­3GPP TSG-RAN WG1 Meeting #107-e R1- 2112507

e-Meeting, November 11th – 19th, 2021

Agenda Item: 8.4.1

Source: Moderator (Ericsson)

Title: Feature lead summary#1 on timing relationship enhancements

Document for: Discussion

# Introduction

A study item on solutions for NR to support non-terrestrial networks (NTN) was completed in Rel-16 [1]. The Rel-17 work item on solutions for NR to support NTN was approved at RAN#86 and the work item description is updated in [2]. One objective is to specify timing relationship enhancements for NTN. The last feature summary from RAN1#106-e on this topic can be found in [3].

In this contribution, we summarize the related issues and proposals based on the contributions submitted to RAN1#106b-e under agenda item 8.4.1 [4] – [21].

There are in total 13 issues summarized in this contribution. For the first round of discussion:

* Companies are encouraged to provides views on the following issues by filling in comments in the provided tables:
	+ Issue #1, Issue #3, Issue #6, Issue #10, Issue #11, Issue #12, Issue #13, Issue #14
* Companies are encouraged to have offline discussions on the following issues:
	+ Issue #4, Issue #5, Issue #7, Issue #8, Issue #9

# 1 [ACTIVE] Issue #1: K\_offset update

## 1.1 Background

At RAN1#107-e, many companies provide views on K\_offset update after initial access.

**[Nokia, NSB]**

Proposal 6: The MAC-CE containing the K\_offset update provides an absolute update for the K\_offset value. The range of the indicated values are the same as in SIB.

Proposal 7: The MAC-CE containing the K\_offset update is made by 2 Octets (total of 16 bits), where 10 bits are used for providing the absolute K\_offset value, as exemplified in Figure 1.

Proposal 8: The application time of the updated cell-specific K\_offset should be the same for a UE acquiring the new SI via RRC or via SIB acquisition.

Proposal 9: The application time of the updated K\_offset at cell level needs to pre-defined and different from the first SIB occasion in the modification period.

Proposal 10: RAN1 shall discuss the rules for the application time of cell-specific K\_offset.

Proposal 11: As options for the application time of the recently acquired updated K\_offset we propose:

1. The end of the first (or the n-th) SI-window for the SIB containing K\_offset in the modification period
2. The end of the first modification period after the update
3. A specific SFN.

Proposal 12: RAN1 shall discuss UE behavior if UE fails to acquire updated K\_offset within valid time.

Proposal 13: To reduce UE power consumption for SIB acquisition, RAN1 shall consider special indication for modifications in the NTN SIB in a given modification period.

**[Huawei, HiSilicon]**

Proposal 5: There is no need to support RRC configuration for K\_offset update.

Proposal 6: Differential indication with a granularity of one slot is adopted for UE-specific K\_offset update.

**[Apple]**

Proposal 2: UE specific $K\_{offset}$ signaled via RRC reconfiguration is not supported in Release 17.

Proposal 3: UE specific $K\_{offset}$ has the same unit and value range as cell specific $K\_{offset}$, and MAC CE contains a full UE specific $K\_{offset}$ value.

**[CMCC]**

Proposal 1: UE-specific K\_offset update in RRC reconfiguration is not supported.

Proposal 2: For the MAC CE design to provide UE specific K\_offset, signal a differential value (i.e., Option 2) is preferred to significantly reduce signaling overhead, i.e.,

* Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the sum of the cell specific K\_offset value and the differential UE specific K\_offset value.

**[OPPO]**

Proposal 1: The method MAC CE provides a differential UE specific K\_offset value is preferred.

**[Panasonic]**

Proposal 3: UE specific Koffset indication should use relative value to cell specific Koffset

**[ZTE]**

Proposal-3: Signal a differential value via MAC CE to provide or update UE specific K\_offset. And UE-specific K\_offset = Cell specific K\_offset - Differential value.

**[CATT]**

Proposal 1: A UE-specific K\_offset can be provided and updated by network with RRC reconfiguration.

Proposal 2: Support differential value reporting for K-offset indication with MAC CE.

Proposal 4: TA should be reported in Msg3, and signal UE\_specific K\_offset in Msg4.

**[LGE]**

Proposal 4: RRC reconfiguration is not supported for UE-specific K\_offset update.

Proposal 5: Apply updated K\_offset value X slots/symbols after transmission of acknowledgement for MAC-CE reception.

**[Xiaomi]**

Proposal 3: MAC CE provides a differential UE specific K\_offset value.

Proposal 4: The full UE specific K\_offset value equals the sum of the cell specific K\_offset value and the differential UE specific K\_offset value.

Proposal 5: The ambiguity issue on the update of cell-specific K\_offset can be handled by the network implementation.

**[ITL]**

Proposal 1. There is no need to support additional RRC signaling for K\_offset update, on top of MAC CE signaling

Proposal 2. It is supported that MAC CE provides a full UE specific K\_offset value (i.e. Option 1)

Proposal 3. gNB controlled and UE-initiated mechanisms can be supported for update of K\_offset value

**[MediaTek]**

Proposal 2: MAC CE is used to update K\_offset with full UE specific K\_offset value for LEO, MEO, and GEO.

**[CAICT]**

Proposal 1: Support cell-specific K-offset updating through the SI message updating procedure.

Proposal 2: FFS the issue of conflict period caused by the incident that Koffset\_old is greater than Koffset\_new.

**[NTT DOCOMO]**

Proposal 2: Single indication of updating K\_offset with MAC-CE is sufficient.

**[Lenovo, Motorola Mobility]**

Proposal 1: Update of K-offset can be indicated by a drift rate or by indication of a coordinate of a position.

**[NEC]**

Proposal 1. The MAC-CE containing the K\_offset update provides the full value of K\_offset.

Proposal 2. RAN 2 to design the details of the corresponding MAC CE.

**[Ericsson]**

Proposal 3 MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the sum of the cell specific K\_offset value and the differential UE specific K\_offset value.

Proposal 4 The value range of the differential UE specific K\_offset value provided in MAC CE is 0 – 21 ms with a step size of 1 ms.

**[Spreadtrum]**

Proposal 4: MAC CE provides a full UE specific K\_offset value should be supported.

**[SK Telecom, ETRI]**

Proposal 1: We support that MAC CE provides a full UE specific K\_offset value.

Proposal 2: K1/K2/K\_offset value needs to update regarding UE specific TA change. It is better to change K\_offset rather than K/1K2 value for processing.

**[Intel]**

Proposal 1: Differential scheme is supported for indication of UE-specific K\_offset via MAC CE

* Difference between cell -specific K\_offset and UE-specific K\_offset is indicated
* RRC-based configuration for UE-specific K\_offset is not supported

**[Baicells]**

Proposal 1: In case UL transmission confliction due to cell specific Koffset update, a protection period should be set to avoid the confliction.

### 1.1.1 On the support of RRC reconfiguration to update UE specific K\_offset

One discussion point is about whether to support RRC reconfiguration to update UE specific K\_offset. The table below presents a summary of the proposed design options and the corresponding proponents.

|  |  |
| --- | --- |
| Design option | Proponent(s) |
| Support: RRC reconfiguration | [1] source: [CATT] |
| Not support: RRC reconfiguration | [6] sources: [Huawei/HiSi, Apple, CMCC, LGE, ITL, NTT DOCOMO] |

Given the large number of companies not supporting RRC reconfiguration, it does not seem helpful to spend online/email effort discussing this topic again.

### 1.1.2 On the MAC CE design to provide UE specific K\_offset

The second discussion point is about what to signal in the MAC for providing UE specific K\_offset.

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| --- | --- |
| Design option | Proponent(s) |
| Option 1: MAC CE provides a full UE specific K\_offset value | [6] sources: [Nokia/NSB, Apple, ITL, MediaTek, NEC, Sptreadtrum] |
| Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the sum of the cell specific K\_offset value and the differential UE specific K\_offset value. | [8] sources: [Huawei/HiSi, CMCC, OPPO, Panasonic, ZTE, CATT, Xiaomi, Ericsson] |

Given that (1) companies are roughly equally split between the two options, (2) either option can work, and (3) RAN1#107bis is the last RAN1 meeting in Rel-17, Moderator recommends that we collect another round of companies’ views and then go for the one which receives support from more companies.

For Option 2: [Ericsson] proposes the value range of the differential UE specific K\_offset value provided in MAC CE is 0 – 21 ms with a step size of 1 ms.

### 1.1.3 On the update of cell specific K\_offset

The usual system information update procedure can be used to update K\_offset carried in system information. [CAICT, Nokia/Nokia Shanghai Bell, Baicells] hold the view that there may be an ambiguity period, during which different UEs may update the cell specific K\_offset at different time instants. [Xiaomi] points out that the issue can be handled by network implementation.

This issue was discussed at RAN1#106bis-e, when it was found that a large number of companies did not consider it necessary to address this issue.

From the submitted proposals to RAN1#107-e, the proponents remain the same – no additional companies propose to address this issue.

In Moderator’s view, the issue is not different from the update of other information in system information. For example, network may update other configurations such as PDCCH configuration information or K2 in SIB1, but that does not appear to be an issue.

Given (1) the low interest in this topic, (2) the discussions happened already, and (3) RAN1#107-e is the last RAN1 meeting in Rel-17, it does not seem helpful to spend online/email effort discussing this topic again.

Given this situation, Moderator would like to recommend the proponents to offline discusses with other companies to make progress and let Moderator know if there is a possibility for potential consensus.

## 1.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 1.2 (Moderator):**

1. Indicate your support between the following two options:
	1. Option 1: MAC CE provides a full UE specific K\_offset value
	2. Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the sum of the cell specific K\_offset value and the differential UE specific K\_offset value.
2. If Option 1 were chosen, what would be the exact value range?
	1. Same as the value range of cell-specific K\_offset
	2. Other?
3. If Option 2 were chosen, what would be the exact value range?
	1. 0 – 21 ms
	2. 0 – 31 ms
	3. Other?

|  |  |
| --- | --- |
| Company | Comments |
| Apple | 1). We support Option 1 for its simplicity. Also, we may have the ambiguity period when cell specific K\_offset is updated. If Option 2 is chosen, we may have additional ambiguity period on UE specific K\_offset. 2.) The UE specific K\_offset simply has the same value range as cell-specific K\_offset.3). In case of Option 2, we think the value range is -11 ms to 11 ms, considering the maximum differential delay in a GEO cell is 10.3 ms.  |
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# 2 Issue #2: K\_offset value determination

## 2.1 Background

At RAN1#107-e, one company provides views on K\_offset configuration.

**[LGE]**

Proposal 1: Support explicit signaling of K\_offset.

This proposal does not need further discussion as it was already agreed at RAN1#106bis-e that signaling one value for cell-specific K\_offset is supported.

# 3 [ACTIVE] Issue #3: K\_offset unit and value range

## 3.1 Background

At RAN1#107-e, many companies provide proposals on this topic:

**[Nokia, NSB]**

Proposal 1: For signalling of K\_offset range in the SI, select the Option 1: unified range.

Proposal 2: Utilize 10 bits in the SI to provide a full range of possibilities [0] to (up to) [1024] slots of K\_offset.

**[Huawei, HiSilicon]**

Proposal 1: Different value ranges of K\_offset are defined for different scenerios as follows

* LEO : 2~49 ms, 6 bits
* MEO: 47~396 ms, 9 bits
* GEO: 239~542 ms, 9 bits

**[Apple]**

Proposal 1: The value range of cell specific $K\_{offset}$ is 0-542 ms for all scenarios.

**[CMCC]**

Proposal 5: For defining value range(s) of K\_offset, support different value ranges of K\_offset for different scenarios (Option 2).

Proposal 6: A scenario is indicated by the network, and it can be used for determining the following parameters ranges

* Cell specific K\_offset
* Common TA parameters
* satellite ephemeris

Proposal 7: For defining value range(s) of K\_offset, the value range for ATG and HAPS is 0-2 ms.

**[OPPO]**

Proposal 3: It is suggested to study the K\_offset / K\_mac unit and range for FDD in FR2 in further release.

Proposal 4: It is suggested that the minimum value of the K\_offset should consider the reference point on the satellite for the different scenarios.

**[Panasonic]**

Proposal 2: The Koffset signaling design should follow the general direction of signaling design for NTN (i.e. common signaling or separate signaling for LEO/MEO/GEO). For Koffset signaling only, one value range covering all scenarios (Option 1) would be preferable.

**[ZTE]**

Proposal-1: For FR1, one value range of K\_offset as (0~1023) should be supported for GEO, MEO, LEO scenarios.

Proposal-2: It’s up to gNB’s implementation that K\_offset can be zero for HAPS/ATG.

**[CATT]**

Proposal 3: Support (A+B) bits for notifying and updating of K\_offset:

* bits indicate the orbit type
* bits indicate the value of K-offset.

**[Zhejiang Lab]**

Proposal 1: For the reference subcarrier spacing value for the unit of K\_offset and K\_mac in FR2, a value of 15 kHz should also be used.

Proposal 2: For defining value range(s) of K\_offset and K\_mac, support option 2 with multiple value ranges.

**[LGE]**

Proposal 3: Support option 1 for value range of K\_offset and K\_mac.

|  |  |  |
| --- | --- | --- |
| Option | Value range | Step size |
| Option 1: One value range of K\_offset covering all scenarios. | 0 – 542 ms | Same as the unit of K\_offset |
| Option 1: One value range of K\_mac covering all scenarios. | 1 – 271 ms | Same as the unit of K\_mac |

**[Xiaomi]**

Proposal 2: Different value ranges of K\_offset for different scenarios are supported.

**[ITL]**

Proposal 5. It is supported to define same reference SCS (i.e. 15 kHz SCS) for the unit of K\_offset between FR1 and FR2

Proposal 6. It is supported to define one value range of K\_offset covering all scenarios (i.e. Option 1)

**[MediaTek]**

Proposal 1: Support signalling of one value range for update of UE-specific K\_offset [0] – [542] ms - 10 bits.

**[Sony]**

Proposal 1: RAN1 should approve the working assumption on serving satellite ephemeris format bit allocations for LEO/MEO/GEO.

Proposal 2: RAN1 should support different value ranges of K\_offset for different scenarios.

**[NTT DOCOMO]**

Proposal 3: If scenario identification is introduced only for the K\_offset and K\_mac value range determination, single value range should be defined for K\_offset (Option 1).

**[Lenovo, Motorola Mobility]**

Proposal 5: Support different range of K-offset and K-mac for different scenarios.

Proposal 6: SCS for K-offset and K-mac is related to frequency band rather than scenarios. The reference SCS for unit of K-offset and K-mac for FR2 is 60KHz.

**[Ericsson]**

Proposal 1 The value range of K\_offset is 0 – 542 ms with a step size of 1 ms.

**[Spreadtrum]**

Proposal 1: Different value ranges of K\_offset for different scenarios should be supported.

Proposal 2: For the reference subcarrier spacing value for the unit of K\_offset in FR2, a value of 120 kHz is used.

**[Samsung]**

Proposal 1: For the range of K\_offset, LEO, MEO, and GEO use 0-63 ms, 46-410 ms, and 238 to 556 ms, respectively.

**[SK Telecom, ETRI]**

Proposal 6: For the reference subcarrier spacing value for the unit of K\_offset in FR2, a value of 120 kHz is used.

**[InterDigital]**

Proposal-2: K\_offset/K\_mac value range is determined based on NTN deployment scenario (i.e., Option 2).

**[Intel]**

Proposal 4: For the reference subcarrier spacing value for the unit of K\_offset and K\_mac in FR2, a value of 60 kHz is used

Proposal 6: Support indication of one value range of K\_offset and K\_mac covering all scenarios

**[vivo]**

Proposal 1: Support different value ranges of K\_offset for different scenarios (Option 2).

**[Qualcomm]**

Proposal 2: The value ranges of K\_offset are

* LEO: 0-63 ms
* MEO: 64-575 ms
* GEO: 479-542 ms
* FFS ATG and HAPS

### 3.1.1 K\_offset value range

The views are summarized in the table below.

|  |  |
| --- | --- |
| Option | Proponent |
| Option 1: One value range of K\_offset covering all scenarios. | [10] sources: [Nokia/NSB, Apple, Panasonic, ZTE, LGE, ITL, MediaTek, NTT DOCOMO (conditional), Ericsson, Intel] |
| Option 2: Different value ranges of K\_offset for different scenarios. | [12] sources:[Huawei/HiSi, CMCC, CATT, Zhejiang Lab, Xiaomi, Sony, Lenovo/Motorola Mobility, Spreadtrum, Samsung, InterDigital, vivo, Qualcomm] |

Given that (1) companies are roughly equally split between the two options, (2) either option can work, and (3) RAN1#107bis is the last RAN1 meeting in Rel-17, Moderator recommends that we collect another round of companies’ views and then go for the one which receives support from more companies.

Several companies propose to revise the detailed value range slightly:

* For Option 1:
	+ [Nokia/NSB, ZTE] propose to utilize all code points of 10 bits, i.e., 0 – 1023 ms
* For Option 2,
	+ [Huawei/HiSi]: LEO: 2 – 49 ms; MEO: 47 – 396 ms; GEO: 239 – 542 ms.
	+ [Samsung]: LEO: 0 – 63 ms; MEO: 46 – 410 ms; GEO: 238 – 556 ms.
	+ [Qualcomm]: LEO: 0 – 63 ms; MEO: 64 – 575 ms; GEO: 479 – 542 ms.
	+ [CMCC]: ATG/HAPS: 0 – 2 ms.
	+ [ZTE]: ATG/HAPS: up to gNB implementation (e.g., K\_offset can be zero)

### 3.1.2 K\_offset unit in FR2

K\_offset unit in FR2 was left as FFS at RAN1#106bis-e because it was brought up that the PRACH configuration design for FDD in FR2 is missing.

At RAN1#107-e, several companies provide proposals on this topic:

* No need to define K\_offset unit in FR2 in Rel-17: [OPPO]
* 15 kHz: [Zhejiang Lab, ITL]
* 60 kHz: [Lenovo/Motorola Mobility, Intel]
* 120 kHz: [Spreadtrum, SK Telecom/ETRI]

## 3.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 3.2 (Moderator):**

1. Indicate your support between the following two options:
	1. Option 1: One value range of K\_offset covering all scenarios.
	2. Option 2: Different value ranges of K\_offset for different scenarios.
2. If Option 1 were chosen, what would be the exact value range?
	1. 0 – 542 ms
	2. 0 – 1023 ms
3. If Option 2 were chosen, what would be the exact value range for LEO/MEO/GEO?
	1. LEO: 0 – 49 ms; MEO: 93 – 395 ms; GEO: 477 – 542 ms
	2. LEO: 2 – 49 ms; MEO: 47 – 396 ms; GEO: 239 – 542 ms
	3. LEO: 0 – 63 ms; MEO: 46 – 410 ms; GEO: 238 – 556 ms
	4. LEO: 0 – 63 ms; MEO: 64 – 575 ms; GEO: 479 – 542 ms
4. If Option 2 were chosen, what would be the exact value range for ATG/HAPS?
	1. 0 – 2 ms
	2. No need to define; up to gNB implementation (e.g., K\_offset can be zero)
5. For K\_offset unit in FR2:
	1. No need to define K\_offset unit in FR2 in Rel-17 (because e.g., FDD NTN cannot be supported in FR2 due to other functionality missing)
	2. 15 kHz
	3. 60 kHz
	4. 120 kHz

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Q1: We prefer Option a (Option 1) for simplicity. There is some remaining work in Option 2, e.g., Koffset for HAPS or ATG. Also, the value ranges of LEO/MEO/GEO in Option 2 need to be further aligned between companies. Q2: We prefer Option aQ3: We prefer Option bQ4: We prefer Option aQ5: We prefer Option c, which is the lowest SCS for FR2.  |
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# 4 Issue #4: K\_offset usage

## 4.1 Background

At RAN1#107-e, several companies provide views on K\_offset usage.

**[Nokia, NSB]**

Proposal 21: For Fallback DCI formats, the cell-specific K\_offset, which is broadcasted in SI, should be used.

**[CMCC]**

Proposal 3: To address the ambiguity period issue for MAC CE updating UE specific K\_offset, the following options can be considered.

* Option 1: up to network implementation, e.g., avoid scheduling in the ambiguity period.
* Option 2: if cell-specific K\_offset is always used for the additional transmission timings related to fallback DCI format, use fallback DCI in the ambiguity period.
* Option 3: Use a DCI field to indicate whether cell- specific K\_offset or UE specific K\_offset is used.
* Option 4: RRC and MAC CE configure/update more than one UE specific K\_offset, and use a DCI field to indicate which UE specific K\_offset is used. Furthermore, MAC CE only updates part of UE specific K\_offset values, and in the ambiguity period, DCI indicates UE specific K\_offset value which keeps unchanged in the MAC CE update procedure.

Proposal 4: In order to address the ambiguity period issue for MAC CE updating UE specific K\_offset, support Option 2, i.e.,

* Option 2: if cell-specific K\_offset is always used for the additional transmission timings related to fallback DCI format, use fallback DCI in the ambiguity period.

Proposal 8: Support always use the cell-specific K\_offset for the additional transmission timings related to fallback DCI format.

**[OPPO]**

Proposal 5: The method of TDRA table configuration can be considered for the K\_offset configuration.

**[Panasonic]**

Proposal 4: For PUSCH scheduled by DCI 0\_0 and HARQ-ACK to PDSCH scheduled by DCI 1\_0, Koffset value signaled in system information should be used.

**[ZTE]**

Proposal-5: For transmission scheduled by fallback DCI formats, UE-specific K\_offset can be used if the value was updated via signalling.

**[CATT]**

Proposal 5: For transmission timings related to fallback DCI formats, use UE\_specific K\_offset if configured, otherwise, cell\_specific K\_offset is applied.

**[ITL]**

Proposal 4. To ensure that UE is always reachable, for the transmissions scheduled by fallback DCIs, the K\_offset value signaled in system information is used

Proposal 7. Cell-specific K\_offset is only supported in initial access procedure

**[Sony]**

Proposal 3: In NR NTN the initialisation of generators for scrambling codes for UL channels and DM-RS shall use the subframe number of the UL channel or UL signal that is indicated by the Koffset-modified timing relationship.

The main proposals center around the “FFS: how to treat additional transmission timings related to fallback DCI formats”.

The table below presents a summary of the proposed design options and the corresponding proponents.

|  |  |
| --- | --- |
| How to treat additional transmission timings related to fallback DCI formats | Proponent(s) |
| Always use the cell-specific K\_offset (i.e., the K\_offset value signaled in system information) | [4] sources: [Nokia/NSB, CMCC, Panasonic, ITL] |
| UE-specific K\_offset if provided (otherwise, use the cell-specific K\_offset) | [2] sources: [ZTE, CATT] |

It can be seen that the views are polarized in this case, with not many inputs. This issue has been discussed over the last several RAN1 meetings. Moderator’s understanding is that if there is no further agreement, the default option would be “*UE-specific K\_offset if provided (otherwise, use the cell-specific K\_offset)*” for the additional transmission timings related to fallback DCI formats.

Given this issue has been discussed over the last several RAN1 meetings and there is no strong support to always use the cell-specific K\_offset for the additional transmission timings related to fallback DCI formats, it does not seem helpful to spend online/email effort discussing this topic again.

Besides, each of the other proposals appears to come from a single company.

Given this situation, Moderator would like to recommend the proponents to offline discusses with other companies to make progress and let Moderator know if there is a possibility for potential consensus.

# 5 Issue #5: Beam-specific K\_offset in initial access

## 5.1 Background

At RAN1#107-e, several companies provide proposals on this topic:

**Proposals that support introducing beam specific Koffset**

**[Huawei, HiSilicon]**

Proposal 3: Support beam specific K\_offset used for initial access and the value range and bit overhead is the same as cell specific K\_offset.

Proposal 4: If a UE is provided with a beam-specific K\_offset value, the beam-specific K\_offset value is used for

* The transmission timing of RAR/fallbackRAR grant scheduled PUSCH
* The transmission timing of Msg3 retransmission scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI
* The transmission timing of HARQ-ACK on PUCCH to contention resolution PDSCH scheduled by DCI format 1\_0 with CRC scrambled by TC-RNTI
* The transmission timing of HARQ-ACK on PUCCH to MsgB scheduled by DCI format 1\_0 with CRC scrambled by MsgB-RNTI

**[CMCC]**

Proposal 9: gNB has the flexibility of configuring cell-specific or beam specific value of K\_offset.

* Beam specific SIB can be supported, i.e., different beam specific SIB may carry different beam specific values (e.g., K\_offset).

**[LGE]**

Proposal 2: Support beam (group)-specific K\_offset signaling in addition to cell-specific K\_offset in initial access.

**[Xiaomi]**

Proposal 1: Beam-specific K\_offset configuration during the initial access should be supported.

**[Lenovo, Motorola Mobility]**

Proposal 2: Support indication of beam specific K-offset.

Proposal 3: The beam specific K-offset can be indicated by an associated RS explicitly or implicitly.

**[Spreadtrum]**

Proposal 3: Beam-specific values of K\_offset configuration for initial access should be supported.

**[Zhejiang Lab]**

Proposal 3: Per beam K\_offset configuration should be supported.

**[InterDigital]**

Proposal-3: beam-specific K-offset indication is also supported optionally.

**Proposals that do no support introducing beam specific Koffset**

**[Panasonic]**

Proposal 1: Beam specific Koffset is not necessary.

**[NTT DOCOMO]**

Proposal 1: K\_offset in initial access is a cell-specific parameter. Beam-specific K\_offset is not supported.

**[Samsung]**

Proposal 3: Only Cell-specific K\_offset in initial access is supported.

Proposal 4: More than one of above Koffset configurations can be supported, and using which one is dependent on gNB configuration.

This issue has been discussed at many RAN1 meetings with several rounds of email discussion and debated at GTW session. The pros and cons of supporting beam specific K\_offset configured in system information and used in initial access are clear to the group – same comments have been made by both sides over the meetings.

In fact, given the views expressed, it was recommended at the last several RAN1 meetings that the proponents to offline discuss with other companies to make progress.

However, the proponents had not brought to the Moderator’s attention whether there had been such offline discussion, and if yes, what the outcome was.

Reading through the submitted contributions, the status does not change much compared to where we have been in over the past several RAN1 meetings.

Given that RAN1#107-e is the last RAN1 meeting in Rel-17, it does not seem helpful to spend online/email effort discussing this topic again.

Therefore, Moderator would like to continue to encourage the proponents of beam-specific K\_offset to offline convince the other camp to make progress and let Moderator know if there is a possibility for potential consensus.

# 6 [ACTIVE] Issue #6: MAC CE timing relationships

## 6.1 Background

At RAN1#107-e, several companies provide proposals on this topic:

**[Nokia, NSB]**

Proposal 3: For the signalling of K\_mac range in SI, select the Option 1: unified range.

Proposal 4: Utilize 9 bits in the SI to provide a full range of possibilities [0] to (up to) [512] slots for K\_mac.

**[Huawei, HiSilicon]**

Proposal 2: Different value ranges of K\_mac are defined for different scenerios as follows

* LEO: 1~25 ms, 5 bits
* MEO: 1~198 ms, 8 bits
* GEO: 1~271 ms, 9 bits

**[Apple]**

Proposal 6: The value range of $K\_{mac}$ is 1-271 ms for all scenarios.

**[CMCC]**

Proposal 10: The usual system information update procedure is enough to initialize/update K\_mac. Additional K\_mac updating mechanism is not needed.

**[Panasonic]**

Proposal 7: Update of K\_mac based on SIB re-reading should be supported. The same mechanism for UE re-reading SIB using validity timer as used for signaling of common TA parameters should be used.

**[ZTE]**

Proposal-4: For FR1, one value range of K\_mac as (0~511) should be supported for GEO, MEO, LEO scenarios.

**[CATT]**

Proposal 6: Support the update of K\_mac with MAC CE.

Proposal 7: A single common drift can be used to update the common delay, or K\_mac, or feeder link RTT depending on requirement.

**[LGE]**

Proposal 3: Support option 1 for value range of K\_offset and K\_mac.

|  |  |  |
| --- | --- | --- |
| Option | Value range | Step size |
| Option 1: One value range of K\_offset covering all scenarios. | 0 – 542 ms | Same as the unit of K\_offset |
| Option 1: One value range of K\_mac covering all scenarios. | 1 – 271 ms | Same as the unit of K\_mac |

**[MediaTek]**

Proposal 3: Support signalling of one value range for K\_mac [0] – [271] ms - 9 bits.

**[Lenovo/Motorola Mobility]**

Proposal 5: Support different range of K-offset and K-mac for different scenarios.

Proposal 6: SCS for K-offset and K-mac is related to frequency band rather than scenarios. The reference SCS for unit of K-offset and K-mac for FR2 is 60KHz.

**[Ericsson]**

Proposal 2: For the case where UE is provided by network with a K\_mac value, the value range of K\_mac is 1 – 271 ms with a step size of 1 ms.

**[Spreadtrum]**

Proposal 5: K\_mac can be update by the system information.

Proposal 6: For the reference subcarrier spacing value for the unit of K\_mac in FR2, a value of 120 kHz is used.

Proposal 7: Different value ranges of K\_mac for different scenarios should be supported.

**[Samsung]**

Proposal 2: For the maximum value of Kmac, LEO, MEO, and GEO use 31 ms, 205 ms, and 278 ms.

**[SK Telecom/ETRI]**

Proposal 7: For the reference subcarrier spacing value for the unit of K\_mac in FR2, a value of 120 kHz is used.

**[Zhejiang Lab]**

Proposal 1: For the reference subcarrier spacing value for the unit of K\_offset and K\_mac in FR2, a value of 15 kHz should also be used.

Proposal 2: For defining value range(s) of K\_offset and K\_mac, support option 2 with multiple value ranges.

**[InterDigital]**

Proposal-2: K\_offset/K\_mac value range is determined based on NTN deployment scenario (i.e., Option 2).

**[Intel]**

Proposal 2: Slot offset for MAC CE DL action (K\_mac) indication via RRC or MAC CE is not supported

Proposal 4: For the reference subcarrier spacing value for the unit of K\_offset and K\_mac in FR2, a value of 60 kHz is used

Proposal 6: Support indication of one value range of K\_offset and K\_mac covering all scenarios

**[vivo]**

Proposal 2: Support different value ranges of K\_mac for different scenarios (Option 2).

**[Qualcomm]**

Proposal 3: For the value range of Kmac, Option 1 is supported.

### 6.1.1 K\_mac value range

The views are summarized in the table below.

|  |  |
| --- | --- |
| Option | Proponent |
| Option 1: One value range of K\_mac covering all scenarios. | [8] sources: [Nokia/NSB, Apple, ZTE, LGE, MediaTek, Ericsson, Intel, Qualcomm] |
| Option 2: Different value ranges of K\_mac for different scenarios. | [7] sources:[Huawei/HiSilicon, Lenovo/Motorola Mobility, Spreadtrum, Samsung, Zhejiang Lab, InterDigital, vivo] |

Given that (1) companies are roughly equally split between the two options, (2) either option can work, and (3) RAN1#107bis is the last RAN1 meeting in Rel-17, Moderator recommends that we collect another round of companies’ views and then go for the one which receives support from more companies.

Several companies propose to revise the detailed value range slightly:

* For Option 1, [Nokia/NSB, ZTE] propose to utilize all code points of 9 bits, i.e., 1 – 512 ms
* For Option 2, [Samsung] proposes to revise the maximum value of LEO, MEO, and GEO to be 31 ms, 205 ms, and 278 ms, respectively.

### 6.1.2 K\_mac unit in FR2

K\_mac unit in FR2 was left as FFS at RAN1#106bis-e because it was brought up that the PRACH configuration design for FDD in FR2 is missing.

At RAN1#107-e, several companies provide proposals on this topic:

* 15 kHz: [Zhejiang Lab]
* 60 kHz: [Lenovo/Motorola Mobility, Intel]
* 120 kHz: [Spreadtrum, SK Telecom/ETRI]

### 6.1.3 Whether/how to update K\_mac

[2] companies provide proposals on K\_mac update (besides the usual system information update procedure for updating K\_mac carried in system information):

|  |  |
| --- | --- |
| Views | Proponents |
| K\_mac updated upon expiry of the validity timer used for signaling of common TA parameters | [Panasonic] |
| K\_mac updated by using drift information | [CATT] |

This issue was discussed at RAN1#106bis-e, when it was found that a large number of companies are not supportive of having additional mechanism(s) for updating K\_mac.

Given (1) the low interest in this topic, (2) the discussions happened already, and (3) RAN1#107-e is the last RAN1 meeting in Rel-17, it does not seem helpful to spend online/email effort discussing this topic again.

Given this situation, Moderator would like to recommend the proponents to offline discusses with other companies to make progress and let Moderator know if there is a possibility for potential consensus.

## 6.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 6.2 (Moderator):**

1. Indicate your support between the following two options:
	1. Option 1: One value range of K\_mac covering all scenarios.
	2. Option 2: Different value ranges of K\_mac for different scenarios.
2. If Option 1 were chosen, what would be the exact value range?
	1. 1 – 271 ms
	2. 1 – 278 ms
	3. 1 – 512 ms
3. If Option 2 were chosen, what would be the exact value range?
	1. LEO: 1 – 25 ms; 1 – 198 ms; GEO: 1 – 271 ms
	2. LEO: 1 – 31 ms; 1 – 205 ms; GEO: 1 – 278 ms
	3. LEO: 1 – 32 ms; 1 – 256 ms; GEO: 1 – 512 ms
4. For K\_offset unit in FR2:
	1. No need to define K\_mac unit in FR2 in Rel-17 (because e.g., FDD NTN cannot be supported in FR2 due to other functionality missing)
	2. 15 kHz
	3. 60 kHz
	4. 120 kHz

|  |  |
| --- | --- |
| Company | Comments |
| Apple | 6): We prefer Option a (Option 1) for simplicity. There is some remaining work in Option 2, e.g., Kmac for HAPS or ATG. 7): We prefer Option a8): We prefer Option b9): We prefer Option c |
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# 7 Issue #7: Exceptional MAC CE timing relationships

## 7.1 Background

At RAN1#107-e, only one company provides a proposal on this topic:

**[Huawei, HiSilicon]**

Proposal 9: The MAC CE action timing for the aperiodic CSI Trigger State subselection indication and updating the spatial relation of the aperiodic SRS are for the CSI request and SRS triggering respectively.

At RAN1#104-e, RAN1#104bis-e, RAN1#105-e, this issue was discussed. Based on the submitted contributions at RAN1#107-e, the interest in this topic is quite low.

Given (1) the low interest in this topic and (2) the discussions happened already, it does not seem helpful to spend online/email effort discussing this topic again.

Given this situation, Moderator would like to recommend the proponent to offline discusses with other companies to make progress and let Moderator know if there is a possibility for potential consensus.

# 8 Issue #8: On K1 range extension

## 8.1 Background

At RAN1#107-e, several companies provide proposals on this topic:

**[Apple]**

Proposal 7: The $K\_{1}$ range extension in unpaired spectrum does not change the PDSCH-to-HARQ\_feedback timing indicator field size in DCI.

* For non-fallback DCI, only extend the value range of entries in the configured dl-DataToUL-ACK table.
* For fallback DCI, consider introducing a scaling factor when determining $K\_{1}$ value.

**[CMCC]**

Proposal 11: Increased K1 value range in DCI can be further studied.

**[ZTE]**

Proposal 8: For unpaired spectrum, indication of the extended K1 value via enhanced DCI should be supported.

**[CATT]**

Proposal 8: In case of K1 indication extension for larger HARQ process, utilize existing 3 bits without changing the DCI and the highest bit of the HARQ process ID to extend the K1 range to support 16 different K1 candidates.

**[LGE]**

Proposal 6: Do not increase the size of the PDSCH-to-HARQ\_feedback timing indicator field in DCI.

* For non-fallback DCI, increase the range of dl-DataToUL-ACK in PUCCH-config IE from (0,…,15) to (0,…,31).
* For fallback DCI, consider introducing fixed or configurable offset.

**[ITL]**

Proposal 8. Followings on K1 range extension issue are proposed:

* It is not supported to extend the K1 range for FDD
* DCI field range related to the K1 range extension should not be increased

**[NTT DOCOMO]**

Proposal 4: Keep the K1/K2 range for paired spectrum.

Proposal 5: Keep the field size for K1 indication in DCI.

**[NEC]**

Proposal 3. The size of the PDSCH-to-HARQ\_feedback timing indicator field in DCI is not changed when the range of the K1 value is extended from (0..15) to (0..31)

**[vivo]**

Proposal 3: Support to extend the size of the PDSCH-to-HARQ\_feedback timing indicator field up to 4 bits.

Based on the proposals submitted at this RAN1#107-e, it appears that the group is still not converging on the necessity of enhancing K1 (besides the already agreed range extension).

Given (1) the issue has been discussed over several meetings, (2) the topic is not essential for NTN, and (3) RAN1#107-e is the last RAN1 meeting in Rel-17, it does not seem helpful to spend online/email effort discussing this topic again.

Given this situation, Moderator would like to recommend the proponents to offline discusses with other companies to make progress and let Moderator know if there is a possibility for potential consensus.

# 9 Issue #9: Configured grant type 1 timing relationship

## 9.1 Background

At RAN1#107-e, one company provides a proposal on this topic:

**[Samsung]**

Proposal 5: The timing relationship for Configured Grant Type 1 should be left to Network implementation.

The proposal is not in favor of introducing K\_offset for type 1 configured grant. Therefore, in Moderator’s view, there is no need to discuss this issue further at RAN1#107-e.

# 10 [ACTIVE] Issue #10: Start of RAR window

## 10.1 Background

At RAN1#107-e, a few companies provide proposals on this topic:

**[Nokia, NSB]**

Proposal 14: The choice of the value of N\_TA used for postponement of the RAR window is left for UE implementation.

Proposal 15: The choice of the value of N\_TA used for postponement of the contention resolution timer is left for UE implementation.

Proposal 16: RAN 1 shall not consider further problems at the UE behaviour during a CBRA with a valid running TAT.

**[OPPO]**

Proposal 9: For the starts of Msg2/MsgB RAR window, the following options can be considered:

* Option1: the starts of Msg2/MsgB RAR window are delayed by $T\_{TA}$, meanwhile the RAR window should be extended by K\_mac.
* Option2: the unit of K\_mac can be defined by a finer granularity, e.g. Tc or symbol, for a given subcarrier spacing.

**[SK Telecom, ETRI]**

Proposal 5: This issue ought to be discussed in Rel-18 instead of discussing it additionally in Rel-17.

The proposals from [Nokia/NSB, SK Telecom/ETRI] center around N\_TA / TAT issue that was brought up by [FGI/Asia Pacific Telecom/III/ITRI] at RAN1#106bis-e. The proposals are not in favor of further discussions / enhancements at least in Rel-17. Therefore, in Moderator’s view, there is no need to discuss this issue further at RAN1#107-e.

The proposal from [OPPO] stems from the observation that due to the granularity of K\_mac (number of slots), there may be a small error between the real value of the K\_mac and the value broadcasted to the UE by the gNB. So, the starts of Msg2/MsgB RAR window may be a bit earlier or a bit later than ideal.

* In Moderator’s view, the small error is known to network. It is not an issue if the window starts a bit early. If the window starts a bit later, network can accordingly send RAR a bit later. Therefore, further optimization does not seem to be strongly motivated.

## 10.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 10.2 (Moderator):**

Discuss the necessity of the following proposal:

***[OPPO]*** *For the starts of Msg2/MsgB RAR window, the following options can be considered:*

* *Option1: the starts of Msg2/MsgB RAR window are delayed by* $T\_{TA}$*, meanwhile the RAR window should be extended by K\_mac.*
* *Option2: the unit of K\_mac can be defined by a finer granularity, e.g. Tc or symbol, for a given subcarrier spacing.*

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We do not see strong motivation of discussing this issue. The granularity of K\_mac is 1 ms, and the quantization error can be addressed by network implementation. Basically, network sends Msg2/MsgB with a proper delay (depending on difference between indicated K\_mac value and actual K\_mac value) to ensure UE getting the message within its monitoring window.  |
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# 11 [ACTIVE] Issue #11: PDCCH ordered PRACH

## 11.1 Background

At RAN1#107-e, several companies provide proposals on this topic:

**[Nokia, NSB]**

Proposal 17: The common cell-specific K\_offset value shall be used also for the PDCCH ordered RACH.

**[Huawei, HiSilicon]**

Proposal 10: For random access procedure initiated by a PDCCH order received in downlink slot $n$, UE determines the next available PRACH occasion after uplink slot $n+K\_{offset}$, where K\_offset is the cell-specific K\_offset.

**[CMCC]**

Proposal 12: Support cell-specific K\_offset in the enhanced PDCCH ordered PRACH timing relationship.

**[OPPO]**

Proposal 6: The cell-specific K\_offset value signaled in system information is always used for PDCCH ordered PRACH timing relationship.

**[Panasonic]**

Proposal 5: Cell specific Koffset should be used to determine RO for PDCCH order RACH.

Proposal 6: Timing relationship of PDCCH order RACH and UE behavior on validity of NTN specific SIB contents should be handled independently.

**[ZTE]**

Proposal 6: Support cell-specific K\_offset for PDCCH order PRACH.

Proposal 7: Capturing the following CR in 38.213 section 8.1 to reflect the enhancement on timing relationship for PDCCH ordered PRACH:

#===

#38.213 section 8.1

For a PRACH transmission triggered by a PDCCH order, the PRACH mask index field [5, TS 38.212], if the value of the random access preamble index field is not zero, indicates the PRACH occasion for the PRACH transmission where the PRACH occasions are associated with the SS/PBCH block index indicated by the SS/PBCH block index field of the PDCCH order. The available PRACH occasion should be after the uplink slot $n+K\_{offset}$n+K\_offset if the PDCCH order is received in downlink slot $n$n.

**[CATT]**

Proposal 9: Utilize cell-specific K\_offset in PDCCH ordered PRACH.

**[LGE]**

Proposal 7: For RACH procedure triggered by PDCCH order in Rel-17 NTN, cell-specific K\_offset signaled in system information is always used in addition to minimum gap, $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.

**[Xiaomi]**

Proposal 6: The cell-specific K\_offset value signaled in system information is always used for PDCCH ordered PRACH timing relationship.

**[CAICT]**

Proposal 3: Support to use cell-specific K-offset in the timing relationship of PDCCH ordered RACH.

**[NEC]**

Proposal 4. gNB complexity issue can be addressed by using cell specific K\_offset for PDCCH ordered RACH occasion using.

**[Ericsson]**

Proposal 5 For K\_offset enhanced PDCCH ordered PRACH timing relationship, down-selection one option from below:

* Option 1: UE does not expect that the duration from the downlink slot $n$ to the uplink slot $n+2^{μ}⋅K\_{offset}$ is smaller than the processing time $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.
* Option 2: For random access procedure initiated by a PDCCH order received in downlink slot $n$, UE determines the next available PRACH occasion after uplink slot $n+2^{μ}⋅K\_{offset}+ceil\left(D⋅N\_{slot}^{subframe, μ}\right)$ to transmit the ordered PRACH, where $D= N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.

**[Spreadtrum]**

Proposal 8: Either cell specific K\_offset or UE specific K\_offset can be applied to enhance the timing of PDCCH ordered PRACH.

**[vivo]**

Proposal 4: Support to apply UE-specific K\_offset to PDCCH ordered PRACH if configured; otherwise, cell-specific K\_offset is applied.

Proposal 5: The n+K\_offset timing relationship is not impacted by UE behavior within or after the validity duration.

**[Baicells]**

Proposal 2: Use cell-specific Koffset in PDCCH ordered RACH.

**[Qualcomm]**

Proposal 1: For UEs configured with UE-specific K\_offset, one bit in the PDCCH order DCI is used to indicate if cell-specific or UE-specific K\_offset to be used.

* If cell-specific K\_offset is indicated, UE -specific K\_offset is no longer valid until reconfigured.

### 11.1.1 Which K\_offset to use

The views are summarized in the table below.

|  |  |
| --- | --- |
| Option | Proponents |
| **Option 1:** Cell-specific K\_offset | [Nokia/NSB, Huawei/HiSi, CMCC, OPPO, Panasonic, ZTE, CATT, LGE, Xiaomi, CAICT, NEC, Baicells]  |
| **Option 2:** UE-specific K\_offset if configured and cell-specific K\_offset otherwise | [vivo] |
| **Option 3:** 1 bit in DCI to indicate the selection between cell-specific K\_offset and UE-specific K\_offset. If cell-specific K\_offset is indicated, UE -specific K\_offset is no longer valid until reconfigured. | [Qualcomm] |
| *Neutral: Either Cell-specific K\_offset or UE-specific K\_offset* | [Spreadtrum] |

It is clear that Option 1 receives the majority support.

Regarding [Qualcomm]’s proposal on invalidating UE-specific K\_offset if cell-specific K\_offset is signaled, [Huawei/HiSi] provides a response:

*The second issue is whether the UE specific K\_offset is valid after receiving a PDCCH order. PDCCH ordered in NTN (similar to TN) shall be invoked when the time alignment Timer gets expired due to the reason that there is no UL/DL data transmission for a long time and also when there is no Time alignment command sent from the gNB. Given that there is no UE-specific TA report during this period, there is no need for the gNB to reconfigure the UE-specific K\_offset. Therefore, it is not obvious that the PDCCH order PRACH should inactivate the UE-specific K\_offset. On the other hand, if the gNB would like to deactivate the UE-specific K\_offset, it can include the signaling in MAC-CE of a subsequent PDSCH. Therefore, it is not reasonable to couple PDCCH ordered PRACH to UE-specific K\_offset inactivation. ...*

Moderator agrees that there is no need to couple PDCCH ordered PRACH to UE-specific K\_offset inactivation.

### 11.1.2 How to handle “$N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$”

During the draft CR review post RAN1#106bis-e, the issue on how K\_offset in PDCCH ordered PRACH relates to “$N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$” was brought up.

[ZTE] proposes to capture the following CR in 38.213 section 8.1 to reflect the enhancement on timing relationship for PDCCH ordered PRACH:

*#===*

*#38.213 section 8.1*

*For a PRACH transmission triggered by a PDCCH order, the PRACH mask index field [5, TS 38.212], if the value of the random access preamble index field is not zero, indicates the PRACH occasion for the PRACH transmission where the PRACH occasions are associated with the SS/PBCH block index indicated by the SS/PBCH block index field of the PDCCH order. The available PRACH occasion should be after the uplink slot* $n+K\_{offset}$*n+K\_offset if the PDCCH order is received in downlink slot* $n$*n.*

[Ericsson] elaborates on this issue:

* *The current agreement on K\_offset enhanced PDCCH ordered PRACH is given by: For random access procedure initiated by a PDCCH order received in downlink slot* $n$*, UE determines the next available PRACH occasion after uplink slot* $n+K\_{offset}$ *to transmit the ordered PRACH.*
* *The term “*$N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$*” is absolute processing time between the reception of last symbol of the PDCCH order (which is in the DL) and the first symbol of the PRACH transmission (which is in the UL).*

*There are two possible cases:*

* *Case 1: The duration from the downlink slot* $n$ *to the uplink slot* $n+K\_{offset}$ *is greater than or equal to the processing time* $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$*.*
* *Case 2: The duration from the downlink slot* $n$ *to the uplink slot* $n+K\_{offset}$ *is smaller than the processing time* $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$*.*
	+ *If the uplink slot* $n+K\_{offset}$ *occurs before the downlink slot* $n$*, this duration has a negative value.*

*These two cases are illustrated in the figures below.*

* *Case 1: There is no issue as UE processing time is respected.*
* *Case 2: UE processing time is not respected. To fix the issue, two straightforward options may go as follows.*
	+ *Option 1: Treat this as error case, i.e., UE does not expect that the duration from the downlink slot* $n$ *to the uplink slot* $n+K\_{offset}$ *is smaller than the processing time* $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$*.*
	+ *Option 2: Add a small extra delay of* $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$ *for the PRACH transmission, i.e., UE determines the next available PRACH occasion after uplink slot* $n+K\_{offset}+N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$ *to transmit the ordered PRACH.*

**

***Figure 1: The duration from the downlink slot*** $n$ ***to the uplink slot*** $n+K\_{offset}$ ***is greater than or equal to the processing time*** $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$***.***

**

***Figure 2: The duration from the downlink slot*** $n$ ***to the uplink slot*** $n+K\_{offset}$ ***is smaller than the processing time*** $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$***.***

Based on the above, [Ericsson] proposes to down-select one option from below:

* Option 1: UE does not expect that the duration from the downlink slot $n$ to the uplink slot $n+2^{μ}⋅K\_{offset}$ is smaller than the processing time $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.
* Option 2: For random access procedure initiated by a PDCCH order received in downlink slot $n$, UE determines the next available PRACH occasion after uplink slot $n+2^{μ}⋅K\_{offset}+ceil\left(D⋅N\_{slot}^{subframe, μ}\right)$ to transmit the ordered PRACH, where $D= N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.

## 11.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 11.2 (Moderator):**

1. The K\_offset value signaled in system information is always used for PDCCH ordered PRACH timing relationship.
2. For K\_offset enhanced PDCCH ordered PRACH timing relationship, down-select one option from below:
	1. Option 1: UE does not expect that the duration from the downlink slot $n$ to the uplink slot $n+2^{μ}⋅K\_{offset}$ is smaller than the processing time $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.
	2. Option 2: For random access procedure initiated by a PDCCH order received in downlink slot $n$, UE determines the next available PRACH occasion after uplink slot $n+2^{μ}⋅K\_{offset}+ceil\left(D⋅N\_{slot}^{subframe, μ}\right)$ to transmit the ordered PRACH, where $D= N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$.

|  |  |
| --- | --- |
| Company | Comments |
| Apple | 1). We are fine with the proposal. 2). We are open to other options.Option 1 may have continuous issue for some UEs. If the Koffset is not large enough and a farest UE may always have this error. Option 2 seems not efficient since an additional offset is always applied no matter whether the UE processing timeline is satisfied or not.  |
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# 12 [ACTIVE] Issue #12: Beam failure recovery timing relationship

## 12.1 Background

At RAN1#107-e, several companies provide proposals on this topic:

**[Nokia, NSB]**

Proposal 18: For beam failure recovery, the monitoring window for the PDCCH after the PRACH transmission must be postponed.

Proposal 19: The postponement used for the PDCCH monitoring window is equal to K\_mac.

Proposal 20: For the BFR, the PUCCH transmission should occur in the first PUCCH opportunity, after the time interval corresponding to 28 symbols in DL have been elapsed.

**[Huawei, HiSilicon]**

Proposal 11: The timing relationship for beam failure recovery needs to be enhanced with K\_mac, i.e. a UE monitors PDCCH from slot n+4+K\_mac within a window configured by BeamFailureRecoveryConfig.

Proposal 12: The 28 symbols delay between PDCCH reception and application of new PUCCH beam can be interpreted as an absolute time and clarifications of the specification is needed for NTN.

**[Apple]**

Proposal 8: RAN1 to enhance the timing relationship on the beam failure recovery response window offset, by introducing $K\_{mac}$.

Proposal 9: RAN1 to introduce $K\_{offset}$ to enhance the timing relationship on the PUCCH transmission with new beam in the beam failure recovery procedure.

**[OPPO]**

Proposal 7: If downlink and uplink frame timings are not aligned at gNB, the K\_mac is needed to guarantee the timing relationship between UL and DL for beam failure recovery procedure.

Proposal 8: The interpretations 1 about the “28 symbols” is more reasonable.

**[ZTE]**

Proposal-9: If BFR is supported for NR-NTN, delay the start of PDCCH monitoring for receiving RAR with a value of K\_mac when DL-UL frame timing is not aligned at gNB side.

**[Lenovo, Motorola Mobility]**

Proposal 4: The timing relationship between PRACH transmission and start of PDCCH monitoring in beam failure recovery is 4+K\_mac.

**[InterDigital]**

Proposal-4: BFR enhancement including timing relationship is not supported for NR-NTN in Rel-17.

**[Intel]**

Proposal 3: Support of Beam Failure Recovery (BFR) is considered as a low priority for NR NTN

* Timing relationships for BFR can be enhanced by reusing solution with K\_offset

This issue was debated at RAN1#106-e and RAN1#106bis-e.

At RAN1#107-e, 1 company is not in favor of enhancing BFR timing relationship:

* [InterDigital]: BFR enhancement including timing relationship is not supported for NR-NTN in Rel-17.

In Moderator’s view, the proponents need to convince [InterDigital] to resolve the deadlock.

## 12.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 12.2 (Moderator):**

Proponents of enhancing BFR timing relationships are encouraged to address the concern raised by [InterDigital]:

*[InterDigital]: BFR enhancement including timing relationship is not supported for NR-NTN in Rel-17.*

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| --- | --- |
| Company | Comments |
| Apple | If BFR timing relationship enhancement is not addressed, then the whole BFR mechanism is not usable in NTN. This is not preferrable, since BFR is used to address the issues resulting from dynamic blockage (including self-blockage) and UE rotation, which may still occur in NTN. Although we concluded that BFR enhancement for FRF (frequency reuse factor) >1 is not considered in Rel-17, we still prefer that the BFR mechanism is at least usable in the NTN scenario where FRF = 1. Considering that the timing relationship enhancement for BFR in NTN does not have large specification impact, we encourage InterDigital to re-think their position.  |
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# 13 [ACTIVE] Issue #13: UE reporting of information about the UE specific TA pre-compensation

## 13.1 Background

At RAN1#107-e, many companies provide proposals on this topic:

**[Nokia, NSB]**

Proposal 5: The slot definition used by the UE for reporting TA should be the 15 kHz reference slot for FR1.

**[Huawei, HiSilicon]**

Proposal 7: RAN1 sends an LS to RAN2 address the following issue

* *The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)*

From RAN1 point of view, the event-triggers for reporting information about UE specific TA are based on TA values. RAN1 also understands that RAN2 has already agreed that a TA offset threshold can be used for event-triggered reporting, at least the offset threshold can be between current information about UE specific TA and the last successfully reported information about UE specific TA.

* *Under the work assumption "the UE location information cannot be reported in connected mode", the content of UE specific TA reported in connected mode is UE specific TA pre-compensation(for the details of the TA value, confirmation from RAN1 is needed).*

*Under the work assumption "the UE location information can be reported in connected mode", for TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation (for the details of the TA value, confirmation from RAN1 is needed) or the UE location information*

RAN1 understands that whether the above two issues would require some further input from SA3, e.g. whether User Consent is required before NW acquires location information from the UE in NTN. If it can be reported, gNB can obtain a GNSS-based location information from the UE using existing signalling, i.e., by configuring includeCommonLocationInfo in the corresponding reportConfig, which allows the network to request the accuracy it wants on the reported information. From RAN1 point of view, the accuracy can be same as the coarse UE location reported in RACH.

**[Apple]**

Proposal 4: UE reports the differential UE specific TA or differential full TA, where the differential UE specific TA/full TA is the difference between the current UE specific TA/full TA and the last reported UE specific TA/full TA.

Proposal 5: Support at least event-triggered UE reporting for the purpose of uplink scheduling adaptation, where the triggering condition is the difference between the current UE specific TA (or full TA) and the last reported UE specific TA (or full TA) is larger than a threshold.

* FFS reporting failure handling

**[CMCC]**

Proposal 13: For UE reporting of information about the UE specific TA pre-compensation, at least one of the following options is supported.

* Option 3: UE location.
* Option 4: Difference between UE-specific K\_offset and cell-specific K\_offset.
* Option 5: Difference between the last applied K\_offset (e.g., cell-specific K\_offset or UE-specific K\_offset indicated by the network) and one new K\_offset suggested by UE.

**[OPPO]**

Proposal 2: Supporting different slot granularity is associated with different subcarriers in rounding TA value to slot level granularity.

**[Panasonic]**

Proposal 8: The granularity of reported TA should be same as the granularity of Koffset. Round up to the granularity should be used.

**[CATT]**

Proposal 10: On UE-specific TA reporting, periodic reporting can be supported.

Proposal 11: Using RRC signaling to report TA can be supported.

Proposal 12: Reporting differential TA between current TA and previous TA is preferred.

**[CAICT]**

Proposal 4: Send LS to RAN2 to confirm the TA reporting procedure for UEs in RRC connected mode, which is highly related to the TA reporting frequency determination RAN1 is working at.

Proposal 5: For TA reporting frequency for UEs in RRC connected mode:

* if RACH procedure for conventional RACH-triggering issues (e.g., RRC re-establishment) is adopted, event trigger and network request defined to trigger conventional RACH, are supported
* if procedure other than RACH procedure (e.g., BSR-like procedure) is adopted, event trigger, network request and periodic reporting can all be supported
* RACH procedure only for TA reporting should be avoided.

**[SK Telecom, ETRI]**

Proposal 3: If TA is reported larger than K\_offset, UE should perform an event-triggered report to gNB.

Proposal 4: Not only event- triggered report but also periodic event report may be needed for K\_offset update. We suggest a full value for event-triggered and a differential value for periodic report.

**[InterDigital]**

Proposal-1: no further discussion on UE reporting of information about UE-specific TA pre-compensation in RAN1 unless RAN2 request any feedback on RAN2 agreements/working assumption.

**[Intel]**

Proposal 5: UE rounds UE-reported TA according to the ceil function (to the larger integer)

RAN2 has made much progress on this topic, with a few items that requiring RAN1 input:

1. *The content of UE specific TA pre-compensation reported in RA procedure using MAC CE is UE specific TA (this can be revisited after receiving RAN1 response).*
2. *Event-triggers for reporting on the information about UE specific TA in connected mode is supported. FFS on the details. Confirmation by RAN1 is also needed*
3. *The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)*
4. *Under the work assumption "the UE location information cannot be reported in connected mode", the content of UE specific TA reported in connected mode is UE specific TA pre-compensation(for the details of the TA value, confirmation from RAN1 is needed).*
5. *Under the work assumption "the UE location information can be reported in connected mode", for TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation (for the details of the TA value, confirmation from RAN1 is needed) or the UE location information*

The first item was resolved at RAN1#106bis-e. From the submitted proposals, it appears that there is no concern on the rest of the items.

There are also several proposals on reference SCS for the reported TA as well as how to round TA value to slot level granularity.

* [Nokia, NSB]: The slot definition used by the UE for reporting TA should be the 15 kHz reference slot for FR1.
* [OPPO]: Supporting different slot granularity is associated with different subcarriers in rounding TA value to slot level granularity.
* [Panasonic]: The granularity of reported TA should be same as the granularity of Koffset. Round up to the granularity should be used.
* [Intel]: UE rounds UE-reported TA according to the ceil function (to the larger integer).

## 13.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 13.2 (Moderator):**

1. RAN1 to conclude that from RAN1’s perspective, the following RAN2 agreements are fine:
2. *Event-triggers for reporting on the information about UE specific TA in connected mode is supported. FFS on the details. Confirmation by RAN1 is also needed*
3. *The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)*
4. *Under the work assumption "the UE location information cannot be reported in connected mode", the content of UE specific TA reported in connected mode is UE specific TA pre-compensation(for the details of the TA value, confirmation from RAN1 is needed).*
5. *Under the work assumption "the UE location information can be reported in connected mode", for TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation (for the details of the TA value,* confirmation from RAN1 is needed) or the UE location information
6. 15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1.
7. The reported TA is the least integer number of slots greater than or equal to the corresponding TA value.

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| --- | --- |
| Company | Comments |
| Apple | 1)-a). We support to confirm event-trigger based reporting. Maybe, RAN2 needs to consider the case (e.g., UE behavior) when gNB does not receive event-trigger based reporting.1)-b). We support to confirm. 1)-c). We support to confirm in general. Regarding the details of the TA value, we think differential TA value could be reported for signaling overhead saving. 1)-d). It seems that RAN2 only wants RAN1 to confirm UE specific TA pre-compensation part. We are fine to confirm that. For the UE location information, since it is still pending SA3 confirmation and it is not related to RAN1 in general, we do not need to mention/confirm that part in the reply LS.2). We are fine to use 15 kHz as the reference SCS for the unit of TA reporting in FR1, which is aligned with Koffset unit. 3). We may need to first determine whether differential TA value or absolute TA value is reported. For differential TA value reporting, we think rounding is fine.  |
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# 14 [ACTIVE] Issue #14: DCI-based BWP switch

## 14.1 Background

At RAN1#107-e, one company brings up a proposal on DCI-based BWP switch:

**[Huawei, HiSilicon]**

Proposal 8: Apply K\_offset to the timing relationship of DCI-based UL BWP switch, i.e. BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y+K\_offset which starts from the beginning of DL slot n.

The corresponding specification text is in Section 8.6.2, TS 38.133:

For DCI-based BWP switch, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y which starts from the beginning of DL slot n. Where,

- Y=0, if the serving cell where UE receives DCI for BWP switch request is same as the serving cell on which BWP switch occurs.

- Y equals to the length of 1 slot, if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. In this scenario, TBWPswitchDelay + Y shall follow the smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths.

The main argument made by the proponent is as follows:

*[Huawei/HiSi] Essentially, even though the UE switches to a new UL BWP after a timer duration of TBWPswitchDelay + Y which starts from the beginning of DL slot n, it may still need to transmit UL data on the old UL BWP due to large TA. However, the gNB cannot receive the UL transmissions since it has also switched to the new UL BWP.*

In Moderator’s view:

* Network can handle the issue by implementation, i.e., it can avoid scheduling UL data on the old UL BWP when it would like to trigger a DCI-based BWP switch.
* Besides, since it is a RAN4 issue, it’s better that the proponent brings up the proposal in RAN4.

## 14.2 Company views

Based on the above discussion, an initial proposal is made as follows. Companies are encouraged to provide views on the proposal.

**Initial proposal 14.2 (Moderator):**

Companies are encouraged to provide views on the necessity of the following proposal:

*[Huawei, HiSilicon] Apply K\_offset to the timing relationship of DCI-based UL BWP switch, i.e. BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y+K\_offset which starts from the beginning of DL slot n.*

* Option 1: It can be handled by network implementation.
* Option 2: Up to RAN4 to discuss.
* Other option(s)?

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| Company | Comments |
| Apple | We think this issue is similar as the timing relationship on the PUCCH transmission with new beam in BFR. Both of them use an absolute timing. To align the understanding between gNB and UE, we may consider applying Koffset.We are fine for RAN4 discussion since it is related to RAN4 spec.  |
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# 15 Proposals for discussion at GTW sessions

## 15.1 GTW on Nov 12, 2021

TBA

# References

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4. R1-2110804, Discussion on timing relationship enhancements for NTN, Huawei, HiSilicon
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23. R1-2111734, Timing relationship enhancements for NTN, Samsung
24. R1-2111820, Remaining issues on timing relationship enhancement for NTN, InterDigital, Inc.
25. R1-2111870, Timing Relationship Enhancements for NR NTN, Apple
26. R1-2111968, Discussions on timing relationship enhancements in NTN, LG Electronics
27. R1-2112004, Discussion on NTN timing relationship, Lenovo, Motorola Mobility
28. R1-2112104, Discussion on timing relationship enhancements for NTN, NTT DOCOMO, INC.
29. R1-2112169, Timing relationship enhancements for NTN, ITL
30. R1-2112213, Enhancements on Timing Relationship for NTN, Qualcomm Incorporated

# Appendix I: RAN1 agreements on timing relationship

**RAN1#102-e:**

Agreement:

* Introduce K\_offset to enhance the following timing relationships:
	+ The transmission timing of DCI scheduled PUSCH (including CSI on PUSCH).
	+ The transmission timing of RAR grant scheduled PUSCH.
	+ The transmission timing of HARQ-ACK on PUCCH.
	+ The CSI reference resource timing.
	+ The transmission timing of aperiodic SRS.
* Note: Additional timing relationships that require K\_offset of the same or different values can be further identified.

Agreement:

For K\_offset used in initial access, the information of K\_offset is carried in system information.

* FFS implicit and/or explicit signaling of K\_offset in system information.
* FFS a cell specific K\_offset value used in all beams of a cell and/or each beam in a cell uses a beam-specific K\_offset value.
* FFS whether/how to update K\_offset after initial access.

**RAN1#103-e:**

Agreement:

Introduce K\_offset (may or may not be the same as the K\_offset value in other timing relationships) to enhance the timing relationship of HARQ-ACK on PUCCH to MsgB.

Agreement:

* For K\_offset configured in system information and used in initial access, at least a cell specific K\_offset configuration, which is used in all beams of a cell, should be supported.
* FFS: Beam specific K\_offset configured in system information and used in initial access.

Working Assumption:

K\_offset can be applied to indicate the first transmission opportunity of PUSCH in Configured Grant Type 2 in the same way as K\_offset is applied to the transmission timing of DCI scheduled PUSCH.

**Conclusion:**

The agreement made at RAN1#102-e about introducing K\_offset in the transmission timing of RAR grant scheduled PUSCH is also applicable to fallbackRAR scheduled PUSCH.

Agreement:

Denote by K\_mac a scheduling offset other than K\_offset:

* If downlink and uplink frame timing are aligned at gNB:
	+ For UE action and assumption on downlink configuration indicated by a MAC-CE command in PDSCH, K\_mac is not needed.
	+ For UE action and assumption on uplink configuration indicated by a MAC-CE command in PDSCH, K\_mac is not needed.
* If downlink and uplink frame timing are not aligned at gNB:
	+ For UE action and assumption on downlink configuration indicated by a MAC-CE command in PDSCH, K\_mac **is needed**.
	+ For UE action and assumption on uplink configuration indicated by a MAC-CE command in PDSCH, K\_mac is not needed.
* Note: This does not preclude identifying exceptional MAC CE timing relationship(s) that may or may not require K\_mac.

**RAN1#104-e:**

Agreement:

Confirm the following working assumption:

K\_offset can be applied to indicate the first transmission opportunity of PUSCH in Configured Grant Type 2 in the same way as K\_offset is applied to the transmission timing of DCI scheduled PUSCH.

Agreement:

Update of K\_offset after initial access is supported

Agreement:

For unpaired spectrum, extend the value range of K1 from (0..15) to (0..31)

FFS: Whether there is an impact on the size of the PDSCH-to-HARQ\_feedback timing indicator field in DCI.

Working assumption:

Introduce K\_offset to enhance the adjustment of uplink transmission timing upon the reception of a corresponding timing advance command.

**RAN1#104bis-e:**

Agreement:

For updating K\_offset after initial access, at least one of the following options is supported:

* Option 1: RRC reconfiguration
* Option 2: MAC CE

FFS: Other options

Agreement:

* For determination of cell-specific K\_offset in system information, down-select one option from below:
	+ Option 1: Signal one offset value for K\_offset
		- Note: For example, the value is expected to cover the RTT of service link plus the RTT between serving satellite and reference point
	+ Option 2: Signal a first offset value and a second offset value. K\_offset is equal to the sum of the two offset values
		- Note: For example, the first offset value is expected to cover the RTT between serving satellite and reference point or is determined by common TA, and the second offset value is expected to cover RTT of service link

Agreement:

Confirm the following working assumption:

Introduce K\_offset to enhance the adjustment of uplink transmission timing upon the reception of a corresponding timing advance command.

Agreement:

When UE is not provided with K\_offset value other than the one signaled in system information, the K\_offset value signaled in system information is used for all timing relationships that require K\_offset enhancement.

Agreement:

UE can be provided by network with a K\_mac value.

* When UE is not provided by network with a K\_mac value, UE assumes K\_mac = 0.

**RAN1#105-e:**

Agreement:

If a UE is provided with a K\_mac value, when the UE would transmit a PUCCH with HARQ-ACK information in uplink slot *n* corresponding to a PDSCH carrying a MAC CE command on a downlink configuration, the UE action and assumption on the downlink configuration shall be applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}+K\_{mac}$, where µ is the SCS configuration for the PUCCH.

Note: Here K\_mac is assumed to have the unit of the PUCCH slot. This can be revisited after the K\_mac signaling design is finalized.

Agreement:

The starts of ra-ResponseWindow and msgB-ResponseWindow are delayed by an estimate of UE-gNB RTT.

* The estimate of UE-gNB RTT is equal to the sum of UE’s TA and K\_mac.

Note 1: The UE’s TA is based on the RAN1#104bis-e agreement on Timing Advance applied by an NR NTN UE given by  $N\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$$T\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$. The estimate of gNB-satellite RTT is equal to the sum of $N\_{TA,common}×T\_{c}$ and K\_mac.  How to treat $N\_{TA}$ and $N\_{TA,offset}$ can be further discussed.

Note 2: According to the RAN1#104bis-e agreement: When UE is not provided by network with a K\_mac value, UE assumes K\_mac = 0.

Note 3: The accuracy of the estimated UE-gNB RTT with respect to the true UE-gNB RTT can be further discussed.

Note 4: Other options of determining the estimate of UE-gNB RTT can be further discussed.

Agreement:

The K\_offset value signaled in system information is always used for

* The transmission timing of RAR / fallbackRAR grant scheduled PUSCH
* The transmission timing of Msg3 retransmission scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI
* The transmission timing of HARQ-ACK on PUCCH to contention resolution PDSCH scheduled by DCI format 1\_0 with CRC scrambled by TC-RNTI
	+ FFS: The transmission timing of HARQ-ACK on PUCCH to contention resolution PDSCH scheduled by DCI format 1\_0 with CRC scrambled by C-RNTI
* The transmission timing of HARQ-ACK on PUCCH to MsgB scheduled by DCI format 1\_0 with CRC scrambled by MsgB-RNTI
	+ FFS: The transmission timing of HARQ-ACK on PUCCH to MsgB scheduled by DCI format 1\_0 with CRC scrambled by C-RNTI

FFS: how to treat additional transmission timings related to fallback DCI formats

FFS: how to update this formulation with beam-specific K\_offset if beam-specific K\_offset is agreed to be supported

**RAN1#106-e:**

Agreement:

* The UE-specific K\_offset can be provided and updated by network with MAC CE.
* FFS: UE can be provided and updated by network with a UE-specific K\_offset in RRC reconfiguration
	+ FFS: Details on whether and how the two solutions work together

Agreement:

For random access procedure initiated by a PDCCH order received in downlink slot , UE determines the next available PRACH occasion after uplink slot to transmit the ordered PRACH.

* Note: The UE’s TA is based on the RAN1#104bis-e agreement on Timing Advance applied by an NR NTN UE given by  , where is assumed for PDCCH ordered PRACH.

* FFS: Which value of should be applied

* FFS: Whether the timing relationship is impacted by UE behavior within or after the validity duration.

Agreement:

The unit of K\_offset is number of slots for a given subcarrier spacing.

* FFS: one subcarrier spacing value or different subcarrier spacing values for different scenarios.

Agreement:

The information of K\_mac is carried in system information.

Agreement:

The unit of K\_mac is number of slots for a given subcarrier spacing.

* FFS: one subcarrier spacing value or different subcarrier spacing values for different scenarios.

Agreement:

In the estimate of UE-gNB RTT, which is equal to the sum of UE’s TA and K\_mac, for delaying the starts of ra-ResponseWindow and msgB-ResponseWindow, the UE’s TA is equal to with .

Agreement:

For defining value range(s) of K\_offset, down-select one option from below:

* Option 1: One value range of K\_offset covering all scenarios.
* Option 2: Different value ranges of K\_offset for different scenarios.

**RAN1#106bis-e:**

Agreement:

Signalling one value for cell-specific K\_offset is supported.

Agreement:

* For the reference subcarrier spacing value for the unit of K\_offset in FR1, a value of 15 kHz is used.
* FFS: FR2

Agreement:

The granularity of the reported TA is slot.

* FFS how to round TA value to slot level granularity

Agreement:

For the reference subcarrier spacing value for the unit of K\_mac in FR1, a value of 15 kHz is used.

* FFS: FR2

Agreement:

For defining value range(s) of K\_offset, down-select one option from below:

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| --- | --- | --- |
| Option | Value range | Step size |
| Option 1: One value range of K\_offset covering all scenarios. | [0] – [542] ms | Same as the unit of K\_offset |
| Option 2: Different value ranges of K\_offset for different scenarios. | LEO: [0] – [49] msMEO: [93] – [395] msGEO: [477] – [542] msFFS: ATG and HAPSFFS: How to determine the scenarios | Same as the unit of K\_offset |
| Note: If deemed necessary, numbers in bracket can be further updated at RAN1#107-e. |

Agreement:

For defining value range(s) of K\_mac, down-select one option from below:

|  |  |  |
| --- | --- | --- |
| Option | Value range | Step size |
| Option 1: One value range of K\_mac covering all scenarios. | [1] – [271] ms | Same as the unit of K\_mac |
| Option 2: Different value ranges of K\_mac for different scenarios. | LEO: [1] – [25] msMEO: [1] – [198] msGEO: [1] – [271] msFFS: ATG and HAPSFFS: How to determine the scenarios | Same as the unit of K\_mac |
| Note 1: If deemed necessary, numbers in bracket can be further updated at RAN1#107-e.Note 2: Note that it was agreed already that when UE is not provided by network with a K\_mac value, UE assumes K\_mac = 0. |

**RAN1#106bis-e (cont’d):**

Agreement:

RAN1 to conclude the following as a basis to reply to RAN2:

RAN1 definition of UE’s TA is given by the following agreement:

Agreement:

The Timing Advance applied by an NR NTN UE in RRC\_IDLE/INACTIVE and RRC\_CONNECTED is given by:

$$T\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$$

Where:

* $N\_{TA}$ is defined as 0 for PRACH and updated based on TA Command field in msg2/msgB and MAC CE TA command.
	+ FFS: details of NTA update/accumulation.
* $N\_{TA, UE-specific}$  is UE self-estimated TA to pre-compensate for the service link delay.
* $N\_{TA,common}$ is network-controlled common TA, and may include any timing offset considered necessary by the network.
* $N\_{TA,common}$ with value of 0 is supported.
	+ FFS:  details of signaling including granularity.
* $N\_{TA,offset}$ is a fixed offset used to calculate the timing advance.

In addition, RAN1 has agreed the following for UE TA reporting:

Agreement:

The granularity of the reported TA is slot.

* FFS how to round TA value to slot level granularity

It is up to RAN2 to decide which component or what combination of the components in the UE’s TA formula to use in TA reporting.