3GPP RAN WG2 Meeting #113bis-e R2-210xxxx

eMeeting April 12th – April 20th, 2021

Agenda Item: 8.6.3

Source: InterDigital (email discussion rapporteur)

Title: [DRAFT] [Post113-e][503][SDT] T319, cell reselection and re-establishment

Document for: Discussion, Decision

# Introduction

This discussion document is intended to define the new T319-like timer for small data transmission, as well as address cell reselection during SDT procedure and related security aspects. The following objectives have been provided by session chair:

* [Post113-e][503][SDT] T319, cell reselection and re-establishment (InterDigital)

Scope: 1) Extended T319 timer/new handling (option on how to start/maintain timer) 2) how to deal with timer expiry, 3) Cell reselection handling and related security aspects

Intended outcome: Report to the next meeting.

The following deadlines are provided:

* Initial deadline (for companies' feedback): **Friday 2021-03-26 23:59 UTC**

# Discussion

## SDT failure detection timer

In Rel-16, to detect transmission failure in INACTIVE state UE starts T319 timer upon transmission of *RRCResumeRequest/RRCResumeRequest1*. TS 38.331 [1] defines timer operation as follows:

| Timer | Start | Stop | At expiry |
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| T319 | Upon transmission of *RRCResumeRequest* or *RRCResumeRequest1.* | Upon reception of *RRCResume,* *RRCSetup, RRCRelease, RRCRelease* with *suspendConfig* or *RRCReject* message, cell re-selection and upon abortion of connection establishment by upper layers. | Perform the actions as specified in 5.3.13.5. |

The current maximum value of T319 may be insufficient to account for multiple small data packets during subsequent small data transmission, possibly leading to unnecessary transmission failure and data loss since the UE transitions into IDLE mode upon timer expiry.

Extending T319 could avoid premature declaration of RRC connection resume failure during subsequent small data transmission. However, as T319 is configured in *ue-TimersAndConstants* in SIB1, the same T319 value applies to all UEs within the cell, which would impact legacy procedures such as RNAU and RRC connection resume by increasing detection time of connection resume failure.

It was therefore agreed in R2#112e to introduce a new timer, **referred to as SDT failure detection timer in this discussion**, to detect and handle failures during the small data procedure [2]:

**Agreements**

Define a new timer. FFS whether it has the same definition as T319 or it is restarted every UL/DL

Considering this timer is intended to detect small data transmission failure, it was proposed in [3, 4] that SDT failure detection timer be started upon initial small data transmission, with [3] further adding reception of DL small data as a start condition.

**Q1: Do you agree SDT failure detection timer starts upon transmission/reception of initial small data PDU?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
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For RRC-based SDT, an RRC message is transmitted along with initial small data. If this RRC message is *RRCResumeRequest* or *RRCResumeRequest1* both SDT failure detection timer and legacy T319 timer would be running simultaneously, which may lead to data loss if T319 is configured with a shorter duration and expires (sending the UE to IDLE) before completion of SDT procedure.

**Q2: Do you agree if *RRCResumeRequest* or *RRCResumeRequest1* is transmitted for the purposes of SDT, legacy T319 timer is not started? (i.e. failure detection relies on new SDT failure detection timer instead)**

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| **Company** | **Agree/Disagree** | **Additional comments** |
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In [Post112-e][551][SDT], the following FFS details were further captured regarding timer duration:

Option 1) extended T319 like timer, or;

Option 2) timer restarted after each UL/DL.

Proponents of Option 1 state that extending the duration of SDT failure detection timer to accommodate subsequent SDT would be a simple solution, and that having a time bound on subsequent small data transmission (as in LTE EDT) is acceptable considering the target use case for SDT is applications with short and infrequent data.

Proponents of Option 2 note an extended timer restricts the network to configuring a timer duration based on the predicted total/max time for subsequent small transmission. Considering this duration is variable, defining a timer duration which can accommodate all scenarios may be difficult, and result in unnecessary delay to SDT transmission failure detection.

**Q3: What is the preferred SDT failure detection timer handling to accommodate subsequent SDT?**

* **Option 1: An extended timer to accommodate full duration of subsequent SDT;**
* **Option 2: Timer is restarted upon (re)transmission or reception of small data;**
* **Option 3: Other, please describe.**

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| **Company** | **Preferred Option(s)** | **Additional comments** |
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Legacy T319 timer is stopped upon reception of a response RRC message (e.g. *RRCResume*), cell re-selection, or abortion of connection establishment by upper layers. Assuming the network may respond with a similar set of RRC messages, the same stop conditions may also apply to SDT failure detection timer.

**Q4: Which legacy T319 stop conditions are also applicable to SDT failure detection timer?**

* **1: Reception of *RRCResume***
* **2: Reception of *RRCSetup***
* **3: Reception of *RRCRelease***
* **4: Reception of *RRCRelease* with *SuspendConfig***
* **5: Reception of *RRCReject***
* **6: Cell reselection**
* **7: Abortion of connection establishment by upper layers**
* **8: Other, please describe.**

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| **Company** | **Applicable stop condition(s)** | **Additional comments** |
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## Cell re-selection during SDT procedure

As per legacy procedure if cell reselection occurs while T319 is running, UE transitions to IDLE. Adopting similar behaviour while SDT failure detection timer is running (i.e. during ongoing SDT procedure) would lead to interruption of small data transmission and possible data loss.

However, several contributions [5, 10, 12] note cell reselection occurring during an SDT procedure would be rare and transitioning to IDLE and re-attempting the SDT procedure on a new cell is a simple solution with minimal specification impact. Even if UE transitions to IDLE during cell reselection, [4-6] note that UE could recover lost data from higher layers (i.e. PDCP retransmission) without complexity and specification change, and data loss prevention could be left to UE implementation.

Alternatively, proponents of enhancement note subsequent small data would extend the SDT procedure increasing the probability of cell reselection during SDT, and that small data transmission should have a similar reliability to connected mode data transmission. It is further noted in [6] that retransmission based on UE implementation may result in data duplication as the PDCP SN for the data is not maintained in the network and UE when UE goes to IDLE.

**Q5: Which of the following do you agree with:**

1. **The possibility of small data loss during cell re-selection justifies enhancement to existing procedures (i.e. UE should not transition to IDLE as in legacy T319 behaviour)**
2. **Existing recovery mechanisms (e.g. higher-layer retransmission) are sufficient to prevent small data loss even if UE transitions to IDLE during cell reselection;**
3. **Cell re-selection during SDT is a corner case, no enhancement/recovery mechanism is necessary;**
4. **Other, please describe**

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| **Company** | **Supported statement(s)** | **Additional comments** |
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An alternative solution to transitioning to IDLE is for UE to remain in INACTIVE and attempt a second RRC Resume to the new cell. However, per TS 33.501 [7] UE is provided with updated I-RNTI and NCC in subsequent *RRCRelease* with *suspendConfig* messages to prevent tracking of UE based on I-RNTI value. This may lead to security concerns if UE attempts the new Resume procedure before completion of the first and does not receive updated I-RNTI and NCC. One option mentioned in [4,6] is to temporarily allow re-use of the NCC and I-RNTI from the former cell to initiate an RRC Resume in the new cell, which could then be updated afterwards.

**Q6a: From RAN2 perspective, if UE remains in INACTIVE during cell reselection can same NCC and I-RNTI be used temporarily for RRC Resume procedure in new cell?**

**Note: A related discussion is ongoing in email discussion [Post113-e][502] [8] for data arriving on non-SDT DRBs. Companies are asked to highlight issues specific to cell reselection, if available.**

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| **Company** | **Yes/No** | **Additional comments** |
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If temporarily reusing NCC and I-RNTI value in sperate cells is supported from a RAN2 perspective, possible impacts and feasibility should be verified by SA3.

**Q6b: If ‘Yes; to Q6a, is an LS to SA3 necessary?**

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| **Company** | **Yes/No** | **Additional comments** |
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An alternative solution described in [4,6] is to provide UE with a new I-RNTI and NCC while SDT procedure is ongoing. Proponents of this solution are invited to describe how such signalling would work.

**Q6c: Are additional mechanisms (e.g. not relying on RRC Release message) needed to provide an updated I-RNTI/NCC value during SDT procedure? If ‘Yes’, please describe.**

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| **Company** | **Yes/No** | **Additional comments** |
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UE in CONNECTED for which AS security is activated with SRB2 and at least one DRB setup may initiate an RRC re-establishment procedure to continue RRC connection. Application of this procedure to cell reselection during SDT could avoid drawbacks of other candidate solutions such as potential data loss if transitioning to IDLE or security concerns of second Resume procedure. However, specification currently defines the re-establishment procedure only for connected mode UEs and would require extension to support INACTIVE UEs with SDT.

NOTE: resumption of SRB2 is currently a working assumption, however, for the purposes of this discussion it can be assumed that SRB2 is resumed during SDT.

**Q7: Assuming SRB2 is resumed, can RRC re-establishment procedure be extended to INACTIVE UEs with ongoing SDT procedure? If ‘No’ please provide technical reason(s) which preclude this.**

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| **Company** | **Yes/No** | **Additional comments** |
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**Q8: What is the preferred UE behaviour for cell re-selection during an on-going SDT procedure?**

* **Option 1: UE transitions to IDLE and initiates an SDT procedure on the new cell;**
* **Option 2: UE remains in INACTIVE;**
* **Option 3: UE performs RRC re-establishment procedure;**
* **Option 4: Other, please describe**.

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| **Company** | **Preferred Option(s)** | **Additional comments** |
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## SDT failure detection timer expiry

Current behaviour upon legacy T319 timer expiry is to transition to IDLE. However, enhancements applicable to cell reselection (i.e. higher-layer retransmission, remaining in INACTIVE, or RRC re-establishment) may also be applicable to SDT failure detection timer expiry to prevent small data loss during connection failure.

**Q9: Are the same potential UE behaviours listed in Q8 also applicable to SDT failure detection timer expiry? If ‘No’, please describe aspect(s) specific to timer expiry which would preclude an option(s).**

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**Q10: Assuming options described for cell reselection are also applicable for SDT failure detection timer expiry, what is the preferred UE behaviour at SDT failure detection timer expiry?**

* **Option 1: UE performs actions in TS 38.331, section 5.3.13.5 (i.e. transition to IDLE as per legacy T319 timer) and attempts RRC connection setup;**
* **Option 2: UE remains in INACTIVE;**
* **Option 3: UE performs RRC re-establishment procedure;**
* **Option 4: Other, please describe**.

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| **Company** | **Preferred Option(s)** | **Additional comments** |
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**Q11: Are there any other SDT failure detection timer or cell-reselection related aspects RAN2 should discuss?**

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| **Company** | **Other Aspects** |
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# Summary

<To be generated pending company feedback>

# Conclusion

<To be generated pending company feedback>

# Contact Information

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# References

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2. [R2-2100001](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100001.zip) Report of 3GPP TSG RAN2#112-e meeting – ETSI MCC
3. [R2-2101578](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101578.zip) Small data transmission failure timer – InterDigital, APT, Ericsson, ETRI, FGI, Sharp, Sony
4. [R2-2101184](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101184.zip) Control plan common aspects for SDT – Huawei, HiSilicon
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6. [R2-2100366](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100366.zip) Common Control plane aspects for SDT – Intel Corporation
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8. [R2-210xxxx](https://www.3gpp.org/ftp/Email_Discussions/RAN2/%5BRAN2%23113-e%5D/%5BPost113-e%5D%5B502%5D%5BSDT%5D%20GeneralOtherCpIssues(ZTE)) [Post113-e][502] General and other control plane open issues for SDT (ZTE)
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