3GPP TSG RAN WG1 #118 R1-240XXXX

Maastricht, NL, August 19th – 23rd, 2024

**Agenda item:** 8.1

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Feature lead summary on RACH during uplink transmission extension

**Document for:** Discussion and Decision

# Background

RAN2 sent an LS to RAN1 in R1-2405784 on RACH during uplink transmission extension. The LS content is as follows:

RAN2 has discussed whether random access is possible while the timer T390 (in RAN1 referred to as the uplink transmission extension timer, which is the timer during which the UE is in RRC connected mode with invalid GNSS position) is running and has agreed the following in RAN2#126:

**RAN2 confirms the understanding that connected mode random access to Pcell (including intra-cell handover case) is possible while T390 is running. No RAN2 spec impact.**

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

The following documents have been submitted to RAN1#118 regarding this LS:

R1-2406220 Discussion on RACH during uplink transmission extension OPPO

R1-2406221 Draft reply LS on RACH during uplink transmission extension OPPO

R1-2406425 Discussion on RAN2 LS on RACH during uplink transmission extension Nokia, Nokia Shanghai Bell

R1-2406818 Discussion on RAN2 LS on RACH during uplink transmission extension Apple

R1-2407006 On RACH during uplink transmission extension for NTN IOT Qualcomm Incorporated

From FL point of view, the contributions can be summarized as follows:

* x6220 / x6221 (OPPO) and x7006 (Qualcomm): Both sourcing companies propose to revisit the issue of RACH during T390, since the closed loop commands do not apply to NPRACH. Qualcomm proposes a TP which is reproduced in Section 2.3.
* x6818 (Apple) and x6425 (Nokia): Both sourcing companies do not see any issues with supporting RACH during T390.

In view of the submitted contributions, FL proposes the questions in Section 2 to try to direct the discussion.

# Discussion

## 2.1: Q1: Is your understanding that during uplink transmission extension, according to current specifications, the UE transmits (N)PRACH with $N\_{TA}=0$?

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | YES |
| Lenovo | The issue is similar as discussed in RAN1-116. It may be up to UE implementation to determine the TA (open loop TA and “closed loop TA” with NTA=0) in NRACH procedure.When T390 is running, UE intends to perform NRACH, that means, UE’s position may be changed, there is possibility that the closed loop NTA may not be valid, we can accumulate the potential invalid NTA for NRACH. |
| Ericsson | Yes |
| Qualcomm | Yes |
| Nokia, NSB | Yes. |
| Huawei, HiSilicon | Yes |
| ZTE | According to RAN1 discussion, the uplink transmission extension is to correct GNSS error based on closed loop TA adjustment. However, PRACH transmission is based on the assumption of N\_TA=0, i.e., closed loop TA adjustment is not applicable. Therefore, PRACH transmission during uplink transmission extension should not be performed if timing error is not tolerable with N\_TA=0. |

## 2.2: Q2: If the answer to Q1 was “yes”, how does the UE/eNB handle the timing error due to outdated GNSS during uplink transmission extension?

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| --- | --- |
| Company | Comment |
| OPPO | If the UE transmits NPRACH using only open-loop UL sync, the timing error is unavoidable.  |
| Ericsson | Since the UE applies NTA=0, regardless of closed-loop TA commands, the eNB cannot handle the timing error of (N)PRACH. |
| Qualcomm | The eNB cannot compensate the timing error due to GNSS with closed loop corrections. |
| Nokia, NSB | UE precompensated TA can use original GNSS, thus PRACH in extension should also be allowed based on original GNSS with N\_TA as 0. The network will provide a Timing Advance Command in the msg2/RAR.PRACH before UL extension also use N\_TA = 0 and it works, similar for the case in UL extension. |
| Huawei, HiSilicon | UE will not compensate the timing error due to outdated GNSS |

## 2.3: Q3: Do you agree with the TP from x7006 (Qualcomm), incorporated below?

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | We think that the NPRACH can use closed-loop UL sync when T390 is running. Thus, the TP needs to be revised to set the condition of T390 running.  |
| Moderator | Modified the TP to refer to T390 instead of the RRC parameter. |
| Ericsson | We agree that likely a change to RAN1 specifications is needed but we need more time to identify any required changes. At this point, we can reply to the LS from RAN2 informing them that RAN1 specification impact is expected to be required. |
| Qualcomm | Yes (also fine with the modification from OPPO) |
| Nokia, NSB | Not support as we do not see need to add. |
| Huawei, HiSilicon | As the UL extension is not to be used when GNSS is significantly deviated from the actual value, we think the timing error due to GNSS should be accommodated by the RACH preamble. No need to update the existing procedure. |
| ZTE | RAN1 has already discussed this issue and not agree to use closed loop TA for NPRACH. |

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5.7.1 Time and frequency structure

**<Unchanged parts are omitted>**

The start of the random access preamble formats 0-3 shall be aligned with the start of the corresponding uplink subframe at the UE assuming  except if T390 (as specified in [TS 36.321]) is running, in which case the accumulated $N\_{TA}$ is used. The random access preamble format 4 shall start  before the end of the UpPTS at the UE, where the UpPTS is referenced to the UE's uplink frame timing assuming.

**<Unchanged parts are omitted>**

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4.2.3 Transmission timing adjustments

Upon reception of a timing advance command or a timing adjustment indication for a TAG containing the primary cell or PSCell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS, and PRACH if T390 (as specified in [TS 36.321]) is running*,* of the primary cell or PSCell based on the received timing advance command or a timing adjustment indication.

**<Unchanged parts are omitted>**

In case of random access response, and if T390 (as specified in [TS 36.321]) is not running*,* an 11-bit timing advance command [8], *TA*, for a TAG indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 256 if the UE is configured with a SCG, and *TA* = 0, 1, 2, ..., 1282 otherwise, where an amount of the time alignment for the TAG is given by *NTA* = *TA* ´16. *NTA* is defined in [3].

In case of random access response, and if T390 (as specified in [TS 36.321]) is running*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ´16.

In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format 6-0A/B if present [4], *TA*, for a TAG indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* -31)´16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a given amount respectively.

**<Unchanged parts are omitted>**

16.1.2 Timing synchronization

Upon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH, and SR if configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, and NPRACH if T390 (as specified in [TS 36.321]) is running*,* based on the received timing advance command.

The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16. The start timing of the random access preamble is specified in [3].

In case of random access response, and if T390 (as specified in [TS 36.321]) is not running*,* an 11-bit timing advance command [8], *TA*, indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA* = *TA* ´16. *NTA* is defined in [3].

In case of random access response, and if T390 (as specified in [TS 36.321]) is running*,* an 11-bit timing advance command [8], *TA*, indicates adjustment of the current *NTA* value, *NTA\_old* , to the new *NTA* value, *NTA,new* by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA,new* = *NTA,old +TA* ´16.

In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format N0 if present [4], *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* -31)´16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.

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