**3GPP TSG-RAN WG1 Meeting #106-e R1-210xxxx**

**e-Meeting, August 16th – 27th, 2021**

**Agenda Item: 5.2**

**Source: Moderator (ZTE)**

**Title: Summary on the physical layer aspects of small data transmission**

**Document for: Discussion**

# Introduction

In this meeting, it is necessary to continue the discussion on the remaining physical layer issues, i.e. mainly on the mapping details of SSB-to-PUSCH resource and TA validation for CG-SDT.

This document contains the summary of remaining issues related to the physical layer aspects of small data transmission in RAN1#106-e meeting.

[106-e-NR-R17-SDT-01] Email discussions on remaining issues on NR SDT in INACTIVE state – Li (ZTE)

* 1st check point: August 19
* 2nd check point: August 25
* 3rd check point: August 27

# TA validation for CG-SDT

Agreement from the last meeting:

Agreement in 105-e:

* The SSB subset for RSRP based TA validation is determined at least based on a configured absolute RSRP threshold.
* FFS the SSB subset which could be
* within a set of SSBs configured per CG configuration
* or within a set of SSBs configured for all CG configurations
* or within a set of all SSBs actually transmitted as indicated in SIB1.
* or highest N SSBs that are measured to derive the subset for a UE across all CG configurations

## SSB subset determination

Companies’ views from the submitted contributions are collected in the following table:

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106458 Huawei [1] | *Observation 1: The TA validation is highly correlated to the distance between UE and gNB, and is decoupled to the CG configuration. The SSBs in the subset should indicate this distance and do not relate to the CG configurations.*  *Proposal 4: The SSB subset for RSRP based TA validation* *should be included in the SSBs actually transmitted as indicated in SIB1, and is the highest N SSBs that are measured by a UE to derive the subset.* |
| R1-2106683 Spreadtrum [2] | *Proposal 1: The SSB subset for RSRP based TA validation is determined at least based on a configured absolute RSRP threshold, where the subset of SSBs is a set of SSBs configured per CG configuration.* |
| R1-2106765 Ericsson [3] | [Proposal 10 SSB subset for the average RSRP calculation is within a set of SSBs per CG PUSCH configuration.](#_Toc79227320)  [Proposal 11 RSRP change is the difference between RSRP calculated at the time when the UE receives the latest TAC from the network and the RSRP calculated at the time when UE determines TA validation for a CG PUSCH SDT.](#_Toc79227321)  [Proposal 12 Different RSRP variation thresholds and TAT configuations can be configured for different sets of SSBs configured within a set of SSBs configured per CG configuration](#_Toc79227322) |
| R1-2106855 Samsung [5] | *Proposal 2: SSB subset is determined from all SSBs actually transmitted as indicated in SIB1.* |
| R1-2106926 CATT [6] | Proposal 5: the SSB subset which is within a set of SSBs configured for all CG configurations is used for RSRP based TA validation. |
| R1-2107007 ZTE [7] | *Proposal 4: For TA validation based on RSRP change criterion of the SSB set, the subset of SSBs could be determined within a set of all SSBs actually transmitted as indicated in SIB1.* |
| R1-2107075 InterDigital [8] | *Proposal 1: SSB subset for RSRP-based TA validation is within a set of SSBs configured per CG configuration.* |
| R1-2107971 vivo [14] | Proposal : For CG-SDT, the SSB subset for RSRP based TA validation could be up to gNB configuration with the following:   * + a set of SSBs configured for all CG configurations   + or a set of all SSBs actually transmitted as indicated in SIB1.   + or highest N SSBs that are measured to derive the subset for a UE across all CG configurations |
| R1-2108089 Nokia [16] | Observation 3: A single absolute RSRP threshold might lead to no SSB being eligible to be part of the TA validation subset.  Proposal 4: The RSRP threshold is based on strongest SSBs  Proposal 5: RAN 1 to agree that the same subset of SSBs should be used for TA validation for obtaining the reference RSRP and the subsequent RSRP measurements to monitor the RSRP variation. |

### 2.1.1 First round discussion

Companies’ views are quite split, and there are more options than those listed in the FFS bullet from the last meeting. So the moderator would like to suggest companies to provide views on these options, especially on which option(s) is preferred and which one(s) is not acceptable.

***Discussion point 2.1***:

The following options are summarized from the companies’ contributions:

* Option 1: Within a set of SSBs configured per CG configuration[2][3][8]
* Option 2: Within a set of SSBs configured for all CG configurations[6][14]
* Option 3: Within a set of all SSBs actually transmitted as indicated in SIB1[5][7][14]
* Option 4: Highest N SSBs that are measured to derive the subset for a UE across all CG configurations[14]
* Option 5: The same SSB subset as for obtaining reference RSRP[16]
* Option 6: Highest N SSBs of all SSBs actually transmitted as indicated in SIB1[1]

Any comments on the above options?

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Option(s) preferred | Option(s) cannot accept | Comment |
|  |  |  |  |
|  |  |  |  |

### 2.1.2 Second round discussion

Proposal to be updated

## Other issues related to TA

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106765 Ericsson [3] | [Proposal 12 Different RSRP variation thresholds and TAT configuations can be configured for different sets of SSBs configured within a set of SSBs configured per CG configuration](#_Toc79227322)  [Proposal 13 On top of the TA validation based on RSRP change, support TDOA based crieterial for TA validation in CG based SDT.](#_Toc79227323)  [Proposal 14 TA based on latest UL transmissions before RRC release message should be provided in the RRC release message as initial TA to be used by CG SDT in RRC inactive.](#_Toc79227324)  [Proposal 15 The TA for CG SDT should be relative to the subcarrier spacing of initial UL BWP or the separately configured for CG SDT.](#_Toc79227325)  [Proposal 16 TA offset is optionally configured in RRC release message for CG SDT and the default TA offset is used when absent.](#_Toc79227326) |
| R1-2106683 [2] | In RAN1 view, other criterion for TA validation is still under discussion of RAN1. Some companies in RAN1 concern about the accuracy of TA validation based on absolute RSRP. It should be firstly studied in RAN4 in RAN1’s understanding. |

### 2.2.1 First round discussion

It is the moderator’s suggestion to focus on SSB subset determination, and the issues related to TA configuration can be discussed later if justified sufficiently. For any other TA validation mechanism, let us wait for RAN4’s response for now.

Any comments?

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |

# SSB to PUSCH mapping details for CG-SDT

Agreement from the last meeting is copied as below. Still some details regarding the implicit mapping between SSB and PUSCH resource for CG-SDT need to be finalized.

Agreement in 105-e:

* The SSB-to-PUSCH resource mapping within the CG configuration is implicitly defined.
* The ordering of the SSB and CG PUSCH resources are to be captured in RAN1 spec.
* A PUSCH resource refers to a transmission occasion and a DMRS resource used for PUSCH transmission
* The ordering of the SSB can reuse from the SSB-to-RO mapping
* The ordering of CG PUSCH resources can reuse from that of MsgA PUSCH as much as possible
* FFS determination of mapping ratio and association period, e.g., explicitly signaled or implicitly derived
* FFS any limitation on the combination of the parameters for CG resources

## Mapping ratio and association period

Companies’ views from the submitted contributions are collected in the following table:

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106458 Huawei [1] | *Proposal 3:* *Each of consecutive SSB indexes associated to one CG configuration*  *- in increasing order of SSB indexes*  *are mapped to PUSCH occasion in CG period and the associated DMRS resource*  *- first, in increasing order of DMRS resource indexes within a PUSCH occasion, where a DMRS resource index is determined first in an ascending order of a DMRS port index and second in an ascending order of a DMRS sequence index*  *- second, in increasing order of CG period indexes*  *where , is a total number of SSBs mapped to this CG configuration provided by configuredGrantConfig, and is a total number of valid CG periods per association period multiplied by the number of DMRS resource indexes provided by cg-DMRS-Config.* |
| R1-2106683 Spreadtrum [2] | *Proposal 3: The mapping ratio of SSB-to-RO mapping is determined by the legacy parameters in SIB1.* |
| R1-2106765 Ericsson [3] | [Proposal 4 Number of SSBs per CG PUSCH resource can be explicitly configured by network.](#_Toc79227314)  [Proposal 5 SSB to CG PUSCH association (pattern) period is implicitly derived based on the SSB period and the CG period. Ask RAN2 about the CG period candidate values for SDT.](#_Toc79227315)  [Proposal 6 When multiple CG PUSCH configurations are configured, RAN1 to discuss how a common SSB to CG PUSCH association period should be derived.](#_Toc79227316) |
| R1-2106855 Samsung [5] | *Proposal 5: the SSB-PUSCH mapping ratio is signalled to UE and if it’s absent, UE will calculate it based on the SSB number and PUSCH resource number in one CG-PUSCH resource.* |
| R1-2106926 CATT [6] | Proposal 2: For CG-SDT, mapping ratio between SS/PBCH blocks and TOs of one Type1 CG configuration can be configured by RRC signaling within the association period. The association period is integer number of CG period starting from SFN0 and is configured by high layer signaling.  Proposal 3: For CG-SDT, if mapping ratio between SS/PBCH blocks and TOs of one Type1 CG configuration is > 1, DMRS resource including DMRS port and DMRS sequence in one TO is used to further distinguish SSBs. |
| R1-2107007 ZTE [7] | *Proposal 1: By default support 1-to-1 mapping between SSBs and CG PUSCH resources.*  *Proposal 2: The association period could be either implicitly derived or explicitly signaled*   * *If implicit determination is selected, the value set of CG period should be limited to reduce complexity, e.g. {1,2,4,8,16} frames.* * *If explicit indication is selected, the association period could be set as the same value as CG period, or a different value from a set such as {10ms, 20ms, 40ms, 80ms, 160ms}.* |
| R1-2107566 Intel [12] | Proposal 3   * *For the association between SSBs and CG-PUSCH resources*   + *Multiple DMRS resources can be configured within a CG-PUSCH occasion.*   + *Mapping ratio and association period are explicitly configured*   + *Many-to-one and one-to-one mapping between SSB and CG-PUSCH occasion are supported.* |
| R1-2107707 Apple [13] | Proposal 1: SSB-to-PUSCH association period is configured by the network explicitly. The SSB-to-PUSCH mapping ratio is derived implicitly. |
| R1-2107971 vivo [14] | Proposal : Support many-to-one or one-to-one mapping between SSBs and PUSCH resource units within a CG configuration.   * + Mapping ratio between SSBs and PUSCH resource units per CG configuration can be configured by higher layer, e.g. *N* SSB(s) is associated with a PUSCH resource unit.   Proposal 4: Each consecutive number of 𝑁 SSB indexes provided for a CG configurationare mapped to the CG PUSCH occasions within the CG configuration in the following order.   * + first, in increasing order of DMRS resource indexes within a PUSCH occasion, where a DMRS resource index is determined first in an ascending order of a DMRS port index and second in an ascending order of a DMRS sequence index   + second, in increasing order of time resource indexes for time multiplexed PUSCH occasions within a CG periodicity   + third, in increasing order of indexes for PUSCH occasions across CG periodicities |
| R1-2108089 Nokia [16] | Proposal 1: Adopt the following rule for mapping the SDT-CG-PUSCH resources to SS/PBCH blocks:   * UE is provided with *K* SDT-CG-PUSCH resources, that map to the *N* SS/PBCH blocks 0,…,*N*-1 provided in the cell, where *n*=*N*/*K* * The first SDT-CG-PUSCH is mapped to SS/PBCH blocks {0,…floor (*n*-1)}, * The second SDT-CG-PUSCH is mapped to SS/PBCH blocks {floor (*n*),…,floor (2*n*-1)}, * The third SDT-CG-PUSCH is mapped to SS/PBCH blocks {floor (2*n*),…, floor (3*n*-1)}, * And so on until all the *K* SSBs are mapped to one SDT-CG-PUSCH resource each. |

### 3.1.1 First round discussion

For the mapping ratio and association period, at least one of them should be determined (pre-defined or explicitly indicated), and the other one can be implicitly derived; or both values are explicitly indicated.

***Discussion point #3.1:***

Down-selection among the following options for the indication of mapping ratio and association period:

* Option 1: Mapping ratio and association period are both explicitly signalled[6][7][12]
  + The association period is an integer number of CG period
  + FFS candidate value sets of mapping ratio and association period
* Option 2: Mapping ratio is explicitly signalled and association period is implicitly derived (similar to SSB-to-RO mapping) [1][3][5][7][14][16]
  + FFS candidate value set of mapping ratio, e.g. {1/8,1/4,1/2,1,2,4,8,16}
    - If <1, each SSB index is mapped to 1/N consecutive valid CG PUSCH resources. If , each valid CG PUSCH resource is associated with all the N SSB index.
  + The SSB to CG PUSCH association period is the duration of multiple of CG periods depending the smallest time duration required to map all SSBs at least once to CG PUSCH resources.
    - FFS if the association pattern period needs to be defined
* Option 3: Association period is explicitly signalled and mapping ratio is implicitly derived[13]
  + FFS candidate value set of association period

Regarding the details for the ordering of CG PUSCH resources, since it is highly related to the issues listed in section 3.2 (multiple DMRS) and 3.3 (repetition), let us come back later once we have consensus on those issues.

Preference and comments on the above options?

|  |  |
| --- | --- |
| Company | Comment |
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|  |  |

### 3.1.2 Second round discussion

Proposal to be updated

## Multiple DMRS per CG configuration

Companies’ views from the submitted contributions are collected in the following table:

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106458 Huawei [1] | *Proposal 1: The multiple DMRSs per CG configuration is supported for CG-SDT.* |
| R1-2106926 CATT [6] | Proposal 3: For CG-SDT, if mapping ratio between SS/PBCH blocks and TOs of one Type1 CG configuration is > 1, DMRS resource including DMRS port and DMRS sequence in one TO is used to further distinguish SSBs. |
| R1-2107971 vivo [14] | Proposal : For CG-SDT, one or multiple DMRS resources per CG configuration are supported.   * + The number of DMRS ports and/or DMRS sequences per CG configuration can be configured by gNB |
| R1-2108089 Nokia [16] | Observation 2: The DMRS resource based SSB identification can be achieved by configuring the same CG-PUSCH resources for the SSBs with different *DMRS-UplinkConfig.* No additional specification rules for SSB-to-DMRS mapping is needed to achieve this.  Proposal 3: Do not specify redundant mechanism for mapping different *DMRS-UplinkConfig* on one CG-PUSCH configuration e.g. for SSB identification purposes |
| R1-2107566 Intel [12] | Proposal 3   * *For the association between SSBs and CG-PUSCH resources*   + *Multiple DMRS resources can be configured within a CG-PUSCH occasion.*   + *Mapping ratio and association period are explicitly configured*   + *Many-to-one and one-to-one mapping between SSB and CG-PUSCH occasion are supported.* |

### 3.2.1 First round discussion

5 companies mentioned the issue of multiple DMRS per CG configuration, 4 companies support multiple DMRS per CG configuration when single layer PUSCH transmission is assumed, and whether each DMRS resource is mapped to the same or different SSB(s) depends on the mapping ratio between SSBs and CG PUSCH resource, one company believe the DMRS resource based SSB identification can be achieved by configuring the same CG-PUSCH resources for the SSBs with different *DMRS-UplinkConfig* and there is no need to specify other mechanisms.

The other relevant issue mentioned during the discussion in the last meeting is whether multi-layer PUSCH transmission is supported for CG-SDT. Companies are also encouraged to provide views on it.

***Discussion point 3.2***:

Down-select from the following options:

* Option 1: Support multiple DMRS resources per CG configuration when single layer PUSCH transmission is assumed, and each DMRS resource could be mapped to the same or different SSB(s) [1][6][12][14]
  + FFS if multi-layer PUSCH transmission is supported for CG-SDT
* Option 2: Multiple DMRS resources per CG configuration for single layer PUSCH transmission is not supported for CG-SDT. No spec change is needed. [16]

Preference and comments?

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| --- | --- |
| Company | Comment |
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### 3.2.2 Second round discussion

Proposal to be updated

## Repetitions

Companies’ views from the submitted contributions are collected in the following table:

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106458 Huawei [1] | *Proposal 2: The repetition mechanism in CG configuration in licensed band is reused for CG-SDT. Do not support different repetitions within one CG period mapped to different SSBs.* |
| R1-2106855 Samsung [5] | *Proposal 3: Configure the number of PUSCH transmission occasion (PO) in one CG-PUSCH period by new parameter or re-interpret the number of repetitions configured.* |
| R1-2106926 CATT [6] | Proposal 4: PUSCH repetition should be supported for CG-SDT. When PUSCH repetition is applied for Type1 CG configuration during CG-SDT, SS/PBCH blocks should be associated with one TO bundle including K TOs corresponding to the K repetitions. |
| R1-2107007 ZTE [7] | *Proposal 3: For CG repetition, the repetitions are considered as a bundle of transmission occasions that are mapped to the same SSB(s).* |
| R1-2107707 Apple [13] | Proposal 2: Time domain repetition can be supported for CG-SDT. |
| R1-2108089 Nokia [16] | Observation 1: When SDT-CG-PUSCH configuration is associated to an SSB, there is no additional SSB mapping complication when repetitions are allowed.  Proposal 2: Allow using PUSCH repetition with SDT-CG-PUSCH. No spec changes needed. |

### 3.3.1 First round discussion

6 companies mentioned repetitions, 5 companies among them support to consider the repetitions as a bundle of transmission occasions that are mapped to the same SSB(s), while one company support to re-interpret the configured repetitions as TDMed transmission occasions within a CG period.

***Discussion point 3.3***:

Down-select between the following two options for the interpretation of PUSCH repetation:

* Option 1: Re-interpret the configured repetitions as TDMed transmission occasions within a CG period.[5]
* Option 2: The repetitions are considered as a bundle of transmission occasions that are mapped to the same SSB(s), no additional specification rule is needed. [1][6][7][13][16]

The situation is unchanged from the previous meetings. So the moderator would suggest to go with the majority view, i.e. option 2.

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| --- | --- |
| Company | Comment |
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### 3.3.2 Second round discussion

Proposal to be updated

## Validation of PUSCH occasion

Companies’ views from the submitted contributions are collected in the following table.

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106765 Ericsson [3] | [Proposal 7 Further discuss in RAN1 on whether and how CG SDT can be allowed on flexible symbols when UE is in RRC inactive state. Similar UE behavior for CG PUSCH transmissions in RRC connected state can be followed by UE doing CG based SDT.](#_Toc79227317) |
| R1-2106855 Samsung [5] | *Proposal 4: the valid PO is the PO in UL part in a slot, or at least Ngap symbols after the end of the DL part in a slot or after the end of the SSB in a slot.* |
| R1-2107566 Intel [12] | Proposal 4   * *CG-PUSCH occasion validation rule for CG-SDT follows that was defined for MsgA PUSCH occasion for 2-step RACH.*    + *FFS: potential overlapping between CG-PUSCH occasions for CG-SDT and MsgA PUSCH occasions for 2-step RACH.* |

### 3.4.1 First round discussion

The PUSCH validation has been discussed in previous meeting with low priority. Let us check if more companies are positive to discuss it at this stage.

***Discussion point 3.3***:

* The following PUSCH occasion validation rule is applied for CG-SDT
  + the valid PO is the PO in UL part in a slot, or at least *Ngap* symbols after the end of the DL part in a slot or after the end of the SSB in a slot
    - FFS: potential overlapping between CG-PUSCH occasions for CG-SDT and MsgA PUSCH occasions for 2-step RACH

Any comment?

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |

### 3.4.2 Second round discussion

Proposal to be updated

# Other physical layer issues

|  |  |
| --- | --- |
| Tdocs | Proposals |
| R1-2106765 Ericsson [3] | Proposal 3 Further discuss in RAN1 on how to generate multiple CG PUSCH resources on top of the PO determined by TDRA per CG period. |
| R1-2106788 Sony [4] | Proposal 4: RAN1 to discuss whether BFD and BFR procedures are employed for SDT or just rely on the expire of the SDT failure detection timer.  Proposal 10: For CG-SDT, the UE shall monitor the SDT-RNTI (or SDT-CS-RNTI) for CG retransmissions. If adopted, RAN1 should send an LS to RAN2 about the agreement. |
| R1-2107443 LGE [11] | *Proposal 5: For CG-SDT, the UE can assume the PDCCH carrying the DCI has the same DM-RS antenna port quasi co-location properties as for a SSB associated to the CG PUSCH transmission e.g. for detection of retransmission DCI in response to a CG PUSCH transmission.* |
| R1-2106855 Samsung [5] | *Proposal 1: in case of the SSB set indication is absent, the UE determines the SSB(s) associated with the CG-PUSCH by one of the following*  *1.Associating to all the indicated SSB in the SIB1*  *2.Determine the SSB according to the sequential order of CG-PUSCH configuration lists*  *Proposal 3: Configure the number of PUSCH transmission occasion (PO) in one CG-PUSCH period by new parameter or re-interpret the number of repetitions configured.*  *Proposal 6: if the selected SSB by UE is not within the indicated/determined SSB set, UE switch to RA-SDT.* |
| R1-2107566 Intel [12] | Proposal 4   * *CG-PUSCH occasion validation rule for CG-SDT follows that was defined for MsgA PUSCH occasion for 2-step RACH.*    + *FFS: potential overlapping between CG-PUSCH occasions for CG-SDT and MsgA PUSCH occasions for 2-step RACH.* |
| R1-2107139 NEC [9] | *Proposal 4: UE should monitor PDCCH on USS using DMRS QCL (Quasi Co-located) with SSB and/or CSI which is used to transmitted CG PUSCH resource during RRC INACTIVE state.* |

According to the submitted contributions, the following issues may have RAN1 impact:

* 4.1 Multiple CG occasions per CG period based on TDRA configuration[3][5]
* 4.2 Default SSB subset if not indicated[5]
* 4.3 SDT type switching[5]
* 4.4 BFD and BFR procedure[4]
* 4.5 RNTI definition for SDT[4]
* 4.6 QCL relationship between PDCCH and SSB[11]

### 4.1.1 First round discussion

These issues are mostly proposed by single company. So the moderator suggests to first identify which issues are critical and need RAN1’s input, and for the low priority issues we can either treat them later or ask RAN2 to trigger the discussion if needed. Any comments?

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| --- | --- |
| Company | Comment |
|  |  |
|  |  |

# Issued raised in the latest RAN2 reply LS (R1-2106405)

This one will be handled in a separate email discussion, by using the NWM tool with the document name [***RAN1-106-e-NWM-NR-R17-SDT-02***].

[106-e-NR-R17-SDT-02] Reply LS to [R1-2106405](../../Docs/R1-2106405.zip) (Reply LS to RAN1 on physical layer aspects of small data transmission, RAN2) by August 20 – Xiaohang (vivo)

Any other comments?

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |

# Summary

The final proposals will be added later.

# References

1. [R1-2106458](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106458.zip) Physical layer aspects of CG-SDT Huawei, HiSilicon
2. [R1-2106683](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106683.zip) Discussion on physical layer aspects of small data transmission Spreadtrum Communications
3. [R1-2106765](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106765.zip) Physical layer aspects for NR small data transmissions in INACTIVE state Ericsson
4. [R1-2106788](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106788.zip) Physical layer aspects of small data transmission Sony
5. [R1-2106855](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106855.zip) Discussion on physical layer aspects for NR small data transmissions in INACTIVE state Samsung
6. [R1-2106926](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106926.zip) Discussion on remaining issues on small data transmission CATT
7. [R1-2107007](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107007.zip) Discussion on the remaining physical layer issues of small data transmission ZTE, Sanechips
8. [R1-2107075](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107075.zip) Physical layer aspects of small data transmission InterDigital, Inc.
9. [R1-2107139](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107139.zip) Discussion on RAN1 Aspects for NR small data transmissions NEC
10. [R1-2107309](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107309.zip) Draft Reply to RAN2 LS on Physical Layer Aspects of SDT Qualcomm Incorporated
11. [R1-2107433](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107433.zip) Discussion on physical layer aspects of small data transmission LG Electronics
12. [R1-2107566](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107566.zip) Discussion on physical layer aspects of small data transmission Intel Corporation
13. [R1-2107707](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107707.zip) Discussion on physical layer aspects of small data transmission Apple
14. [R1-2107971](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107971.zip) Discussion on RAN1 impacts for small data transmisison vivo
15. [R1-2107972](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2107972.zip) Draft reply LS on physical layer aspects of small data transmission vivo
16. [R1-2108089](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2108089.zip) On physical layer aspects of small data transmission Nokia, Nokia Shanghai Bell
17. [R1-2106924](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106924.zip) Draft Reply LS on on physical layer aspects of small data transmission CATT
18. R1-2106405 Reply LS to RAN1 on physical layer aspects of small data transmission vivo