**3GPP TSG-RAN WG2 Meeting #118 Electronic *R2-220xxxx***

**Elbonia, 09 – 20 May 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.300** | **CR** | **0465** | **rev** | **1** | **Current version:** | **17.0.0** |  |
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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:***  | Corrections on SDT |
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| ***Source to WG:*** | Nokia, Nokia Shanghai Bell, Samsung, OPPO |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_SmallData\_INACTIVE-Core |  | ***Date:*** | 2022-05 |
|  |  |  |  |  |
| ***Category:*** | **Cat F** |  | ***Release:*** | Rel-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)Rel-19 (Release 19)* |
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| ***Reason for change:*** | 1. Section 18.0: The MAC TS references are incorrect.
2. Section 18.0: CG-SDT resources are associated with SSBs which is not currently clear in Stage-2.
3. Section 16.4:“UE monitors ETWS/CMAS indication in its own paging occasion in RRC\_INACTIVE”.This is incorrect. We have agreed that in RRC\_INACTIVE, UE monitors ETWS/CMAS indication in any paging occasion while the SDT procedure is ongoing. If SDT procedure is not ongoing, UE monitors ETWS/CMAS indication in its own paging occasion in RRC\_INACTIVE.
4. Section 9.2.5: The paging procedures in case of SDT are not inline with Stage-3 specification.
5. Section 18.0: states that “The CG resources for SDT are valid only within the cell the UE received RRCRelease and transitioned to RRC\_INACTIVE state.”- UE can also receive CG resources in RRCRelease message send at the end of SDT procedure. In this case there is no state transition. So text needs to be corrected.
6. Section 18.0: states that “The network may configure UE to apply ROHC continuity for SDT either when the UE initiates SDT in the cell where the UE received RRCRelease and transitioned to RRC\_INACTIVE state or when the UE initiates SDT in a cell of its RNA.”- UE can also receive ROHC continuity indication for SDT in RRCRelease message send at the end of SDT procedure. In this case there is no state transition.
7. Section 18.0: states that “Once initiated, the SDT procedure is either:- successfully completed after the UE is directed to RRC\_IDLE (via RRCRelease) or RRC\_INACTIVE (via RRCRelease or RRCReject) or to RRC\_CONNECTED (via RRCResume or RRCSetup); or “UE is not directed to RRC\_INACTIVE as it is already in RRC\_INACTIVE.
8. Section 9.2.6: For R17 SDT, it was agreed that legacy RACH procedure can be triggered during SDT procedure for the following cases:- UL transmission is needed when TA timer expires during SDT.- SR is triggered during SDT and there is no PUCCH resources.While in current spec, these two cases are not covered in the list of RACH trigger events.
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| ***Summary of change:*** | 1. Section 18.0: The MAC TS references are corrected.
2. Section 18.0: Add an explanation that each CG resource is associated with one or multiple SSB(s).
3. Section 16.4: Update the text to calrify that UE monitors ETWS/CMAS indication in any paging occasion while the SDT procedure is ongoing. If SDT procedure is not ongoing, UE monitors ETWS/CMAS indication in its own paging occasion in RRC\_INACTIVE.
4. Section 9.2.5: Align with Stage-3.
5. Section 18.0: Change to “The CG resources for SDT are valid only within the cell the UE received RRCRelease with *suspendConfig*.”
6. Section 18.0: Change to “The network may configure UE to apply ROHC continuity for SDT either when the UE initiates SDT in the cell where the UE received RRCRelease with *suspendConfig* or when the UE initiates SDT in a cell of its RNA.”
7. Section 18.0: Change to “successfully completed after the UE is directed to RRC\_IDLE (via RRCRelease) or to continue in RRC\_INACTIVE (via RRCRelease or RRCReject) or to RRC\_CONNECTED (via RRCResume or RRCSetup); or”
8. Section 9.2.6: Add the RACH trigger events that would occur during an onging SDT procudure.

 **Impact analysis**Impacted functionality: SDT procedure.Inter-operability: 1. If the network is implemented according to the CR and the UE is not, no inter-operability issues.
2. If the UE is implemented according to the CR and the network is not, no inter-operability issues.
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| ***Consequences if not approved:*** | Stage-2 and Stage-3 specifications remain not synchronized. |
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| ***Clauses affected:*** | 9.2.5, 9.2.6, 16.4, 18.0 |
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|  | **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*

### 9.2.5 Paging

Paging allows the network to reach UEs in RRC\_IDLE and in RRC\_INACTIVE state through *Paging* messages, and to notify UEs in RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED state of system information change (see clause 7.3.3) and ETWS/CMAS indications (see clause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see clause 6.5 of TS 38.331 [12]).

While in RRC\_IDLE the UE monitors the paging channels for CN-initiated paging. While in RRC\_INACTIVE with no ongoing SDT procedure (see clause 18.0), the UE monitors paging channels for RAN-initiated paging and CN-initiated paging. A UE need not monitor paging channels continuously though; Paging DRX is defined where the UE in RRC\_IDLE or RRC\_INACTIVE is only required to monitor paging channels during one Paging Occasion (PO) per DRX cycle (see TS 38.304 [10]). The Paging DRX cycles are configured by the network:

1) For CN-initiated paging, a default cycle is broadcast in system information;

2) For CN-initiated paging, a UE specific cycle can be configured via NAS signalling;

3) For RAN-initiated paging, a UE-specific cycle is configured via RRC signalling;

- The UE uses the shortest of the DRX cycles applicable i.e. a UE in RRC\_IDLE uses the shortest of the first two cycles above, while a UE in RRC\_INACTIVE uses the shortest of the three.

The POs of a UE for CN-initiated and RAN-initiated paging are based on the same UE ID, resulting in overlapping POs for both. The number of different POs in a DRX cycle is configurable via system information and a network may distribute UEs to those POs based on their IDs.

While in RRC\_CONNECTED and while in RRC\_INACTIVE with an ongoing SDT procedure , the UE monitors the paging channels in any PO signalled in system information for SI change indication and PWS notification. In case of BA, a UE in RRC\_CONNECTED only monitors paging channels on the active BWP with common search space configured.

For operation with shared spectrum channel access, a UE can be configured for an additional number of PDCCH monitoring occasions in its PO to monitor for paging. However, when the UE detects a PDCCH transmission within the UE's PO addressed with P-RNTI, the UE is not required to monitor the subsequent PDCCH monitoring occasions within this PO.

If Paging Cause is included in the Paging message, a UE in RRC\_IDLE or RRC\_INACTIVE state may use the Paging Cause as per TS 23.501[3].

**Paging optimization for UEs in CM\_IDLE**: at UE context release, the NG-RAN node may provide the AMF with a list of recommended cells and NG-RAN nodes as assistance info for subsequent paging. The AMF may also provide Paging Attempt Information consisting of a Paging Attempt Count and the Intended Number of Paging Attempts and may include the Next Paging Area Scope. If Paging Attempt Information is included in the Paging message, each paged NG-RAN node receives the same information during a paging attempt. The Paging Attempt Count shall be increased by one at each new paging attempt. The Next Paging Area Scope, when present, indicates whether the AMF plans to modify the paging area currently selected at next paging attempt. If the UE has changed its state to CM CONNECTED the Paging Attempt Count is reset.

**Paging optimization for UEs in RRC\_INACTIVE**: at RAN Paging, the serving NG-RAN node provides RAN Paging area information. The serving NG-RAN node may also provide RAN Paging attempt information. Each paged NG-RAN node receives the same RAN Paging attempt information during a paging attempt with the following content: Paging Attempt Count, the intended number of paging attempts and the Next Paging Area Scope. The Paging Attempt Count shall be increased by one at each new paging attempt. The Next Paging Area Scope, when present, indicates whether the serving NG\_RAN node plans to modify the RAN Paging Area currently selected at next paging attempt. If the UE leaves RRC\_INACTIVE state the Paging Attempt Count is reset.

**UE power saving for paging monitoring:** in order to reduce UE power consumption due to false paging alarms, the group of UEs monitoring the same PO can be further divided into multiple subgroups. With subgrouping, a UE shall monitor PDCCH in its PO for paging if the subgroup to which the UE belongs is paged as indicated via associated PEI. If a UE cannot find its subgroup ID with the PEI configurations in a cell or if the UE is unable to monitor the associated PEI occasion corresponding to its PO, it shall monitor the paging in its PO.

These subgroups have the following characteristics:

- They are formed based on either CN controlled subgrouping or UE ID based subgrouping;

- If specific subgrouping information is not provided from CN, UE ID based subgrouping is used if supported by the UE and network;

- The RRC state (RRC\_IDLE or RRC\_INACTIVE state) doesn’t impact UE subgroup of a UE;

- Subgrouping support for RAN is broadcast in the system information as one of the following: Only CN controlled subgrouping supported, Only UE ID based subgrouping supported, or both CN controlled subgrouping and UE ID based subgrouping supported;

- Total number of subgroupings allowed in a cell is limited to 8 and represents the sum of CN-assigned and UEID-based subgrouping configured by the network;

- A UE with CN-assigned subgroup ID shall derive UEID-based subgroup ID in a cell supporting only UEID-based subgrouping.

PEI associated with subgroups has the following characteristics:

- If the PEI is supported by the UE, it shall at least support UEID-based subgrouping method;

- PEI monitoring can be limited via system information to the cell in which its last connection was released;

- A PEI-capable UE shall store its last used cell information;

- UE that expects MBS group notification shall ignore the PEI and shall monitor paging in its PO.

**CN controlled subgrouping:** AMF is responsible for assigning subgroup ID to the UE. The total number of subgroups for CN controlled subgrouping can be configured up to 8, e.g. by OAM. The following figure describes the procedure for CN controlled subgrouping:



Figure 9.2.5-1: Procedure for CN controlled subgrouping

1. The UE indicates its support of CN controlled subgrouping via NAS signalling.

2. If the UE supports CN controlled subgrouping, the AMF determines the subgroup ID assignment for the UE.

3. The AMF sends subgroup ID to the UE via NAS signalling.

4. The AMF informs the gNB about the assigned subgroup ID for paging the UE in RRC\_IDLE/ RRC\_INACTIVE state.

5. When the paging message for the UE is received from the CN or is generated by the gNB, the gNB determines the PO and the associated PEI occasion for the UE.

6. Before the UE is paged in the PO, the gNB transmits the associated PEI and indicates the subgroup(s) of the UE(s) that is paged in the PEI if supported by the UE(s).

**UE ID based subgrouping:** gNB and UE can determine the subgroup ID based on the UE ID and the total number of subgroups for UE ID based subgrouping in the cell. The total number of subgroups for UE ID based subgrouping is decided by the gNB for each cell and can be different in different cells. The following figure describes the procedure for UE ID based subgrouping:



Figure 9.2.5-2: Procedure for UE ID based subgrouping

1. The gNB determines the total number of subgroups for UE ID based subgrouping in a cell.

2. The gNB broadcasts the total number of subgroups for UE ID based subgrouping in a cell.

3. When paging message for the UE is received from the CN to the gNB or is generated by the gNB, the gNB determines the PO and the associated PEI occasion for the UE.

4. Before the UE is paged in the PO, the gNB transmits the associated PEI and indicates the subgroup(s) of the UE(s) that is paged in the PEI if supported by the UE(s).

*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 or during RRC\_INACTIVE while SDT procedure (see clause 18.0) is ongoing, when UL synchronisation status is "non-synchronised";

- UL data arrival, during RRC\_CONNECTED or during RRC\_INACTIVE while SDT procedure is ongoing, when there are no PUCCH resources for SR available;

- SR failure;

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

- RRC Connection Resume procedure 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 18);

- Positioning purpose during RRC\_CONNECTED requiring random access procedure, e.g., when timing advance is needed for UE positioning.

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*

16.4 Public Warning System

NR connected to 5GC provides support for public warning systems (PWS) through means of system information broadcast capability. NR is responsible for scheduling and broadcasting of the warning messages as well as for paging the UE to provide indication that the warning message is being broadcast:

- Earthquake and Tsunami Warning System: ETWS is a public warning system developed to meet the regulatory requirements for warning notifications related to earthquake and/or tsunami events (see TS 22.168 [14]). ETWS warning notifications can either be a primary notification (short notification) or secondary notification (providing detailed information).

- Commercial Mobile Alert System: CMAS is a public warning system developed for the delivery of multiple, concurrent warning notifications (see TS 22.268 [15]).

Different SIBs are defined for ETWS primary notification, ETWS secondary notification and CMAS notification. Paging is used to inform UEs about ETWS indication and CMAS indication (see clause 9.2.5). UE monitors ETWS/CMAS indication in its own paging occasion for RRC\_IDLE and for RRC\_INACTIVE while no SDT procedure (see clause 18.0) is ongoing. UE monitors ETWS/CMAS indication in any paging occasion for RRC Connected and during the SDT procedure in RRC\_INACTIVE. Paging indicating ETWS/CMAS notification triggers acquisition of system information (without delaying until the next modification period).

KPAS and EU-Alert are public warning systems developed for the delivery of multiple, concurrent warning notifications (see TS 22.268 [15]). KPAS and EU-Alert uses the same AS mechanisms as CMAS. Therefore, the NR procedures defined for CMAS equally apply for KPAS and EU-Alert.

*Next Modified Subclause*

18 Small Data Transmission

18.0 General

Small Data Transmission (SDT) is a procedure allowing data and/or signalling transmission while remaining in RRC\_INACTIVE state (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 as specified in clause 5.27.1 of TS 38.321 [6].

SDT procedure is initiated with either a transmission over RACH (configured via system information) or over Type 1 CG resources (configured via dedicated signalling 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. The CG resources for SDT are valid only within the PCell of the UE when the *RRCRelease* with suspend indication is received. CG resources are associated with one or multiple SSB(s). For RACH, the network can configure 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 clause 9.2.6. CFRA is not supported for SDT over RACH.

Once initiated, the SDT procedure is either:

- successfully completed after the UE is directed to RRC\_IDLE (via *RRCRelease*) or to continue in RRC\_INACTIVE (via *RRCRelease or RRCReject*) or to RRC\_CONNECTED (via *RRCResume or RRCSetup*); or

- unsuccessfully completed upon cell re-selection, expiry of the SDT failure detection timer, a MAC entity reaching a configured maximum PRACH preamble transmission threshold, an RLC entity reaching a configured maximum retransmission threshold, or expiry of SDT-specific timing alignment timer while SDT procedure is ongoing over CG and the UE has not received a response from the network after the initial PUSCH transmission.

Upon unsuccessful completion of the SDT procedure, the UE transitions to RRC\_IDLE.

The initial PUSCH transmission during the SDT procedure includes at least the CCCH message. When using CG resources for initial SDT transmission, the UE can perform autonomous retransmission of the initial transmission if the UE does not receive confirmation from the network (dynamic UL grant or DL assignment) before a configured timer expires as specified in clause 5.4.1 of TS 38.321 [6]. After the initial PUSCH transmission, 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 (dynamic UL grant or DL assignment) for the initial PUSCH transmission from the network. For subsequent UL transmission, the UE cannot initiate re-transmission over a CG resource.

- 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.

While the SDT procedure is ongoing, if data appears in a buffer of any radio bearer not enabled for SDT, the UE initiates a transmission of a non-SDT data arrival indication using *UEAssistanceInformation* message to the network and, if available, includes the resume cause.

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 a SDT-specific timing alignment timer configured by the network via dedicated signalling and, for initial CG-SDT transmission, also by DL RSRP of configured number of highest ranked SSBs which are above a configured RSRP threshold. Upon expiry of the SDT-specific timing alignment timer, the CG resources are released while maintaining the CG resource configuration.

Logical channel restrictions configured by the network while in RRC\_CONNECTED state and/or in *RRCRelease* message for radio bearers enabled for SDT, if any, are applied by the UE during SDT procedure.

The network may configure UE to apply ROHC continuity for SDT either when the UE initiates SDT in the PCell of the UE when the *RRCRelease* with suspend indication was receivedor when the UE initiates SDT in a cell of its RNA.

*End of Changes*