**3GPP TSG-RAN WG2 Meeting #116 Electronic *R2-2xxxxxx***

**Elbonia, 01 – 12 November 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **38.300** | **CR** |  | **rev** | **4** | **Current version:** |  |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  | Introduction of SDT |
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| ***Source to WG:*** | Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_SmallData\_INACTIVE-Core |  | ***Date:*** | 2022-01 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** | 17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | Introduction of SDT. |
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| ***Summary of change:*** | The agreements made in RAN2 for SDT are captured in this version.RAN2#111-e:1. The 2-step RACH or 4-step RACH should be applied to RACH based uplink small data transmission in RRC\_INACTIVE.
2. Small data transmission is configured by the network on a per DRB basis.
3. Data volume threshold is used for the UE to decide whether to do SDT or not.
4. UL/DL transmission following UL SDT without transitioning to RRC\_CONNECTED is supported.
5. When UE is in RRC\_INACTIVE, it should be possible to send multiple UL and DL packets as part of the same SDT mechanism and without transitioning to RRC\_CONNECTED.

RAN2#112-e:1. For RACH based solutions, upon successful completion of contention resolution, the UE shall monitor the C-RNTI.
2. The configuration of configured grant resource can include one type 1 CG configuration.

RAN2#113-e:1. For CG-SDT the subsequent data transmission can use the CG resource or DG (i.e dynamic grant addressed to UE’s C-RNTI).
2. RAN2 design assumes that RRCRelease message is sent at the end to terminate the SDT procedure from RRC point of view.
3. If CG-SDT resources are configured on the selected UL carrier and are valid, then CG-SDT is chosen. Otherwise,

• If 2 step RA-SDT resources are configured on the UL carrier and criteria to select 2 step RA SDT is met, then 2 step RA-SDT is chosen• else If 4 step RA-SDT resources are configured on the UL carrier and criteria to select 4 step RA SDT is met, then 4 step RA-SDT is chosen• else UE does not perform SDT (i.e. perform non-SDT resume procedure) • If both 2 step RA-SDT and 4 step RA-SDT resources are configured on the UL carrier, RA type selection is performed based on RSRP threshold. 1. From RAN2 point of view, assume similar to PUR, that we introduce a TA validation mechanism for SDT based on RSRP change, i.e. RSRP-based threshold(s) are configured. Ask RAN1 to confirm. FFS on how to handle CG configuration when TA expires or when is invalid due to RSRP threshold. Details of the TA validation procedure can be further discussed.
2. UE releases CG-SDT resources when TAT expires in RRC\_Inactive state

RAN2#113Bis-e:1. Switching from SDT to non-SDT is supported.
2. UE switches from SDT to non-SDT in following cases:
	1. Case 1 (27/0): UE receive indication from network to switch to non-SDT procedure.
	2. Network can send RRCResume. FFS whether network can send indication in RAR/fallbackRAR/DCI to switch to non-SDT procedure.
	3. FFS Case 2 (18/9): Initial UL transmission (in msgA/Msg3/CG resources) fails configured number of times

RAN2#114-e:1. CFRA is not supported for RA-SDT
2. CG-SDT resource can be configured on either initial BWP or separate SDT BWP. Ask RAN1 to confirm

RAN2#115-e:1. DL SPS is not supported for SDT
2. Events that trigger a termination or failure of an ongoing SDT session 1) cell reselection, 2) expiry of the SDT failure detection timer, 3) when Max retx is reached in RLC. RLC AM max retransmission functionality remains unchanged.
3. When a UE detects a failure of an ongoing SDT session, UE transitions autonomously into RRC\_IDLE (as baseline solution). If time allows or have a ready solution we can consider further optimizations.
4. SDT related RACH resources are configured via system information, i.e., SIB1
5. RA-SDT can be configured on initial BWP. FFS for non-initial BWP

RAN2#116-e:1. RAN2 changes the agreements and as a baseline we will focus on initial BWP for RA and CG SDT. FFS if further work on CG SDT for non-initial BWP will be needed, based on RAN1 consensus.
2. Highest N SSBs of all SSBs actually transmitted as indicated in SIB1 is used for RSRP based TA validation
3. LCH restrictions can be applied, re-using existing signalling, and it is up to gNB how restrictions are configured and MAC applies current specification rules)
4. If LCH restriction is applied for SDT, it is applied both for CG-SDT and RA-SDT.
5. The UE is allowed to initiate subsequent UL data transmission only after the reception of confirmation of initial transmission from the gNB
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| ***Consequences if not approved:*** | SDT feature not introduced in Stage-2 TS. |
|  |  |
| ***Clauses affected:*** | 3.1, 7.2, 9.2.6, XX |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*First Modified Subclause*

3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

5GC 5G Core Network

5GS 5G System

5QI 5G QoS Identifier

A-CSI Aperiodic CSI

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

ARP Allocation and Retention Priority

BA Bandwidth Adaptation

BCH Broadcast Channel

BH Backhaul

BL Bandwidth reduced Low complexity

BPSK Binary Phase Shift Keying

C-RNTI Cell RNTI

CAG Closed Access Group

CAPC Channel Access Priority Class

CBRA Contention Based Random Access

CCE Control Channel Element

CD-SSB Cell Defining SSB

CFRA Contention Free Random Access

CG Configured Grant

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CPC Conditional PSCell Change

DAG Directed Acyclic Graph

DAPS Dual Active Protocol Stack

DFT Discrete Fourier Transform

DCI Downlink Control Information

DCP DCI with CRC scrambled by PS-RNTI

DL-AoD Downlink Angle-of-Departure

DL-SCH Downlink Shared Channel

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell-ID (positioning method)

EHC Ethernet Header Compression

ETWS Earthquake and Tsunami Warning System

FS Feature Set

GFBR Guaranteed Flow Bit Rate

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

LDPC Low Density Parity Check

MDBV Maximum Data Burst Volume

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

MMTEL Multimedia telephony

MNO Mobile Network Operator

MPE Maximum Permissible Exposure

MT Mobile Termination

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

NB-IoT Narrow Band Internet of Things

NCGI NR Cell Global Identifier

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NGAP NG Application Protocol

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PS-RNTI Power Saving RNTI

PSS Primary Synchronisation Signal

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

QPSK Quadrature Phase Shift Keying

RA Random Access

RA-RNTI Random Access RNTI

RACH Random Access Channel

RANAC RAN-based Notification Area Code

REG Resource Element Group

RIM Remote Interference Management

RMSI Remaining Minimum SI

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RNTI Radio Network Temporary Identifier

RQA Reflective QoS Attribute

RQoS Reflective Quality of Service

RS Reference Signal

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSSI Received Signal Strength Indicator

RSTD Reference Signal Time Difference

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SMC Security Mode Command

SMF Session Management Function

S-NSSAI Single Network Slice Selection Assistance Information

SNPN Stand-alone Non-Public Network

SNPN ID Stand-alone Non-Public Network Identity

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TPC Transmit Power Control

TRP Transmit/Receive Point

UCI Uplink Control Information

UL-AoA Uplink Angles of Arrival

UL-RTOA Uplink Relative Time of Arrival

UL-SCH Uplink Shared Channel

UPF User Plane Function

URLLC Ultra-Reliable and Low Latency Communications

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

*Next Modified Subclause*

7.2 Protocol States

RRC supports the following states which can be characterised as follows:

**- RRC\_IDLE**:

- PLMN selection;

- Broadcast of system information;

- Cell re-selection mobility;

- Paging for mobile terminated data is initiated by 5GC;

- DRX for CN paging configured by NAS.

- **RRC\_INACTIVE**:

- PLMN selection;

- Broadcast of system information;

- Cell re-selection mobility;

- Paging is initiated by NG-RAN (RAN paging);

- RAN-based notification area (RNA) is managed by NG- RAN;

- DRX for RAN paging configured by NG-RAN;

- 5GC - NG-RAN connection (both C/U-planes) is established for UE;

- The UE Inactive AS context is stored in NG-RAN and the UE;

- NG-RAN knows the RNA which the UE belongs to;

- Transfer of unicast data and/or signallign to/from the UE over radio bearers configured for SDT.

- **RRC\_CONNECTED**:

- 5GC - NG-RAN connection (both C/U-planes) is established for UE;

- The UE AS context is stored in NG-RAN and the UE;

- NG-RAN knows the cell which the UE belongs to;

- Transfer of unicast data to/from the UE;

- Network controlled mobility including measurements.

*Next Modified Subclause*

9.2.6 Random Access Procedure

The random access procedure is triggered by a number of events:

- Initial access from RRC\_IDLE;

- RRC Connection Re-establishment procedure;

- DL or UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised";

- UL data arrival during RRC\_CONNECTED when there are no PUCCH resources for SR available;

- SR failure;

- Request by RRC upon synchronous reconfiguration (e.g. handover);

- Transition from RRC\_INACTIVE;

- To establish time alignment for a secondary TAG;

- Request for Other SI (see clause 7.3);

- Beam failure recovery;

- Consistent UL LBT failure on SpCell;

- SDT in RRC\_INACTIVE (see clause XX).

Two types of random access procedure are supported: 4-step RA type with MSG1 and 2-step RA type with MSGA. Both types of RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA) as shown on Figure 9.2.6-1 below.

The UE selects the type of random access at initiation of the random access procedure based on network configuration:

- when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type;

- when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type;

- when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type.

The network does not configure CFRA resources for 4-step and 2-step RA types at the same time for a Bandwidth Part (BWP). CFRA with 2-step RA type is only supported for handover.

The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.

The MSGA of the 2-step RA type includes a preamble on PRACH and a payload on PUSCH. After MSGA transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble and PUSCH resource are configured for MSGA transmission and upon receiving the network response, the UE ends the random access procedure as shown in Figure 9.2.6-1(d). For CBRA, if contention resolution is successful upon receiving the network response, the UE ends the random access procedure as shown in Figure 9.2.6-1(b); while if fallback indication is received in MSGB, the UE performs MSG3 transmission using the UL grant scheduled in the fallback indication and monitors contention resolution as shown in Figure 9.2.6-2. If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSGA transmission.

If the random access procedure with 2-step RA type is not completed after a number of MSGA transmissions, the UE can be configured to switch to CBRA with 4-step RA type.

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**(a) CBRA with 4-step RA type (b) CBRA with 2-step RA type**

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**(c) CFRA with 4-step RA type (d) CFRA with 2-step RA type**

 **Figure 9.2.6-1: Random Access Procedures**

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**Figure 9.2.6-2: Fallback for CBRA with 2-step RA type**

For random access in a cell configured with SUL, the network can explicitly signal which carrier to use (UL or SUL). Otherwise, the UE selects the SUL carrier if and only if the measured quality of the DL is lower than a broadcast threshold. UE performs carrier selection before selecting between 2-step and 4-step RA type. The RSRP threshold for selecting between 2-step and 4-step RA type can be configured separately for UL and SUL. Once started, all uplink transmissions of the random access procedure remain on the selected carrier.

When CA is configured, random access procedure with 2-step RA type is only performed on PCell while contention resolution can be cross-scheduled by the PCell.

When CA is configured, for random access procedure with 4-step RA type, the first three steps of CBRA always occur on the PCell while contention resolution (step 4) can be cross-scheduled by the PCell. The three steps of a CFRA started on the PCell remain on the PCell. CFRA on SCell can only be initiated by the gNB to establish timing advance for a secondary TAG: the procedure is initiated by the gNB with a PDCCH order (step 0) that is sent on a scheduling cell of an activated SCell of the secondary TAG, preamble transmission (step 1) takes place on the indicated SCell, and Random Access Response (step 2) takes place on PCell.

*Next Modified Subclause*

XX Small Data Transmission

Small Data Transmission (SDT) is a procedure allowing data transmission while remaining in RRC\_INACTIVE (i.e. without transitioning to RRC\_CONNECTED state). SDT is enabled on a radio bearer basis and is initiated by the UE only if less than a configured amount of UL data awaits transmission across all radio bearers for which SDT is enabled, the DL RSRP is above a configured threshold, and a valid SDT resource is available.

Editor’s Note: MAC TS reference to be added once the section number is available.

SDT procedure is initiated with either a transmission over RACH (configured via system information) or over Type 1 CG resources (configured via dedicated signaling in *RRCRelease*). The SDT resources can be configured on initial BWP for both RACH and CG. RACH and CG resources for SDT can be configured on either or both of NUL and SUL carriers. For RACH, the network configures 2-step and/or 4-step RA resources for SDT. When both 2-step and 4-step RA resources for SDT are configured, the UE selects the RA type according to subclause 9.2.6. CFRA is not supported for SDT over RACH.

Once initiated, the SDT procedure is terminated successfully after the UE is directed to RRC\_IDLE or RRC\_INACTIVE (via *RRCRelease*) or to RRC\_CONNECTED (via *RRCResume*), or unsuccessfully upon cell re-selection, expiry of the SDT failure detection timer, or an RLC entity reaching a configured maximum retransmission threshold. Upon failure of the SDT procedure, the UE transitions to RRC\_IDLE.

Editor’s Note: FFS to RRC\_CONNECTED via other means.

Editor’s Note: FFS to RRC\_INACTIVE upon failure of an SDT procedure.

After the initial PUSCH transmission during the SDT procedure, subsequent transmissions are handled differently depending on the type of resource used to initiate the SDT procedure:

- When using CG resources, the network can schedule subsequent UL transmissions using dynamic grants or they can take place on the following CG resource occasions. The DL transmissions are scheduled using dynamic assignments. The UE can initiate subsequent UL transmission only after reception of confirmation for the initial PUSCH transmission from the network.

- When using RACH resources, the network can schedule subsequent UL and DL transmissions using dynamic UL grants and DL assignments, respectively, after the completion of the RA procedure.

SDT procedure over CG resources can only be initiated with valid UL timing alignment. The UL timing alignment is maintained by the UE based on network configured SDT-specific timing alignment timer and DL RSRP of configured number of highest ranked SSBs. Upon expiry of the SDT-specific timing alignment timer, the CG resources are released.

Logical channel restrictions can be configured by the network for radio bearers enabled for SDT and are applied by the UE regardless of whether the SDT procedure is initiated with either a transmission over RACH or over Type 1 CG resources.

*End of Changes*

# Annex (not part of the specification): RAN2 agreements:

## RAN2#111-e

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| 1 Small data transmission with RRC message is supported as baseline for RA-based and CG based schemes 2 RRC-less can be studied for limited use cases (e.g. same serving cell and/or for CG) with lower priority3 Context fetch and data forwarding with anchor re-location and without anchor re-location will be considered. FFS if there are problems with the scenario “without anchor relocation”. 4 From RAN2 perspective, stored “configuration” in the UE Context is used for the RLC bearer configuration for any SDT mechanism (RACH and CG).5 The 2-step RACH or 4-step RACH should be applied to RACH based uplink small data transmission in RRC\_INACTIVE6 The uplink small data can be sent in MSGA of 2-step RACH or msg3 of 4-step RACH.7 Small data transmission is configured by the network on a per DRB basis8 Data volume threshold is used for the UE to decide whether to do SDT or not. FFS how we calculate data volume.  FFS if an “additional SDT specific” RSRP threshold is further used to determine whether the UE should do SDT9 UL/DL transmission following UL SDT without transitioning to RRC\_CONNECTED is supported 10 When UE is in RRC\_INACTIVE, it should be possible to send multiple UL and DL packets as part of the same SDT mechanism and without transitioning to RRC\_CONNECTED on dedicated grant. FFS on details and whether any indication to network is needed.  |

## RAN2#112-e

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| 1 For small data, for RACH and CG based solutions when the UE receives RRC release with Suspend config, the UE at least performs the following actions (i.e. same action as in legacy): - MAC is reset and default MAC cell group configuration is released - RLC entities for SRB1 are re-established - SRBs and DRBs are suspended except SRB0NOTE: SDT termination will be discussed with later papers2 For both RACH and CG based solutions, upon initiating RESUME procedure for SDT initiation (i.e. for first SDT transmission), the UE shall re-establish at least the SDT PDCP entities and resume the SDT DRBs that are configured for small data transmission (along with the SRB1). FFS for non-SDT DRBs. FFS on implicit vs. explicit. FFS on whether we a new Resume cause. FFS on whether we need to deal with suppressing PDCP status report 3 The first UL message (i.e. MSG3 for 4-step RACH, MSGA payload for 2-step RACH and the CG transmission for CG) may contain at least the following contents (depending on the size of the message):- CCCH message (needs to be included)LCP can be used to determine to priority of the content below that may be included- DRB data from one or more DRBs which are configured by the network for small data transmission - MAC CEs – (e.g. BSR). FFS other MAC CEs - Padding bits FFS if we need to ensure that SDT data only is included. Depends on whether the UE initiates legacy/normal resume 4 For RACH and CG, the existing UAC procedure to determine whether access attempt is allowed, will be reused for SDT.5 SDT is transparent to NAS layer (i.e. NAS generates one of the existing resume causes and AS decides SDT vs non-SDT access)6 In case of RRC-based solution, for both RACH and CG based solutions, the CCCH message contains ResumeMAC-I generated using the stored security key for RRC integrity protection – i.e same as Rel-16.7 For both RACH and CG based solutions, new keys are generated using the stored security context and the NCC value received in the previous RRCRelease message (i.e. same as legacy procedure) and these new keys are used for generating the data of DRBs that are configured for SDT.8 For RACH based solutions, upon successful completion of contention resolution, the UE shall monitor the C-RNTI. 9 Determine if RAN1 LS is needed later – current list of possible questions input on the coreset/search space for the C-RNTI (i.e. is it common or dedicated)10: As a baseline, the RACH resource i.e. (RO+preamble combination) is different between SDT and non-SDT - If ROs for SDT and non SDT are different, preamble partitioning between SDT and non SDT is not needed.- If ROs for SDT and non SDT are same, preamble partitioning is neededFFS if common configuration should be allowed11: If the RACH resource i.e. (RO+preamble combination) is different between SDT and non-SDT then there is no further need for any differentiation between MSG2/MSGB for SDT vs non-SDT12: Define a new timer. FFS whether it has the same definition as T319 or it is restarted every UL/DL13 The configuration of configured grant resource for UE uplink small data transfer is contained in the RRCRelease message. FFS if other dedicated messages can configure CG in INACTIVE CG. Configuration is only type 1 CG with no contention resolution procedure for CG. 14 The configuration of configured grant resource can include one type 1 CG configuration. FFS if multiple configured CGs are allowed15 A new TA timer for TA maintenance specified for configured grant based small data transfer in RRC\_INACTIVE should be introduced. FFS on the procedure, the validity of TA, and how to handle expiration of TA timer. The TA timer is configured together with the CG configuration in the RRCRelease message.16 The configuration of configured grant resource for UE small data transmission is valid only in the same serving cell. FFS for other CG validity criteria (e.g. timer, UL/SUL aspect, etc)17 The UE can use configured grant based small data transfer if at least the following criteria is fulfilled (1) user data is smaller than the data volume threshold; (2) configured grant resource is configured and valid; (3) UE has valid TA. FFS for the candidate beam criteria. 18 From RAN2 point of view: An association between CG resources and SSBs is required for CG-based SDT. FFS up to RAN1 how the association is configured or provided to the UE. Send an LS to RAN1 to start the discussion on how the association can be made. Mention that one option RAN2 considered was explicit configuration with RRC Release message19 A SS-RSRP threshold is configured for SSB selection. UE selects one of the SSB with SS-RSRP above the threshold and selects the associated CG resource for UL data transmission. |

## RAN2#113-e

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| 1. CG-SDT resource configuration is provided to UEs in RRC\_Connected only within the RRCRelease message, i.e. no need to also include it in RRCReconfiguration message 2. CG-PUSCH resources can be separately configured for NUL and SUL. FFS if we allow them at the same time. This depends on the alignments CRs for Rel-16. 3. RRCRelease message is used to reconfigure or release the CG-SDT resources while UE is in RRC\_INACTIVE4. For CG-SDT the subsequent data transmission can use the CG resource or DG (i.e dynamic grant addressed to UE’s C-RNTI). Details on C-RNTI, can be the same as the previous C-RNTI or may be configured explicitly by the network can be discussed in stage 35. TAT-SDT is started upon receiving the TAT-SDT configuration from gNB, i.e. RRCrelease message, and can be (re)started upon reception of TA command. 6. From RAN2 point of view, assume similar to PUR, that we introduce a TA validation mechanism for SDT based on RSRP change, i.e. RSRP-based threshold(s) are configured. Ask RAN1 to confirm. FFS on how to handle CG configuration when TA expires or when is invalid due to RSRP threshold. Details of the TA validation procedure can be further discussed.7. As a baseline assumption, it’s a network configuration issue whether to support multiple CG-SDT configurations per carrier in RRC\_INACTIVE (i.e. we will not restrict network configuration for now). 8. FFS Discuss further in stage 3 how to specify the agreement that CG-SDT resources are only valid in one cell (i.e. cell in which RRCRelease is received)9. UE releases CG-SDT resources when TAT expires in RRC\_Inactive state10. For RA-SDT, up to two preamble groups (corresponding to two different payload sizes for MSGA/MSG3) may be configured by the network11. If RACH procedure is initiated for SDT (i.e. RA-SDT initiated), the UE first performs RACH type selection as specified in MAC (i.e. Rel-16). FFS whether threshold is SDT specific or not 12. RAN2 continues to progress the work based the separate RACH resources for SDT (i.e. explicit mechanisms to support common resources won’t be pursued unless there is sufficient support for this. However, use of common RACH resources will not be precluded if possible via implementation13. RAN2 design assumes that RRCRelease message is sent at the end to terminate the SDT procedure from RRC point of view. The RRCRelease sent at the end of the SDT may contain the CG resource (as per previous agreement). Write an LS to SA3 to explain SDT procedure and agreement.14. The UE behaviour for handling of non-SDT data arrival after sending the first UL data packet is fully specified (i.e. not left to UE implementation)15. FFS RAN2 will consider the additional option of using DCCH message to indicate arrival of non-SDT data (details to be discussed). Discussion will continue on all three options.16. FFS: RSRP threshold to select between SDT and non-SDT procedure. 17. FFS also whether this RSRP threshold to select between SDT and non-SDT procedure is used for CG-SDT, RA-SDT, or both and whether the RSRP threshold is the same for CG-SDT and RA-SDT. FFS when the RSRP threshold check is made18. FFS If both carriers can be selected and CG resources are available on one carrier only, does the UE select the carrier with CG?19. For SDT, UE performs UL carrier selection (i.e. if SUL is configured in the cell, UL carrier selected based on RSRP threshold). FFS whether the RSRP threshold for carrier selection is specific to SDT)20. If CG-SDT resources are configured on the selected UL carrier and are valid, then CG-SDT is chosen. Otherwise,• If 2 step RA-SDT resources are configured on the UL carrier and criteria to select 2 step RA SDT is met, then 2 step RA-SDT is chosen• else If 4 step RA-SDT resources are configured on the UL carrier and criteria to select 4 step RA SDT is met, then 4 step RA-SDT is chosen• else UE does not perform SDT (i.e. perform non-SDT resume procedure) • If both 2 step RA-SDT and 4 step RA-SDT resources are configured on the UL carrier, RA type selection is performed based on RSRP threshold. - FFS whether RSRP threshold for RA type selection is common or different for SDT and non SDT.- FFS what validity includes if we need to deal with CG resource availability delay?**Working assumptions**1. Support configuring of SRB1 and SRB2 for small data transmission for carrying RRC and NAS messages.2. Upon initiating RRC Resume procedure for SDT initiation (i.e. for first SDT transmission), the UE shall also resume SRB2 that is configured for SDT, in addition to SDT DRBs that are configured for SDT3. RAN2 recommends to include SRB2 in WID |

## RAN2#113Bis-e

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| 1. 1 RSRP threshold is used to select between SDT and non-SDT procedure, if configured (RSRP refers to the same RSRP measured for carrier selection).2 RSRP threshold to select between SDT and non-SDT procedure is used for both CG-SDT and RA-SDT3 RSRP threshold to select between SDT and non-SDT procedure is same for both CG-SDT and RA-SDT4 RSRP threshold for carrier selection is specific to SDT (i.e. separately configured for SDT). This is optional for the network. 5 Confirm that cell selection mechanism is not modified 6 RSRP threshold for RA type selection is specific to SDT (i.e. separately configured for SDT)7 Data volume threshold is the same for CG-SDT and RA-SDT (can be checked further in stage 3 if we obtain majority support)8 FFS on the order and missing pieces (e.g. failure, fallback) of the high level procedure. The details of the procedures are left for stage 3. FFS on the procedure below, but copied for information. A. Upon arrival of data only for DRB/SRB(s) for which SDT is enabled, the high level procedure for selection between SDT and non SDT procedure is as follows: If CG-SDT criteria is met: UE selects CG-SDT. UE initiate SDT procedure Else if RA-SDT criteria is met: UE selects RA-SDT. UE initiate SDT procedure Else: UE initiate non SDT procedure. B. CG-SDT criteria is considered met, if all of the following conditions are met,1) available data volume <= data volume threshold2) RSRP is greater than or equal to a configured thresholdFFS 3) CG-SDT resources are configured on the selected UL carrier and are validC. RA-SDT criteria is considered met, if all of the following conditions are met,1) available data volume <= data volume threshold2) RSRP is greater than or equal to a configured threshold3) 4 step RA-SDT resources are configured on the selected UL carrier and criteria to select 4 step RA SDT is met; or 2 step RA-SDT resources are configured on the selected UL carrier and criteria to select 2 step RA SDT is met9 Switching from SDT to non-SDT is supported.10 FFS Switching from CG-SDT to RA-SDT is not allowed11 UE switches from SDT to non-SDT in following cases:- Case 1 (27/0): UE receive indication from network to switch to non-SDT procedure. - Network can send RRCResume. FFS whether network can send indication in RAR/fallbackRAR/DCI to switch to non-SDT procedure.- FFS Case 2 (18/9): Initial UL transmission (in msgA/Msg3/CG resources) fails configured number of times12 gNB can only configure MN terminated MCG bearer type for SDT 13 Non-SDT radio bearers are only resumed upon receiving RRCResume (same as today)14 Down-scope to two solutions (CCCH or DCCH) and ask SA3 about security issues (explain that CCCH message will be repeated in same cell and ask if there is a question)15 The UE performs PDCP re-establishment implicitly, i.e. without explicit indication for PDCP re-establishment, when the UE initiates SDT procedure. 16 As in legacy, whether to support ROHC continuity is explicitly configured by the network. 17 PDCP duplication is not supported for SDT18 connected mode DRX is not supported for SDT19 PHR functionality is supported for SDT. FFS on PHR procedure20 SR resource is not configured for SDT. When the BSR is triggered by SDT data, the UE will trigger RA because SR resource is not available, same as legacy21 SDT failure detection timer is started upon initiation of SDT procedure22 T319 legacy is not started if RRCResumeRequest or RRCResumeRequest1 is transmitted for SDT23 T319 legacy stop conditions also apply to SDT failure detection timer24 RRC re-establishment procedure is not supported for SDT 25 An LS is sent to SA3 to verify feasibility/impacts of re-using same NCC/I-RNTI value temporarily for RRC Resume procedure in new cell during SDT procedure (include same cell question from 502]26 FFS - RAN2 to select between the following options for cell re-selection during ongoing SDT procedure next meeting: 1) UE transitions to IDLE, possibly performing high-layer retransmission (8/25); or 2) UE remains in INACTIVE and sends RRC Resume to new cell27 FFS Upon SDT failure detection timer expiry, the same procedure as T319 expiry is used (e.g. transition to IDLE as in the case of expiry of the T319 timer and attempts RRC connection setup) (18/8)28 CG-SDT resources can be configured at the same time on NUL and SUL 29 Implicit release of CG-SDT resource is not supported30 UE start a window after CG/DG transmission for CG-SDT. FFS whether to design a new timer or to reuse an existing timer.31 Support retransmission by dynamic grant for CG-SDT. 32 Support multiple HARQ processes for uplink CG-SDT. 33 CG resource availability delay is not considered as a criterion for CG validation.34 UL carrier selection is performed before CG-SDT selection35 FFS CG-SDT resource can be configured on BWPs other than initial BWP |

## RAN2#114-e

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| 1. CFRA is not supported for RA-SDT2. The separate search space is common to the UEs performing RA-SDT. Inform RAN1 of this agreement3. Working assumption: UE-specific search space is configured for UEs performing CG-SDT. RAN2 asks RAN1 whether this working assumption can be confirmed4. The UE needs to monitor paging after UE initiates SDT for system information change, PWS. FFS for other cases5. CG-SDT resource can be configured on either initial BWP or separate SDT BWP. Ask RAN1 to confirm6. FFS CS-RNTI based dynamic retransmission is reused for CG-SDT7. Release of CG-SDT configuration by system information indication is not supported8. RAN2 thinks that some feedback may be beneficial in case CG is used for subsequent transmission. RAN2 assumes that existing mechanism can be used. 9. For initial CG transmission, UE does not select any SSB if none of the SSBs’ RSRP is above the RSRP threshold. FFS if re-evaluation for every CG transmission is necessary |

## RAN2#115-e

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| 1. Data volume used for SDT selection criteria is calculated as the total sum of Buffer Size across SDT RBs (i.e. same approach as BSR)2. At initiation of SDT procedure, the PDCP status report is not triggered even if the RB is configured with statusReportRequired3. If ROHC is configured, the area scope of ROHC continuity is specified in the specification, i.e. gNB configuration is not needed4. For SDT procedure selection, Same data volume threshold is used for CG-SDT and RA-SDT5. The BSR configuration used for SDT can be different from the BSR configuration used in RRC\_CONNECTED. 6. [CB] FFS Whether the BSR configuration used for SDT is configured by gNB or used from default configuration needs further discussion. (gNB 10 / default 11)7. Legacy PHR triggers are applied for SDT8. DL SPS is not supported for SDT9. DataInactivityTimer is not supported for SDT. 10. RLC polling is supported for SDT. 11. The UE performs RLC re-establishment implicitly, i.e. without explicit indication for RLC re-establishment, when the UE initiates SDT procedure. 12. At initiation of SDT procedure, the RRC indicates to the PDCP to disable the PDCP status report, e.g. by de-configuring statusReportRequired (i.e. UE internally indicates). FFS how PDCP status reporting is enabled. 13. The LCP priority of PHR MAC CE in SDT is same as in RRC\_CONNECTED, i.e. the PHR MAC CE in SDT is prioritized over SDT data14. During the SDT procedure, all the triggered PHRs are cancelled if all SDT data are included in the UL grant, if there is NO room in the MAC PDU to fit the PHR. 15. Working assumption: LCH restrictions can be applied, re-using existing signalling. It is up to gNB how restrictions are configured and MAC applies current specification rules. Revisit next meeting if we have technical issues. 16. No new solution is defined to prevent data loss or duplication for the scenario where the anchor relocation is required in the middle of an SDT session, i.e. network can release UE back into RRC\_INACTIVE17. PDCP entities of only the non-SDT RBs are re-established (i.e. not for the SDT RBs) when the UE moves from RRC\_INACTIVE with SDT session ongoing to RRC CONNECTED. 18. Events that trigger a termination or failure of an ongoing SDT session 1) cell reselection, 2) expiry of the SDT failure detection timer, 3) when Max retx is reached in RLC. RLC AM max retransmission functionality remains unchanged. 19. When a UE detects a failure of an ongoing SDT session, UE transitions autonomously into RRC\_IDLE (as baseline solution). If time allows or have a ready solution we can consider further optimizations.20. SDT related RACH resources are configured via system information, i.e., SIB121. Explicit indication (other than RA-SDT configuration) to enable/disable RA-SDT is not supported22. At least the following parameters can be RA-SDT specific. - SSB selection related parameters, i.e., rsrp-ThresholdSSB, msgA-RSRP-ThresholdSSB.- Power control related parameters, i.e., preambleReceivedTargetPower/gA-PreambleReceivedTargetPower, powerRampingStep/msgA-PreamblePowerRampingStep, msg3-DeltaPreamble/msgA-DeltaPreamble. - Preamble group related parameters, i.e., msg3-DeltaPreamble/msgA-DeltaPreamble, messagePowerOffsetGroupB for 2-step RA-SDT and 4-step RA-SDT. 23. For shared ROs case, all the following configurations can be allowed: (28/28)• 4-step RA-SDT shares ROs with 4-step RA and/or 2-step RA• 2-step RA-SDT shares ROs with 4-step RA and/or 2-step RA• 2-step RA-SDT shares ROs with 4-step RA-SDT and/or 4-step RA and/or 2-step RA.24. For the RA-SDT preamble group selection, the UE should consider SDT data size plus MAC subheader in addition to CCCH SDU size plus MAC subheader and pathloss, same in legacy. FFS whether any additional things on top of legacy criteria is needed. 25. The fallbackRAR reception as legacy 2-step RACH is supported in 2-step RA-SDT, i.e., fallback from 2-step RA-SDT to 4-step RA-SDT when fallbackRAR is received26. As legacy, UE can be configured to switch from 2-step RA-SDT to 4-step RA-SDT after N times of MsgA transmission27. Send an LS to RAN1 to provide overall relevant agreements. Check if the PUCCH resources used for HARQ-ACK during subsequent SDT transmissions (applicable for both RA and CG). Ask if other L1 PHY resources may be needed for subsequent SDT transmission, for example RAN2 thinks we can use the common resources (PDCCH and PUCCH) for RA and ask if we need others. - Add that RAN2 discussed RA-SDT configuration on non-initial BWP. There was a large number of companies supporting and other companies expressed concerns on complexity and paging monitoring. Ask RAN1 if they have any concerns from their side. NOTE that RAN2 agreed for CG-SDT we already agreed to dedicated BWP and why we decided to support it. 28. UE suspends all UL transmissions and triggers RACH if any UL transmission is needed (same as in connected mode) when TAT expires during RA-SDT procedure29. RA-SDT can be configured on initial BWP. FFS for non-initial BWP30. RA prioritization related parameters cannot be configured for RA-SDT, i.e., powerRampingStepHighPriority, scalingFactorBI31. UE selects any SSBs if there is no qualified SSB for RA-SDT, like in legacy. No optimizations are considered. 32. Switching from SDT to non-SDT via RAR/fallbackRAR/DCI sent by network is not supported for RA-SDT33. No new timer (other than the SDT failure detection timer) is introduced to control the PDCCH monitoring during subsequent transmissions in RA-SDT34. If none of the SSBs’ RSRP is above the RSRP threshold of CG-SDT criteria in the type selection phase, UE should select RA-SDT if RA-SDT criteria is met35. MAC PDU rebuilding is not required (unless we find a case that is needed)36. During subsequent CG transmission phase (i.e. after the UE has received response from NW) UE can initiate at least legacy RACH procedure (e.g. trigger due to no UL resources). No MAC PDU rebuilding is required. FFS if the RA-SDT RA resources can be used for subsequent data. a. At least the following conditions are agreed: (1) no qualified SSB when the evaluation is performed; (2) when TA is invalid; (3) when SR is triggered due to lack of UL resource37. UE should release CG-SDT resource (if stored) when UE initiates RRC resume procedure from another cell which is different from the cell in which the RRCRelease is received.38. The C-RNTI previously configured in RRC\_CONNECTED state is used for UE to monitor PDCCH in CG-SDT. 39. CS-RNTI based dynamic retransmission mechanism can be reused for CG-SDT. FFS whether CS-RNTI is the same one as the one previously configured in RRC\_CONNECTED or a new CS-RNTI one is provided to the UE40. During the subsequent new CG transmission phase, for the purpose of CG resource selection, UE re-evaluates the SSB for subsequent CG transmission. FFS what happens if no SSBs are valid or if no sample is available41. From RAN2 perspective, at least the following parameters should be included in the CG-SDT configuration. FFS whether these parameters are common for multiple CG-SDT configurations or per CG-SDT configuration.• The new TA timer in RRC\_INACTIVE;• The RSRP change threshold for TA validation mechanism in SDT (details dependent on RAN1);• The SSB RSRP threshold for beam selection (i.e. UE selects the beam and associated CG resource for data transmission). |

## RAN2#116-e

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| 1. The statusReportRequired is automatically enabled at termination of SDT procedure, i.e. PDCP status report is temporarily disabled during SDT procedure. (22/22)2. BSR format enhancements are not considered for SDT. (21/23)3. BSR calculation take suspended RBs into consideration during SDT. (21/23)4. If NAS data arrives at PDCP layer of suspended RBs, the NAS data should be just stored in PDCP SDU buffer without further processing. (23/23). How to ensure this is up to UE implementation, and no spec change is needed. 5. PDCP header is not considered for the SDT data volume calculation. (23/23). No spec change is needed.6. Buffered packets in PDCP/RLC entities should be counted in SDT data volume calculation. (21/23). Whether and how to avoid any buffered packets in PDCP/RLC entities at the time of SDT data volume calculation is FFS.7. The legacy TAT (i.e. timeAlignmentTimerCommon in SIB) is used for UL timing maintenance during RA-SDT procedure. (21/23)8. The legacy TAT (i.e. timeAlignmentTimerCommon in SIB) starts/restarts when RAR TAC or TAC MAC CE is received, regardless of SDT procedure. No spec change is needed. (23/23)9. CG-SDT resource is not released even if the legacy TAT expires. (23/23)10. The token bucket mechanism is applied for SDT. (21/23)11. Confirm that PHR is triggered at initiation of SDT procedure based on the existing PHR trigger. All the triggered PHRs are cancelled if all SDT data are included in the UL grant, if there is NO room in the MAC PDU to fit the PHR.12. The R15/R16 PUSCH skipping mechanism is supported for CG-SDT13. PHR is configured only by default MAC Cell Group configuration14. BSR is configured only by default MAC Cell Group configuration15. For SDT, ROHC continuity functionality can be configurable between the cell and RNA. Send LS to RAN316. LCH restrictions can be applied, re-using existing signalling, and it is up to gNB how restrictions are configured and MAC applies current specification rules)17. If LCH restriction is applied for SDT, it is applied both for CG-SDT and RA-SDT. 18. FFS whether the logicalChannelSR-DelayTimer is not applied for logical channels configured with SDT19. The NAS data can arrive at PDCP layer even if the RB is suspended. When does the NAS deliver UL data to AS is up to UE implementation. No spec changes are needed20. If NAS data does not arrive at PDCP layer of suspended RBs, the SDT data volume is calculated by UE implementation. No spec changes are needed. A NOTE can be added to clarify calculation of data volume and can be discussed in the running CR. 21. FFS if the size of CCCH message is considered in SDT data volume calculation22. Highest N SSBs of all SSBs actually transmitted as indicated in SIB1 is used for RSRP based TA validation23. The Rel-16 CG configuration mechanism in licensed band is reused the baseline for CG-SDT.24. At least for initial transmission we will have a mechanism to allow the UE to transmit the message again. FFS for retransmission for subsequent. 25. The UE uses/selects the same HARQ process for retransmission 26. The “CG-SDT timer” starts at the first “valid” PDCCH occasion from the end of the CG-SDT PUSCH transmission. The first “valid” PDCCH occasion is defined in RAN127. The “CG-SDT timer” can be started/restarted during for initial and subsequent transmissions28. The UE restarts the “CG-SDT timer” at least:• upon the PUSCH retransmission indicated by the CS-RNTI PDCCH• after each CG-SDT transmission29. The “CG-SDT timer” stops at least:• When the UE receives RRC feedback messages (e.g. RRCResume, RRCSetup, RRCRelease and RRCReject)30. The Rel-16 calculation on the HARQ process ID of the CG type-1 for licensed band is reused as the baseline for CG-SDT31. The UE is allowed to initiate subsequent UL data transmission only after the reception of confirmation of initial transmission from the gNB32. The UE can use multiple CG resources for the HARQ initial transmission as Rel-16 in the subsequent CG transmission phase33. The following CG-SDT configurations are per UE:- The new TA timer in RRC\_INACTIVE- The RSRP change threshold for TA validation mechanism in SDT- The SSB RSRP threshold for beam selection34. RAN2 changes the agreements and as a baseline we will focus on initial BWP for RA and CG SDT. FFS if further work on CG SDT for non-initial BWP will be needed, based on RAN1 consensus.35. Assumption that we won’t have L1 feedback as a functionality. Discuss subsequent and autonomous CG transmissions with email discussion. |