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

e-Meeting, 11th – 19th November 2021

**Agenda Item: 5.2**

**Source: Moderator (ZTE)**

**Title: RAN1 agreements for Rel-17 WI on SDT**

**Document for: Information**

Introduction

This contribution includes a list of RAN1 agreements made so far for the following Rel-17 WI. It also includes outgoing and incoming LS for information.

Title of WI: ‘NR small data transmissions in INACTIVE state’

WI code: NR\_SmallData\_INACTIVE

1. RAN1 Agreements

RAN1#104e:

Agreement:

* From RAN1 perspective, at least a separate SearchSpace that is different from the existing common SearchSpace should be supported for monitoring the PDCCH addressed to the C-RNTI after successful completion of the RACH procedure during RA-SDT
	+ It is up to RAN2 decision if the separate SearchSpace is UE-specific or common to the UEs performing RA-SDT
* If the separate SearchSpace is not configured, type-1 PDCCH CSS can be reused.
* FFS UE-specific CORESET or common CORESET

Agreement:

* One or multiple SSBs can be associated with each CG configuration for CG-SDT.
* From RAN1 perspective, the following options can be considered for the association between the SSBs and the CG resources (including transmission occasions and DMRS) per CG configuration for CG-SDT.
	+ Opt. 1: Define the SSB-to-CG-PUSCH mapping rule
		- Reuse the SSB-to-RO mapping as the baseline
		- FFS the potential RAN1 impact, e.g. mapping ratio and association period
	+ Opt. 2: CG resources per CG configuration are associated with a set of SSB(s) by explicit signalling.
		- FFS the potential RAN1 impact
	+ Other solutions are not precluded
* FFS whether repetition is supported for CG-SDT or not, and if supported how to handle the mapping between the SSBs and repetitions
* FFS TA validation and PUSCH validation for CG-SDT.

RAN1#104bis-e:

**Conclusion:**

* It is RAN1’s common understanding that the CG configuration mechanism in licensed band can be reused for CG-SDT in principle.

Agreement:

* CG resources per CG configuration are associated with a set of SSB(s) configured by explicit signalling.
	+ FFS how to define an SSB-to-PUSCH resource mapping within the CG configuration.
	+ FFS specific changes to the CG configuration to support the additional SSB-to-PUSCH mapping, if any.

RAN1#105e:

Agreement:

* 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

Agreement:

* 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

RAN1#106e:

**Conclusion**

RAN1 cannot reach consensus on the following options for the SSB subset for RSRP based TA validation. Ask RAN2 if they can do the down-selection.

1. Option 1: Within a set of SSBs configured per CG configuration
2. Option 2: Within a set of SSBs configured for all CG configurations
3. Option 3: Within a set of all SSBs actually transmitted as indicated in SIB1
4. Option 4: Highest N SSBs of all SSBs actually transmitted as indicated in SIB1

**Agreement**

* Each N of consecutive SSB indexes associated to one CG configuration are mapped to valid CG PUSCH resources
	+ first, in increasing order of DMRS resource indexes, where a DMRS resource index *DMRSid* 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 in the association period
* The mapping ratio N is explicitly signalled and the association period is implicitly derived
	+ FFS candidate value set of mapping ratio, and whether it is configured per CG configuration or per cell
	+ The SSB to CG PUSCH association period is the duration of multiple of CG periods depending the smallest time duration in the set determined by the CG period such that all SSBs associated with the CG configuration are mapped at least once to CG PUSCH resources.
	+ An association pattern period includes one or more association periods and is determined so that a pattern between CG PUSCH occasions and SS/PBCH block indexes associated with the CG configuration repeats at most every 640 msec.
* Note: The mapping ordering and steps may be revisited if multiple CG PUSCH occasions in one CG period is supported

**Agreement**

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)

* FFS if multi-layer PUSCH transmission is supported for CG-SDT
* FFS any limitation on the DMRS configuration if multiple CG PUSCH occasions per CG period is supported

 **Agreement**

* The following PUSCH occasion validation rule is applied for CG-SDT
	+ for unpaired spectrum and for SS/PBCH blocks with indexes provided by ssb-PositionsInBurst in SIB1 or by ServingCellConfigCommon
		- if a UE is provided tdd-UL-DL-ConfigurationCommon, 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
		- if a UE is not provided tdd-UL-DL-ConfigurationCommon, the valid PO does not precede a SS/PBCH block in the PUSCH slot, starts at least *Ngap* symbols after a last SS/PBCH block symbol
		- *Ngap* is provided in Table 8.1-2 in TS 38.213
	+ FFS if any validation rule following the CG-PUSCH in RRC connected state is applicable, and whether and how to handle the overlapping between CG-PUSCH occasions for CG-SDT and any valid PRACH occasion or MsgA PUSCH occasion.
* FFS the rule for paired spectrum, and whether/how to support CG-SDT for UEs operating in Type-A HD-FDD.

**Agreement:**

* For RA-SDT, when PRACH occasions are separate between SDT and non-SDT, PRACH resource configurations/parameters for 4-step RACH and/or 2-step RACH should be re-used as much as possible for 4-step RACH and/or 2-step RACH based SDT, respectively.
	+ Note: It is up to RAN2 discussion on the RO configuration for RA-SDT in separate ROs.
* For RA-SDT, when PRACH occasions are shared between SDT and non-SDT, at least following parameters can be configured, including 4-step RACH and/or 2-step RACH based SDT operation.
	+ Number of contention-based preambles for SDT per SSB per valid RO
	+ Note: whether starting position of the preambles for SDT per SSB per valid RO needs to be configured for RA-SDT in shared ROs is up to RAN2 discussion.
* **For RA-SDT, when PRACH occasions are shared between SDT and non-SDT, a PRACH mask can be configured to indicate a subset of ROs for RA-SDT.**
* For RA-SDT in shared ROs and separate ROs with non-SDT, the power control parameters follow those for non-SDT,
	+ i.e. preambleReceivedTargetPower and power ramping setting follow those for non-SDT.

**Conclusion:**

* Further discuss on the case when ROs are shared between SDT and non-SDT, but different RACH types have separate ROs after RAN2’s decision

**Agreement:**

* RAN1 confirms the RAN2 agreement that CG-SDT resource can be configured on initial BWP
	+ FFS whether CG-SDT resource can be configured on a separate BWP.

RAN1#106bis-e:

**Agreement**

Multi-layer PUSCH transmission is not supported for CG-SDT.

**Agreement**

When SSB set indication is absent, UE assumes the SSB set includes all actually transmitted SSBs configured by SIB1.

**Agreement**

* RAN1 confirms that common PUCCH resources (i.e. those that are shared with non-SDT UEs) can also be used for HARQ-ACK feedback for Msg4 /MsgB and subsequent SDT transmissions.
* RAN1 thinks there is no need for any other PUCCH resources than common PUCCH resources shared with non-SDT UEs.

**Agreement**

BFD/BFR procedure is not required for SDT in Rel-17.

* FFS: whether or not to support reporting the beam change to gNB.

**Agreement**

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.

**Conclusion**

No need to define UL/DL pattern type of validation rule specific for paired spectrum at least for non-RedCap UEs.

* FFS the case for RedCap UEs

**Conclusion**

It is RAN1’s common understanding that dynamic grant based retransmission has already been supported.

**Conclusion**

RA-SDT resource cannot be configured on non-initial BWP.

**Conclusion**

From RAN1’s perspective, there is no other L1 configuration for RA-SDT and CG-SDT to support subsequent data transmission.

**Agreement**

The pathloss for CG-SDT PUSCH power control can be determined by the measurement of selected SSB associated with the CG PUSCH.

**Conclusion**

* RAN1 cannot reach a consensus on whether to confirm RAN2 agreement that CG-SDT resource can be configured on separate SDT BWP.
* Capture the following in the LS: the concern is on the necessity.

**Conclusion**

* RAN1 cannot reach consensus on reusing CG-DFI mechanism for CG-SDT for operation in licensed band.

**Agreement**

* Mapping ratio of SSB to CG PUSCH is configured per CG configuration.
	+ FFS whether to restrict the same value for all CG configuration and/or allow different value for different CG configurations.
* For the candidate value set of SSB to CG PUSCH mapping ratio, support at least {1, 2, 4, 8, 16}
	+ FFS {1/8,1/4,1/2}

**Agreement**

* RAN1 confirms the working assumption in RAN2 that UE-specific search space is configured for UEs performing CG-SDT. This does not exclude the configuration of CSS for UEs performing CG-SDT.
* CORESET for UE performing RA-SDT should be a common CORESET.

**Agreement**

A CG PUSCH occasion is not valid if it overlaps with any valid PRACH occasion.

* FFS overlapping between CG PUSCH occasions and MsgA PUSCH occasion

RAN1#107-e:

**Agreement**

* UE specific power control parameters P0 and alpha should be configured for initial UL transmission for CG-SDT
	+ Existing closed loop power control mechanism can be reused for re-transmission and subsequent data transmission.
* For RA-SDT power control parameters preambleReceivedTargetPower and powerRampingStep:
	+ For separate ROs, the power control parameters can be RA-SDT specific

**Agreement**

Separate common search space that can be configured for RA-SDT within the initial DL BWP can also be configured for CG-SDT.

**Conclusion**

No need to restrict the same value of mapping ratio for all CG configurations.

**Conclusion**

RAN1 cannot reach consensus on whether to support multiple CG occasions per CG period

* Note that the CG PUSCH with multiple DMRS is considered as one CG occasion.

**Conclusion**

During subsequent data transmission, no need to explicitly report beam to gNB.

**Conclusion**

RA-SDT and CG-SDT can be supported for RedCap UEs without considering specific optimization for Redcap, at least when RedCap UE share both the initial DL BWP and initial UL BWP with non-RedCap UEs.

**Agreement**

Reply LS on the physical layer aspects of small data transmission is endorsed in R1-2112782

1. Outgoing LS

RAN1#104e:

[R1-2102125](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2102125.zip) Reply LS on physical layer aspects of small data transmission RAN1, ZTE

RAN1#104bis-e:

[R1-2104012](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2104012.zip) Reply LS on uplink timing alignment for small data transmissions RAN1, Lenovo

RAN1#105e:

[R1-2106309](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106309.zip) LS on Beam correspondence with Small Data Transmission in Inactive State RAN1, Nokia

[R1-2106335](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106335.zip) LS on the physical layer aspects of small data transmission RAN1, ZTE

RAN1#106e:

[R1-2108649](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2108649.zip) LS on the TA validation and mapping details for CG-SDT RAN1, ZTE

[R1-2108533](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2108533.zip) Reply LS on on physical layer aspects of small data transmission RAN1, vivo

RAN1#106bis-e:

[R1-2110661](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110661.zip) Reply LS on the physical layer aspects of small data transmission RAN1, ZTE

RAN1#107-e:

[R1-2112782](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Inbox/R1-2112782.zip) Reply LS on the physical layer aspects of small data transmission RAN1, ZTE

1. Incoming LS

RAN1#104e:

[R1-2100025](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2100025.zip) LS on physical layer aspects of small data transmission RAN2, ZTE

RAN1#104bis-e:

[R1-2102286](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104b-e/Docs/R1-2102286.zip) LS on uplink timing alignment for small data transmissions RAN2, Lenovo

RAN1#106e:

[R1-2106405](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2106405.zip) Reply LS to RAN1 on physical layer aspects of small data transmission RAN2, vivo

RAN1#106bis-e:

[R1-2108715](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2108715.zip) LS on agreements related to SDT RAN2, ZTE

RAN1#107-e:

[R1-2112630](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Inbox/R1-2112630.zip) Reply LS on the physical layer aspects of small data transmission RAN2, ZTE

References

1. RP-212594, Work Item on NR small data transmissions in INACTIVE state , ZTE Corporation, RAN#93e, September 2021