability indication, use one bit to indicate multiple TRS resource sets   + The same association method between SSBs and an indication bit is applied to both paging DCI and PEI * **Option d (MediaTek):** PEI DCI provides L1 availability indication information ~~only~~ can be configured for RS resources with QCL references to be the same as for the L1 availability indication occasion * **Option e (majority view):** For PEI PDCCH based L1 availability indication, the design of the indication content is same as paging PDCCH based availability indication discussed in Proposal 1-1. |

**Please a) provide your preference option(s) to support below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Option a | **Sharp(1st** priority), LGE (1st preference), Spreadtrum, Apple |
| Option b | Sharp(2nd priority), Spreadtrum, Apple |
| Option c |  |
| Option d | Panasonic, Apple |
| Option e | Qualcomm, Samsung, ZTE, Sanechips, TCL, LGE (2nd preference), vivo,Xiaomi, DOCOMO, IDCC, CMCC, Lenovo/Motorola Mobility, CATT, Ericsson2,OPPO |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | For paging PDCCH based indication, the DCI content should be maintained same across beams for backward compatibility. For PEI based indication, there is too much spec efforts to make the two designs work together if they are based on different mechnisms. |
| Samsung | In general, we don’t think PEI based availability indication is needed. As a compromise, we are open to consiuder it if no duplicated spec efforts are needed. Also, it won’t impact the reliability of PEI DCI detection, .e.g it won’t exceed the maximum payload size of the new DCI format can support, and no need to consider it in the decision to determine the maximum payload size. |
| ZTE, Sanechips | (1)According to the agreements in RAN-#93, the same mechanism should be applied to PEI and paging DCI to reduce the workload.  (2)The indication carried by PEI and paging DCI should be the same to make sure that the different UEs that detect different L1 signaling receive the same information. Therefore, it is simple to use the same design. |
| LGE | Our best preference is option a from the PEI overhead reduction perspective. However, we can compromise to option e if it is acceptable to the most of companies. |
| Vivo | Similar view as Qualcomm. |
| Nokia2 | We think that it would be preferable to restrict the L1 availability indication payload in PEI (if supported). To achieve this implicit mapping as in option a could be considered.  We don’t support option b. As commented earlier, the L1 vailability indication in paging DCI should not be restricted to same QCL source. It is not clear how the option b could be realized in the light of the other discussions. |
| MediaTek | Option d or Option e. We support minimum specification effort. For Option d, PEI can simply indicate the first TRS resource set group (based on Proposal 1-1) with the same QCL reference/SSB source, which reduces the bit number per PEI to only 1 bit. Nevertheless, for sake of progress, we can also go with the majority, i.e., Option e. |
| CATT | The question is not clear whether the availability indication should be transmitted on PEI and/or paging DCI in the same time. |
| Ericsson2 | Same design should be used for Paging PDCCH and PEI. |
| OPPO | Agree with the majority view |
| Moderator | [2RD summary]  Option e was selected based on the majority view. It’s integrated into P 1-1 (v3). Other details, such as availability indication should be transmitted on PEI and/or paging DCI in the same time, will be discussed in next round. |
| Apple | Please see our compromised proposal for P1-1. We do think there is a strong technical argument to support a different approach for PEI. The design should be quite straightforward if we adopt the approach, or we can go with the simpler design (e.g. to have a unified design on the validity time for paging PDCCH and PEI). |

* Issue 1-3: Indication of ‘unavailability’

**Summary on Proposal 1-3 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Option a or b)** | **Companies** |
| Option a | TCL, ZTE, Sanechips, vivo, OPPO, Qualcomm, Intel, Sharp, CATT, CMCC, Xiaomi, Spreadtrum, DOCOMO, Panasonic, Nordic, Huawei, HiSilicon, MTK, Lenovo/Motorola Mobility **(19)** |
| Option b | LG, Samsung, Apple, Nokia **(4)** |

Reasons for Option b:

* We think Option b should be adopted for the cases where two DCIs indicating availability cover overlapping time duration [Apple]
* unavailability should be derived implicitly based on absence of availability indication, and is not limited by the valid duration. [Samsung]

Additional comments:

* This relates bit to the ‘inconsistency’ discussion [Nokia]
* if no indication received, TRS is not available [Nordic]
* “reserved” means that “no information”. So, UE will maintain its knowledge on the availability for the associated TRS resource(s) when the “reserved” is indicated by a bit in a bitmap. [LG]
  + *Moderator*: Your understanding is correct. We can further clarify that in the proposal to make it more clear to the group.

As commented by Apple/Nokia, the motivation for option b relate to the ‘inconsistency’ discussion. Moderator suggests to revisit the proposal after the ‘inconsistency’ discussion or merge the discussion.

# Validity time of L1 availability indication

The following was agreed for determining the valid duration for L1 based availability indication:

|  |
| --- |
| From RAN1#106bis-e:  **Agreement**  At least for paging PDCCH based L1 availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the L1 availability indication is valid for a time duration starting from a reference point, where   * the time duration is a validity duration configured by higher layer,   + FFS applicable values, e.g. # of DRX cycles, or multiple of default paging cycle duration (i.e. modification period)   + FFS UE doesn’t expect inconsistent L1 based indication during the time duration * the reference point for start of the validity duration is one of the following alternatives:   + Alt1: SFN of the first PF from the next DRX cycle   + Alt2: SFN of the first PF from the current DRX cycle where UE receives the indication   + Alt3: based on SFN configured by higher layer, i.e. modification period configured as multiple of default paging cycle duration   + Alt4: start of the PF for the PO where UE receives the indication   + Note: the DRX cycle in Alt1 and Alt2 is the default paging cycle broadcast in SIB   + Note: The SFN for the first PF is ~~for (UE mod N) = 0, and can be~~ calculated by (SFN + PF\_offset) mod T = 0 * the time duration can be optionally configured by gNB   + when the time duration is not configured, one of the following alternatives can be considered:     - Alt1: the availability indication is valid until when the UE receives another availability indication.     - Alt2: the availability indication is valid until L1 availability indication is changed by network     - Alt3: default time duration e.g. default paging cycle * FFS whether and how to handle the miss detection issue of L1 signaling |

In contributions [1-24], the following proposals were made to address the remaining issues for determining the valid duration for L1 based availability indication of TRS/CSI-RS occasion(s) to idle/inactive UEs:

|  |  |
| --- | --- |
| Huawei, HiSilicon | **Observation 1: It is difficult on both gNB side and UE side to handle miss-detection of L1 signalling, considering gNB cannot know whether the L1 signalling is miss-detected by UEs and the UE cannot know whether an expected L1 signalling is miss-detected or just not transmitted by gNB.**  **Proposal 1: The selected validity duration design needs to be robust to minimize the misalignment between gNB and UE caused by miss-detection of L1 signaling.**  **Proposal 2: The validity duration length is configured to be N default paging cycle length in SIB, where N is a value configured in {1, 2, 4, 8, 16, 32}.**  **Observation 2: If L1 indication during the same validity time duration can be inconsistent, the miss-detection of paging/PEI DCI would cause UE’s incorrect assumption on the availability of TRS occasions until the validity time ends, which needs to be considered into the availability indication design.**  **Proposal 3: UE doesn’t expect inconsistent L1 based indication during the time duration.**  **Observation 3: The sliding/float validity time duration causes gNB has no chance to change the TRS availability from ‘available’ to ‘unavailable’ for long time and causes more complicated gNB implementation.**  **Observation 4: Alt1, Alt2 and Alt4 for defining reference point lead to ‘sliding’ solution, which may make gNB have no chance to change the availability.**  **Proposal 4: Adopt Alt.3 to use modification period as the validity during which the availability of assistance TRS(s) is assumed to be the same.**  **- The reference point is based on SFN configured by higher layer, i.e. modification period configured as multiple of default paging cycle duration**  **Proposal 5: When the time duration is not configured, the modification period is defined to be 1 default paging cycle by default.** |
| ZTE,  Sanechips | **Proposal 9: When the time duration is not configured, the availability indication is valid when UE receives another availability indication.**  **Proposal 10: The modification period can be used to determine the valid time for TRS resource, where the time duration is multiple paging cycles, and the reference time for the start of the validity duration is based on the SFN configured by higher layer.** |
| Vivo | **Proposal 4: When validity time is configured, the length of the validity time can be multiple paging cycles.**  **- {2,4,8,16} default paging cycles can be considered as baseline.**  **Proposal 5: Unavailability for TRS resources can be indicated before the validity timer expires.**  **Proposal 6: When the time duration for the validity time is not configured, UE assumes the availability indication is valid until L1 availability indication is changed by network.**  **Observation 1: In a typical NW deployment, the reliability if paging PDCCH/PEI can be guaranteed.**  **Proposal 7: No additional mechanism is needed to handle the miss-detection of the availability indication.**  ** Reference point for start of the validity duration**  **Proposal 8: The L1 availability indication for TRS takes effect once it is received.**  **- Alt-2 is preferred for reference point for validity time for paging DCI.**  **Proposal 9: For PEI based availability indication, the reference time of the start of validity time follows the reference time for the associated monitoring occasion for the paging DCI, i.e., UE assumes the L1 availability is detected in the associated paging DCI when determine the starting of validity time.** |
| TCL | **Proposal 6: For paging PDCCH based TRS availability indication’s validity time, support the following.**  **• The time duration configured by higher layers is based on the default paging (DRX) cycle**  **• For Reference point support alt1: i.e. SFN of the first PF from the next DRX cycle**  **• For the case when the validity time’s duration is not configured by gNB, support alt3, i.e. the default time duration e.g. the default paging cycle, for time duration.**  **Observation 3: The validity time’s duration and reference point of paging PDCCH based TRS availability indication is different from PEI based TRS availability indication.**  **Proposal 7: For validity time of PEI based TRS availability indication:**  **• The time duration is the default paging cycle’s duration, or multiple of default paging cycle’s duration for which PEI is transmitting the indication.**  **• The reference point is the time location of PEI occasion where the PEI is transmitted.**  **Proposal 8: Consider an indication cycle of N paging occasions, where an indication is transmitted in the first paging occasion to inform the availability of TRS for N paging occasions.** |
| Spreadtrum | **Proposal 6: The applicable values of time duration of the validity time should be # of DRX cycles.**  **Proposal 7: Support Alt-2 or Alt-3 for the reference point for start of the validity duration** |
| CATT | **Proposal 2: The value of valid time can be configured as [1, 2, 4, 8]\*T, where T is a multiple of default DRX value, e.g., T=10 or 20 default DRX.**  **Proposal 3: The reference point of validity time duration should be after the current PO which L1-based signaling indicating the availability of TRS/CSI-RS is detected and before the next DRX cycle, i.e., SFN of the first PF from the next DRX cycle.**  **Proposal 4: When the time duration is not configured, the availability indication is valid until when the UE receives another availability indication.** |
| OPPO | **Proposal 4: DCI in previous paging cycle can be used to indicate whether there is TRS for the current paging cycle.**  **Proposal 5: Alt-4 (start of the PF for the PO where UE receives the indication) shall be adopted to determine the reference point.**  **Proposal 6: if it were agreed that the time duration can be optionally configured by gNB, default time duration shall be utilized by the UE.** |
| Sony | **Proposal 4: The reference point for start of the validity duration is the SFN of the first PF from the current DRX cycle where UE receives the indication.** |
| Intel | **Proposal 3: When the time duration is not configured for the validity of L1 availability indication, support Alt3: default time duration, e.g., default paging cycle.**  **Proposal 4: Support one of the following for start of the validity duration**  **• Alt1: SFN of the first PF from the next DRX cycle**  **• Alt2: SFN of the first PF from the current DRX cycle where UE receives the indication** |
| Xiaomi | **Proposal 8: Support valid time duration is a multiple of default DRX cycle or multiple of modification period.**  **Proposal 9: Support default valid period as a modification period when the time duration is not configured.**  **Proposal 10: Support SFN of the first PF from the next DRX cycle as the reference starting point for L1 indication validity duration.** |
| CMCC | **Proposal 4. For paging DCI based availability indication, support Alt 1 as the reference point of L1 availability indication valid duration.**  **Proposal 5. For paging DCI based availability indication, support Alt 3 to define a default time duration when the time duration is not configured by gNB.**  **Proposal 6. For PEI based availability indication, the validity time duration is** **a predefined window before the associated PO and the reference point is the time location where UE receives the indication.** |
| Panasonic | **Proposal 4: The TRS validity duration is configured by high layer with a certain number of DRX cycles.**  **Proposal 5: For unavailability indication, the valid time duration is absent by default and the indication is valid until when the UE receives another availability indication.**  **Proposal 6: No need to limit the UE assumption on whether UE expects inconsistent L1 based indication during the validity time duration.**  **Proposal 7: The reference point for start of the validity duration of the L1 indication of TRS availability/unavailability is the SFN based on SIB configuration. SFN of the first PF from the next DRX cycle is also acceptable with us.** |
| Samsung | **Proposal 6: Support the applicable values for the validity duration be to a number of DRX cycle for paging.**  **Proposal 7: For the reference point for the start of the validity duration, support Alt 2, i.e. SFN of the first PF from the current DRX cycle where UE receives the indication.**  **Proposal 8: UE doesn’t expect inconsistent L1 based indication during a validity duration for a L1 availability indication, such that UE can ignore the TRS availability indication field received during the validity duration with a bitmap of all “0”s.**  **Proposal 9: When the time duration is not configured, support a default time duration of N>1 DRX cycles.** |
| Apple | **Proposal 7: For paging PDCCH based availability indication of TRS occasions, the validity time duration is configured as multiple of default paging cycle. The reference point for the validity time duration is start of the PF for the PO where UE receives the indication (Alt 4).**  **Proposal 8: For PEI based availability indication of TRS occasions, the availability indication is valid until the end of the current PO, starting from when the UE receives the indication.** |
| Lenovo | **Proposal 3: For L1 based signalling for the availability indication of TRS/CSI-RS at the configured occasion(s),**  **• PEI transmitted in a current DRX cycle can indicate TRS availability/unavailability information of configured TRS occasions within the current DRX cycle.**  **• Paging DCI of a current DRX cycle can include TRS availability information for a following DRX cycle.**  **Proposal 4: 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.** |
| InterDigital | **Proposal 3: The reference point for start of the validity duration is SFN of the first PF from the next DRX cycle.**  **Proposal 4: When the time duration is not configured, a default time duration is assumed.** |
| LG | **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 which can be determined as follows:**  **o UE can assume the actual TRS/CSI-RS transmission for X modification period from the reference point, where the value X is configured values via higher layer and the reference point is determined as follows:**  **o If a L1 based availability indication is received during the last default paging cycle within a validation period, the boundary of which is defined by the two radio frames that satisfy SFN mod (X\*m) = 0, the reference point is the radio frame that satisfies SFN mod (X\*m) = 0 after the received L1 signaling.**  **o Otherwise, the reference point is the radio frame that satisfies SFN mod (X\*m) = 0 before the received L1 signaling.** |
| NTT  DOCOMO | **Proposal 2: The reference point depends on what kind of L1 indication is used.**  **• When the paging DCI is used to indicate the available TRS, we prefer to Alt1**  **• When the paging PEI is used to indicate the available TRS, we prefer to Alt4**  **Proposal 3: when the time duration is not configured, UE assume gNB transmits TRS until default time duration.** |
| Ericsson | **Proposal 1 For L1-based TRS availability indication via a bitfield in Paging DCI, validity time is in units of defaultPagingCycle and allowed values are [1,…,40].**  **Proposal 2 When validity time is not explicitly configured, default validity time duration is [10] defaultPagingCycle.**  **Proposal 3 The reference point for validity time when paging DCI is used for availability indication is the SFN of the first PF associated with the current DRX cycle where UE receives the indication.**  **Proposal 6 For supporting TRS availability in the PEI DCI, following is supported :**  **a. Configuration of the bitfield within the DCI via a start position within the DCI and a length field - can be different from Paging DCI**  **b. Configuration of validity time**  **c. Reference point is the SFN of the first PF associated with the current DRX cycle where UE receives the indication.**  **d. Configuration of grouping (if explicit) of TRS resource sets - can be different from Paging DCI**  **e. Beam-based grouping – grouping/indication mechanism is same as that for Paging DCI (if configured)** |
| Qualcomm | **Observation 2: The validity duration for the L1 based TRS availability indication is the time duration when the availability information is valid but not the duration when L1 based TRS availability indication is enabled. It is only meaningful for network to configure the validity duration if consistent availability information is provided during the validity duration.**  **Proposal 5: Confirm the FFS “UE doesn’t expect inconsistent L1 based indication during the time duration”. Otherwise, revert the agreement “the time duration is a validity duration configured by higher layer”.**  **Observation 3: All UEs should have the same understanding in whether a TRS is transmitted during the paging cycle. All L1 availability indication signaling in the same paging cycle for same or different UEs should indicate the same availability information for the configured TRS resource.**  **Observation 4: The timer-based validity duration reset for L1 based TRS availability indication has the problem that network cannot change the availability information for a configured TRS resource if the availability information is transmitted more than once (i.e., in more than one paging cycles) for a UE before the validity duration expires.**  **Proposal 6: Do not support timer-based validity duration reset for L1 based TRS availability indication.**  **Proposal 7: Regarding reference time for the validity duration, clarify which understanding should be assumed**  **• Understanding 1: the reference time is the starting time of a duration when UE expects consistence of availability information received from the L1 based indication signaling**  **• Understanding 2: the reference time is the starting time when UE can apply the received availability information to receive available TRS resources**  **• Note: there should be an application delay of at least one paging cycle between the two instances so that causality is ensured for the L1 based availability signaling, i.e., a UE uses the received L1 based indication to determine whether TRS resource is available or not on future TRS occasions.**  **Proposal 8: Define application delay for the L1 based TRS availability indication signaling. The application delay has a paging cycle level resolution with the minimum delay value equal to a paging cycle.**  **Proposal 9: For the reference time of validity duration of the L1 TRS availability indication, adopt Alt 3 with the following updates:**  **• Reference point for start of the validity duration is based on SFN configured by network based on a periodicity and an offset. The periodicity has a resolution equal to one or multiple paging cycle. The offset is aligned with the start of a paging cycle.**  **• Note: then unavailability of the TRS resource can be indicated by value 0 of the corresponding bit in the DCI format.**  **Proposal 10: When the validity duration is not configured by network, a default value of the validity duration is used.** |
| MediaTek | **Proposal 1: Use maximum paging DRX cycle, 2.56 sec, as the unit of validity duration.**  **Proposal 2: Application delay of TRS availability indication, [5] ms, is introduced.**  **Observation 2: Alt 2 can provide useful TRS availability indication for all POs.**  **• Alt 1 cannot provide useful TRS availability indication for a PO in the first PF of paging DRX cycle**  Observation 3: Alt 2 is unified solution to provide availability information with either paging PDCCH or PEI.  Proposal 3: Support Alt2 as the reference point  **• The same reference point is utilized for paging PDCCH and PEI.** |
| Nokia | **Observation: With “time block window” approach, such as Alt 3, if the modification period and validity duration are aligned, the L1 availability indication could be assumed to be consistently ‘available’ during the modification period, but could also be considered to change to ‘available’ during modification period.**  **Observation: For “sliding window” approaches, such as Alt1, Alt2 and Alt4, if validity duration can be longer than period of L1 availability indication, it should be allowed to change the status of the L1 availability indication during validity duration.**  **Observation: On the considered options Alt 3, where ‘modifcation period’ and validity duration are time aligned, or Alt 2 would seem preferable to align with TRS availability to the CONNECTED mode UE activity.**  **Proposal: Adopt either Alt 3 with the assumption that modification period and validity duration are time aligned or Alt 2.**  **Proposal: Network is allowed to change the L1 availability indication status during the validity duration.**  **Proposal: Determine validity duration to be same as or multiples of default paging cycle provided in broadcast. The reference point could be the first PF of the validity duration.**  **Proposal: For the case when validity duration is not configured, UE would either assume the availability to be valid for some default duration, or that the availability indication is only valid until network changes it, without considering the UE detection of the said indication.** |
| Nodic | **Proposal-1: At least for paging PDCCH based L1 availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the L1 availability indication is valid for a time duration starting from a reference point, where**  **• the time duration is a validity duration configured by higher layer in units of default DRX paging cycles**  ** UE expects to receive consistent indication within the validity duration/modification period in received paging PDCCH(s)**  **• the reference point for start of the validity duration is one of the following alternatives:**  ** Alt3: based on SFN configured by higher layer, i.e. modification period configured as multiple of default paging cycle duration (i.e. assuming UE-ID=0),**  **• modification period is validity duration**  **• indication applies to next modification period**  **• the time duration can be optionally configured by gNB**  ** when the time duration is not configured, one of the following alternatives can be considered:**  **• Alt3: default time duration e.g. default paging cycle (value up to RAN2)**  **• Conclude that there is no need to define any additional UE behavior to address missed paging PDCCH carrying the L1 availability indication.** |

According to the above proposals, the remaining issues for determining validity time for L1 based availability indication include:

* Issue #2-1: determine values for the validity duration configured by higher layer
* Issue #2-2: determine reference point for the start of the validity duration
* Issue #2-3: when the time duration is not configured, down-select one alternative
* Issue #2-4: FFS UE doesn’t expect inconsistent L1 based indication during the time duration
* Issue #2-5: whether to support application delay

## 3.1 <1st round discussion>

Companies views for Issue#2-1/2/3/4/5 in contributions [1-24] are summarized in tables below.

Issue #2-1: determine values for the validity duration configured by higher layer

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | Time unit to be a default paging cycle | Huawei, HiSilicon, ZTE, Sanechips, TCL, Spreadtrum, Xiaomi, Panasonic, Samsung, Apple, Nokia, Nordic, Vivo, Ericsson, LG ,OPPO**(16)** |
|  | {1, 2, 4, 8, 16, 32} paging cycles | Huawei, HiSilicon |
|  | {2,4,8,16} paging cycles | Vivo |
|  | [1,…,40] paging cycles | Ericsson |
|  | Multiples of modification period  ( = default paging cycle\**modificationPeriodCoeff* \*X) | LG |
| Alt2 | The value of valid time can be configured as [1, 2, 4, 8]\*T, where T is a multiple of default DRX value, e.g., T=10 or 20 default DRX. | CATT |
| Alt3 | Use maximum paging DRX cycle, 2.56 sec, as the unit of validity duration. | MediaTek |

Issue #2-2: determine reference point for the start of the validity duration

For paging PDCCH based availability indication

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | SFN of the first PF from the next DRX cycle | TCL, CATT, Intel, Xiaomi, CMCC, Panasonic, InterDigital, DOCOMO **(8)** |
| Alt2 | SFN of the first PF from the current DRX cycle where UE receives the indication | Vivo, Spreadtrum, Sony, Intel, Samsung, Ericsson, MediaTek, Nokia **(8)** |
| Alt3 | based on SFN configured by higher layer, i.e. modification period configured as multiple of default paging cycle duration | Huawei, HiSilicon, ZTE, Sanechips, TCL, Spreadtrum, Panasonic, Qualcomm, Nokia, LG **(10)** |
| Alt4 | start of the PF for the PO where UE receives the indication | OPPO, Apple **(2)** |

For PEI based availability indication

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | Same as paging PDCCH | Huawei, HiSilicon, vivo, Ericsson, MediaTek (5) |
| Alt2 | Reference point is the time location/PF where UE receives the indication, where time duration can be | DOCOMO, TCL, CMCC, Apple (4) |
|  | Alt2-1: he time duration is the default paging cycle’s duration, or multiple of default paging cycle’s duration | TCL |
|  | Alt2-2: the validity time duration is a predefined window before the associated PO | CMCC |
|  | Alt2-3: the availability indication is valid until the end of the current PO | Apple |

Issue #2-3: when the time duration is not configured, down-select one alternative

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | the availability indication is valid until when the UE receives another availability indication. | ZTE, Sanechips, Vivo, CATT **(4)** |
| Alt2: | the availability indication is valid until L1 availability indication is changed by network | Nokia **(1)** |
| Alt3 | default time duration e.g. default paging cycle or modification period | Huawei, HiSilicon, Intel, OPPO, Xiaomi, CMCC, Samsung, InterDigital, DOCOMO, Qualcomm, Nokia, Nodic, Ericsson, LG **(14)** |
|  | 1 default paging cycle | Huawei, HiSilicon, Intel |
|  | [10] default paging cycle | Ericsson |

Issue #2-4: FFS UE doesn’t expect inconsistent L1 based indication during the time duration

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | UE doesn’t expect inconsistent L1 based indication during the time duration | Huawei, HiSilicon, Samsung, Qualcomm, Nordic **(5)** |
|  | UE can ignore the TRS availability indication field received during the validity duration with a bitmap of all “0”s. | Samsung |
|  | Do not support timer-based validity duration reset for L1 based TRS availability indication. | Qualcomm |
| Alt2 | Network is allowed to change the L1 availability indication status during the validity duration. | Nokia, vivo, Panasonic **(3)** |
|  | Unavailability for TRS resources can be indicated before the validity timer expires | vivo |
|  | No need to limit the UE assumption on whether UE expects inconsistent L1 based indication during the validity time duration. | Panasonic |

Issue 2-5: whether to support application delay

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| 1 | The application delay has a paging cycle level resolution with the minimum delay value equal to a paging cycle. | Qualcomm |
| 2 | Application delay of TRS availability indication, [5] ms, is introduced. | MediaTek |
| 3 | indication applies to next modification period | Nordic |

Based on the summary above, proposals 2-1, 2-2, 2-3 are drafted to address issue 2-1/2/3/4 with high priority.

For issue#2-1 and #2-3, proposal 2-1 is drafted based on the majority support:

* time unit of validity duration to be a default paging cycle,
* applicable values of {1,2,4,8,16}
* when the time duration is not configured, support a default time duration

|  |
| --- |
| **[1RD] Proposal 2-1 (v1)**  For the validity duration configured by higher layer, support   * time unit is one default paging cycle, * applicable values: {1, 2,4,8,16}   When the validity duration is not configured, UE assumes a default time duration to be [x] default paging cycle(s). |

Please provide your views about **Proposal 2-1 (v1).** Y or N? Any modifications? What’s the **value for the default time duration**?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y or N)** | **Comments** |
| TCL | Y | We are fine with this proposal |
| LG | Y  with modification | Our views on the validity time are not captured, hence I update the tables above to share LG’s preference. (with red color)  Regarding the proposal, as we commented in our paper, using a modification period as a time unit for the validity duration should be considered. First, it should be noted that modification period is determined by a higher layer as a multiples of default paging cycle (i.e. m\*default paging cycle). Secondly, if option b in the proposal 2-2 is adopted, using a modification period instead of the default paging cycle is a natural choice. From these perspectives, we prefer to modify the proposal as bellow:  **[1RD] Proposal 2-1 (v1)**  For the validity duration configured by higher layer, support   * time unit is one ~~default paging cycle~~ modification period, * applicable values: {1, 2,4,8,16}   When the validity duration is not configured, UE assumes a default time duration to be [x] ~~default paging cycle(s)~~ modification period(s). |
| ZTE, Sanechips | Y  with modification | We agree with LG that modification period is better choice which can (1) handle the issue of extention of on-going valid time duration (more analysis can be found in our contribution), and (2) provide an unfied time boundary and application delay for the alignement of the understanding of availability/unavailability indication.  As to the case that the validity duration is not configured, our original proposal is Alt1. But we are okay to compromise to one modification period for the sake of simplicication and progress.  Our suggestion on the top of LG’s version is as below to make it clearer.  **[1RD] Proposal 2-1 (v1)**  For the validity duration configured by higher layer, support   * time unit is one ~~default paging cycle~~ modification period, * applicable values: {1, 2,4,8,16} of default paging cycle   When the validity duration is not configured, UE assumes a default time duration to be [x] ~~default paging cycle(s)~~ modification period(s). where x=1. |
| Vivo | N | For the case validity time is configured, if Alt-1/2/4 is selected, the discussion on applicable values for validity duration may be needed; if Alt-3 is selected, then the validity duration can be the modification period, and discussion on applicable values can be avoided.  Prefere to separate discuss for cases ‘validity duration is configured’ and ‘validity duration is not configured’. And we also suggest to discuss **Proposal 2-2 (v1)** first, then come back to this issue.  For issue 2#3, when the time duration is not configured, the current proposal suggest a default time duration to be X default paging cycles. If we agree this, the network need to periodically send L1 avalibility in order to keep the TRS alive for IDLE/INACTIVE Ues. From network-wide perspective, the indication could be every paging frame(s). We think it is too frequent and a waste of the resources especially when the TRS availability is stable, and does not change for quite a long time. |
| Samsung | Y |  |
| OPPO | Y | We are fine with this proposal |
| Qualcomm | Partially Y | First, we agree with LG and ZTE that the validity duration should be defined as modification period. In our opinion, this resolves all the major design difficulties for validity duration we encounter now.  Second, we have the same view as MTK that the basic unit of the modification period should be multiple of the actual paging cycle but not default paging cycle. Otherwise, if the default paging cycle is shorter than UE’s actual paging cycle, the UE will not be able to receive the availability indicate if TRS availability information changes after the UE is paged. For that MTK’s proposal to use the maximum default paging cycle as the time unit would work. An alternative (maybe with better network flexibility) is to add a “**Note: network guarantees that the time unit and default value are multiples of the paging cycle for every UE that receives the L1 based TRS availability indication**” |
| Intel | Y | Support FL’s version |
| Sharp | Y |  |
| CMCC | Y |  |
| Ericsson1 | Y, with modifications | We support to use the default paging cycle. We do not see need to link this to modification period, which seems to be itself defined in units of default paging cycles.  Suggest updating the value range as below:  1, 2, 4, 8,16, 32, 64, 128, 256, 512 |
| Xiaomi | Y | And also open to add some more possible values |
| Spreadtrum | Y  with modification | We agree to ZTE’s modified version. |
| DOCOMO | Y |  |
| Apple | Y in principle for paging DCI-based indication | We think the value range should be extended to cover larger values for paging-DCI-based indication.  But for PEI-based indication, this needs some further discussion. It is not clear to us why the indication needs to cover anything beyond the upcoming PO. |
| ZTE, Sanechips 2 |  | We would like to clarify that we think the validity time duration should be a modification period, where the modification period can be multiple paging cycles.  And when the validity time duration is not configured, the default value of a modifcition period is one paging cycle. |
| Panasonic |  | If this proposal only applies for availability indication, it is fine with us. If it also applies to unavailability, we do not support and think it should be until the next availability indication. |
| Nordic | Y |  |
| Nokia(1st round) | Y | We would support the FL proposal with default paging cycle. We could consider also larger values. Default could be 1. |
| Huawei, HiSilicon | Y | We are generally OK with the proposal, but for the applicable values, we are wondering whether some larger value, e.g. 32 can also be supported to give gNB more flexibility.  Regarding the comment from LG and ZTE, we think validity duration can be defined the same as modification period. And the validity duration/modification period can be configured in a number of default paging cycles.  Therefore, we are fine with the current proposal. |
| MTK | Y with modification | We are fine with LG and ZTE modification. But as Qualcomm mentioned before, network should guarantee that every UE can receive the L1 based TRS availability indication during validity duration. To guarantee the functionality of this feature, either the following modification or the Note added by Qualcomm can be supported.  **[1RD] Proposal 2-1 (v1)**  For the validity duration configured by higher layer, support   * time unit is ~~one default paging cycle~~ maximum UE-specific paging DCI * applicable values: {1, 2,4,8,16}   When the validity duration is not configured, UE assumes a default time duration to be [x] default paging cycle(s). |

For issue #2-2, there are many supports for Alt1, Alt2, and Alt3.

* The proponents of Alt3 support modification period to be aligned with the validity duration, where the reference time is same for different L1 availability indications received within the same modification period.
* For Alt1 and Alt2, it is considered as “sliding window” based approach by many companies, where the reference time slides according to the time UE receives the indication.

During the first round discussion, the main goal is to down-select from the two types of approaches.

|  |
| --- |
| **[1RD] Proposal 2-2 (v1)**  Option a  The reference point for start of the validity duration is SFN of the first PF from the [current] DRX cycle where UE receives the indication  Option b  The reference point for start of the validity duration is based on SFN of a modification period configured by higher layer, where   * the modification period is aligned with validity duration |

Please provide your views about **Proposal 2-2 (v1).** Which option do you support? Any modifications? Additional details?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Option a or b)** | **Comments** |
| TCL | Y with modification | In paging PDCCH based TRS indication, the paging DCI of the previous PO is used to indicate the TRS availability indication for the next PO as discussed in our contribution. Thus the DRX cycle where UE receives the indication is the previous cycle and cannot be used as a reference point. Therefore we do not support option a and option b.  Furthermore, Several companies support alt1 i.e. SFN of the first PF from the next DRX cycle. For that reason, we suggest to include another option c in proposal 2-2 as given below.  **Proposal 2-2 (v1)**  Option a  The reference point for start of the validity duration is SFN of the first PF from the [current] DRX cycle where UE receives the indication  Option b  The reference point for start of the validity duration is based on SFN of a modification period configured by higher layer, where   * the modification period is aligned with validity duration   Option c  The reference point for start of the validity duration is SFN of the first PF from the [next] DRX cycle |
| LG | Option b | We support option b  As pointed out by several companies, the reference point shall be common to all UEs in a cell to avoid the issue from the “sliding window” based approach. Moreover, when configuration of TRS resource(s) are changed via SI change procedure, it would be worth using a modification period boundary as a reference point.  Meanwhile, it would be better to modify the sub-bullet in option b, since how to configure the validity duration (e.g. multiples of the modification period) is discussed in the proposal 2-1.   * the modification period boundary is aligned with starting/ending slot of validity duration |
| ZTE, Sanechips | Option b | We support to use modification period as valid time durantion, so option b is preferred.  As to option a, we agree with TCL that it can not be used as reference point as different Ues detect L1 signaling in different occasions, and the detected information of availability can not be used for the synchronization for the reception of L1 signaling. And also, the L1 signaling indicates “unavailability”, it implies TRS resources are unavailable before the L1 detection, which will impact the sync performance. |
| Vivo | Option b | Option b may avoid sliding window issue, and option b align with the current mechanism that the change of broadcast configurations at least per modification period level.  Besides, paging DCI and PEI may located in different DRX cycle or different modification period, since PEI is transmitted before the associated PO. Therefore, the validity duration for L1 indication in PEI and its associated paging DCI may be different, as shown in following figure. This issue exists for both option a and option b.    To align the validity duration between paging DCI and PEI, the validity duration for PEI should follow its associated PO. That is if PEI is transmitted in a different DRX cycle/modification period from its associated Paging DCI, the validity duration is determined based on the DRX cycle/modification period of the paging DCI. |
| Samsung | Option a | We don’t see the need to restrict the time when gNB can transmit the availability indication. We prefer option a, as it allows gNB to transmit the availability indication in any paging cycle based on demand. For the concern on sliding window, if it means no update of an on-going validity duration, we are fine to restricit that UE doesn’t expect to reset the validity timer.  For [current] in option a. We prefer “current” over “next” as gNB usually needs to ensure there are TRS resoruces afvaiable from connected Ues first before trasnmiting the availability indication to idle/inactive Ues. |
| Qualcomm | Option b | Option a implies a floating start of the validity duration which has the problem that network can not switch between availability and unavailability for a TRS unless the indication is only transmitted once before the duration expires (this is less likely to happen). Option b resolves this problem. |
| Intel | Option a |  |
| CMCC | Option a |  |
| Ericsson1 | Option a | We support Option a.  Regarding Option b, it is unclear and seems to cause complication/confusion with the existing modification period used for SI scheduling, etc - is the intention to support a ‘new’ modification period concept for TRS availability or use existing modification period used for SI ? It is also unclear what the relation is between availability received in a Paging DCI and the reference point. It is further unclear why modification period should be aligned with validity duration. |
| Xiaomi | Option a | If Option b is adopted, that means the TRS has to be transmitted, or keeps not transmitting, at least for one modification period. This is not flexible and is contradictory to the intention of introducing L1 indication |
| Spreadtrum | Option b | We agree that option b can avoid “sliding window” issue caused by option a. |
| Apple | Option a for paging DCI-based indication | But to clarify, what is the difference between “SFN of the first PF from the current DRX cycle where UE receives the indication” and “start of the PF for the PO where UE receives the indication”? They seem to be the same for us.  For PEI-based indication, depending on how we define the validity time, it may be easier to define the reference point as when the indication is received. |
| Panasonic | N | For option a, we do not support.  For option b, it is sufficient to say that the SFN is configured by higher layer. |
| Nordic | Option b | The problem with Option a is ckicken-egg problem, UE has to first detect Paging PDCCH in PO before it can rely on TRS to receive Paging PDCCH 😊 |
| Nokia(1st round) | option a. | If we set validity duration to 1, modification period is aligned to validity duration andif SFN of the modification period and PF are same, there should not be any practical difference.  Option a would work as a function of paging cycles, and hence the PDCCH content (with respect to L1 availability) could be determined by paging cycle (by NW). For option b, if we have multiple PFs, it could be that the reference SFN would not be aligned with the paging cycle, resulting need to determine the L1 availability content per PF. Of course this can be avoided by setting the SFN properly (making option b more or less equal to option a). Hence, while difference in my understanding is minor, would prefer option a. |
| Huawei, HiSilicon | Option b | Option a is a ‘sliding window’ solution, which is not robust to DCI missing issue. When gNB changes ‘available’ to ‘unavailable’, gNB cannot know which DCI is missed by the UE, thus it cannot easily decide when to stop transitting TRS. On the contrary, if option b is supported, gNB can stop transmitting TRS at the next modification period.  Also, we think we should define modification period and validity duration to be the same concept. No need to introduce more levels of concept. |
| MTK | Option a, b | We are fine with both options.  The difference may lie in NW implementation capability.  Option a may require NW dynamically adjust validity duration per UE reception time |

For issue #2-4, Proposal 2-3 is drafted based on the majority view to confirm “UE doesn’t expect inconsistent L1 based indication during the time duration”. But many companies haven’t provided views in their contributions yet.

|  |
| --- |
| **[1RD] Proposal 2-3 (v1)**  When a validity duration for a paging PDCCH based L1 availability indication is larger than a paging cycle, UE can receive other paging PDCCH during the validity duration.   * UE doesn’t expect inconsistent availability indication during the validity duration |

Please provide your views about **Proposal 2-3 (v1).** Y or N? Any modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y or N)** | **Comments** |
| TCL | Y | We support the statement “UE doesn’t expect inconsistent availability indication during the validity duration” |
| LG | N | In our understanding, this proposal is related to the issue of unavailability indication discussed in the proposal 1-3. If the option b in the proposal 1-3 is adopted, this proposal is not required. |
| ZTE, Sanechips | Y | We agree with that “UE doesn’t expect inconsistent availability indication during the validity duration”, otherwise, there is no need of valid time duration. |
| Vivo |  | We are fine with this proposal if it is intended for the case that ‘validity duration is configured’, and if option b is selected in **Proposal 2-2 (v1).** |
| Samsung |  | In our understanding, the motivation of this proposal is to avoid reset/update of an on-going validity duration. To achieve that, we think gNB should not transmit another availability indication during any on-going validity duration, i.e. the availabity indication field should be all “0”s during an on-going validity duration from previous availity indication if UE is paged. So, we suggest the following revision.   * UE doesn’t expect any ~~inconsistent~~ availability indication during the validity duration |
| OPPO | Y | Fine with the proposal.  But on the hand, this shall not complicated the indication procedure. That is, in each paging cycle, the UE can be able to receive the indication. |
| Qualcomm | Y | This is the direct outcome of modification period. Our views can be found under Proposal 2-1 and Proposal 2-2. Agree with ZTE that network configured validity duration is only meaningful if the indication is consistent. Otherwise, we should revert the agreement of higher layer configured validity duration. |
| Intel | Y |  |
| Sharp | Y |  |
| CATT | N | UE could receive the new availability indication from paging DCI for over-write of the existing the TRS resource |
| CMCC | Y | We agree the sub-bullet. |
| Ericsson1 | Y with modification | Below update is sufficient – we do not see need for preamble text.  *~~When a validity duration for a paging PDCCH based L1 availability indication is larger than a paging cycle, UE can receive other paging PDCCH during the validity duration.~~*   * *UE doesn’t expect inconsistent availability indication ~~during the validity duration~~* |
| Xiaomi | Y | Agree with the modification proposed by Ericsson. |
| Spreadtrum | Y |  |
| Apple | Y in principle | The question is what is considered as inconsistent availability indication. This is related to the question earlier, whether ‘0’ means unavailable or reserved. If ‘0’ means reserved, then there is no inconsistent indication. |
| Panasonic | N | In our understanding, the meaning of validity period and modification period are different. The proposal is trying to define the later one, modification period. However, for validity period, the main function is to let UE keep the previous assumption of the TRS on-off status when it does not receive any paging. |
| Nordic | Y (acceptable) |  |
| Nokia(1st round) | (Q?) | It would be good to clarify whether the inconsistency concern is for changing from “1” (available) to “0”, or whether network would be allowed to indicate availability e.g. middle of validity duration (“0”🡪”1”)? |
| Huawei, HiSilicon | Y | We support the proposal. |
| MTK | Y | We are fine to support this proposal, but this proposal will have certain restriction to NW.  The limitation of updating TRS availability information after validity duration will make this feature lack of flexibility. For example, NW cannot update the TRS information during the validity duration even if the connected mode UE left. |

## 3.2 <2nd round discussion>

Issue #2-1: determine values for the validity duration configured by higher layer

Issue #2-3: when the time duration is not configured, down-select one alternative

**Summary on Proposal 1-2 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Y or N)** | **Companies** |
| Y | TCL, Samsung, OPPO, Intel, Sharp, CMCC, DOCOMO, Apple, Nordic, Nokia, Huawei, HiSilicon (12) |
| Y w/ modifications | LG, ZTE, Sanechips, Qualcomm, Ericsson1, Spreadtrum, MTK (7) |
| N | Vivo |

Additional comments:

* using a modification period as a time unit for the validity duration should be considered [LG, ZTE, QC, Spreadtrum, vivo]
  + the validity time duration should be a modification period, where the modification period can be multiple paging cycles. And when the validity time duration is not configured, the default value of a modification period is one paging cycle [ZTE]
* Suggest updating the value range: 1, 2, 4, 8,16, 32, 64, 128, 256, 512 [Ericsson, Xiaomi, Nokia]
  + but for the applicable values, we are wondering whether some larger value, e.g. 32 can also be supported to give gNB more flexibility. [HW]
* But for PEI-based indication, this needs some further discussion. It is not clear to us why the indication needs to cover anything beyond the upcoming PO. [Apple]
* If this proposal only applies for availability indication, it is fine with us. If it also applies to unavailability, we do not support and think it should be until the next availability indication. [Panasoic]
* Add a “Note: network guarantees that the time unit and default value are multiples of the paging cycle for every UE that receives the L1 based TRS availability indication” [QC, MTK]

The majority are OK with the proposal. The proposal is further updated to address the additional comments above. Whether or not a validity duration can be defined as modification period will be address in Proposal 2-2. The intention of P2-1 is to complete the configuration of validity duration. The proposal is further split into two based on suggestion from Vivo.

|  |
| --- |
| **[2RD]**  **Proposal 2-1a (v2)**  For the validity duration configured by higher layer at least for paging PDCCH based L1 availability indication, support   * time unit is one default paging cycle, * applicable values: {1, 2,4,8,16, 32, 64, 128, 256, 512} * FFS validity duration can be defined as modification period * “Note: network guarantees that the time unit and default value are multiples of the paging cycle for every UE that receives the L1 based TRS availability indication”   **Proposal 2-1b (v2)**  When the validity duration is not configured, UE assumes a default time duration to be [~~x~~ 1] default paging cycle(s). |

**Please a) provide your view on whether or not to support P2-1a and P2-1b below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| P2-1a | Yes: Qualcomm, Samsung ,Sharp, ZTE, Sanechips, TCL, Xiaomi, DOCOMO, IDCC, CMCC, Panasonic, CATT, Ericsson2 (with updates),OPPO, Apple, Sony  No: LGE |
| P2-1b | Yes: Qualcomm, Samsung, Sharp, ZTE, Sanechips,TCL, Xiaomi, Nokia2, DOCOMO, IDCC, CMCC, Lenovo/Motorola Mobility, Panasonic,OPPO, Apple, Sony  No: LGE, CATT |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Based on the latest version of proposal 2-1a, a update is made for the note. Also added the case that duration is same as actual paging cycle for each UE.   * “Note: network guarantees that the ~~time unit~~ configured validity duration and default value are equal to or multiples of the paging cycle for every UE that receives the L1 based TRS availability indication”   To furether clarify, the note is to ensure that the availability information does not change within the actual paging cycle for any UE. |
| Samsung | For 2-1b, we are OK with default time duration of 1 paging cycle, also applicable value of 1, we are OK with it if the reference time in P2-3 is associated with [next] DRX. If the reference time is associated with [current] DRX, 1 paging cycle is not enough, we think it should be at least 2. |
| ZTE, Sanechips | For proposal 2-1a, we think the version provided by QC is better.  For proposal 2-1b, we think defining the default paging cycle as one default paging cycle is sufficient. |
| LGE | For 2-1a and 2-1b,  If we decide using “modification period boundary” as a reference point, configuring valid duration as a unit of modification period is a straight forward way. Thus, we think this issue should be discussed with or after making decision on the reference point. |
| Vivo | Have following concerns  1, Prefer to discuss [2RD] Proposal 2-2 (v2) first, Proposal 2-1a (v2) and Proposal 2-1b (v2) seems tend to pick Alt-a in [2RD] Proposal 2-2 (v2), because number of 1, 32, 64, 128, 256, 512 DRX cycles is not candidate values for modification period, which includes only {2,4,8,16}.  2, when validity time is not configured, the validity time is only one default DRX cycle, that is not good for UE power saving. We are ok to live with default number of DRX cycles, but prefer not to limit to only one DRX cycle, it should be longer.  If we discuss these two proposals first, suggest the following revision.  **Proposal 2-1a (v2)**  For the validity duration configured by higher layer at least for paging PDCCH based L1 availability indication, support   * time unit is one default paging cycle, * applicable values: {~~1,~~2,4,8,16~~, 32, 64, 128, 256, 512~~}, which is the duration of modification period * ~~FFS validity duration can be defined as modification period~~ * “Note: network guarantees that the time unit and default value are multiples of the paging cycle for every UE that receives the L1 based TRS availability indication”   **Proposal 2-1b (v2)**  When the validity duration is not configured, UE assumes a default time duration to be [~~1~~,8 (at least)] default paging cycle(s). |
| Nokia2 | **For Proposal 2-1a (v2):**  As we are to provide this configuration in broadcast, we could consider to limit e.g. to 8 applicable values {1, 2,4,8,16, 32, 64, 128}.  To align with Alt b (in next proposal) should we adjust:   * FFS validity duration can be defined as modification window~~period~~   For Proposal 2-1b (v2), we think one defaut paging cycle is OK. Network may choose when to send the indication or not. |
| MediaTek | For 2-1a, flexible applicable values should be fine. Since TRS availability indication is different from modification period, it is not very clear to us why we need to align the modificaiotn period.  For 2-1b, the issue of different UE paging cycles cannot be resolved by network configuration. We identified a case where x should be set to 16:   * UE paging cycle is max DRX cycle (2560 ms) while default paging cycle is min DRX cycle (320 ms) * UE PO is in a non-first PF * As illustrated in the figure below, validity time should be at least 2x UE paging cycles; otherwise TRS will never be available for the UE. The corresponding |
| Panasonic | Although we are okay with the proposals, it is suggested to explicitly mention the validity duration is for indication of availability only. |
| CATT | We had agreements in RAN1#106b-e that when the duration is not configure as follows,   * when the time duration is not configured, one of the following alternatives can be considered:   + Alt1: the availability indication is valid until when the UE receives another availability indication.   + Alt2: the availability indication is valid until L1 availability indication is changed by network   + Alt3: default time duration e.g. default paging cycle   Proposal P2-1b(v2) is against the agreements above. |
| Ericsson2 | 2-1a(v2) : Note should be removed/or in square brackets – NW indicates TRS availability based on TRS transmissions for connected UEs – if the validity duration is not suitable for a particular UE, it can simply ignore it. NW does not know which UEs are receiving the indication (optional with/without capability signaling). We don’t prefer wording such as “NW guarantees….”. It should be up to configuration.  The applicable value range should not be unnecessarily restricted and prefer to add some additional values in square brackets until the Note is resolved i.e. as below.   * {1, 2,4,8,16, 32, 64, 128, 256, 512, [x1], [x2],[x3]} |
| Moderator | [2RD summary]  For the proposal 2-1a,   * The note can be updated based on modification from QC.   For the proposal 2-1b, the majority seems to be fine with x =1, However, there are some different preference as follows:   * x = 2, Samsung * x >=8, vivo * 16, MediaTek   To address the comment form CATT for P2-1b(v2), it is the Alt3 from the agreement in RAN1#106b-e.  Let’s revisited them after P2-2 as suggested by [LGE, vivo]. |
| Apple2 | We are generally fine with both proposals.  For proposal 2-1b, we don’t have strong view on the default value. If it is difficult to converge on the default value, we can also choose not to agree on any default and mandate the network to always configure a value. Functionally it is the same. |

Issue #2-2: determine reference point for the start of the validity duration

Issue #2-4: FFS UE doesn’t expect inconsistent L1 based indication during the time duration

**Summary on Proposal 2-2 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Option a or b)** | **Companies** |
| a | Samsung, Intel, CMCC, Ericsson, Xiaomi, Apple, Nokia, MTK ,OPPO(9) |
| b | LG, ZTE, Sanechips, Vivo, Qualcomm, Spreadtrum, Nordic, Huawei, HiSilicon, MTK (10) |
| c | TCL |

\*Option c: The reference point for start of the validity duration is SFN of the first PF from the [next] DRX cycle

Reasons for b:

* the reference point shall be common to all UEs in a cell to avoid the issue from the “sliding window” based approach. [LG, vivo, Spreadtrum, HW]
* align with the current mechanism that the change of broadcast configurations at least per modification period level [LG, Vivo]

Concerns for a:

* it can not be used as reference point as different UEs detect L1 signaling in different occasions, and the detected information of availability cannot be used for the synchronization for the reception of L1 signaling. [TCL, ZTE]
* Option a implies a floating start of the validity duration which has the problem that network can not switch between availability and unavailability for a TRS unless the indication is only transmitted once before the duration expires (this is less likely to happen). [QC]
* the L1 signaling indicates “unavailability”, it implies TRS resources are unavailable before the L1 detection, which will impact the sync performance. [ZTE]
* The problem with Option a is ckicken-egg problem, UE has to first detect Paging PDCCH in PO before it can rely on TRS to receive Paging PDCCH [Nordic]

concerns for b:

* it is unclear and seems to cause complication/confusion with the existing modification period used for SI scheduling, etc - is the intention to support a ‘new’ modification period concept for TRS availability or use existing modification period used for SI ? It is also unclear what the relation is between availability received in a Paging DCI and the reference point. It is further unclear why modification period should be aligned with validity duration. [Ericsson]
* TRS has to be transmitted, or keeps not transmitting, at least for one modification period. This is not flexible and is contradictory to the intention of introducing L1 indication [Xiaomi]
* it is sufficient to say that the SFN is configured by higher layer [Panasonic]
* For option b, if we have multiple PFs, it could be that the reference SFN would not be aligned with the paging cycle, resulting need to determine the L1 availability content per PF[Nokia]

Additional comments:

* “SFN of the first PF from the current DRX cycle where UE receives the indication” and “start of the PF for the PO where UE receives the indication”? They seem to be the same for us.
  + *Moderator*: the former one means the start of the default paging cycle common to all UEs, the latter means the start of PF for a specific UE.

There are reasonable supports for each option. Thanks to the clarifications and discussion on the concerns summarized above, option a and b can be updated accordingly to sync the views about how each approach works. Also, Proposal 2-3 is merged with P 2-2 as UE behavior of “inconsistent availability indication” varies for each option.

|  |
| --- |
| **[2RD] Proposal 2-2 (v2)**  Alt a  The reference point for start of the validity duration is SFN of the first PF from the [current or next] DRX cycle where UE receives the availability indication   * The availability indication is transmitted once before the validity duration expires   + When UE is paged before the expiration of the validity duration, the availability indication field is reserved with value of all “0”s.   Alt b  The reference point for start of the validity duration is based on SFN ~~of a modification period~~ configured by higher layer, where   * the validity duration is defined as periodic modification window * start of the validity duration is SFN of the modification window where UE receives the availability indication * UE doesn’t expect inconsistent availability indication within a modification window * ~~the modification period is aligned with validity duration~~ |

**Please a) provide your preference for supporting Alt1 a or Alt1 b below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Alt a | Samsung, TCL(with modification),Xiaomi, CMCC, Panasonic, CATT (without sub-bullet), Ericsson2 (subbullet not needed), Apple (without sub-bullet) |
| Alt b | Qualcomm, ZTE, Sanechips, LGE, Spreadtrum, vivo, IDCC, Panasonic (without definition of modification period/window) |

**and b) any additional comments (e.g. justificaitons, additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | For Alt b the following bullet needs to be removed, otherwise it is still the floating window which does not work as we previously commented.   * start of the validity duration is SFN of the modification window where UE receives the availability indication   For Alt a, the following bullet is not good for UE newly camped on the cell or switched to idle/inactive to obtain the avaibility information quickly. Network should have the flexibility to transmit the indication signaling more than once in each validity draution.   * The availability indication is transmitted once before the validity duration expires |
| Samsung | We think both work. We prefer Alt a, as the start of TRS availability can be in any paging cycle, which fully utilize of the benfit of dynamic signaling of the indication.  For Altb, the start of TRS availability is restricted to the boundary of modification window, which will introduce delay of availabity indication. |
| ZTE, Sanechips | For alt a, the following bullet restrict NW implementation and has negative impact on UE PS. If the availability indication is only allowed to be transmitted once, UE that doesn’t detect the L1 signaling in that only one transmission occasion can not use TRS for sync.  And for NW, it should have the flexibility to transmit the availability indication more than once to make sure the UEs that are new to the cell can use TRS for power saving.  As a result, it will lead to a float window with alt1 a, therefore, Alt b is suggested.   * The availability indication is transmitted once before the validity duration expires   Moreover, if the validity duration is accounted from the start of the current DRX cycle, it will consume more NW energy as for any UE that detects the L1 signaling will probably not use the TRS for sync after the L1 signaling detection. Hence, it is a waste of NW energy and also resource overhead to use the current DRX cycle as the start of validity time duration  For alt b, the following sub-bullet is not needed which will result in sliding window.   * start of the validity duration is SFN of the modification window where UE receives the availability indication |
| TCL | We support alt1 but we have some concerns on it. Our main concern is, in paging PDCCH based indication, a DRX cycle where UE odifica the avialiabltiy indication is the current DRX cycle and the DRX cycle from where the indication becomes effective is the [next] DRX cycle reference to the current DRX cycle as shown in the following figure.    The wording “where UE receives the availability indication” focus on the previous DRX cycle where the TRS availability indication may be not required. Based on this we suggest the following modification for alt1.  Alt1 a  The reference point for start of the validity duration is SFN of the first PF from the [current or next] DRX cycle, ~~where~~ for which UE receives the availability indication in the previous DRX cycle |
| LGE | For Alt b,  Could we clarify that what “modification window” means? As far as I concern, “modification period” is a term that used in the current spec. Our original intention is using a modification period as a unit of the validity duration and using a modification period boundary as a reference point. If the intention of the “modificaiotn window” is introducing a new definition, for example multiple modification period, it should be captured in this proposal. If so, “floating window problem” that is raised by Qualcomm and ZTE can be resolved. Otherwise, if the intention of the modification window was modification period itself, we have similar concern with Qualcomm and ZTE.  Also, we would like to clarfy the meaning of “inconsistent availability indication”. As commented by Nokia in a previous round, there can be a two types of inconsistency, 1) changing from “1” (available) to “0”, and 2) middle of validity duration (“0”🡪”1”). We think the first inconsistency should be considered since it is related to the issue whether the unavailability indication is supported or not, and we support the third sub-bullet in alt b in this manner. However, there is no reason to preclude indicating validity in the middle of the validity duration even when the availability has not indicated in a previous duration.  For Alt a,  If I understood correctly, Alt a also supports cell common reference point (based on the definition of the first PF from the agreement in the last meeting). However, Alt a requires new definition for PEI only while Alt b reuses the existing definition. Moreover, as we commented in a previous round, Alt a requires additional standard work how to assume availability for the TRS resources at the modification period boundary when SI update for the TRS resource configuration is triggered. Meanwhile Alt b may not require additional work, since the indicated validity duration will be expired at the end of the modification period. |
| Vivo | Please see our comment for Proposal 2-1a (v2) and Proposal 2-1b (v2).  For these two alternatives, we prefer Alt-b. And we agree with Qualcommm, and suggest 2nd bullet under Alt-b is revised as follows.   * start of the validity duration is start SFN of the modification window where UE receives the availability indication   If Alt-a is supported, agree with Qualcomm that the subbullet leads too much restriction. |
| Xiaomi | Both Alt a/b can work and we prefer Alt a, especially “ start from the next DRX cycle”. Alt a is more flexible compared to Alt B because it has finer time granularity.  But for the sub-bullet in Alt a, we think it is a little restrictive, L1 indication can be transmitted multiple times but be consistent with each other. |
| Nokia2 | **On Alt a**  The wording “The availability indication is transmitted once before the validity duration expires” seems to imply a requirement to transmit the availability indication once every validity duration, which should not be mandated. I think we should try to focus to clarify what is the UE expectation if L1 availability indication is received multiple timers during ‘valdity duration’/’modification window’ and leave the when/how often the paging DCI is sent to network implementation. If this was the intention of the wording we would suggest to modify as follows:   * If I availability indication is transmitted already once during~~before~~ the validity duration ~~expires~~   + When UE is paged before the expiration of the validity duration, the availability indication field is reserved with value of all “0”s.   In other words; after first transmission of availability indication during the validity duration, UE expects that in the following transmissions of L1 availability indications the field is reserved with value of all ‘0’s  We would not prefer to consider next DRX cycle. If Alt a goes for next DRX cycle we would tend to refer Alt b.  **On Alt b**  For Alt a the ‘inconcistency’ seems to be somewhat clarified (i.e. “0”🡪”1” is allowed ), but for Alt b this is not fully clear. It seems to be consensus that change from “1” (ot “0”) is not allowed, but if odification window is multiple of (Ues) paging cycles, is “0”🡪”1” allowed middle of the modification window or does this need to be fixed at the start of the modification period. |
| MediaTek | We think both Alts can work. But, **for Alt a, the reference point should be current DRX cycle**; otherwise the UE with PO at 1st PF start can never use TRS, as illustrated below:    Since both Alts can work, we are fine to go for majority decision. |
| CMCC | We think both alternatives can work, but Alt a can facilitate UE using the TRS as soon as possible. |
| CATT | We need to have separate check if the L1 availability indication of TRS resource set is carried by PEI and/or paging DCI. Both Alt 1 and Alt 2 are not clear without clarificiaotn of the DCI carried L1 based availability indication. |
| Ericsson2 | For Alt 1 : the subbullet is not needed – whether the availability field indicates availability in subsequent occasion should be update to the NW (whether TRS is available in the associated occasions). Our preference is “current DRX cycle”. This allows NW full flexibility to indicate availability based on ongoing TRS transmissions.  “UE doesn’t expect inconsistent availability indication.” can be a standalone proposal.  Below are some follow-up comments (in blue) to comments from companies regarding Alt 1:   * *it can not be used as reference point as different UEs detect L1 signaling in different occasions, and the detected information of availability cannot be used for the synchronization for the reception of L1 signaling. [TCL, ZTE]*   =>it can be since it refers to the “SFN of the first PF from the [current or next] DRX cycle” and UE can rely on TRS for paging PDCCH if previously indicated availability is applicable for the TRS occasion.   * *Option a implies a floating start of the validity duration which has the problem that network can not switch between availability and unavailability for a TRS unless the indication is only transmitted once before the duration expires (this is less likely to happen). [QC]*   =>switching is not needed since unavailability is indicated by timer expiry.   * *the L1 signaling indicates “unavailability”, it implies TRS resources are unavailable before the L1 detection, which will impact the sync performance. [ZTE]*   =>UE can assume TRS in TRS occasions only the availability has been indicated. There is no sync performance issue.   * *The problem with Option a is ckicken-egg problem, UE has to first detect Paging PDCCH in PO before it can rely on TRS to receive Paging PDCCH [Nordic]*   =>UE can assume TRS in TRS occasions only the availability has been indicated - UE can rely on TRS for paging PDCCH if previously indicated availability is applicable for the TRS occasion. |
| Moderator | [2RD summary]  For Alt a,   * One remaining issue is to select from [current or next] DRX cycle as reference. No consensus yet.   + Next: TCL, Xiaomi   + Current: Nokia, Ericsson * The restriction based on the bullet/sub-bullet is necessary. Because gNB has to make sure UEs receive the paging PDCCH in **different paging cycles (when validity duration is a larger than one default paging cycle)** have the same understanding of the start of the validity duration. * The modification suggested by Nokia is reasonable.   For Alt b, the key idea is to reuse the principle of modification period for SI update. However, it will be new in RAN1 for L1 signaling based availability indication. So, the name doesn’t matter. We just need to clarify the definition. Also, the applicable values are not necessary to be same as modification period for SI. The following modifications are considered based on the additional comments:   * Second bullet is removed as suggested by [QC, ZTE] * For the inconsistent, the majority support no changing from “1” to “0”. So “inconsistent availability indication” is changed to “inconsistent availability information” to clarify that. * For change from “0” to “1”, the majority support it. The last bullet is added to clarify UE can receive change of “0” to “1” based on receiving the availability indication in any location. * “Modification window” is replace by “time window” to address the concern from Panasonic that no need definition of the modification period/window.   To address CATT’s comment regarding applicable signaling methods, the majority consider to support it at least for paging PDCCH based availability indication.  **Proposal 2-2 (v3)**  Down-select one from the following two alternatives for at least paging PDCCH based L1 availability indication in RAN1#107-e meeting:  Alt a  The reference point for start of the validity duration is SFN of the first PF from the [current or next] DRX cycle where UE receives the availability indication   * If t~~T~~he availability indication is transmitted already once during ~~before~~ the validity duration expires   + When UE is paged before the expiration of the validity duration, the availability indication field is reserved with value of all “0”s.   Alt b  The reference point for start of the validity duration is based on SFN configured by higher layer, where   * the validity duration is configured ~~defined~~ as a periodic ~~modification~~ time window * ~~start of the validity duration is SFN of the modification window where UE receives the availability indication~~ * UE doesn’t expect inconsistent availability information ~~indication~~ within the same validity duration ~~a modification window~~ * UE can receive availability indication in any location of the validity duration |
| Apple | For Alt a, we have a few questions:   1. it is unclear what this means: “When UE is paged before the expiration of the validity duration, the availability indication field is reserved with value of all “0”s.” Or why do we need to have this restriction? In our view, each availability indication has its own validity duration. Whenever the gNB indicates the availability, it needs to make sure it is available in that duration. Value ‘0’ does not invalidate the TRS occasions that were indicated as available by earlier DCI. 2. Does the DRX cycle mean default paging cycle here? Thanks the moderator for the response to our earlier question. But even if the UE’s paging cycle is different from the default paging cycle, the first PF is still the same, isn’t it? Just want to make sure I did not miss anything here.   For Alt b, does it imply that there could be gap from the start of the modification window to the PO where the UE cannot get any availability indication? Isn’t this too restrictive? |
| SONY | In principle both can work. However, our preference is Alt. a and the reference is the current DRX. |

# Signaling methods

The following were agreed to support L1 based signaling signaling for availability indication of TRS/CSI-RS occasion(s) to idle/inactive UEs.

|  |
| --- |
| From RAN1#105-e  Agreement:  Confirm the following working assumption:  Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive Ues.   * FFS details, including paging DCI and/or PEI for L1 based signaling * FFS SIB-based signaling/configuration   + Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signalling   **Working assumption:**  Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.  Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues at least if PDCCH-based PEI is down-selected.   * FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB   From RAN1#106bis-e  Working Assumption  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration. |

In contributions [1-24], proposals related to L1 based signalling methods are summarized in table below:

|  |  |
| --- | --- |
| Huawei, HiSilicon | **Proposal 10: Confirm the whole working assumption, i.e.**  ** Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  ** Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues at least if PDCCH-based PEI is down-selected.**   1. **FFS how to enable/disable L1 based availability indication configurable by SIB**   **Proposal 11: Confirm the working assumption:**  **- If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.** |
| ZTE, Sanechips | **Proposal 4: The TRS availability indication mechanism, bit size, and indication content for paging PDCCH and PEI should be the same.**  **Proposal 6: Confirm the following working assumption**  **If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.** |
| Vivo | **Proposal 1: the network configures the TRS resources for Ues by SIB and**  **- TRS is available for IDLE/INACTIVE Ues when SIB indicates to Ues that L1 availability indication is NOT applicable**  **- TRS availability information is provided by L1when SIB indicates to Ues that L1 availability indication is applicable**  **Proposal 2: If L1 availability indication is enabled, it should be provided in both PEI (if configured) and paging DCI.**  **- The paging DCI and PEI should provide the same availability/unavailability** |
| TCL | **Observation 1: Using PEI based availability indication of TRS/CSI-RS occasion to the idle/inactive UE is more beneficial in terms of power saving when a UE or a group of Ues are paging in non- contiguous way in successive Pos.**  **Observation 2: Using paging PDCCH based availability indication of TRS/CSI-RS occasion is more beneficial in terms of power saving when a UE or a group of Ues are paging in contiguous way in successive Pos.**  **Proposal 1: Support the same design mechanism/principle for mapping methods and DCI fields of paging PDCCH and PEI based TRS availability indication.**  **Proposal 2: If L1 based indication is enabled it can be provided in either PEI (if configured) or in paging DCI, but not in PEI and paging DCI simultaneously.**  **Proposal 3: A gNB can enable paging PDCCH or PEI based TRS indication at a target PO implicitly by:**  **• Using paging PDCCH when a UE or a group of Ues are paging in contiguous way in successive Pos**  **• Using PEI when a UE or a group of Ues are paging in non- contiguous way in successive Pos**  **Proposal 4: A gNB can enable paging PDCCH or PEI based TRS indication at a target PO explicitly by configuring a NewBitField of one-bit size in the SIB\_X, where the NewBitField value indicates to enable paging PDCCH or PEI based TRS indication.** |
| Spreadtrum | **Proposal 1: Confirm the working assumption that “Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues”.**  **Proposal 2: Confirm the working assumption that “Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues”.**  **Proposal 3: Paging PDCCH based availability indication and PEI DCI based availability indication should be of equal priority.** |
| CATT | **Observation 1: PEI based availability indication has a negligible UE power saving gain over that of paging DCI.**  **Observation 2: TRS availability indication included in the PDCCH based PEI would reduce the PEI detection performance and potential power saving gain.**  **Observation 3: TRS availability should not change frequently by L1 based signaling to achieve the power saving gain.**  **Proposal 1: TRS availability indication should be carried in paging DCI only.** |
| OPPO | **Proposal 1: support PEI based availability indication and with the same DCI field as that of paging DCI based availability indication.**  **Proposal 2: how to use/configure the two L1 indication methods is up to the gNB’s implementation. The gNB can configure to use one of them or both.** |
| Sony | **Observation 1: The usage of TRS/CSI-RS for idle/inactive Ues and paging enhancements are two different features in rel-17. Depending on the progress of the WI, each of the features can be either mandatory or optional features.**  **Proposal 1: PEI PDCCH should only be used to carry the sub-group indication for paging enhancements. Do not support PEI PDCCH based L1 availability indication of TRS/CSI-RS for idle/inactive UE.** |
| Intel | **Proposal 1: Prioritize paging PDCCH based availability indication signaling design.**  **Observation 1: TRS availability indication is not an essential functionality of the PEI.**  **Proposal 2: Similar design mechanism/principle for PEI (if agreed) and paging DCIs for TRS availability indication includes adopting a similar applicable validity duration, reference starting point, bitmap/codepoint mapping to TRS resources/resource sets etc.** |
| Xiaomi | **Proposal 1: The availability of TRS/CSI-RS can be implicitly indicated by the existing of the TRS/CSI-RS configuration in SIB.**  **Proposal 2: Not support the working assumption. L1 based availability indication can be absent, and when it is absent, the availability of TRS/CSI-RS can be implicitly indicated by the existing of the TRS/CSI-RS configuration in SIB.**  **Proposal 3: Before UE receive a first L1 indication after entering a cell, UE should assume the TRS/CSI-RS for idle is not transmitted.** |
| CMCC | **Proposal 1. Confirm the working assumption: If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.**  **Proposal 2. If L1 availability indication is enabled, it can be provided in either PEI or in paging DCI.** |
| Panasonic | **Proposal 1: Confirm the working assumption that if TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.** |
| Samsung | **Observation 1: The additional power saving gain for PEI based availability indication compared with paging PDCCH based availability indication is limited given the fact that gNB doesn’t expect to transmit the availability indication frequently for idle/inactive Ues.**  **Observation 2: If no consensus on the same design mechanism/principle for PEI based availability indication and paging PDCCH based availability indication, large duplicated spec efforts are expected to support the two L1 based signalling methods.**  **Observation 3: UE may not be able to achieve target reliability for the PDCCH based PEI due to the increased payload size if the PDCCH is further used for providing availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  **Proposal 1: Confirm to support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  **Proposal 2: Deprioritize PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  **Proposal 3: Confirm the following working assumption**  **Working Assumption**  **If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.** |
| InterDigital | **Proposal 2: PEI availability information is the same as the paging PDCCH availability information.** |
| LG | **Observation 1: Both paging DCI and PEI can afford the information on availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive Ues.**  **Observation 2: The availability indication over PEI is beneficial from UE power saving and NW overhead perspective when PEI is supported.**  **Observation 3: If the availability indication over PEI is not supported,**  **o UE that monitors a PEI consumes the power due to the PO monitoring when PEI is transmitted**  **o NW overhead will be increased if gNB transmit PEI even if there is no paging message**  **Proposal 1: Confirm the working assumption regarding L1 based availability indication.**  **O Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  **O Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues at least if PDCCH-based PEI is down-selected.** |
| NTT  DOCOMO | **Proposal 1: Paging early indication should be adopted to indicate the availability of TRS/CSI-RS for idle/inactive mode UE.** |
| Ericsson | **Proposal 6 For supporting TRS availability in the PEI DCI, following is supported :**  **a. Configuration of the bitfield within the DCI via a start position within the DCI and a length field - can be different from Paging DCI**  **b. Configuration of validity time**  **c. Reference point is the SFN of the first PF associated with the current DRX cycle where UE receives the indication.**  **d. Configuration of grouping (if explicit) of TRS resource sets – can be different from Paging DCI**  **e. Beam-based grouping – grouping/indication mechanism is same as that for Paging DCI (if configured)** |
| Qualcomm | **Observation 1: According to the RAN #93 conclusion, RAN1 should strive to align the TRS availability indication design between the paging PDCCH based solution and the PEI based solution.**  **Proposal 2: For PEI based TRS availability indication, RAN1 adopt one of the following two options**  **• Option 1: PEI based TRS availability indication is not supported. Only paging PDCCH based TRS availability indication is adopted**  **• Option 2: PEI based TRS availability indication and paging PDCCH based TRS availability indication use the same number of bits in the DCI format to indicate availability for the same set of TRS resources based on the same resolution of TRS resources (e.g., one bit per resource, resource set, or group of resource sets).** |
| MediaTek | **Proposal 7: Confirm the following working assumption for TRS/CSI-RS availability information:**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues at least if PDCCH-based PEI is down-selected.**  **• FFS whether and how to enable/disable L1 based availability indication configurable by SIB**  **Proposal 8: Confirm the following working assumption:**  **Working Assumption**  **If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.** |
| Nokia | **Proposal: Confirm the working assumption:**  **Working assumption:**  **Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive Ues.**  **Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues at least if PDCCH-based PEI is down-selected.**  **• FFS whether and how to enable/disable L1 based availability indication configurable by SIB**  **Observation: Monitoring PEI is not mandatory to the UE, and UE could choose to monitor paging DCI directly instead, thus if L1 availabilty indication is configured, it should be provided in both PEI and in paging DCI.** |
| Nordic | **Proposal-2: Confirm the working assumption**  **Working Assumption**  **If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration** |

According to the above proposals, the remaining issues related to signalling methods for availability indication of TRS/CSI-RS occasion(s) to idle/inactive Ues include:

* Issue 3-1: confirm WA on how to enable L1 availability indication
* Issue 3-2: confirm WA on supporting paging PDCCH based and PEI based availability indication
* Issue 3-3: same mechanism/principle for PEI DCI and paging DCI based availability indication if both are supported

## 4.1 <1st round discussion>

Companies views for Issue#3-1/2/3 in contributions [1-24] are summarized in tables below.

Issue 3-1: whether to confirm the following WA on how to enable L1 availability indication

**If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration/**

|  |  |  |
| --- | --- | --- |
|  | **Confirm the WA** | **Support** |
| Alt1 | Yes | Huawei, HiSilicon, ZTE, Sanechips, CMCC, Panasonic, Samsung, MediaTek, Nordic **(9)** |
| Alt2 | No, L1 based availability indication is enabled/disabled by SIB  TRS is available for IDLE/INACTIVE Ues when L1 availability indication is not enabled. | Vivo, Xiaomi **(2)** |
| Alt2 | No, A gNB can enable paging PDCCH or PEI based TRS indication at a target PO explicitly by configuring a NewBitField of one-bit size in the SIB\_X, where the NewBitField value indicates to enable paging PDCCH or PEI based TRS indication. | TCL |

Issue 3-2: confirm WA on supporting paging PDCCH based and PEI based availability indication

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

**Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive Ues at least if PDCCH-based PEI is down-selected.**

|  |  |  |
| --- | --- | --- |
|  | **Confirm the WA** | **Support** |
| Alt1 | Yes for both paging PDCCH and PEI PDCCH based availability indication | Huawei, HiSilicon, Spreadtrum, LG, DOCOMO, MediaTek, Nokia **(7)** |
| Alt2 | Prioritize paging PDCCH | Intel, Samsung **(2)** |
| Alt3 | Yes for paging PDCCH, do not support PEI based availability indication | CATT, Sony, [Qualcomm] **(3)** |

Issue 3-3: same mechanism/principle for PEI DCI and paging DCI based availability indication if both are supported.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Design aspects** | **Yes** | **No** |
| 1 | Same indication content, i.e. associated TRS resources per bit, and bitmap size | ZTE, Sanechips, TCL, OPPO, Intel, InterDigital, Qualcomm **(7)** | Ericsson |
| 2 | Same validity duration and reference point | Intel | Ericsson |
| 3 | if L1 availability indication is enabled, it should be provided in both PEI (if configured) and in paging DCI | Vivo | TCL, OPPO, CMCC, |

Issue 3-2 and 3-3 are highly related to the design of indication content and validity duration discussed in Section 2 and 3. So, they can be revised in late stage of this meeting based on the progress in Section 2 and 3.

For issue 3-1, the following proposal is drafted based on the majority view to confirm the WA, also based on the conclusion in last meeting.

|  |
| --- |
| **[1RD] Proposal 3-1 (v1)**  Confirm the following working assumption  Working Assumption  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration. |

Please provide your views about **Proposal 3-1 (v1).** Y or N? Any modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y or N)** | **Comments** |
| TCL | Y | We support the WA, and apologize for not writing the proposal, related to the use of paging PDCCH based indication or PEI based indication, clearly in our contribution. The intention of our proposal is how to use only one L1 based singlaing (either paging PDCCH based indication or PEI based indication) at a target PO as we support single L1 indication signaling at a target PO. |
| LG | Y | We support this proposal. |
| ZTE, Sanechips | Y |  |
| vivo | N | If the WA is confirmed, and if the network does not change the TRS for IDLE/INACTIVE Ues very frequently (e.g., the change only occurs when from day to night), in order to keep the TRS active for Ues, the network needs to send L1 indication frequently to IDLE Ues. It is a waste of network resources.  Hence, we propose that, the network configures the TRS resources for Ues by SIB and   * TRS is available for IDLE/INACTIVE Ues when SIB indicates to Ues that L1 availability indication is NOT applicable (for case TRS availability does not change frequently, e.g. availability only switch on/off for day/night) * TRS availability information is provided by L1 when SIB indicates to Ues that L1 availability indication is applicable (for cases TRS availability may change frequently) |
| Samsung | Y |  |
| OPPO | Y |  |
| Qualcomm |  | We are ok to support the proposal, but vivo’s argument does make sense if TRS presence/absence is not frequently changing. This may happen in the field given TRS is similar to the LTE CRS. Then it might be beneficial to keep the flexibility that L1 indication is enabled/disabled by network. If it is disabled, all configured TRS are transmitted. |
| Intel |  | Agree with vivo’s comments |
| Sharp | Y |  |
| CATT | N | TRS should not change frequent in order for UE to achieve power saving. The availability could be enable/disabled by SIB-X. |
| CMCC |  | Support vivo’s comments. |
| Ericsson1 | Y |  |
| Xiaomi | N | TRS availability can be implicitly indicated by the presence of configuration in SIB |
| Spreadtrum | Y |  |
| DOCOMO | Y |  |
| Apple |  | We also agree with vivo’s commments |
| Panasonic | Y in principle | We support this proposal. But we are also open to hear views from network vendors if there is strong concern. |
| Nordic | Y |  |
| Nokia(1st round) |  | With the assumption that network can piggy pack the L1 availability indication to paging message (i.e. send it only when/if paging is sent), we are fine to confirm this WA. |
| Lenovo/Motorola Mobility | Y |  |

## <2nd round discussion>

Issue 3-1: confirm WA on how to enable L1 availability indication

**Summary on Proposal 3-1 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Y or N)** | **Companies** |
| Y | TCL, LG, ZTE, Sanechips, Samsung, OPPO, Qualcomm, Sharp, Ericsson, Spreadtrum, DOCOMO, Panasonic, Nordic, Nokia, Lenovo/Motorola Mobility, Sony **(16)** |
| N | Vivo, CATT, Xiaomi |

Reason for N:

* if TRS presence/absence is not frequently changing, the availability could be enable/disabled by SIB-X. [Vivo, QC, Intel, CATT, CMCC, Xiaomi, Apple]

The only controversial thing is whether to support SIB based availability indication. Same as the conclusion in last meeting, there is no consensus. We already spent lots of time discussion this issue, pros and cons for each side should be clear to the group. For the sake of time, moderator suggests to deprioritize the discussion on SIB based availability indication. Let’s try to confirm the WA at least when no SIB based availability indication is supported.

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| --- |
| **[2RD] Proposal 3-1 (v2)**  ~~Confirm the following working assumption~~  ~~Working Assumption~~  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration if only L1 based availability is supported. |

**Please a) provide your view on whether or not support the proposal 3-1 (v2) below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Y | Qualcomm, Samsung, Sharp, ZTE, Sanechips,TCL, LGE(with modification), Spreadtrum, Xiaomi, DOCOMO, IDCC, CMCC, Panasonic |
| N | Nokia2, CATT,Ericsson2 |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | We are fine with the intention of the proposal, but prefer some updates. In my understanding, this proposal might require additional decision point whether the L1 based availability is supported only. But as long as companies have common understanding that “if only L1 based availability indication is supported” can be automatically decided even without any additional decision, we also fine with the current wording. Otherwise we prefer to update the proposal as follow:  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration if ~~only L1 based availability~~ SIB based availability indication is not supported. |
| Vivo | The technical concerns have not been solved. If the WA is confirmed, and if the network does not change the TRS for IDLE/INACTIVE Ues very frequently (e.g., the change only occurs when from day to night), in order to keep the TRS active for Ues, the network needs to send L1 indication frequently to IDLE Ues. It is a waste of network resources.  For progress, if we confirm the working assumption, we suggest to allow validity time of L1 availability indication can be long enough (e.g., until recption of the another L1 indication or not limited to one DRX cycle) if the validity time is not configured. |
| Nokia2 | To progress, we should confirm the working assumption. |
| MediaTek | We are also supportive to confirm the working assumption that focus on L1 based availability indication. From the latest RAN2 agreement, RAN2 already assumes to support current RAN1 working agreement, and there is no reason RAN1 still spend time to debate.   * 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.   From RAN2 agreement, it looks RAN2 may also decide whether L1 availability indication can be enable/disable via SIB. If RAN1 cannot decide, we may leave the decision to RAN2 (but not preferred) |
| CATT | L1 availability of TRS resource set would be configured by SIB-X. The field in the SIB-X could be optional in present or absent (which is RAN2’s decision in RRC parameter). |
| Ericsson2 | The WA should be confirmed. |
| Moderator | [2RD summary]  There are still different views on whether or not SIB-based availability indication should be supported. Since there is still no consensus, the intention of this proposal is to complete L1 availability indication in case no further progress for SIB based availability indication, which is likely to be the final situation. A note is added to clarify that the condition “if only L1 based availability is supported” can be confirmed automatically if no further progress.  **Proposal 3-1 (v3)**  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration if only L1 based availability is supported.  Note: According to the conclusion that “no consensus to support SIB based availability indication” in RAN1#106bis-e, “if only L1 based availability indication is supported” can be automatically decided if no agreement to support SIB based availability indication in RAN1#107-e meeting. |
| Apple | Given where we are now, we are fine with either P3-1 (v3) or confirming the previous working assumption. |
|  |  |

# Higher Layer Configurations

The following was agreed for the ompaniesion of TRS/CSI-RS occasion(s) for idle/inactive Ues.

|  |
| --- |
| From RAN1#106bis-e:  **Agreement**  Configuration of TRS/CSI-RS occasion(s) for idle/inactive Ues include a list of one or more TRS resource sets, where:          a TRS resource set can be configured to include   * a set of TRS resources up to two consecutive slots,     Note: a TRS resource is same as Rel-15/16, i.e. a CSI-RS in a symbol.   * at least common configuration parameters:     a QCL reference    firstOFDMSymbolInTimeDomain,    ‘frequencyDomainAllocation for row1’, ‘startingRB’ ,‘nrofRBs’,’powerControlOffsetSS’, periodicityAndOffset’    FFS          scramblingID,          a TRS resource set ID, number of slots {1, 2} or number of symbols {2, 4} if supported          Note: the ‘TRS resource set’ configuration is not (necessarily) identical to ‘NZP-CSI-RS-ResourceSet’ configuration for TRSin R15/16. |

In contributions [1-24], proposals related to high layer configuration of TRS/CSI-RS ompanies(s) for idle/inactive Ues are summarized in table below:

|  |  |
| --- | --- |
| Huawei, HiSilicon | **Proposal 12: scramblingID is configured per TRS resource.**  **Proposal 13: TRS resource set ID, ‘number of slots {1, 2}’ and ‘number of symbols {2, 4}’ are not common parameters configured in a TRS resource set.**  **Proposal 14: Support ‘associatedIndicationBit’ as a common parameter per TRS resource set in the TRS-ResourceSetConfig to support the association method proposed in Proposal 6.** |
| ZTE,  Sanechips | **Observation 1: The configuration of scrambling ID is needed to mitigate interference.**  **Proposal 11: The scramblingID can be configured as a common parameter per resource set.**  **Proposal 12: The number of slot of TRS/CSI-RS occasion(s) should be configured as a common parameter common in TRS resource set.**  **Observation 2: For FR2, there are at most 49 TRS resource sets with 49 different beams can be configured by one SIB message (less than 64 beams).** |
| CATT | **Proposal 6: TRS/CRS-RS resource/resource set configuration should meet the requirement of SIB message size limit.**  **Proposal 7: TRS resources configuration scheme should have ability to support multi-beam operation with up to 64 beams.**  **Proposal 8: Scrambling ID and TRS resource set ID should be common parameters of the TRS resource set to meet the requirement of SIB message size limit.**  **Proposal 9: Slot number of the TRS resource set should be indicated implicitly, i.e., slot number=2 for FR1 and slot number=1 for FR2.**  **Proposal 10: The following TRS resource set configuration parameters: startingRB, nrofRBs, periodicity and validity duration could be common for all the TRS resources sets.**  **Proposal 11: TRS resources configuration should support a maximum of 64 TRS resource sets.**  **Observation 4: When CSI-RS resources are configured by SI without association with the paging occasion(s), UE might not use the TRS for channel tracking to achieve the UE power saving gain.**  **Observation 5: gNB could configure the CONNECTED mode UE with the TRS/CSI-RS resource bundled with SSB/paging occasion which is configured for IDLE mode UE.**  **Proposal 12: 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 13: The following procedure can be used for TRS/CSI-RS occasion(s) configuration:**  **Step1) Configured parameters of TRS/CSI-RS resource from the resourceMapping and periodicityAndOffset of nzp-CSI-RS-Resource set**  **Step 2) SIB indicates parameters details, including**  **- QCL assumption of the configured TRS/CSI-RS resources associated with a SSB;**  **Step 3) TRS occasion(s) after the SSB is obtained based on the configured TRS/CSI-RS resource grid and periodicity in step1 and step 2** |
| Sony | **Proposal 3: Support higher layers to provide the configuration of multiple validity time value(s) of TRS/CSI-RS transmission and L1 based availability indicating the applied validity time (i.e, the index of the configuration).**  **Proposal 6: Support providing multiple TRS/CSI-RS configurations to idle/inactive Ues.**  **Proposal 7: TRS/CSI-RS configuration index is defined for the resource-set of TRS/CSI-RS and a bit is associated with a TRS resource set (i.e., TRS/CSI-RS configuration index).** |
| Xiaomi | **Proposal 5: The maximum number of configured TRS resource sets should be less than bitmap size.** |
| Samsung | **Proposal 10: Support a SIB based configuration parameter of *TRS-ResourceConfig*, where**   * **the *TRS-ResourceConfig* consists of up to X TRS resource set(s), and each TRS resource set is configured by *TRS-ResourceSet*,** * **a TRS-ResourceSet consists of up to Y NZP CSI-RS resources, and each NZP CSI-RS resource is configured by *TRS-Resource*,** * **X is the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1,** * **Y = 4.**   **Observation 4: According to the restriction supported in 5.1.6.1.1 of TS 38.214, number of slots configured can be implicated indicated by the number of RS resources per resource set.** |
| Apple | **Proposal 1: A common parameter of scramblingID is supported for a TRS resource set. In addition, scramblingID can also be configured per CSI-RS symbol if needed.**  **Proposal 2: For a TRS resource set, introduce a new parameter for the number of slots, which indicates 1 or 2 slots for the TRS configuration.**  **Proposal 3: Further consider introducing common parameters (e.g., starting RB and nrofRBs) for multiple/all TRS resource sets to reduce the signaling overhead.** |
| Lenovo | **Proposal 1: All TRS resources in a TRS resource set is configured with a common configuration parameter scramblingID.**  **Proposal 2: A TRS resource set ID explicitly indicates an SSB index as a QCL source of the TRS resource set.** |
| Sharp | **Observation: ScramblingID can be optionally configured for each resource in one resource set**  **Proposal 1: For FR2, the slots number of TRS resources can be configured in set to reduce overhead**  **Proposal 2: The indication of QCL information of TRS resources can be associated with the resources configuration order in SIB** |
| NTT DOCOMO | **Proposal 4: The common configuration parameter among all TRS resources should be supported to reduce the SIB overhead for TRS/CSI-RS for idle/inactive mode UE.** |
| Ericsson | **Observation 1 For configuration of TRS occasions in FR1, there is no need to introduce RRC parameter for indicating number of slots.**  **Observation 2 For the TRS used for connected mode Ues, specification allows scramblingID to be different among resources within a resource set, and the same flexibility should be ensured for TRS occasions for idle mode Ues.**  **Proposal 7 For configuration of TRS resource set,**  **a. TRS resource set ID can be implicit, e.g., based on order of the resource sets in the higher layer configuration.**  **b. Parameter scramblingID should be configured per resource in a TRS resource set.**  **c. For FR2, introduce an optional parameter (twoSlotTRSforFR2) to indicate number of slots i.e. if twoSlotTRSforFR2 is configured/present, then the CSI-RS resources of the TRS resource set are in two consecutive slots, otherwise the CSI-RS resources of the TRS resource set are in one slot.** |
| Nokia | **Proposal: Either introduce an additional bit to TRS resource set to indicate the number of slots/symbols or agree that for IDLE/Inactive TRS occasions one slot (2 symbols) is always assumed.**  **Proposal: Association of TRS resource set to a group indicated of L1 availability bitmap is informed as a part of the TRS resource set (e.g. bit/group index).**  **Proposal: Provide scramblingID as a part of the TRS resource set and assume it to be common for all symbols of TRS resource set.** |
| Nordic | **Proposal-5: Only resource-sets are defined for Idle TRS and contain all necessary parameters.**  **Observation-1: When TRS periodicity is larger than SSB periodicity, Ues with TRS location being far ahead of PF nominal location will have unnecessarily large power consumption.**  **Proposal-6: For the case when TRS periodicity is larger than SSB cycle, consider delaying UE’s PF from nominal location to frame after TRS, in order to facilitate power saving. In other words, consider defining separate PF for R17 Ues supporting Idle TRS.** |

According to the above proposals, the remaining issues related to configuration for availability indication of TRS/CSI-RS occasion(s) to idle/inactive Ues include:

* Issue 4-1: whether to configure scrambling ID per TRS resource or TRS resource set
* Issue 4-2: other configuration parameters
  + e.g. resource set ID, number of slots, associatedIndicationBit, validity time duration, location association with SSB/paging occasion(s)
* Issue 4-3: configuration limit, e.g. maximum # of resource/resource set
* Issue 4-4: configuration overhead reduction, e.g. common parameters per multiple/all TRS resource sets

## 5.1<1st round discussion>

Companies views for Issue#4-1/2/3/4 in contributions [1-24] are summarized in tables below.

Issue 4-1: whether to configure scrambling ID per TRS resource set

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | Yes, | ZTE, Sanechips, CATT, Apple, Lenovo, Nokia, Nordic **(7)** |
| Alt2 | No, per TRS resource | Huawei, HiSilicon, Apple, Ericsson, Samsung **(5)** |

Issue 4-2: other configuration parameters

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Additional configuration parameters** | **Yes** | **No** |
| 1 | TRS resource set ID | CATT, Sony | Huawei, HiSilicon, Ericsson |
| 2 | number of slots {1, 2}, | ZTE, Sanechips, Apple, Nokia  -For FR: sharp, Ericsson | Huawei, HiSilicon,  Alt1: based on number of TRS resources per set  -samsung  Alt2:slot number=2 for FR1 and slot number=1 for FR2  - CATT  Alt3: one slot (2 symbols) is always assumed  - Nokia |

Issue 4-3: Configuration limit, e.g. maximum # of resource/resource set

|  |  |  |
| --- | --- | --- |
|  | **Maximum number of TRS resource sets** | **Support** |
| Alt1 | 64 | CATT |
| Alt2 | limited by the bitmap size of L1 avalability indication | Xiaomi |
| Alt3 | the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 | Samsung |

Issue 4-4: configuration overhead reduction,

|  |  |  |
| --- | --- | --- |
|  | **Descriptions** | **Support** |
| Alt1 | Support common ompaniesion parameters for all TRS resource sets, e.g. startingRB, nrofRBs, periodicity and validity duration | CATT, Apple, DOCOMO |
| Alt2 | The indication of QCL information of TRS resources can be associated with the resources configuration order in SIB | Xiaomi |

Based on the summary above, proposals 4-1 and 4-2 are drafted to address Issue #4-1/2/3. For issue 4-4, the two methods to reduce ompaniesion overhead can be discussed in late stage if time allows.

Issue 4-1 and 4-2 are related, considering the scrambling ID is the only configuration parameter that may be configured per TRS resource:

* If there is no any TRS resource specific ompaniesion parameter, how to determine the number of TRS esources or CSI-RS symbols should be either explicit configured or be fixed. Option a is drafted based on the majority view to support explicit ompaniesion of number of slots/symbols;
* Othwerwise, the number of CSI-RS symbols can be indicated by the number of configured TRS esources. Thus no explicit ompaniesion of number of slots/symbols is needed, i.e. option b.

|  |
| --- |
| **[1RD] Proposal 4-1 (v1)**  **Option a**  Support the following additional common configuration parameters for a TRS resource set:   * scrambling ID * number of slots/symbols   **Option b**  Scrambling ID is configured for each TRS resource in a TRS resource set   * the number of symbols is indicated by the number of TRS resources * the maximum number of TRS resources in a TRS resource set is 4 |

Please provide your views about **Proposal 4-1 (v1).** Which option do you support? Any modifications?

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Option a or b)** | **Comments** |
| TCL | support b | We prefer option b |
| LG | Option a |  |
| ZTE, Sanechips | Option a | As to scrambling ID, there is no significant benefits to configure it per resource.  As to the number of slots, since there is resource-level parameter, the slot information should be explicitly configured at least for FR2. |
| Vivo |  | Support number of slots/symbols as common parameter.  For scrambling ID, not sure it leads to too much restriction if it is considered as common parameter. |
| Samsung | Option b | We think Option b must be supported, considering the TRS resources are shared from connected Ues. Otherwise the restriction of common scrambling ID will be applied to connected Ues, which conflicts with the R16 design. |
| Qualcomm | Option b | Since for connected mode UE, the scrambling ID is configured per TRS resource, we doubt whether it is feasible for network to configure per TRS resource set scrambling ID given the basic assumption that Rel-17 iTRS is not dedicated resource but borrowed from connected mode UEs.  It could be better to reflect the difference of the maximum number of resources for FR1 and FR2 in a similar way to connected mode TRS. |
| Intel | Option a |  |
| Sharp |  | In General, Scrambling ID can be configured per resource set, or be configured per resource optionally when the inter-cell interference should be considered especially for FR1.  number of slots can be configured per resource set |
| Ericsson1 | Option b, main bullet only | We are not OK with Option a –specification allows scramblingID to be different among resources within a TRS resource set for connected mode UEs, and the same flexibility should be ensured for TRS occasions for idle mode UEs.  Regarding Option b, main text is OK, but the subbullets are unnecessary –  1) there is no parameter for indicating number of TRS resources, and such parameter is not needed for FR1 – it is known by specification. OK to introduce a parameter for FR2 case.  2) bullet 2 is unnecessary as it is already reflected in draft spec – it is a bit confusing to have this now. |
| Xiaomi | Option a |  |
| DOCOMO | Option a | We don’t see need to configure scrambling ID per resource. |
| Apple | Option a with modification | We support a common configuration for scramblingID because it is a 10-bit field, and generates significant overhead relatively speaking if it is configured per resource.  However, additional flexibility can be porivded to still allow scramblingID to be configured per resource, in order to support different scramblingID if network chooses to do so. (addressing the concern from proponents of Option b)  By supporting both, we can get either flexibility or overhead reduction depending on gNB’s configuration.  **Option a**  Support the following additional common configuration parameters for a TRS resource set:   * scrambling ID * number of slots/symbols   ScramblingID per TRS resource can be optionally configured. |
| Panasonic | Option b |  |
| Nordic | Option a |  |
| Nokia(1st round) |  | We would be fine to go with option b, with the assumption that scramblingID1,2,3 would be optional, while scramblingID0 would be always present. Then we would not need separate indication for the number of slots/symbols if we can agree some implicit assumption for the case when only one scrambling ID is provided (e.g. FR1: 2 slots, FR2: 1 slot). I.e. we could have one joint scrambling ID with number of resources defined implicitely, two scrambling ID implying two resources, or 4 scrambling IDs implying 4 resources. |
| Huawei, HiSilicon | Option b | Firstly, Option b is our first preference.  However, it seems the views are controversial now. We think Apple’s proposal could be a compromise we can accept, which seems possible to reduce the configuration overhead meanwhile provides flexibility on gNB to support the same configuration as that for connected mode.  However, regarding the number of slots/symbols, we are not sure whether RAN2’s ASN.1 design could provide a way to know how many optional IEs are configured and not configured, which could be used to figure out the number of symbols. Therefore, we propose the following acceptable compromise based on Apple’s one, and leave RAN2 to decide whether number of symbols are introduced.  **Option a**  Support the following additional common configuration parameters for a TRS resource set:   * scrambling ID * ~~number of slots/symbols~~   ScramblingID per TRS resource can be optionally configured. |
| Lenovo/Motorola Mobility | Alt 1 & Alt 3 | Fine with the Huawei’s updated proposal. |

Proposal 4-2 includes all the alterantives proposed to determine the maximum number of TRS resource sets

|  |
| --- |
| **[1RD] Proposal 4-2 (v1)**  The maximum number of TRS resource sets configured by higher layer, X, is down-selected from one of the following alterantives in RAN1#107-e meeting:   * Alt1: X = 64 * Alt2: X equals to the bitmap size of L1 avalability indication * Alt3: X is the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 * Other alterantives are not precluded |

Please provide your views about **Proposal 4-2 (v1).** Y or N ? Any modifications? If support it, please further down-select from the alterantives.

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(Y w/ AltX or N)** | **Comments** |
| TCL | Alt3 | We prefer alt3 |
| LG | Alt 1 in principle | In my understanding, Alt 2 should be modified as “X eqaults to the maximum bitmap size of L1 availability indication.” Since the intention of this proposal is to determine the maximum number of configurable TRS resource sets.  Anyway, we slightly prefer Alt 1 in principle. However we are not sure maximum number of TRS resource sets can be decided at this moment because we have several issues on higher layer configuration to be discussed further. |
| ZTE, Sanechips | Alt1 | There are up to 64 beams in FR2, hence, it is natural to support alt1 for idle/inactive UE power saving.  As to the alt3, we think the max value is also 64 in FR2, hence, it is more straightforward to support alt1. |
| Vivo | Y with Alt-1/3 | In our understanding, Alt-3 seems a more detailed description for Alt-1? |
| Samsung | Y w/ Alt-3 | For Alt2, it only works if a bit maps to one TRS resource set. However, the majority view is to consider a bit maps to a group of TRS resource sets. |
| Qualcomm | Y with Alt 3 | For Alt 1, X=64 may be a little bit loose for FR1. |
| Intel |  | Revisit after bitmap definition of L1 indication |
| Sharp |  | Multiple TRS resource sets can use same SSB as QCL references, we don’t think the numbers of resource set must be smaller than SSB number |
| CATT | Alt 1 | The maximum number of TRS resource set should be decided based on the maximum number of beams NR supported, which is 64 beams. Alt 3 would be different in different network, which could not be captured in the specification. |
| Ericsson1 | Alt 1 | Since this is referring to maximum number of resource sets, it should be 64. We don’t support Alt 2 – too limiting on #resource sets, or Alt 3 (unnecessarily linkage to other higher layer parameters). |
| Xiaomi | Alt 1 |  |
| DOCOMO | Alt1 |  |
| Apple | Alt 3 |  |
| Panasonic | Y and Alt1 |  |
| Nordic | Alt3/Alt 4 | max 1 Resoruce set per transmitted SSB |
| Nokia(1st round) | Alt1 |  |
| Huawei, HiSilicon | Alt.3 and Alt.1 | It seems companies have different understanding on “The maximum number of TRS resource sets configured by higher layer”.  Maybe we could merge Alt.1 and Alt.3:  The maximum number of TRS resource sets configured by higher layer, X, is ~~down-selected from one of the following alterantives in RAN1#107-e meeting:~~   * ~~Alt1:~~ X = 64 * ~~Alt2: X equals to the bitmap size of L1 avalability indication~~   ~~Alt3: X is~~, and the number of configured TRS resource sets is not larger than the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 |

## 5.2 <2nd round discussion>

Issue 4-1: whether to configure scrambling ID per TRS resource or TRS resource set

Issue 4-2: other configuration parameters

* e.g. resource set ID, number of slots, associatedIndicationBit, validity time duration, location association with SSB/paging occasion(s)

**Summary on Proposal 4-1 (v1)**

|  |  |
| --- | --- |
| **Support**  **(Option a or b)** | **Companies** |
| a | LG, ZTE, Sanechips, Intel, Xiaomi, DOCOMO, Apple, Nordic |
| b | TCL, Samsung, Qualcomm, Ericsson, Panasonic, Nokia, Huawei, HiSilicon |
| c | Vivo, Sharp |

\*c: Support number of slots/symbols as common parameter. For scrambling ID, not sure it leads to too much restriction if it is considered as common parameter.

For scrambling ID, as commented by [QC, Samsung, Ericsson, Nokia], we have to follow the principle in Rel-16 as the TRS resources are shared from connected mode UEs.

Therefore, option a is updated based on modifications from Apple and HW. Option b is updated to address comments from [Nokia, vivo, sharp] regarding number of symbols/slots.

|  |
| --- |
| **[2RD] Proposal 4-1 (v2)**  **Option a**  Support the following additional common configuration parameters for a TRS resource set:   * scrambling ID * number of slots/symbols up to RAN2 decision   Scrambling ID per TRS resource can be optionally configured.  **Option b**  Scrambling ID is configured for each TRS resource in a TRS resource set   * the number of symbols is indicated by the number of configured TRS resources   + the configured TRS resources are allocated in the order of slot index across up to two consecutive slots, where each slot includes up to 2 TRS resources * ~~the maximum number of TRS resources in a TRS resource set is 4~~ |

**Please a) provide your preference for supporting Option a or Option b below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Option a | Yes: Sharp, Xiaomi, DOCOMO, IDCC, Lenovo/Motorola Mobility, Apple (removing “up to RAN2 decision”)  No: |
| Option b | Yes: Qualcomm, Samsung,TCL, LGE, Nokia2, IDCC, Panasonic, , Ericsson2 (with updates)  No: |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We slightly prefer Option b, but Option a is also feasible with “Scrambling ID per TRS resource can be optionally configured” |
| Sharp | We think the “up to RAN2 decision” in second sub-bullet should be removed, because it is in RAN1-specification that four CSI-RS resources are bundled in one resource set in R15 and should be specificed for idle/inactive UEs by RAN1 in R17. |
| ZTE, Sanechips | We are okay with the main bullet of Option b. However, with this main bullet, there seems no resource level parameter. Therefore, at least for FR2, slot number needs to be defined.  One clarification question with regard to the following bullet, it there any explicit configuration of “number of resource per resource set”? or how to determine the “number of resource per resource set”?  the number of symbols is indicated by the number of configured TRS resources |
| Nokia2 | So, just to clarify my understanding for option b based on ZTE comment, that if network configures only two scrambling IDs, that implies two symbols i.e. one slot.  We could further discuss whether we could enable restricting the configuration size by agreeing what is the implicit assumption if only one scrambling ID is configured. I.e. based on RAN1 spesification there should always be in minimum two, thus if only one is profivided we could assume 4 resoucuces for FR1 and 2 resources for FR2 as an example. |
| Ericsson2 | Support Option b with update - there is no need to indicate the number of configured TRS resources for FR1 (known from 38.214). So, the 1st bullet should be limited to FR2.  Regarding option a, if intention is to leave decision to RAN2, RAN1 should provide sufficient information so that RAN2 can make informed decision. |
| Moderator | [2RD summary]  Option b can be down-selected based on majority view.   * An example is added to clarify that no need of slot number to address concern from [ZTE] * A FFS point is added as suggested by Nokia   **Proposal 4-1 (v3)**  **~~Option a~~**  ~~Support the following additional common configuration parameters for a TRS resource set:~~   * ~~scrambling ID~~ * ~~number of slots/symbols up to RAN2 decision~~   ~~Scrambling ID per TRS resource can be optionally configured.~~  **~~Option b~~**  Scrambling ID is configured for each TRS resource in a TRS resource set   * the number of symbols is indicated by the number of configured TRS resources   + the configured TRS resources are allocated in the order of slot index across up to two consecutive slots, where each slot includes up to 2 TRS resources     - e.g. if network configures only two scrambling IDs, that implies two symbols/resources in one slot. * FFS: if only one scrambling ID is provided in a TRS resource set, UE assumes 4 TRS resources for FR1 and 2 TRS resources for FR2 for the TRS resource set. |
| Apple | The number of supporting companies is actually very close for the two options.  For Option a, “up to RAN2 decision” should be removed.  It seems that the updated proposal tries to merge Option a and b together, but we feel it may cause more confusion/inconsistency.  Following a similar spirit, can we consider the following approach (at least it is more straightforward to understand from our perspective)?  Option c  Support a configuration parameter for the number of TRS resources ({2, 4}) for a TRS resource set.  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, the number of scrambling IDs is equal to the number of TRS resources. |

Issue 4-3: configuration limit, e.g. maximum # of resource/resource set

**Summary on Proposal 4-2 (v1)**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Alt1 | LG, ZTE, Sanechips, Vivo, CATT, Ericsson, Xiaomi, DOCOMO, Panasonic, Nokia |
| Alt2 |  |
| Alt3 | TCL, Vivo, Samsung, Qualcomm, Apple, Nordic(max 1 Resoruce set per transmitted SSB) |
| Others | Intel: Revisit after bitmap definition of L1 indication  Sharp: Multiple TRS resource sets can use same SSB as QCL references, we don’t think the numbers of resource set must be smaller than SSB number |

The majority support either Alt 1 or Alt 3 based on the consensus that the number of TRS resource sets is limited by available beams. The proposal is updated by merging Alt1 and Alt3 as suggested by HW.

|  |
| --- |
| **[2RD] Proposal 4-2 (v2)**  For the maximum number of TRS resource sets configured by higher layer, X,   * X = 64 * the number of configured TRS resource sets is not larger than the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 |

**Please a) provide your view on whether or not support the proposal 4-2 (v2) below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Y | Qualcomm, Samsung, ZTE, Sanechips, TCL, LGE, vivo, Xiaomi, Nokia2, DOCOMO, IDCC, Lenovo/Motorola Mobility, Panasonic, CATT, Ericsson2 (with updates i.e. remove 2nd bullet), Apple, Sony |
| N |  |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | The maximum number X=64 could be too large for FR1. To avoid a mandatory requirement for UE that supports iTRS to receive all transmitted TRS resources, we propose to add a note:  **Note: the idle/inactive UE is not required to receive all transmitted TRS resource sets** |
| LGE | We are fine with the proposal but have simple question for ther clarification. Is it possible configuring more than one TRS resource sets which have same QCL reference(i.e. SSB index)? In my understanding, the second sub-bullet is to consider the case where all TRS resources have different QCL references. If so, it should be clearly described to avoid the miss understanding. If not, we do not see the benefits from restricting the number of configured TRS resource sets.  For the Qualcomm’s comment above, we have similar view that some note would be required. |
| Nokia2 | Not fully clear why we need to restrict the configuration based on ssb-PositionsInBurst. The QCL reference is a separate parameter. |
| Ericsson2 | Since X is maximum number, NW can configure a smaller number – 2nd bullet is not needed (up to implementation). There is no such restriction for connected mode UEs. |
| Moderator | [2RD summary]  @QC: the note is added in the updated version.  @LGE: The majority view one TRS resource set per beam is sufficient. However, it is possible configuring more than one TRS resource sets which have same QCL reference based on current proposal. It’s up to gNB implementation, no need to include that in the proposal.  @Nokia, the motivation one TRS resource set per beam is sufficient.  @Ericsson, the 2nd bullet is to address the concern during the 1st RD that maximum number X=64 could be too large for FR1. The majority view is the number TRS resource sets is limited by actual number of beams. The restriction helps for configuration overhead reduction.  **Proposal 4-2 (v3)**  For the maximum number of TRS resource sets configured by higher layer, X,   * X = 64 * the number of configured TRS resource sets is not larger than the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1   Note: the idle/inactive UE is not required to receive all transmitted TRS resource sets |
| Apple | We are fine with the proposal. |

# Others

In addition to the three main topics in Section 2-4, some other issues or design aspects have been discussed by a few companies, and the corresponding proposals are captured below.

|  |  |
| --- | --- |
| Vivo | **Proposal 10: Further clarification is needed on whether and how RRC connected UE would handle the TRS configured for idle/inactive Ues, and following options can be considered.**   * **Opt-1: Assume the same availability as that defined for idle/inactive Ues.** * **Opt-2: Ignores configuration by provided SIB and the availability indication in paging PDCCH.** |
| Samsung | **Proposal 11: Support semi-static rate matching for available TRS resources to idle/inactive Ues.** |
| LG | **Proposal 6: For Res that are configured for a TRS/CSI-RS occasion(s) for idle/inactive Ues and that Ues can assume actual TRS/CSI-RS transmission**  **o The UE expect TRS/CSI-RS transmission in the Res which are overlapped with scheduled PDSCH, and the Res are counted but not used in the PDSCH RE mapping.** |

According to the above proposals, there are some other remaining issues not covered in Section 2/3/4/5:

* Issue 5-1: how RRC connected UE would handle the TRS configured for idle/inactive Ues, and
* Issue 5-2: impact to PDSCH, e.g. whether or not to support semi-static rate matching for the available TRS resources.

## <1st round discussion>

The following proposal is drafted based on ompanies’s proposals in Section 6 to address Issue 5-1 and 5-2.

|  |
| --- |
| **[1RD] Question 6-1**:  Whether or not to support the any of the following:   * **P1:** RRC connected UE ignores configuration of TRS resources provided by SIB and the availability indication in paging PDCCH. * **P2:** When Res of TRS resources configured to idle/inactive Ues are overlapped with PDSCH, the Res are counted but not used in the PDSCH RE mapping |

Please provide views for **Question 6-1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support**  **(P1 and/or P2)** | **Comments** |
| LG | P2 | We support P2.  How to handle PDSCH RE for idle/inactive mode UE that assumes actual TRS transmission at occasions shall be defined. Otherwise, UE cannot be sure whether using TRS Res which overlap with scheduled PDSCH transmissions are available or not. The simplest way, which gurantees backward compatibility, is RE level puncturing. Precisely, TRS resources where UE is indicated by available indication(s) can be used for determining the target Res for puncturing. |
| Vivo | Either P1 or P2 | This issue have to be clarified, since the default UE behavior is rate matching with the configured CSI-RS resources.  For RRC connected Ues, both ignoring the TRS configuration& availability indication and puncturing TRS are feasible, and have spec impacts. |
| Samsung | P2 |  |
| OPPO | P1 | If it is reuse the RS for connected UEs, the connected UEs can of course be a Rel-15/16 UE. In that sense, P1 shall be the wright way. |
| Qualcomm | None | For P1, it should be up to UE implementation.  For P2, the Rel-17 TRS is borrowed from connected mode UE. The collision between REs of TRS and idle/inactive mode UE’s PDSCH is not a new issue. Then no new design is needed. Also the iTRS should be also configured to connected mode UE (may be just a subset of connected mode UE’s TRS). Then collision to connected mode UE’s PDSCH is not a new issue either. In any case, there is no need to specify UE behavior. |
| Sharp | P2 in principle | Need more disucssion |
| Ericsson1 | Not support P1,P2 | Agreement from RAN1#102-e is as follows. Given this, we do not see need to address issue for RRC connected UE (which would anyway have configured TRS configured) or any impact to PDSCH.    *Idle/inactive UE may use the TRS/CSI-RS occasion(s) that are shared to it for functionalities such as:*  *- AGC, time/frequency tracking* |
| Apple | None |  |
| Panasonic |  | We think the UE rate matching behaviour should be defined if time allows. |
| Nokia(1st round) |  | CONNECTED mode UEs should follow the only the dedicated CSI-RS configuration and ignore the TRS occasion configuration intended for IDLE/Inactive UEs. |
| Huawei, HiSilicon | P1 with modification | We think P1 and P2 seems discussing different things.  For P2 we think it is gNB implementation.  For P1, we think there is no need to specify whether connected mode UE could use the potential TRS occasion. But we think we should conclude that the configuration of TRS occasion for IDLE mode UE shall not impact Rel-17 connected mode UE’s rate matching operation on PDSCH.   * **P1:** The available PDSCH REs of Rel-17 RRC connected UE shall not be impacted by ~~ignores~~ configuration of TRS resources provided by SIB ~~and the availability indication in paging PDCCH.~~ |

6. 2 <2nd round discussion>

**Summary on Question 6-1**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| P1 | OPPO, Huawei, HiSilicon |
| P2 | LG, Samsung, Sharp |
| Either P1 or P2 | Vivo |
| None | Qualcomm, Ericsson, Apple |

QC: TRS is borrowed from connected mode UE. The collision between REs of TRS and idle/inactive mode UE’s PDSCH is not a new issue.

P1 and P2 are addressing different issues. One is related to connected mode UEs, the other is for idle/inactive UEs. For P1, a conclusion can be considered to clarify the understanding. For P2, in Rel-16, the TRS resources are based on RRC signaling and are not visible to idle UEs. So, reusing the same rate matching scheme in connected mode seems to be necessary.

|  |
| --- |
| **[2RD]**  Conclusions 5-1 (v1)  RRC connected UEs can ignore configuration of TRS resources provided by SIB and the availability indication in paging PDCCH.  Proposal 5-2 (v1)  When REs of TRS resources configured to idle/inactive UEs are overlapped with PDSCH, the REs are counted but not used in the PDSCH RE mapping |

**Please a) provide your view on whether or not to support conclusion 5-1 and Proposal 5-2 below:**

|  |  |
| --- | --- |
| **Support** | **Companies** |
| Conclusion 5-1 (v1) | Yes: Samsung, Sharp, LGE, vivo, CMCC, Lenovo/Motorola Mobility  No: Qualcomm, ZTE, Sanechips, Nokia2, CATT, Ericsson2 |
| Proposal 5-2(v1) | Yes: Samsung, Sharp, LGE, CMCC, Lenovo/Motorola Mobility  No: Qualcomm, Nokia2, CATT, Ericsson2 |

**and b) any additional comments (e.g. additional modifications, concerns) below**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | For both proposal 5-1 and 5-2, we do not see a need to imply any UE implementation. Without the proposals, both the network and UE work just fine. |
| Samsung | We think P5-2 is needed; otherwise we should conclude that UEs doesn’t expect any overlapping with PDSCH, which decrease the spectrum efficiency. It’s a simple extension to reuse the existing rate matching scheme for idle mode UEs. |
| ZTE, Sanechips | As to 5-1, we think there is no harm if RRC connected UEs use the broadcast TRS for sync. Whether RRC connected UEs ignore the information depends on implementation. |
| LGE | For proposal 5-2, we would like to emphasize following two points:   1. There is no RE handling rule when TRS resource(s) are overlapped with broadcast PDSCHs for idle/inactive UEs (such as for paging, SIB, RACH…) 2. Unlike the conneceted mode case, backward compatibility should be guaranteed.   First, there is no PDSCH RE handling rule for idle/inactive UEs when PDSCH overlapped with TRS resources, since the Rel-15/16 idle/inactive UEs cannot have any prior information on TRS resourcesm. Meanwhile, Rel-17 UEs who can use TRS in idle/inactive mode will have prior information on the potention/actual TRS transmissions. Note that any overlap between the PDSCH REs and the reference signal that UE can assume actual transmission is clearly defined in the specification.  Second, the scheduled broadcast PDSCHs(e.g. paging, SIB, RACH …) are usually shared by a legacy UEs, so backward compatibility should be guaranteed. If the PDSCH RE handling rule defined for the connected mode UE is reused for the broadcast PDSCHs, the legacy UEs scheduled same broadcast PDSCH cannot decode the PDSCHs. Alterantively, RE level puncturing rule (i.e. REs are counted but not used in the PDSCH RE mapping) could be applied for the broadcast PDSCH RE handling rule. |
| vivo | In our understanding, at least conclusion 5-1 is needed. Otherwise, how to deal with these TRS resources when overlapping with PDSCH for RRC connected UE is not clear. |
| Nokia2 | For 5-1, from RRC perspective it should be clear that UE should ignore the TRS occasion configuration. I.e. when network configures the CSI-RS for the CONNECTED mode UEs, it does not need to account the TRS occasions for IDLE/Inactive mode UEs.  On 5-2, like pointed by LGE IDLE/Inactive mode UEs do not assume any CSI-RS overlap with broadcasted PDSCHs, thus we don’t see any reason to change this. |
| CMCC | Conclusions 5-1 (v1): CONNCTED UE should ignore availability indication both in paging PDCCH and PEI. |
| Moderator | [2RD summary]  For conclusion 5-1, there are many objections as it’s related to UE implementation. Since there is no consensus, the conclusion can be skipped.  For proposal 5-2, we need to clarify no overlapping is expected if the proposed RE handling rule is not supported. So, the two alternatives are provided for down-selection in this meeting.  Proposal 5-2 (v3)  Down-select one from the following two alternatives in RAN1#107-e:  Alt1: When REs of TRS resources configured to idle/inactive UEs are overlapped with PDSCH, the REs are counted but not used in the PDSCH RE mapping  Alt2: idle/inactive UEs assume REs of TRS resources configured to idle/inactive UEs never overlap with PDSCH. |
| Apple | For P5-2, we think no new behavior should be introduced for idle/inactive UEs, that is, Alt 2 should be the default and no further discussion is needed. |

# Proposals for GTW handling

7.1 <GTW#1>

The following proposals are suggested for GTW handling on 11/12, Friday.

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# Conclusion

The following agreements were made in this meeting.

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# References

[1] [R1-2110838](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2110838.zip) Assistance RS occasions for IDLE/inactive mode Huawei, HiSilicon

[2] [R1-2110938](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2110938.zip) TRS for RRC idle and inactive UEs ZTE, Sanechips

[3] [R1-2111024](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111024.zip) Remaining issues on TRS/CSI-RS occasion(s) for idle/inactive UEs vivo

[4] [R1-2111063](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111063.zip) TRS/CSI-RS occasions for IDLE/inactive mode TCL Communication Ltd.

[5] [R1-2111104](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111104.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs Spreadtrum Communications

[6] [R1-2111267](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111267.zip) Configuration of TRS/CSI-RS for paging enhancement CATT

[7] [R1-2111326](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111326.zip) Further discussion on RS occasion for idle/inactive UEs OPPO

[8] [R1-2111405](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111405.zip) Remaining issues on TRS occasion(s) for idle/inactive UEs Sony

[9] [R1-2111505](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111505.zip) Discussion on TRS occasions in idle/inactive mode Intel Corporation

[10] [R1-2111583](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111583.zip) On TRS/CSI-RS configuration and indication for idle/inactive UEs Xiaomi

[11] [R1-2111618](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111618.zip) Discussion on TRS/CSI-RS occasion(s) for IDLE/INACTIVE-mode UEs CMCC

[12] [R1-2111676](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111676.zip) Potential enhancements for TRS/CSI-RS occasion(s) for idle/inactive UEs Panasonic

[13] [R1-2111748](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111748.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs Samsung

[14] [R1-2111885](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111885.zip) Indication of TRS configurations for idle/inactive-mode UE power saving Apple

[15] [R1-2111946](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111946.zip) Provision of TRS/CSI-RS for idle/inactive UEs Lenovo, Motorola Mobility

[16] [R1-2111961](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2111961.zip) Remaining issues on TRS/CSI-RS occasion(s) for idle/inactive UEs InterDigital, Inc.

[17] [R1-2112018](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112018.zip) Discussion on TRS/CSI-RS occasions for idle/inactive UEs Sharp

[18] [R1-2112061](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112061.zip) Discussion on TRS/CSI-RS occasion(s) for idle/inactive UEs LG Electronics

[19] [R1-2112117](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112117.zip) Discussion on TRS/CSI-RS occasion for idle/inactive Ues NTT DOCOMO, INC.

[20] [R1-2112150](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112150.zip) Provisioning TRS occasions to Idle/Inactive UEs Ericsson

[21] [R1-2112227](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112227.zip) TRS/CSI-RS for idle/inactive UE power saving Qualcomm Incorporated

[22] [R1-2112309](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112309.zip) On TRS/CSI-RS occasion(s) for idle/inactive mode UE power saving MediaTek Inc.

[23] [R1-2112371](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112371.zip) Open issues on n TRS information forto IDLE/INACTIVE mode UEs Nokia, Nokia Shanghai Bell

[24] [R1-2112380](file:///C:\Users\qiongjie.l\AppData\Local\Docs\R1-2112380.zip) On TRS design for idle/inactive UEs Nordic Semiconductor ASA

# Appendix: Previous Agreements

## RAN1#102-e

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| Agreements:   * New types/patterns of TRS/CSI-RS are not introduced specifically for idle/inactive mode UE.   Agreements:  The TRS/CSI-RS occasion(s) that may be for connected mode UEs can be shared to idle/inactive mode UEs.  -  Note: It is understood that gNB can potentially share the occasions to idle/inactive (which would just mean it up to NW whether to share or not share).  -  Note: It is understood that TRS/CSI-RS in the TRS/CSI-RS occasion(s) may or may not be transmitted.  -  Note: Always-on TRS/CSI-RS transmission by gNodeB is not required  -  At least TRS/CSI-RS occasion(s) corresponding to periodic TRS is supported  - FFS for other RS types  -  FFS: Whether UE blind detection is required or not.  Agreements:  Idle/inactive UE may use the TRS/CSI-RS occasion(s) that are shared to it for functionalities such as:  -           **AGC, time/frequency tracking**  -           **FFS: RRM measurement for serving cell, RRM measurement for neighbor cell, paging reception indication**  **Observation:**  It is up to gNB implementation whether or not to transmit a TRS/CSI-RS to idle/inactive UEs even when the TRS/CSI-RS is not needed by connected UEs (e.g., when there is a connected mode UE in a cell but the UE is no longer using the TRS/CSI-RS, or when there is no longer connected mode UE in a cell, etc.)  Agreements:  The configuration of TRS/CSI-RS occasion(s) for idle/inactive mode UE(s) is provided by higher layer signalling  -           FFS higher layer signalling candidates (e.g., SIB, dedicated RRC, RRC release message, etc.)  -           FFS for other signalling candidates (e.g., pre-configuration, etc.)  -           FFS for detailed configuration parameters (e.g., whether and how to reduce the signalling overhead for configuration, etc.)  Agreements:  Further study whether and how to inform the availability of TRS/CSI-RS to idle/inactive mode UE (implicitly or explicitly).  - Note: Availability corresponds to the information for whether TRS/CSI-RS is actually transmitted or not. |

## RAN1#103-e

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| Agreement:   * Functionality of RRM measurement for neighbour cell is not supported for TRS/CSI-RS for idle/inactive UE(s).   Agreements:   * SIB signalling provides the configuration of TRS/CSI-RS occasion(s) for idle/inactive UE(s).   + Up to RAN2 to decide which SIB is to be used.   + Whether or not to additionally support other high-layer signalling methods (e.g., dedicated RRC, RRC release message, etc.) is up to RAN2   Send an LS to RAN2 informing the above agreements, and   * To further add that RAN1 is working on the detailed physical layer design   Agreement:   * Aperiodic TRS and semi-persistent/aperiodic CSI-RS are not used as TRS/CSI-RS occasion(s) for idle/inactive UEs.   Agreements:   * Target sending an LS to RAN2 and RAN4 to ask whether it is feasible to allow a UE to use the potential TRS/CSI-RS occasion to enhance the SSB based IDLE/Inactive mode evaluations of the serving cell. (to also include agreements from last meeting) * Further discussion whether any additional information needs to be included in the LS or not, including potential re-wording of the leading sentence   Agreements:   * Discuss further based on the following alternatives and down-select at RAN1#104-e:   + Alt 1: The availability of TRS/CSI-RS at the configured occasion(s) is NOT informed to the UE.   + Alt 2: The availability of TRS/CSI-RS at the configured occasion(s) is informed to the UE.   + Alt 3. The conditional availability of TRS/CSI-RS at the configured occasion(s) is informed to the UE.     - The condition can be, e.g., existence of paging.   + Alt 4. Combination of the above alternatives.   + FFS for details   + FFS for UE behavior when the availability is not informed.   + Other techniques are not precluded.   + Companies encourage to provide sufficient information for the proposal, e.g.,     - how to achieve power saving gain     - how to minimize impact on NW   how to minimize extra UE implementation complexity   * + - feasibility check on sharing the TRS/CSI-RS between connected UEs and idle/inactive UEs   + Proposals should be consistent with the WID objective.   **Conclusion:**   * TRS/CSI-RS based PEI is discussed in AI 8.7.1.1. * PEI functionality is not further discussed under AI 8.7.1.2. * Note: This does not prevent to potentially use PEI to carry the indication for TRS/CSI-RS presence. |

## RAN1#104-e

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| Update on 1/28 email:  Agreements:  Configuration of TRS/CSI-RS occasion(s) for idle/inactive Ues include at least:   * powerControlOffsetSS, * scramblingID * firstOFDMSymbolInTimeDomain, * startingRB. * nrofRBs, * FFS other parameters * FFS applicable values   Agreements:  The SCS configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs can be discussed and down-selected from following alternatives at RAN1#105-e:   * Alt1: same as initial BWP * Alt2: configurable parameter   Agreements:  Multiple RS resources can be configured for TRS/CSI-RS occasion(s) for idle/inactive UEs.   * FFS details (including whether or not to restrict the RS to be TRS only)   Update on 1/31:  Agreements:  For a cell with TRS/CSI-RS occasions configured for IDLE/Inactive UEs, IDLE/Inactive UE’s assumption on the availability of TRS/CSI-RS at the configured occasion(s) is informed to the idle/inactive UE based on explicit indication.   * FFS details (e.g., the signalling, detailed information for the TRS/CSI-RS, etc.) * There is no intended blind detection of the presence/absence of TRS/CSI-RS at the UE side in this feature. That is, the UE assumes TRS/CSI-RS is not present if the network does not indicate it is available (or indicates it is unavailable).   **Conclusion**  From RAN1 perspective, there is no consensus on supporting RRM measurement for serving cell functionality for TRS/CSI-RS occasion(s) for idles/inactive UEs.  Agreements:  The configuration of the frequency location of TRS/CSI-RS occasion(s) for idle/inactive UEs are discussed and down-selected from following alternatives at RAN1#104bis-e:   * Alt-1: within initial DL BWP * Alt-2: is not restricted by initial BWP   + IDLE/INACTIVE mode UE is not expected to receive TRS/CSI-RS outside the initial DL BWP.   Agreements:  To study QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs from following alternatives:   * Alt-1: ~~TCI state~~ from higher layer configuration, e.g. qcl-InfoPeriodicCSI-RS * Alt-2: QCL assumptions associated with transmitted SSBs implicitly, e.g. similar to PDCCH monitoring in PO   + ~~FFS details~~ * FFS details * Other alternatives are not precluded   **Conclusion:**  Decide at RAN1#104b-e, whether or not to support periodic CSI-RS in addition to periodic TRS for TRS/CSI-RS occasion(s) for idle/inactive UEs. |

## RAN1#104b-e

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| Agreement:  SCS of TRS/CSI-RS occasion(s) for idle/inactive UEs is same as SCS of CORESET#0.  Agreement:  Support higher layer configuration of the QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs.   * FFS details of the QCL information, e.g. associated SSB index   Agreement:  IDLE/INACTIVE mode UE is not expected to receive TRS/CSI-RS outside the initial DL BWP.   * Configuration of the frequency location of TRS/CSI-RS occasion(s) for idle/inactive UEs is not restricted by initial BWP.   Working assumption:  Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.   * FFS details, including paging DCI and/or PEI for L1 based signaling * FFS SIB-based signaling/configuration   + Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signalling   To further check on 4/19  Agreement:  Configuration for TRS/CSI-RS occasion(s) for idle/inactive UEs is based on periodic TRS only, including following limitations   * Configuration parameters that are necessary to provide configuration of periodic TRS for idle/inactive UEs * Applicable values that are necessary to provide configuration of periodic TRS for idle/inactive UEs * If the configuration is provided, idle/inactive UEs can always implicitly assume that trs-info is configured.   + The parameter trs-info does not need to be provided in the configuration   Agreement:  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, one or more alternatives from the following can be supported:   * Alt1: Availability/unavailability information for all or some of configured RS resources using a bitmap or codepoint * e.g. using bitmap, where each bit ~~from a bitmap or a codepoint~~ is associated with at least one resource~~/configuration~~ or a set/group of resources * e.g. a codepoint to indicate a state of availability/unavailability for all or some of configured RS resources * Alt2: value or codepoint to indicate one or more resource/configuration indices that correspond to the available RS resources * FFS whether and how to indicate the ‘availability’ in beam selective manner. * Other alternatives are not precluded |

## RAN1#105-e

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| Agreement:  Confirm the following working assumption:  Support at least L1 based signaling for the availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs.   * FFS details, including paging DCI and/or PEI for L1 based signaling * FFS SIB-based signaling/configuration   + Note: It is RAN1 understanding that existing SI update procedure is used for SIB based signalling     Agreement:  For the information provided by a physical layer availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availability/unavailability information for configured RS resources using a bitmap or codepoint   * e.g. using bitmap, where each bit is associated with at least one resource/configuration or a set/group of resources * e.g. a codepoint to indicate a state of availability/unavailability for all or some of configured RS resources * FFS maximum number of configured RS resources per physical layer availability indication to support. * FFS whether availability/unavailability information is for all or some of configured RS resources     Agreement:  Support applicable values for the following configuration parameters as below.   * powerControlOffsetSS: {-3, 0, 3, 6}dB * scramblingID: 0 to 1023 * firstOFDMSymbolInTimeDomain: 0 to 9   + firstOFDMSymbolInTimeDomain indicates first symbol in a slot, a second symbol in the same slot can be derived implicitly with symbol index as firstOFDMSymbolInTimeDomain+4 * startingRB: 0 to 274 * nrofRBs: 24 to 276     Agreement:  The QCL information of TRS/CSI-RS occasion(s) for idle/inactive UEs is indicated as a SSB index in range of 0 to 63.   * FFS: how the QCL information can be configured, e.g. per RS resource set or per configuration * FFS: QCL type, which is predetermined   **Working assumption:**  Support paging PDCCH based availability indication of TRS/CSI-RS occasions for idle/inactive UEs.  Support PEI based availability indication of TRS/CSI-RS occasions for idle/inactive UEs at least if PDCCH-based PEI is down-selected.   * FFS ~~whether and~~ how to enable/disable L1 based availability indication configurable by SIB   Agreement:  Configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs include:   * periodicityAndOffset {10, 20, 40, 80} ms * frequencyDomainAllocation for row1 with applicable values from {0, 1, 2, 3} to indicate the offset of the first RE to RE#0 in a RB * FFS Configuration index   + details,     - E.g. Per resource or resource set or group of resource sets     - E.g. explicit or implicit indication based on QCL source   Agreement:  Further study supporting SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive UEs at least based on the presence/absence of the configuration of the TRS/CSI-RS occasion in SIB\_X in case L1 based availability indication is not configured.   * FFS whether and how SIB based signaling and L1 based signaling can be configured simultaneously |

## RAN1#106-e

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| Agreement  Support at least one of the following alternatives   * Alt1: L1 availability indication at an occasion provides availability/unavailability information only for RS resources with the same QCL reference as the L1 availability indication occasion. * Alt2: L1 availability indication at an occasion can provide availability/unavailability information for RS resources with QCL references not confined to be the same as for the L1 availability indication occasion   Note:  The occasion mentioned above refers to a signal/channel monitoring occasion (e.g. a paging PDCCH or PEI monitoring occasion) to provide the L1 availability indication.  Note: a RS resource is a RS from configured TRS/CSI-RS occasion(s) for idle/inactive UEs., where the configuration for TRS/CSI-RS occasion(s) for idle/inactive UEs is based on periodic TRS only.  Agreement  L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs is valid for a time duration starting from a reference point, where   * the time duration can be determined based on at least one from the following (to be down-selected):   + Alt-1: configured by higher layer   + Alt-2: a predefined/configured window   + Alt-3: value indicated by the availability indication, where the value is one of multiple configured time duration(s)   + Alt-4: until when the UE receives another availability indication   + A combination of alternatives or other alternatives is not precluded. * the reference point can be determined as at least one from the following (to be down-selected):   + Alt-1: start of next PO or DRX cycle   + Alt-2: time location where UE receives the indication     - Note: the time location is subject to application delay if agreed   + Alt-3: start of current PO or DRX cycle where UE receive the indication   + Alt-4: a time location which is configured by higher layer   + A combination of alternatives or other alternatives is not precluded.   **Agreement**  For a RS resource configured for TRS/CSI-RS occasion(s) for idle/inactive UEs, a quasi co-location type can be determined as   * + ‘typeC’ with an SS/PBCH block and, when applicable, ‘typeD’ with the same SS/PBCH block |

## RAN1#106bis-e

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| Conclusion  No consensus to support SIB based signaling for availability information of TRS/CSI-RS occasions for idle/inactive UEs  Working Assumption  If TRS resource is configured in SIB, L1 based availability indication is always enabled based on the configuration.  **Agreement**  For L1 based availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, support availabilityinformation for configured RS resources using a bitmap. where each bit indicates whether associated TRS resource(s) are available.   * support L1 availability indication at an occasion can provide availability information RS resources with QCL references not confined to be the same as for the L1 availability indication occasion   + FFS associated TRS resource(s) per bit, e.g. a bit is associated with a TRS resource set   + Bitmap size is up to X bits     - X = [6] for paging PDCCH based L1 availability indication.     - FFS X for PEI DCI based L1 availability indication     - FFS details about how to configure the DCI field: e.g. start and length of bitmap (e.g. explicitly/implicitly configured) * for paging PDCCH based L1 availability indication, support L1 availability indication at an occasion can provide availability information for all configured RS resources   + FFS whether this needs to be supported regardless of the number of beams or for some configured RS resources * FFS: PEI DCI provides L1 availability indication information only for RS resources with QCL references to be the same as for the L1 availability indication occasion * FFS: indication of unavailability     **Agreement**  At least for paging PDCCH based L1 availability indication of TRS/CSI-RS at the configured occasion(s) to the idle/inactive UEs, the L1 availability indication is valid for a time duration starting from a reference point, where   * the time duration is a validity duration configured by higher layer,   + FFS applicable values, e.g. # of DRX cycles, or multiple of default paging cycle duration (i.e. modification period)   + FFS UE doesn’t expect inconsistent L1 based indication during the time duration * the reference point for start of the validity duration is one of the following alternatives:   + Alt1: SFN of the first PF from the next DRX cycle   + Alt2: SFN of the first PF from the current DRX cycle where UE receives the indication   + Alt3: based on SFN configured by higher layer, i.e. modification period configured as multiple of default paging cycle duration   + Alt4: start of the PF for the PO where UE receives the indication   + Note: the DRX cycle in Alt1 and Alt2 is the default paging cycle broadcast in SIB   + Note: The SFN for the first PF is ~~for (UE mod N) = 0, and can be~~ calculated by (SFN + PF\_offset) mod T = 0 * the time duration can be optionally configured by gNB   + when the time duration is not configured, one of the following alternatives can be considered:     - Alt1: the availability indication is valid until when the UE receives another availability indication.     - Alt2: the availability indication is valid until L1 availability indication is changed by network     - Alt3: default time duration e.g. default paging cycle * FFS whether and how to handle the miss detection issue of L1 signaling   **Agreement**  Configuration of TRS/CSI-RS occasion(s) for idle/inactive UEs include a list of one or more TRS resource sets, where:          a TRS resource set can be configured to include  o   a set of TRS resources up to two consecutive slots,    Note: a TRS resource is same as Rel-15/16, i.e. a CSI-RS in a symbol.  o   at least common configuration parameters:    a QCL reference    firstOFDMSymbolInTimeDomain,    ‘frequencyDomainAllocation for row1’, ‘startingRB’ ,‘nrofRBs’,’powerControlOffsetSS’, periodicityAndOffset’    FFS          scramblingID,          a TRS resource set ID, number of slots {1, 2} or number of symbols {2, 4} if supported          Note: the ‘TRS resource set’ configuration is not (necessarily) identical to ‘NZP-CSI-RS-ResourceSet’ configuration for TRSin R15/16. |