**3GPP TSG RAN WG1 #111 R1-220XXXX**

**Toulouse, France, November 14th – 18th, 2022**

**Agenda item:** 9.12.2

**Source:** Moderator (CATT)

**Title:** Moderator summary on Timing advance management: Round 1

**Document for:** Discussion and Decision

# Introduction

In RAN #94e, the Rel-18 WID of Further NR mobility enhancements are approved [1]. In the approved WID, Timing Advance management is a part of RAN1 objectives,

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| *To specify mechanism and procedures of L1/L2 based inter-cell mobility for mobility latency reduction:** *Configuration and maintenance for multiple candidate cells to allow fast application of configurations for candidate cells [RAN2, RAN3]*
* *Dynamic switch mechanism among candidate serving cells (including SpCell and SCell) for the potential applicable scenarios based on L1/L2 signalling [RAN2, RAN1]*
* *L1 enhancements for inter-cell beam management, including L1 measurement and reporting, and beam indication [RAN1, RAN2]*
	+ *Note 1: Early RAN2 involvement is necessary, including the possibility of further clarifying the interaction between this bullet with the previous bullet*
* *Timing Advance management [RAN1, RAN2]*
* *CU-DU interface signaling to support L1/L2 mobility, if needed [RAN3]*

*Note 2: FR2 specific enhancements are not precluded, if any.**Note 3: The procedure of L1/L2 based inter-cell mobility are applicable to the following scenarios:** + - *Standalone, CA and NR-DC case with serving cell change within one CG*
		- *Intra-DU case and intra-CU inter-DU case (applicable for Standalone and CA: no new RAN interfaces are expected)*
		- *Both intra-frequency and inter-frequency*
		- *Both FR1 and FR2*
		- *Source and target cells may be synchronized or non-synchronized*
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This summary includes the following:

* Summary of companies’ views on each of open issues raised by interested companies
* Observation and recommended proposal based on the summary of companies’ views

# Issue 1 – Initial TA acquisition

Open issues on TA acquisition of the candidate target cell and company views are summarized below.

Table 1 Summary for Issue 1

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| **#** | **Issue** | **Companies’ views** |
| 1.1 | Mechanisms to obtain TA of candidate cell | Opt1: RACH based solutionsMTK, Rakuten Symphony, MTK, Rakuten Symphony, Huawei, ZTE, Vivo, CATT, Google(deprioritized), Spreadtrum, Nokia(CFRA), Interdigital, Intel, Oppo, Ericsson(with no RAR), NTT DoCoMo, Samsung(CFRA), Qualcomm(CFRA)* Opt1.1: PDCCH ordered RACH
* Support: Huawei, ZTE, Vivo, CATT, Google(deprioritized), Spreadtrum, Nokia(CFRA), Interdigital, Intel, Oppo, Ericsson(with no RAR), NTT DoCoMo, Samsung(CFRA), Qualcomm(CFRA)
* Not support: Futurewei

Potential enhancements for Opt1.1:* The configuration of RACH for candidate cell(s) needs to be applied before handover: Vivo, Spreadtrum, Intel, CATT, NTT DoCoMo, Apple, QC, OPPO
* Introduce cell indicator in PDCCH order: Nokia, CATT
* Opt1.2: UE-triggered RACH
* Support: Huawei(deprioritized), Samsung
* Not support: Futurewei, Spreadtrum, Qualcomm
* Opt1.3 higher layer triggered RACH from NW other than L3 HO cmd
* Not support: Qualcomm

Opt2: RACH-less solution* Opt2.1: SRS based TA acquisition
* Support: Huawei, vivo, CATT, Oppo, Qualcomm
* Not support: Futurewei
* Opt2.2: RACH-less mechanism as in LTE
* Support: Spreadtrum, Nokia, Intel, Apple, ZTE
* Opt2.3: UE based TA measurement(including UE based TA measurement with one TAC from serving cell)
* Support: Google, Interdigital(deprioritized), Xiaomi, Ericsson, NTTDoCoMo, Qualcomm, Futurewei
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| 1.2  | RACH related issues | * Whether to receive RAR after triggered PRACH transmission
* No: Ericsson, QC
* Whether RAR is received from serving cell or candidate cell
* From serving cell: Samsung
* CFRA or CBRA based RACH
* CFRA: CATT, Nokia, intel, Samsung, QC(CFRA only)
* CBRA: Samsung(lower priority)
* Both: intel
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| 1.3 | Number of TAs associated with candidate cell(s) can be handled by UE  | * At least one TA associated with candidate cell(s) can be handled by UE
* Huawei, CATT, ZTE
* The number of TA associated with candidate cell(s) can be handled by UE depends on UE capability
* vivo,MTK
 |
| 1.4  | Whether two TA(s)/TAG(s) for a candidate cell can be configured | Yes: Nokia(up to two), Huawei, Qualcom |
| 1.5 | TA acquisition of the candidate cell before cell switch command when it is deactivated SCell | Support: Qualcomm, NTTDoCoMo, Apple |

**Proposal 1-1:** On mechanism to acquire TA of the candidate cells, support PDCCH ordered RACH.

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| **Company** | **Input** |
| Mod | **Please share your views on the above issue.** |
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**Proposal 1-2:** On RACH-less mechanism to obtain TA of the candidate cells, discuss and down-select among the following alternatives:

* Alt1: SRS based TA acquisition
* Alt2: RACH-less mechanism as in LTE
* Alt3: UE based TA measurement(including UE based TA measurement with one TAC from serving cell)

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**Proposal 1-3:**  For TA management in L1/L2 based mobility, support at least one of candidate cells can be associated with one acquired TA other than the TA used for the serving cell

* FFS: the maximal number of TA associated with candidate cell(s) can be handled by UE

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**Proposal 1-4:** On whether two TA(s)/TAG(s) for a candidate cell can be configured, discuss and down-select among the following alternatives:

* Alt1: Support two TA(s)/TAG(s) configuration for a candidate cell
* Alt2: Don’t support two TA(s)/TAG(s) configuration for a candidate cell

Note: for STRP operation, more than one TA/TAG per candidate cell is not needed

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**Proposal 1-5:** Support TA acquisition of the candidate cell before cell switch command when it is deactivated SCell.

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# Issue 2 – TA indication

Open issues on TA indication and company views are summarized below.

Table 2 Summary for Issue 2

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| **#** | **Issue** | **Companies’ views** |
| 2.1 | Association between TA and candidate cell | Opt1: Association between TA/TAG and candidate target cell implicitly: MTK, Rakuten Symphony, CATT* Opt 1.1: The association between TA/TAG and TCI states can be configured: Samsung,CATT, MTK

Opt2: Association between TA/TAG and candidate target cell ID explicitly:ZTE, Spreadtrum, Lenovo, Intel, OPPO, CMCC* Opt 2.1: the association is provided as a part of candidate cell(s) configuration: Vivo, Apple, Qualcomm
* Opt 2.2: the association between TA/TAG and SSB(s)/TRS(s) is provided as a part of candidate cell(s) configuration: Huawei, NTTDoCoMo

Opt3: Do not support associating the TA with a candidate cell: GoogleOpt4: depends on the method of TA acquisition: Nokia |
| 2.2 | When does the TA value of candidate target cell being indicated? | Opt1: before the cell switch command: Huawei,Vivo, SamsungOpt2: in the cell switch command: Vivo, Spreadtrum, Interdigital,Xiaomi(NW based TA measurement),Oppo, Ericsson, Samsung, Qualcomm, CATTOpt3: Depend on the TA acquisition mechanism: NokiaOpt4: Not necessary: Xiaomi(UE based TA measurement) |

**Proposal 2-1:** Explicit association of TA/TAG and candidate cell is supported, the following solutions can be further discussed.

* The association is provided as a part of candidate cell(s) configuration
* The association between TA/TAG and SSB(s)/TRS(s) is provided as a part of candidate cells(s) configuration

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# Issue 3 - TA updating

Table 3 Summary for Issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3.1 | Condition to trigger TA updating for candidate cell(s) | Opt1: Expiration of TATNokia, CATT, Ericsson, ZTEOpt2: NW implementation based solutione.g. timing difference between the received uplink signal (e.g. SRS) over the subframe boundary above a threshold(CATT)e.g. based on measurement of uplink signal quality (Nokia) |
| 3.2 | TA updating mechanism for candidate cell(s) | Opt1: NW based TA re-acquisition: Nokia(PDCCH order), Ericsson(trigger RACH), Qualcomm(trigger SRS), Rakuten Symphony, CATT(trigger SRS)Opt2: UE based TA re-acquisition: Nokia(UE-initiated CFRA) |

**Proposal 3-1**: On the condition triggering TA updating for candidate cell, discuss and down select from the following alternatives:

* Alt1: expiration of TAT
* Alt2: triggering of TA updating for candidate cell is up to NW

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# Other issues

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| **#** | **Issue** | **Companies’ views** |
| 4.1 | Whether cell switch confirmation is needed, and if so, the detailed mechanisms | Support:Interdigital |
| 4.2 | Whether the TA acquisition of the candidate cell shall be applied to a deactivated cell if this cell is a candidate cell  | Support:Oppo |

# References

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2. R1-2210853 Comparison of TA acquisition schemes for L1/L2 Mobility FUTUREWEI
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4. [R1-2210943](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2210943.zip) Enhancements on TA management to reduce latency ZTE
5. [R1-2211029](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211029.zip) Discussion on TA management for L1/L2 Mobility vivo
6. [R1-2211131](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211131.zip) On TA management for NR mobility enhancement Google
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13. [R1-2211419](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211419.zip) On Timing Advance Management Intel Corporation
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16. [R1-2211703](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211703.zip) Discussion on timing advance management to reduce latency CMCC
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# Previous agreements

## RAN1 #110bis-e

**Agreement**

Support TA acquisition of candidate cell(s) before cell switch command is received in L1/L2 based mobility.

* FFS: whether this can be applied to candidate cell when it is deactivated SCell (if defined in RAN2)

**Agreement**

On mechanism to acquire TA of the candidate cells, the following solutions can be further studied:

•         RACH-based solutions

e.g., PDCCH ordered RACH, UE-triggered RACH, higher layer triggered RACH from NW other than L3 HO cmd

•         RACH-less solutions

e.g., SRS based TA acquisition, Rx timing difference based, RACH-less mechanism as in LTE, UE based TA measurement (including UE based TA measurement with one TAC from serving cell)

Agreement

For TA acquisition of a candidate cell before cell switch command is received, study at least the following alternatives of associating TA/TAG to candidate cell:

* Alt1: Associate TA/TAG and candidate cell implicitly, e.g.,
* the association between TA/TAG and TCI states can be configured
* Alt2: Associate TA/TAG and candidate cell explicitly, e.g.,
* the association is provided as a part of candidate cell(s) configuration
* the association between TA/TAG and SSB(s)/TRS(s) is provided as a part of candidate cell(s) configuration