3GPP TSG RAN WG1 #110bis-e R1-22xxxxx

e-Meeting, October 10th – 19th, 2022

**Agenda item:** 8.4

**Source:** Moderator (Thales)

**Title:** Summary of [110bis-e-R17-NR-NTN-02] Email discussion for maintenance on timing relationship enhancements and UL time and frequency synchronization for NR NTN for issues 1-6, and 1-4.

**Document for:** Discussion and Decision

## Introduction

This document is the summary of [110bis-e-R17-NR-NTN-02] Email discussion for maintenance on timing relationship enhancements and UL time and frequency synchronization for NR NTN for issues 1-6, and 1-4 (as recommendation for editor’s alignment CR) in R1-2210436.

Please note the following checkpoint for agreements:

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| * Check points: October 14, October 19
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## Issue#1-4 Correction on timing relationship parameter for NR NTN

## Background

It is agreed to discuss issue#1-4 as per the conclusion of the summary of [110bis-e-R17-NR-NTN-01] in R1-2210436:

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| **Issue#** | Issue | **Recommendation from the moderator in R1-2210436.** |
| 1-4 | 38.213- Correction on timing relationship parameter for NR NTN:**Reason for change:** The name of the scheduling offset provided by network if downlink and uplink frame timing are not aligned at gNB is called K-Mac in TS 38.213. While in TS 38.331, the name of the scheduling offset is called kmac. It is better to align the name in TS 38.213 and TS 38.331. **Summary of change:** Align the name of scheduling offset provided by network if downlink and uplink frame timing are not aligned at gNB in TS 38.213 with the parameter name used in TS 38.331. **Consequences if not approved**: Misaligned parameter name between TS 38.213 and TS 38.331. | **Discuss over email in RAN1#110bis-e.**11 companies expressed views on this topic.11 companies agree with the FL assessment: This is an editorial issue that will be handled as editorial CRs/ alignment CR.**Moderator recommendation:** Discuss this issue over email in RAN1#110bis-e. This is an editorial issue that will be handled as editorial CRs (to be communicated to the editors/chairs). |

## Initial Proposal (Round-1)

A draft CR for 38.213 providing correction on timing relationship parameter for NR NTN is proposed in [1]. This CR is about the alignment of kmac in TS 38.213 and TS 38.331. The TP, reason/summary of change are provided within **Initial Proposal 1-4-**1.

The following proposal is made:

**Initial Proposal 1-4-1:**

**Adopt the following TP.**

**The TP is to be provided to the TS 38.213 editor for aligning the name of kmac in TS 38.213 and TS 38.331**

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| ***Reason for change:*** | The name of the scheduling offset provided by network if downlink and uplink frame timing are not aligned at gNB is called K-Mac in TS 38.213. While in TS 38.331, the name of the scheduling offset is called kmac. It is better to align the name in TS 38.213 and TS 38.331. |
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| ***Summary of change:*** | Align the name of scheduling offset provided by network if downlink and uplink frame timing are not aligned at gNB in TS 38.213 with the parameter name used in TS 38.331. |
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| ***Consequences if not approved:*** | Mislignmed parameter name between TS 38.213 and TS 38.331. |

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| 6 Link recovery procedures*====Unchanged parts ====*For the PCell or the PSCell, the UE can be provided, by *PRACH-ResourceDedicatedBFR*, a configuration for PRACH transmission as described in clause 8.1. For PRACH transmission in slot $n$ and according to antenna port quasi co-location parameters associated with periodic CSI-RS resource configuration or with SS/PBCH block associated with index $q\_{new}$ provided by higher layers [11, TS 38.321], the UE monitors PDCCH in a search space set provided by *recoverySearchSpaceId* for detection of a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI starting from slot $n+4+2^{μ}∙k\_{mac}$, where $μ$ is the SCS configuration for the PRACH transmission and $k\_{mac}$ is a number of slots provided by *kmac* [12, TS 38.331] or $k\_{mac}=0$ if *kmac* is not provided, within a window configured by *BeamFailureRecoveryConfig*. For PDCCH monitoring in a search space set provided by *recoverySearchSpaceId* and for corresponding PDSCH reception, the UE assumes the same antenna port quasi-collocation parameters as the ones associated with index $q\_{new}$ until the UE receives by higher layers an activation for a TCI state or any of the parameters *tci-StatesPDCCH-ToAddList* and/or *tci-StatesPDCCH-ToReleaseList*. After the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI in the search space set provided by *recoverySearchSpaceId*, the UE continues to monitor PDCCH candidates in the search space set provided by *recoverySearchSpaceId* until the UE receives a MAC CE activation command for a TCI state or *tci-StatesPDCCH-ToAddList* and/or *tci-StatesPDCCH-ToReleaseList.**====Unchanged parts ====*7 Uplink Power controlUplink power control determines a power for PUSCH, PUCCH, SRS, and PRACH transmissions. A UE does not expect to simultaneously maintain more than four pathloss estimates per serving cell for all PUSCH/PUCCH/SRS transmissions as described in clauses 7.1.1, 7.2.1, and 7.3.1, except for SRS transmissions configured by *SRS-PosResourceSet* as described in clause 7.3.1. If the UE is provided a number of RS resources for pathloss estimation for PUSCH/PUCCH/SRS transmissions that is larger than 4, the UE maintains for pathloss estimation RS resources corresponding to RS resource indexes $q\_{d}$ as described in clauses 7.1.1, 7.2.1, and 7.3.1. If an RS resource updated by MAC CE, as described in clauses 7.1.1, 7.2.1 and 7.3.1, is one from the RS resources the UE maintains for pathloss estimation for PUSCH/PUCCH/SRS transmissions, the UE applies the pathloss estimation based on the RS resources starting from the first slot that is after slot $k+3∙N\_{slot}^{subframe, μ}+2^{μ}∙k\_{mac}$ where $k$ is the slot where the UE would transmit a PUCCH or PUSCH with HARQ-ACK information for the PDSCH providing the MAC CE, $μ $is the SCS configuration for the PUCCH or PUSCH, respectively, that is determined in the slot when the MAC CE command is applied and $k\_{mac}$ is a number of slots for SCS configuration $μ=0$ provided by *kmac* or $k\_{mac}=0$ if *kmac* is not provided*.**====Unchanged parts ====*8.2 Random access response - Type-1 random access procedureIn response to a PRACH transmission, a UE attempts to detect a DCI format 1\_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set as defined in clause 10.1. If$N\_{TA,adj}^{UE}$or$N\_{TA,adj}^{common}$, as defined in [4, TS 38.211], is not zero, the window starts after an additional $T\_{TA}+k\_{mac}$ msec where $T\_{TA}$ is defined in [4, TS 38.211] and $k\_{mac}$ is provided by *kmac* or $k\_{mac}=0$ if *kmac* is not provided.The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*.*====Unchanged parts ====*8.2A Random access response - Type-2 random access procedureIn response to a transmission of a PRACH and a PUSCH, or to a transmission of only a PRACH if the PRACH preamble is mapped to a valid PUSCH occasion, a UE attempts to detect a DCI format 1\_0 with CRC scrambled by a corresponding MsgB-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in clause 10.1, that is at least one symbol, after the last symbol of the PUSCH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set. If$N\_{TA,adj}^{UE}$or$N\_{TA,adj}^{common}$, as defined in [4, TS 38.211], is not zero, the window starts after an additional $T\_{TA}+k\_{mac}$ msec where $T\_{TA}$ is defined in [4, TS 38.211] and $k\_{mac}$ is provided by *kmac* or $k\_{mac}=0$ if *kmac* is not provided. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *msgB-ResponseWindow*.*====Unchanged parts ====*10.1 UE procedure for determining physical downlink control channel assignment *====Unchanged parts ====*For a CORESET other than a CORESET with index 0, if a UE is provided a single TCI state for a CORESET, or if the UE receives a MAC CE activation command for one or two of the provided TCI states for a CORESET, the UE assumes that the DM-RS antenna port associated with PDCCH receptions in the CORESET is quasi co-located with the one or more DL RS configured by the TCI states. For a CORESET with index 0, the UE expects that a CSI-RS configured with *qcl-Type* set to 'typeD' in a TCI state indicated by a MAC CE activation command for the CORESET is provided by a SS/PBCH block- if the UE receives a MAC CE activation command for one of the TCI states, the UE applies the activation command in the first slot that is after slot $k+3N\_{slot}^{subframe,μ}+2^{μ}∙k\_{mac}$ where $k$ is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command, $μ$ is the SCS configuration for the PUCCH in the slot when the activation command is applied, and $k\_{mac}$ is a number of slots for SCS configuration $μ=0$ provided by *kmac* or $k\_{mac}=0$ if *kmac* is not provided.*====Unchanged parts ====* |

Companies are encouraged to comment on the Draft CR within the following table:

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| **Companies** | **Comments and Views** |
| LG | Support |
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## Issue 1-6 Draft CR for 38.213 to clarify calculation and application of timing advance values for common TA and UE specific TA

## Background

In [2], Nokia, Nokia Shanghai Bell made the following observations and proposals:

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| **Observation 1:** The application time of downlink timing reference, *N*TA-offset and*N*TA is well defined in the timing advance requirements as outlined by 38.113. |
| **Observation 2:** The application of *N*TA,common lacks the definition of the expected point of application. |
| **Proposal 8:** Both $N\_{TA,adj}^{UE}$ and $N\_{TA,adj}^{common}$ shall be updated at the beginning of every UL frame.  |
| **Proposal 9:** The timing advance must be fully corrected considering any DL and UL offsets, and satellite mobility, at the moment the UL signal is received by the satellite.  |

It is agreed to discuss issue#1-6 as per the conclusion of the summary of [110bis-e-R17-NR-NTN-01] in R1-2210436:

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| **Issue#** | Issue | **Recommendation from the moderator in R1-2210436:** |
| 1-6 | Draft CR for 38.213 to clarify calculation and application of timing advance values for common TA and UE specific TA:**Reason for change:** Promote unique expected timing advance correction by the UE in NTN **Summary of change:** Introduce the points of application for the common delay and UE specific delay components in the timing advance. Clarify calculation aspects on the common delay and UE specific delay components in the timing advance. **Consequences if not approved:** UEs may implement different solutions in compliance with the text, but yielding to different behaviour, making the conformance testing and gNB development more difficult. | **Discuss over email in RAN1#110bis-e**8 companies (**LG, MediaTek, Qualcomm, Samsung, Apple, ZTE, DCM, Lenovo**) think this is Non-essential issue3 companies (**Ericsson, Nokia, NSB, Panasonic)** prefer or fine to discuss this issue in this meeting.Moderator’s view: The proposed solution could be left to UE implementation. However, further discussions may be needed.Moderator recommendation: The issue can be discussed in this meeting. |

## Initial Proposal (Round-1)

A draft CR for 38.213 to clarify calculation and application of timing advance values for common TA and UE specific TA is proposed in [3]. The TP, reason/summary of change are provided within **Initial Proposal 1-6-1**.

The following proposal is made:

**Initial Proposal 1-6-1:**

**Adopt the following TP.**

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| ***Reason for change:*** | Promote unique expected timing advance correction by the UE in NTN |
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| ***Summary of change:*** | Introduce the points of application for the common delay and UE specific delay components in the timing advance. Clarify calculation aspects on the common delay and UE specific delay components in the timing advance. |
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| ***Consequences if not approved:*** | UEs may implement different solutions in compliance with the text, but yielding to different behaviour, making the conformance testing and gNB development more difficult. |

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| \*\*\* Unchanged text skipped \*\*\*4.2 Transmission timing adjustmentsA UE can be provided a value $N\_{TA,offset}$ of a timing advance offset for a serving cell by *n-TimingAdvanceOffset* for the serving cell. If the UE is not provided *n-TimingAdvanceOffset* for a serving cell, the UE determines a default value $N\_{TA,offset}$ of the timing advance offset for the serving cell as described in [10, TS 38.133]. If a UE is configured with two UL carriers for a serving cell, a same timing advance offset value $N\_{TA,offset}$ applies to both carriers. Upon reception of a timing advance command for a TAG, the UE adjusts uplink timing for PUSCH/SRS/PUCCH transmission on all the serving cells in the TAG based on a value $N\_{TA,offset}$ that the UE expects to be same for all the serving cells in the TAG and based on the received timing advance command where the uplink timing for PUSCH/SRS/PUCCH transmissions is the same for all the serving cells in the TAG. For a band with synchronous contiguous intra-band EN-DC in a band combination with non-applicable maximum transmit timing difference requirements as described in Note 1 of Table 7.5.3-1 of [10, TS 38.133], if the UE indicates *ul-TimingAlignmentEUTRA-NR* as 'required' and uplink transmission timing based on timing adjustment indication for a TAG from MCG and a TAG from SCG are determined to be different by the UE, the UE adjusts the transmission timing for PUSCH/SRS/PUCCH transmission on all serving cells part of the band with the synchronous contiguous intra-band EN-DC based on timing adjustment indication for a TAG from a serving cell in MCG in the band. The UE is not expected to transmit a PUSCH/SRS/PUCCH in one CG when the PUSCH/SRS/PUCCH is overlapping in time, even partially, with random access preamble transmitted in another CG.For a SCS of $2^{μ}∙15$ kHz, the timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG in multiples of $16∙{64∙T\_{c}}/{2^{μ}}$. The start timing of the random access preamble is described in [4, TS 38.211].A timing advance command [11, TS 38.321] in case of random access response or in an absolute timing advance command MAC CE, $T\_{A}$, for a TAG indicates $N\_{TA}$values by index values of $T\_{A}$ = 0, 1, 2, ..., 3846, where an amount of the time alignment for the TAG with SCS of $2^{μ}∙15$ kHz is $N\_{TA}=T\_{A}∙16∙{64}/{2^{μ}}$. $N\_{TA}$is defined in [4, TS 38.211] and is relative to the SCS of the first uplink transmission from the UE after the reception of the random access response or absolute timing advance command MAC CE.In other cases, a timing advance command [11, TS 38.321], $T\_{A}$, for a TAG indicates adjustment of a current $N\_{TA}$value, $N\_{TA\\_old}$, to the new $N\_{TA}$value, $N\_{TA\\_new}$, by index values of $T\_{A}$ = 0, 1, 2,..., 63, where for a SCS of $2^{μ}∙15$ kHz, $N\_{TA\\_new}=N\_{TA\\_old}+\left(T\_{A}-31\right)∙16∙{64}/{2^{μ}}$. If a UE has multiple active UL BWPs, as described in clause 12, in a same TAG, including UL BWPs in two UL carriers of a serving cell, the timing advance command value is relative to the largest SCS of the multiple active UL BWPs. The applicable $N\_{TA\\_new}$ value for an UL BWP with lower SCS may be rounded to align with the timing advance granularity for the UL BWP with the lower SCS while satisfying the timing advance accuracy requirements in [10, TS 38.133]. Adjustment of an $N\_{TA}$ value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a corresponding amount, respectively.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 *CellSpecific\_Koffset* and $K\_{UE,offset}$ is provided by a Differential Koffset MAC CE command [11, TS 38.321]; otherwise, if not respectively provided, $K\_{cell,offset}=0$ or $K\_{UE,offset}=0$. $N\_{1}$ and $N\_{2}$ are determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG and of all configured DL BWPs for the corresponding downlink carriers. For $μ=0$, the UE assumes $N\_{1,0}=14$ [6, TS 38.214]. Slot $n$ and $N\_{slot}^{subframe, μ}$ are determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG. $N\_{TA,max}$ is determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG and for all configured initial UL BWPs provided by *initialUplinkBWP*. The uplink slot $n$ is the last slot among uplink slot(s) overlapping with the slot(s) of PDSCH reception assuming $T\_{TA}=0$, where the PDSCH provides the timing advance command and $T\_{TA}$ is defined in [4, TS 38.211].If a UE changes an active UL BWP between a time of a timing advance command reception and a time of applying a corresponding adjustment for the uplink transmission timing, the UE determines the timing advance command value based on the SCS of the new active UL BWP. If the UE changes an active UL BWP after applying an adjustment for the uplink transmission timing, the UE assumes a same absolute timing advance command value before and after the active UL BWP change.If the received downlink timing changes and is not compensated or is only partly compensated by the uplink timing adjustment without timing advance command as described in [10, TS 38.133], the UE changes $N\_{TA}$ accordingly. If two adjacent slots overlap due to a TA command, the latter slot is reduced in duration relative to the former slot. The UE does not change $N\_{TA}$ during an actual transmission time window for a PUSCH or a PUCCH transmission [6, TS 38.214].Using higher-layer ephemeris parameters for a serving satellite, if provided, a UE pre-compensates the two-way transmission delay on the service link based on $N\_{TA,adj}^{UE}$ that the UE determines using the serving satellite position and its own position, provided that the UE has a running validity timer for this parameter [12, TS 38.331]. The UE shall adjust the $N\_{TA,adj}^{UE}$ component at the beginning of every uplink slot. The adustment in slot n must compensate for the summation of the service link distance travelled by the downlink reference signal to reach the UE, D1, and the distance travelled by the transmitted uplink slot n to reach the satellite, D2. Where $N\_{TA,adj}^{UE}=\left[\frac{D1+D2}{speed\_{light}.T\_{c}}\right]$, D1 and D2 are measured in meters and $speed\_{light}$ is the speed of light, [299 792 458 m/s], and $T\_{C}$ is the basic timing defined in [4, TS 38.211]. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the UE determines $N\_{TA,adj}^{common} $[4, TS 38.211] based on one-way propagation delay $Delay\_{common}\left(t\right)$ that the UE determines as:$$Delay\_{common}\left(t\right)= \frac{TA\_{Common}}{2}+ \frac{TA\_{CommonDrift}}{2}×\left(t-t\_{epoch}\right)+\frac{TA\_{CommonDriftVariant}}{2}×\left(t-t\_{epoch}\right)^{2} $$where $TA\_{Common}$, $TA\_{CommonDrift}$, and $TA\_{CommonDriftVariant}$ are respectively provided by *ta-Common*, *ta-CommonDrift*, and *ta-CommonDriftVariant* and $t\_{epoch}$ is the epoch time of $TA\_{Common}$, $TA\_{CommonDrift}$, and $TA\_{CommonDriftVariant}$ [12, TS 38.331]. $Delay\_{common}(t)$ provides a distance at time $t$ between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by $N\_{TA,offset}$. The UE shall adjust the common delay component, $N\_{TA,adj}^{common}$ at the beginning of every uplink slot. The value of $N\_{TA,common}$ after the adjustment is given by $N\_{TA,adj}^{common} =\left[\frac{Delay\_{common}\left(t\_{0}\right)+Delay\_{common}\left(t\_{1}\right)}{T\_{c}}\right]$, where Tc is the basic timing defined in [4, TS 38.211] and $ t\_{o}$ is the time where the downlink reference signal was transmitted and t1 is the time where the uplink signal transmitted reaches the satellite.\*\*\* Unchanged text skipped \*\*\* |

Companies are encouraged to comment on the Draft CR within the following table:

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| **Companies** | **Comments and Views** |
| LG | Regarding the UE specific TA, following conclusion was already made in RAN1#107-e. Therefore, we cannot support **Initial Proposal 1-6-1**.**Conclusion**$N\_{TA,UE-specific} $is UE self-estimated TA to pre-compensate for the service link delay, which is calculated using the UE position and the serving satellite ephemeris. * How the UE calculates/updates NTA, UE-specific is left to UE implementation.
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## Conclusion

TBC

## References

1. R1-2209823 Correction on timing relationship parameter for NR NTN Huawei, HiSilicon
2. R1-2210045 Additional aspects of Rel-17 maintenance for NR over NTN Nokia, Nokia Shanghai Bell
3. R1-2210048 Draft CR for 38.213 to clarify calculation and application of timing advance values for common TA and UE specific TA Nokia, Nokia Shanghai Bell