3GPP TSG-RAN WG2 Meeting #126 R2-2405760

Fukuoka, Japan, 20th May – 24th May, 2024

**Agenda item: 7.6.3**

**Source: Samsung**

**Title: Summary of [AT126][302][IoT NTN Enh] T390 issues (Samsung)**

**WID/SID: IoT\_NTN\_enh-Core**

**Document for: Discussion and Decision**

# Introduction

This offline handles the following:

* [AT126][302][IoT NTN Enh] T390 issues (Samsung)

 Scope: discuss T390 issues (based on the proposals in R2-2405151, R2-2405499, R2-2405440, R2-2404157, R2-2404653, R2-2405526, R2-2404594)

 Intended outcome: report of offline discussion

 Deadline for companies' feedback: Wednesday 2024-05-22 20:00 (but F2F discussion is invited)

 Deadline for rapporteur's summary (in R2-2405760): Thursday 2024-05-23 08:00

# Discussion

How to handle the timer T390 during handovers was discussed in RAN2#125bis. It was originally proposed that T390 is stopped when the network triggers a handover. However it was realized that the issue is more about handling of connected mode mobility for a UE that is not synchronized.

## T390 and random access

A potentially more fundamental issue that was mentioned is whether a UE can perform connected mode random access to the serving cell (PCell) when T390 is running. According to current procedures, a UE is not prevented from triggering random access during T390, for instance due to no uplink resources, too many SR attempts or even for NB-IoT RACH-based SR.

In *R2-2404594 “Discussion on RACH triggering during T390 running”,* the following is proposed:

1. Upon RACH being triggered while T390 is running, UE considers T390 as expired.

### **Q1: Can a UE perform connected mode random access to PCell during T390? (non-handover case)**

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | Yes | If RACH is not permitted during T390, this would mean UE cannot send SR during UL transmission extension. For NB-IoT, no SR means the UE cannot initiate the UL transmission which will make the UL transmission extension not useful. We think the extension is anyway controlled by NW. The T390 implies the old GNSS position is still relatively accurate so there is no need for GNSS measurement and UE can still perform UL transmission (e.g., when the UE is stationary). |
| OPPO | No |  |
| Google | No |  |
| QC | Yes |  |
| Apple | No |  |
| Vivo | Yes | Based on the current specs, uplink transmission including PRACH which uses out-dated GNSS position is allowable by the serving eNB. |
| Mediatek | Yes | The RACH is a part of UL transmission, which should be allowed in the UL transmission extension, i.e. during the T390.Also, the TAC in RAR can adjust the UE UL synchronization, network may further send UL Transmission Extension Update MAC CE to reset T390. |
| ZTE | Yes |  |
| HW | Yes |  |
| TCL  | Yes | Same view with Nokia  |
| Samsung | See comment | We can see both views, but if RACH is not possible then this may cause severe restrictions. In the non-handover case, the network knows it has configured this feature.  |

**Rapporteurs understanding:**

RAN1 likely did not consider the issue of performing connected mode random access during T390 and RAN2 has modelled the uplink transmissions extension as a period in which the UE may remain in connected mode with invalid GNSS, with no further limitations on UE action.

On one hand the network may be aware of the UE being configured with T390, and on the other hand the UE will be unsynchronized and the resources for random access will be shared with other UEs. There may be a need to consult with RAN1 regarding the issue.

Another interpretation may be that UE performing RACH with invalid GNSS is a consequence that network may have to live with when configuring uplink transmission extension.

#### **Offline F2F discussion:**

OPPO: T390 breaks closed-loop timing advance. May need to consult with RAN1.

Google: Position is inaccurate. If UE performs RACH NTA value is reset. Not preferable.

QC: May not be uplink resource, thus triggering RACH. Agree with OPPO on how to fix. NTA should not be reset. Ok to send LS. An exception that UE should keep using the same NTA for preamble.

Apple: Fundamental change to go with QC approach of NTA=0. Consider to not trigger rACH more simple. UE should not transmit rach during the timer.

Vivo: Based on current procedure. Can send LS to RAN1.

Mediatek: Should be possible to do RACH as this is part of UL TX.

OPPO: RACH part of UL TX indeed, but there are specific requirements in RAN1. RACH and PUSCH are totally different in RAN1.

ZTE: RACH can be performed.

OPPO: Check with RAN1, given the diverse views.

HW: Prefer to allow RACH to be performed.

Mediatek: If companies think that anything should change, then they can bring it up in RAN1. RAN1 designed the feature.

Rapporteur suggestion: No consensus to cehck with RAN1.

QC: To have some progress – send LS to RAN1.

Nokia: IF RACH is not permitted, then this feature is useless.

OPPO: We still need a confirmation with RAN1.

ZTE: RAN2 has not identified any issues.

Rapporteur: No consensus to

#### **Conclusion:**

After discussion with companies the suggestion is that RAN2 confirms that UE can perform connected mode random access to PCell for non-handover case, as is allowed by current procedures. This does not require any specification change in RAN2. RAN2 sends an LS to inform RAN1 about this confirmation, without any request for reply. If RAN1 sees any issues, they can discuss and come back to RAN2.

**Proposal 1: RAN2 confirms understanding that connected mode random access to Pcell (non-handover case) is possible. No RAN2 spec impact.**

**Proposal 2: RAN2 sends LS to RAN1 only to inform RAN1 about the understanding.**

## T390 during (conditional) handover

As explained above, the question that S068 triggered in RAN2#125bis was whether a UE is allowed to perform a handover to a target cell or not when the UE does not have a valid GNSS position. In release 17, the UE is required to have

For performing a handover to a target cell, a number of solutions or resolutions have been suggested:

* UE does not perform handover to target cell if UE does not have valid GNSS position fix:
	+ - UE performs GNSS position fix before executing the handover if T390 is running [2]
		- Handovers while T390 are not allowed while T390 is running. Network ensures that T390 is not running while handover is being triggered for both HO and CHO [2].
		- Other?
* Allow a handover to execute to a target cell while UE does not have valid GNSS position fix:
	+ - For CHO, do not include gnss-ValidityDuration in RRCConnectionReconfigurationComplete to signal T390 is running [4].
		- Signal T390 value in RRCConnectionReconfigurationComplete [5].
		- Other?

A first important decision to be made is whether the system shall allow for a UE to execute a handover to target cell while UE does not have a valid GNSS position. A system may potentially ensure that no handovers are performed either via network implementation or via UE methods to perform GNSS position fix.

### **Q2: Shall the system allow for a UE to be able to execute handover to target cell while UE does not have valid GNSS position?**

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | Yes with comment | If T390 is running, UE can execute handover to target cell with the old GNSS position. |
| Samsung | No |  |
| Google | No |  |
| Apple | No |  |
| OPPO | No |  |
| Vivo | Yes | Agree with rapporteur understanding below. |
| MediaTek | Yes | Although the GNSS position is considered invalid, as long as the TAC can correct the UL timing error, the UL synchronization can still be maintained. When the T390 is running, network is assuming the UL timing can be corrected to an extent. The random access on the target cell during the handover can help to correct the UL timing error. |
| ZTE | Yes(?) |  |
| Huawei | Yes |  |
| Ericsson | No |  |
| TCL  | Yes |  |
| Samsung | No | For us it is not acceptable to allow for an unsynchronized UE to perform random access to a target cell. As it stands, the target cell may not be assumed to have implemented any of the features for the UE to be able to perform GNSS measurement. For instance, for gnss-PositionFixDuration in RRCConnectionReconfigurationComplete, we have a bit that indicates whether UE shall include this field. For this case we cannot even have this type of solution. In other words, the target cell no longer has control how the UE shall operate in the target cell. If this is the case, for inter-operable handovers, the target cell vendor has to do a lot of testing for potentially unsynchronized UEs.  |

**Rapporteurs understanding**

Rapporteur notes that even though answer to Q1 may allow for connected mode random access for non-handovers, this may not mean that handovers are allowed for a UE that does not have valid GNSS position.

Rapporteur notes that during the online discussion there were clear issues raised on whether it can be assumed that the target cell may be able to handle a UE with T390 running. Furthermore, it was also raised that an unsynchronized UE will cause interference to other UEs that are synchronized, especially on common resources such as RACH. It breaks with basic release 17 principles.

Thus rapporteur’s preference is that the system shall not allow a UE to execute to target cell if the UE does not have a valid GNSS position.

#### **Offline F2F discussion:**

HW: Limited to small case. Network can configure.

#### **Conclusion:**

After discussion offline, we think that the acceptable solution is that network ensures that UE does not perform handover or CHO while T390 is running.

**Proposal 3: Network ensures that neither handover or conditional handover is triggered to target cell while T390 is running via network implementation. No stage 3 impact.**

### **Q3a: If yes to Q2, how is target cell made aware of T390 running at the UE?**

**- Option 1: gnss-ValidityDuration is not included in RRCConnectionReconfigurationComplete**

**- Option 2: T390 value is signalled in RRCConnectionReconfigurationComplete**

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | Option 2  | Upon T390 expiry, NW will assume an autonomous GNSS measurement has started or UE has moved to RRC Idle. Therefore, it is better to report the T390 remaining value to the target cell.For Option1, it can also work if UE and NW have the common understanding that if gnss-ValidityDuration is not included in RRCConnectionReconfigurationComplete, NW should assume UE is in UL transmission extension period (hence trigger the GNSS measurement immediately). |
| TCL | Option 1 |  |
| MediaTEk | Option 1 | Since the GNSS position is no long valid, but current GNSS-ValidityDuration-r17 in the RRCConnectionReconfigurationComplete does not support an invalid value, this IE should be absent.This can be used as an indication of awareness of a running T390.The remaining time of T390 is not critical. |
| vivo | Comments | In our understanding, there is no need for target eNB to be aware of T390 running at UE. It is intended for the source Pcell. |

#### **Offline F2F discussion:**

### **Q3b: If no to Q2, how do we ensure that UE has valid GNSS position fix before execution of handover:**

**- Option 1: UE performs GNSS position fix before executing the handover if T390 is running.**

**- Option 2: Handovers are not allowed while T390 is running or GNSS position is invalid. Network ensures that T390 is not running while handover is being triggered.**

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | See comment | We think no matter what option is to be selected, there should have no restriction for NW to trigger the Handover. It is not reasonable for NW to delay the handover for up to 31 second to have a GNSS measurement before a handover (which is time-critical). |
| TCL | Option 1 |  |
| vivo | Option 1 | By NW implementation, NW should guarantee that UE has valid GNSS measurement before performing HO procedure. |
|  |  |  |

#### **Offline F2F discussion:**

## Other T390 issues

**Handling of T390 and GNSS position fix during C-DRX inactive period.**

In [4] and [5], the issue of stopping T390 when a UE performs a GNSS position fix during C-DRX inactive period is mentioned. The issue is that currently there is no condition to stop T390 after has successfully

### **Q4: Shall T390 be stopped after successful GNSS position fix during C-DRX inactive period?**

- Option 1: Yes

- Option 2: Other option

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | Option1/Yes | If UE completes the GNSS measurement successfully, UE has a valid GNSS. UE should not be in UL extension status. Instead, UE should stop the T390 to avoid autonomous GNSS measurement or even go to idle upon the timer expiry.If UE stop the timer, the NW should know that hence UE and NW have the common understanding of T390 status. Otherwise, the cell will assume UE performing autonomous GNSS measurement or going to idle upon the timer expiry in NW.. |
| TCL | Yes | But the NW should know T390 status |
| MediaTek | Other option | UE should stop T390 upon GNSS measurement. Otherwise, T390 may expire during the GNSS measurement. This will trigger another UE autonomously GNSS measurement or UE will leave RRC connected. Neither of these methods is a better choice than waiting for the GNSS measurement during C-DRX inactive time to complete. |
| vivo | Yes | The intention is okay to us.  |
|  |  |  |

**Rapporteurs understanding.**

Currently, T390 is stopped for two cases: 1) an indication is received from lower layers to perform GNSS position fix (triggered GNSS position fix), and 2) RRC re-establishment is triggered.

Thus the T390 is never stopped when a UE successfully acquires GNSS position fix. Rapporteurs understanding is that this is needed.

#### **Offline F2F discussion:**

In [6] is proposed to unify the stopping procedures for GNSS measurement triggered by the network, for autonomous GNSS measurement and for performing GNSS measurement during C-DRX this is done by stopping T390 after a successful GNSS measurement.

**Proposal 1 UE stops T390 (if it is running) upon performing the GNSS measurement, no matter whether the GNSS measurement is triggered by the network, performed by the UE using an autonomous gap, or performed by the UE using available idle periods.**

**Proposal 2 Replace the changes relevant to the conditions for stopping T390 in R2-2403774 with the text proposal in Section 3.**

Part of the CR is the following:



### **Q5: Should the T390 be stopped upon GNSS measurement for all cases, i.e is the CR in R2-2405526 acceptable?**

- Option 1: Yes

- Option 2: No

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | No | For the GNSS measurement in C-DRX inactive time, NW has no idea when it will happen. In this case, the UE should not stop the T390 upon GNSS measurement without informing NW. Otherwise, the cell will assume UE performing autonomous GNSS measurement or going to idle upon the timer expiry in NW. |
| MediaTek | Yes | The network can wait a little longer for duration report of the UE whose T390 expired during the GNSS measurement during C-DRX inactive time. |
| vivo | Yes |  |

**Rapporteurs understanding.**

Rapporteurs understanding is that the CR can be pursued.

#### **Offline F2F discussion:**

**Further procedures for stopping T390**

In [3] it is proposed:

**Proposal 1: For RRC re-establishment procedure, T390 is stopped once GNSS acquisition is initiated.**

### **Q6: Does the T390 stopping condition during RRC re-establishment need to change?**

- Option 1: Yes

- Option 2: No

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| --- | --- | --- |
| **Company** | **Yes/No/See comment** | **Comment** |
| Nokia | Yes |  |
| TCL | Yes |  |
| MediaTek | Yes | As current specification, UE may re-acquire the GNSS before RRC re-establishment. T390 should be stopped upon performing the GNSS measurement. |
| vivo | Yes | if CR proposed in Q5 is agreed, the T390 stopping condition during RRC re-establishment initiation can be removed. |
| Samsung | No | We shall not mix up Release 17 GNSS measurement requirements with Release 18 GNSS measurement procedures. The fix in Q5 does NOT mean that GNSS measurement performed according to release 17 is fixed. There is more spec impact if we try to bring release 17 procedures. For instance, shall the UE trigger GNSS validity duration MAC CE when a release 17 up-to-UE-implementation is performed? Our answer is a clear no, but with the suggestion that Q5 fixes this, this would be the case.  |

**Rapporteurs understanding:**

In the contribution it stated that the current Rel-17 condition to have valid GNSS position fix before initiating RRC re-establishment means that the T390 may not be stopped before the GNSS position fix:

5.3.7.1a Condition for re-establishing RRC Connection in NTN

If s*ystemInformationBlockType31* (*systemInformationBlockType31-NB* in NB-IoT) is broadcast, a RRC connection re-establishment is initiated only if the UE has a valid GNSS position.

NOTE: The UE may need to re-acquire the GNSS position before re-establishing the connection to avoid interruption during the connection.

However, our interpretation is that the Rel-17 condition simply means that the UE shall have a valid GNSS position fix before RRCConnectionReestablishment is sent to the lower layers. With this interpretation, the T390 will always stop after for instance an RLF is triggered. Furthermore, our understanding is that the procedures for Rel-17 GNSS position requirements should not be mixed with Rel-18 GNSS position fix, because the Rel-17 GNSS position requirements does not specify when the GNSS position fixes should be performed.

Furthermore, section 5.5.9 that specify GNSS measurement triggering and reporting, clearly state that the section is for “*GNSS measurement can be triggered aperiodically by the GNSS Measurement Command MAC CE (see TS 36.321 [6]), or triggered by the UE autonomously if enabled by the network, or triggered by the UE using available idle periods.*”, so in order to bring in Rel-17 GNSS position fix for re-establishment, we have to bring it in here.

Rapporteurs understanding is that current stopping condition is sufficient, but a release 17 correction could be pursued to clarify that UE does not transmit *RRCConnectionReestablishmentRequest* before GNSS is invalid.

#### **Offline F2F discussion:**

### **Conclusion of 2.3:**

There was no time to discuss the above other issues in 2.3. Given the answers and the rapporteur understanding we propose the following

**Proposal 4: T390 is stopped after successful GNSS position fix during C-DRX inactive time.**

**Proposal 5: Discuss in CR review phase how to capture T390 stopping condition for the following cases:**

**- Network-triggered GNSS position fix**

**- Autonomous GNSS position fix**

**- GNSS position fix during C-DRX inactive time**

# Conclusion

In this contribution we have the following observations and proposals:

**Proposal 1: RAN2 confirms understanding that connected mode random access to Pcell (non-handover case) is possible. No RAN2 spec impact.**

**Proposal 2: RAN2 sends LS to RAN1 only to inform RAN1 about the understanding.**

**Proposal 3: Network ensures that neither handover or conditional handover is triggered to target cell while T390 is running via network implementation. No stage 3 impact.**

**Proposal 4: T390 is stopped after successful GNSS position fix during C-DRX inactive time.**

**Proposal 5: Discuss in CR review phase how to capture T390 stopping condition for the following cases:**

**- Network-triggered GNSS position fix**

**- Autonomous GNSS position fix**

**- GNSS position fix during C-DRX inactive time**

# Reference

1. R2-2404594, Discussion on RACH triggering during T390 running, OPPO.
2. R2-2405151, [S068] Handling GNSS uplink transmission extension during handover, Samsung, ZTE and Google
3. R2-2404653, T390 handling during mobility [S067][S068], Apple
4. R2-2405499, [S068] UE behaviour on T390 upon handover or CHO, Huawei, HisSilicon
5. R2-2405440, On left open issues for T390 handling, Nokia, Nokia Shanghai bell
6. R2-2405526, Corrections on the conditions for stopping T390, Google