3GPP RAN WG2 Meeting #117-e R2-2203542

eMeeting February 21st – March 3rd, 2022

Agenda Item: 8.10.2.1.1

Source: InterDigital

Title: Report of [AT117-e][103][NTN] MAC open issues: Second Round

Document for: Discussion, Decision

# Introduction

This document is intended address a subset of remaining MAC open issues as per the following email discussion guidelines:

**[AT117-e][NTN][103] MAC open issues (InterDigital)**

* **Updated scope:**
	+ **Continue the discussion on MAC open issues**
	+ **Update the MAC CR**
* **Updated intended outcome: Summary of the offline discussion with e.g.:**
	+ **List of proposals for agreement (if any)**
	+ **List of proposals that require online discussions**
	+ **List of proposals that should not be pursued (if any)**
	+ **Updated MAC CR**

Please note the following deadlines:

* Updated deadline (for companies' feedback): **Thursday 2022-02-24 1800 UTC**
* Updated deadline (for rapporteur's summary in R2-2203542): Thursday 2022-02-24 2000 UTC
* Deadline (for MAC CR in R2-2203547): Thursday 2022-03-03 1000 UTC

Please also note the following chair guidance:

* Proposals marked "for agreement" in R2-2203542 not challenged until **Friday 2022-02-25 1000 UTC** will be declared as agreed via email by the session chair (for the rest the discussion will continue offline).

# Remaining issues from [Pre117e]

## TA report with no UL-SCH resources available

Based on input to [Pre117e] Question 2a/2b, in general companies agree that connected UE should send TA report (if triggered) regardless of whether or not there is UL/DL data. However, opinions diverge as to whether this should always be the case, or conditional on the availability of UL-SCH resources.

Those which do not support triggering an SR when a TA report is triggered and no UL-SCH resources are available (or RACH if SR is triggered but there are no available PUCCH resources) note that this may cause all connected UEs under the satelite coverage to update TA simultaneously due to satellite movement, which may cause signalling storm and significant additional overhead.

Proponents note that TA reporting is important for network to adjust K-Offset and may impact subsequent UL/DL transmission if not reported. Any excessive signalling overhead can be controlled by network implementation.

**Rapporteur suggests the following compromise:** In legacy, UE triggers SR if there are no UL-SCH resources available for Regular BSR (a lower priority MAC CE than UE-specific TA MAC CE) only if *logicalChannelSR-DelayTimer* is not running. As mentioned by several companies in previous offline, perhaps we can leave this up to network implementation by introducing a similar timer for TA reporting?

For example, if there are no UL-SCH resources available and network does not want UE to trigger SR, the new timer value range may include the value “infinity” to effectively disable triggering SR for TA reporting. Alternatively if the network would like the UE to trigger SR immediately even if there are no UL-SCH resources, the timer may be disabled as in BSR case with *logicalChannelSR-DelayTimerApplied* set ot value ‘false’*.* Any additional intermediate values (less than infinity) may further help the network balance timely reception of the TA report with signalling overhead.

This may be captured in MAC specification using text similar to the BSR procedure in Section 5.4.5. The following exemplary text is provided, but can of course refined in Stage 3 (if agreed):

RRC configures the following parameters to control the TA reporting:

- *TAReportSR-DelayTimerApplied*;

- *TAReportSR-DelayTimer*;

…

For TA Report in connected mode, the MAC entity shall:

1> if the TA report is triggered due to [TAOffsetThreshold] and *TAReportSR-DelayTimerApplied* with value *true* is configured by upper layers:

2> start or restart the *TAReportSR-DelayTimer*.

1> else:

2> if running, stop the *TAReportSR-DelayTimer*.

The MAC entity shall:

1> if the UE-specific TA reporting procedure determines that at least one UE-specific TA report has been triggered and not cancelled:

2> if UL-SCH resources are available for a new transmission and the UL-SCH resources can accommodate the UE-Specific TA MAC CE plus its subheader as a result of logical channel prioritization:

3> instruct the Multiplexing and Assembly procedure to generate the UE-Specific TA MAC CE as defined in clause 6.1.3.XX.

2> if a TA Report has been triggered due to [TAOffsetThreshold] and *TAReportSR-DelayTimer* is not running:

3> if there is no UL-SCH resource available for a new transmission, or;

3> if UL-SCH resources available for a new transmission cannot accommodate the UE-Specific TA MAC CE plus its subheader as a result of logical channel prioritization:

4> trigger a Scheduling Request.

**Question 1) As a compromise, do you support introducing an *SR-DelayTimer* for TA reporting (similar to BSR procedure) which includes value ‘infinity’?**

**Note: If UL-SCH resources are not available for TA report, this solution would support the following UE behaviour based on network configuration:**

1. **Immediately trigger SR (if *TAReportSR-DelayTimerApplied* is set to ‘*false*’);**
2. **Never trigger SR (if *TAReportSR-DelayTimerApplied* is set to ‘*true*’ and *TAReportSR-DelayTimer is set to ‘infinity’*);**
3. **Delay triggering SR (if *TAReportSR-DelayTimerApplied* is set to ‘*true*’ and *TAReportSR-DelayTimer* is set to a value other than infinity) allowing network to balance overhead and timely reception of TA reporting**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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## UE location reporting for purposes of TA report

During offline [AT116bis][101] (and again via contribution to RAN2#117e), support for UE location information for TA reporting purposes was split, with small majority preferring to not support. Based on previous agreement, if the content of the TA report in connected mode is TA pre-compensation, then MAC CE is used whereas if the content is UE location report, RRC signalling is used. Each signalling method has it’s advantages: MAC CE would be faster to transmit, however RRC signalling can be more reliable and UE location could be useful for other purposes.

However, Rapporteur notes that although TA reporting has been primarily addressed in UP discussions, reporting UE location information would ultimately be handled by RRC specification. This may require additional discussion on how to implement this functionally in RRC with very little time left in this release.

Considering the very late stage of discussion it is suggested that if UE-location for TA reporting purposes is agreed, a very simple mechanism is captured relying on NW configuration and the same TA reporting threshold (i.e., the TA offset threshold).

This may be captured in MAC specification via the following exemplary text, which can be modified in Stage 3 (if agreed):

RRC configures the following parameters to control the TA reporting:

- [*TAorLocation*]

…

The MAC entity shall:

1> if the UE-specific TA reporting procedure determines that at least one UE-specific TA report has been triggered and not cancelled:

2> if a TA Report has been triggered due to [TAOffsetThreshold] and [*TAorLocation*] with value ‘location’ is configured by upper layers:

3> notify RRC to report UE location information.

2> else

3> if UL-SCH resources are available for a new transmission and the UL-SCH resources can accommodate the UE-Specific TA MAC CE plus its subheader as a result of logical channel prioritization:`

4> instruct the Multiplexing and Assembly procedure to generate the UE-Specific TA MAC CE as defined in clause 6.1.3.XX.

**Question 2) As a compromise, do you agree to support the above mechanism to enable reporting UE-location information for TA reporting purposes in MAC?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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## Naming of new MAC CEs and field descriptions

In [Pre117e], the naming of the newly introduced MAC CEs and corresponding field definitions were addressed. During discussion, it was commented that RAN1 has introduced specification text in 38.211 and 38. 213 to capture the TA reporting procedure.

### Name of UE-specific TA MAC CE

The following is quoted from 38.211 v17.0.0 section 3.1 and 4.3.1:

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|  Timing advance between downlink and uplink; see clause 4.3.1…Uplink frame number  for transmission from the UE shall start $$T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$$before the start of the corresponding downlink frame at the UE where - $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$. |

It was commented “UE specific” is not mentioned in the reported quantity, and can be dropped from the name. Furthermore, this MAC CE is similar to the PHR and BSR (it reports some information from the UE), and should contain “report” at the end.

Rapporteur notes the TA reporting procedure has been led by RAN1, and RAN2 specification should align with terminology used in latest version of 38.211. As suggested, the naming of the UE specific TA MAC CE can be revised to “Timing Advance Report MAC CE” to better align with RAN1 specification and existing RAN2 MAC CE naming convention.

**Question 3a) Do you agree to revise the naming of “UE-Specific MAC CE” to “Timing Advance Report MAC CE” to better align with TS 38.211?**

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### UE-specific MAC CE field descriptions

In [Pre117e] discussion, the following RAN1 agreements were also quoted:

***Agreement***

*15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1.*

***Agreement***

*The reported TA is the least integer number of slots greater than or equal to the corresponding TA value.*

To align with RAN1 agreements, it was commented that the field description of the UE-Specific TA MAC CE contents be revised as follows to better reflect RAN1 agreements:

- Timing Advance: In FR1, the Timing Advance field indicates the least integer number of slots greater than or equal to the Timing Advance value (see TS 38.211 section 4.3.1). The length of the field is 14 bits.

Rapporteur again notes the TA reporting procedure has been led by RAN1, and RAN2 specification should align with terminology/agreements used in latest version of 38.211.

**Question 3b) Do you agree to revise the field description of “UE-Specific MAC CE” as follows to better align with RAN1 agreements?**

- Timing Advance: In FR1, the Timing Advance field indicates the least integer number of slots greater than or equal to the Timing Advance value (see TS 38.211 section 4.3.1). The length of the field is 14 bits.

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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### Differential UE-Specific K-Offset MAC CE name

Similar to the UE-specific TA MAC CE, the following terminology has been used in TS 38.213 v17.0.0 in section 4.2 when referring to the UE-specific Koffset:

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| For a timing advance command received on uplink slot $n$ and for a transmission other than a PUSCH scheduled by a RAR UL grant or a fallbackRAR UL grant as described in clause 8.2A or 8.3, or a PUCCH with HARQ-ACK information in response to a successRAR as described in clause 8.2A, the corresponding adjustment of the uplink transmission timing applies from the beginning of uplink slot $n+k+1+2^{μ}∙K\_{offset}$ where $k=\left⌈N\_{slot}^{subframe, μ}∙{\left(N\_{T,1}+N\_{T,2}+N\_{TA,max}+0.5\right)}/{T\_{sf}}\right⌉$, $N\_{T,1}$ is a time duration in msec of $N\_{1}$ symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured, $N\_{T,2}$ is a time duration in msec of $N\_{2}$ symbols corresponding to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214], $N\_{TA,max}$ is the maximum timing advance value in msec that can be provided by a TA command field of 12 bits, $N\_{slot}^{subframe, μ}$ is the number of slots per subframe, $T\_{sf}$ is the subframe duration of 1 msec, and $K\_{offset}=K\_{cell,offset}-K\_{UE,offset}$, where $K\_{cell,offset}$ is provided by *Koffset* in *ServingCellConfigCommon* and $K\_{UE,offset}$ is provided by a MAC CE command; otherwise, if not respectively provided, $K\_{cell,offset}=0$ or $K\_{UE,offset}=0$. |

It was commented in [Pre117] discussion that similar to UE-Specific TA MAC CE, there is no need to use “specific” in the name, and if we use “Differential Koffset” it is already differentiated from the cell-specififc Koffset, thus we can drop the “UE” in the name.

However, unlike the previously referenced text, the value $K\_{UE,offset}$ does make explicit reference to the UE, and based on RAN1 LS R1-2112840 on MAC CE impacts, the RAN1 temporary name is “UESpecific\_Koffset“, with description “Provides and updates the value of UE specific K\_offset”.

**Question 3c) What is you preferred naming for the currently defined “Differential UE-Specific K-Offset MAC CE”?**

* **Option 1: Differential Koffset MAC CE**
* **Option 2: UE-Specific Koffset MAC CE**
* **Option 3: Other, please describe.**

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| **Company** | **Preferred Option** | **Additional comments**  |
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## Configuration of HARQ mode for HARQ process 0

In [Pre117e], RAN2 further discussed several previously raised technical issues regardingwhen HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA. Although most issues were resolved, a few companies still had concerns regarding increased delay for transmission of UL data, since LCHs configured with different HARQ mode cannot use the PUSCH resource depending on configuration of *allowedHARQ-mode*.

However, it is noted that a large majority of companies still think this can be handled by NW implementation (reflecting a similar outcome in [AT116bis-e] discussion where the same topic was raised), and no new technical arguments were raised as compared to previous discussion. Rapporteur therefore suggests for the sake of progress that the previous proposal be agreed.

 **Question 4) Can companies accept the following proposal for the sake of progress:**

***Proposal: When HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, configuration of HARQ mode and allowedHARQ-DRX-LCP is up to NW implementation, and UE always follows it (no specification impact).***

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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## Implementation of HARQ RTT Timer extension

In [Pre117-e], implementation if HARQ RTT Timer extension in the running MAC CR was discussed. The main concern raised was that current text may be interpreted as changing an RRC configured field. MAC specification Rapporteur agrees that this interpretation should be avoided, and proposes 2 possible implementations:

**Implementation 1) Clarification of current running CR text:**

1> if this Serving Cell is part of a non-terrestrial network:

2> if this Serving cell is configured with *downlinkHARQ-FeedbackDisabled* and DL HARQ feedback is enabled for a HARQ process:

3> set duration of MAC DRX timer *drx-HARQ-RTT-TimerDL* ~~length~~ for the corresponding HARQ process to RRC configured value *drx-HARQ-RTT-TimerDL* included in *DRX-Config* plus UE-gNB RTT.

2> else:

3> set duration of MAC DRX timer *drx-HARQ-RTT-TimerDL* ~~length~~ for the corresponding HARQ process to RRC configured value *drx-HARQ-RTT-TimerDL* included in *DRX-Config*.

2> if this Serving Cell is configured with *uplinkHARQ-Mode* and a HARQ process is configured as HARQ Mode A:

3> set duration of MAC DRX timer *drx-HARQ-RTT-TimerUL* ~~length~~ for the corresponding HARQ process to RRC configured value *drx-HARQ-RTT-TimerUL* included in *DRX-Config* plus UE-gNB RTT.

2> else:

3> set duration of MAC DRX timer *drx-HARQ-RTT-TimerUL* ~~length~~ for the corresponding HARQ process to RRC configured value *drx-HARQ-RTT-TimerUL* included in *DRX-Config*.

**Implementation 2) Introduction of helper variables**

The following UE variables are used for the DRX operation:

- *HARQ\_RTT\_TIMER\_DL* (per downlink HARQ process, except for the broadcast process).

- *HARQ\_RTT\_TIMER\_UL* (per uplink HARQ process).

When DRX is configured, the MAC entity shall:

1> if this Serving cell is configured with *downlinkHARQ-FeedbackDisabled* and DL HARQ feedback is enabled for a HARQ process:

2> set *HARQ\_RTT\_TIMER\_DL* for the corresponding HARQ process to *drx-HARQ-RTT-TimerDL* plus UE-gNB RTT.

1. else:

2> set *HARQ\_RTT\_Timer\_DL* for the corresponding HARQ process to *drx-HARQ-RTT-TimerDL*

1> if this Serving Cell is configured with *uplinkHARQ-Mode* and a HARQ process is configured as HARQ Mode A:

2> set *HARQ\_RTT\_Timer\_UL* for the corresponding HARQ process to *drx-HARQ-RTT-TimerUL* plus UE-gNB RTT.

2> else:

3> set *HARQ\_RTT\_Timer\_UL* for the corresponding HARQ process to *drx-HARQ-RTT-TimerUL*

Rapporteur notes that Implementation 2 is simple, unambiguous, and clear. Although legacy instances of *drx-HARQ-RTT-TimerUL/DL* will be replaced with new helper variables, the UE behaviour remains the same as in legacy. It is therefore suggested that unless there are serious technical concerns, RAN2 procedes with Implementation 2.

**Question 5) Do you agree that HARQ RTT Timer extension will be implemented in MAC CR as per Implementation 2?**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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# Remaining issues from [AT117e]

## Additional details of ra-ContentionResolutionTimer

In [AT117e], additional details of the *ra-ContentionResolutionTimer* were discussed, where it was proposed that upon receiving PDCCH indicating Msg3 retransmission, UE starts *ra-ContentionResolutionTimer* after the end of the Msg3 retransmission plus UE-gNB RTT. Although this received majority support, in subsequent discussion there were serious concerns raised about impact to blind Msg3 retransmission (a legacy function) and resulting impact to coverage. The following is captured in chair notes as a possible way forward:

* Further discuss offline to see whether it's possible to make it configurable

Rapporteur thinks the above compromise is reasonable, and suggests that the former proposal be considered a configurable option.

**Question 6a) Do companies agree to the following compromise proposal:**

**Proposal: *If configured by network,* UE stops *ra-ContentionResolutionTimer* upon receiving PDCCH indicating Msg3 retransmission and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT.**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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If the proposal in Question 6a is agreed, then RAN2 must agree on UE behaviour when UE is not configured with the above behaviour. One possible option raised was that If *ra-ContentionResolutionTimer* expires during the UE-gNB RTT after Msg3 retransmission, (to wait for new CR timer restart) the UE does not consider the Contention Resolution unsuccessful.

**Question 6b) If “Agree” to Question 6a, what is the preferred UE behaviour when configuration is not present?**

* **Option 1: If *ra-ContentionResolutionTimer* expires during the UE-gNB RTT after Msg3 retransmission, (to wait for new CR timer restart) the UE does not consider the Contention Resolution unsuccessful.**
* **Option 2: Other, please describe.**

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| **Company** | **Preferred Option** | **Additional comments**  |
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## **OI 14:** Additional details for *drx-HARQ-RTT-TimerDL/UL*

In open issues discussion from [AT116bis-e], OI14 raises the issue there may need to be further clarification on UE DRX behaviour, as when PDCCH indicates a UL/DL transmission legacy specification doesn’t consider the case where *drx-HARQ-RTT-TimerUL/DL* for the corresponding HARQ process has already been running.

Rapporteur understanding is that this open issue comes from different interpretations on how *drx-HARQ-RTT-TimerDL* and *drx-HARQ-RTT-TimerUL* are defined in legacy specification, and whether a UE may expect a PDCCH indicating a UL/DL transmission while *drx-HARQ-RTT-TimerUL/DL* is running for the corresponding HARQ process.

Regarding this issue, RAN2 Vice Chair has already captured the following guidance in chair notes from RAN2#115e:

*- VC thinks that if further clarification is needed on the legacy behaviour this will have to be discussed in the main room as part of the maintenance session.*

Rapporteur therefore suggests that based on Chair guidance, this issue is not further discussed in this session and if further clarification on DRX behaviour is necessary, it may be brought up in the main session as part of maintenance.

**Question 7) Do you agree that, as per chair guidance “*further clarification on UE DRX behaviour when PDCCH indicates a UL/DL transmission where drx-HARQ-RTT-TimerUL/DL for the corresponding HARQ process has already been running*” is not treated in this session?**

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## **OI 16:** Details of DRX behaviour for SR and CFRA

### Details of DRX behaviour for SR

Open Issue 16 discusses the case that a when UE sends an SR, the UE enters Active time to monitor for a response after an offset time has elapsed. This aspect was addressed via contribution, where company input may be generally classified into support for introducing an offset or not.

For those which did not support an offset, the primary concern raised was that this may be non-trivial to introduce in the specification. For example, since SR may be retransmitted, if introducing an offset to SR triggered DRX Active Time, does it mean for each SR (re)transmission, the UE enters DRX Active Time after an offset time has elapsed, or the offset is only applied to the first transmission of the SR? If the offset is applied for each SR (re)transmission, will the RTT duration after SR retransmssion cancel the Active Time starting from the end of the RTT duration after first SR transmission?

Proponents of introducing an offset clarify that UE will enter Active Time at the first SR transmission + an offset. The active time will continue until no pending SR, and the SR retransmission has no impact on the active time. Rapporteur would like to check if, with this clarification, the following proposal is agreeable.

**Question 8a) Do you agree that in NTN, the UE enters Active Time at the first SR transmission + an offset? The Active Time will continue until no pending SR, and the SR retransmission has no impact on the Active Time.**

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| **Company** | **Agree/Disagree** | **Additional comments**  |
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Form [AT117e] discussion, in SR case there was near consensus that the offset is defined as the UE-gNB RTT.

**Question 8b) If “Agree” to Question 8a), do you agree the offset is defined as UE-gNB RTT?**

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### Details of DRX behaviour for CFRA

For discussion on UE entering DRX Active time an offset time after sending Msg3 in response to RAR message during CFRA, companies concerns were slightly different.

Those which did not agree note that during CFRA, network can identify the UE via Msg1, so after sending RAR, UE has acquired its TA and network may be able to schedule the subsequent transmission for the UE any time it wants (e.g. before or after receiving Msg3, depending on network implementation). To avoid missing any scheduling, UE should enter DRX Active Time after receiving RAR as legacy.

Proponents of an offset note that Msg3 is the ACK message of RAR.The network will therefore typically will not schedule UE before receiving the Msg3, and it is reasonable that UE delays to enters DRX active time.

As a compromise, some mention that it can be configurable whether the UE shall apply the offset or not. The network is then in full control if it want to send Msg3 retransmissions or not and may select that based on the UEs services or subscription or other reasons. Rapporteur thinks that this is a reasonable way forward.

**Question 9) Do you agree that in NTN, UE enters DRX Active time a network configurable offset time after sending Msg3 in response to RAR message during CFRA?**

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## **OI 17:** UL synchronization failure

In Open issues discussion, RAN2 discussed how to handle UL synchronization failure due to the validity timer expiry. Although discussion was inconclusive in previous meetings, it has been noted that in IoT-NTN a similar issue was discussed, and it was agreed: *“when SI used for UL synch (pre-compensation) is no longer valid, the UE autonomously tunes away and re-acquires the required SI, and then comes back.”*

However, several companies mention that an IoT UE cannot read SIB in connected mode, which is not usually the case in NR. Applying IoT-NTN agreement in NR would cause the UE to wait until validity timer expiry and then interrupt connection to perform SI update. Considering UE knows when validity time expires, UE can instead re-aquire SIB prior to validity timer expiry to avoid unnecessary periodic interruption.

Rapporteur would first like to reach a general understanding on how the UE behaves while validity timer is running, which may impact the frequency of the timer expiring and the possibly UE behaviour upon timer expiry (e.g., if this is a rare event a simple solution may be defined).

**Question 10a) What is your understanding of *general* behaviour for connected UE when approaching validity timer expiry?**

* **Option 1: UE does not reaquire SIB until validity timer expires;**
* **Option 2: UE reaquires SIB prior to validity timer expiry (when possible);**
* **Option 3: Other, please describe.**

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| **Company** | **Preferred Option** | **Additional comments**  |
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In the event validity timer does expire (e.g. if Option 1 is the preferred UE behaviour or if UE is configured with a BWP without a common search space and cannot reaquire SIB), then UE behaviour still needs to be defined. In general, contributions to RAN2#117e note the following potential behaviours:1) Be considered out of sync (possibly requiring RACH); 2) Re-aquire SI (with or without flushing HARQ buffers); or 3) trigger RLF (immediately or subject to a timer).

**Question 10b) Upon validity timer expiry, what is your preferred UE behaviour?**

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| **Company** | **Preferred UE behaviour?** |
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# Conclusions

<To be generated pending company input>

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