­3GPP TSG-RAN WG1 Meeting #107-e R1- 21xxxxx

e-Meeting, November 11th – 19th, 2021

Agenda Item: 8.4.1

Source: Moderator (Ericsson)

Title: Feature lead summary#3 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

For the second round of discussion:

* Companies are encouraged to provides views on the following issues by filling comments in the provided tables:
	+ Issue #1 (section 1.4), Issue #12 (section 12.4)
* The other active discussions will be triggered over email reflector directly.

# 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 | [7] sources: [Huawei/HiSi, Apple, CMCC, LGE, ITL, NTT DOCOMO, Intel] |

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.

|  |  |
| --- | --- |
| 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. | [9] sources: [Huawei/HiSi, CMCC, OPPO, Panasonic, ZTE, CATT, Xiaomi, Ericsson, Intel] |

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.  |
| Lenovo/MM | We slightly prefer Option 2 for saving signaling overhead. We think 0-21ms can cover the differential RTT within a footprint. We are fine to both 0-21ms adn 0-31ms as anyway 5 bits are necessary. |
| Intel | 1. a. We prefer Option 2.
2. a.
3. Fine with both since the bitwidth is the same
 |
| NEC | For 1). We prefer Option 1. Indicating a full UE specific K\_offset value is a simple solution. Even though Option 2 could reduce overhead signalling, it increases the complexity of K\_offset updating. For 2). Option a *Same as the value range of cell-specific K\_offset* is slightly preferred.  |
| OPPO | 1) we support the option2. It has been agreed that signaling one value for cell-specific K\_offset in system information in the last meeting. Therefore, signaling a differential UE specific K\_offset via MAC CE can be considered to save the number of signaling bits.3) In option2, considering the max differential RTT within a cell is rounded to 21ms and 7ms for GEO and LEO respectively. We think that the exact value range of the differential UE specific K\_offset should be considered respectively with a step size of 1 ms as follows:

|  |  |
| --- | --- |
| LEO | [0-15 ms] |
| MEO | [0-15 ms] |
| GEO | [0-31 ms] |
| HAPS and ATG | [0-3 ms] |

Furthermore, the full UE specific K\_offset value will not exceed cell specific K\_offset value, so the full UE specific K\_offset value should equal the cell specific K\_offset value minus the differential UE specific K\_offset value. |
| Nokia, Nokia Shanghai Bell | 1) We support Option 1, for its simplicity.We agree with Apple assessment. If the differential part is needed, the ambiguity period of the cell-specific K\_offset will mount on top of the signalling procedure for the MAC-CE determination. What if the MAC-CE is transmitted within a modification period where the SI is updated? We need to specify clearly to avoid corner cases where unexpected behavior may occur. Absolute indication seems more simplistic.By the way, for example, the differential ranges proposed in Question 3 do not include negative values for differential indication, so there is no optimization on top of the more conservative cell-specific K\_offset. This indicates we did not analyze this sub-scenario carefully enough. 2) The UE specific K\_offset simply has the same value range as cell-specific K\_offset.**Additionally**, related to section 1.1.3,we would like to highlight that there is nothing in specifications that forces a UE to read an updated SIB at a specific time when using the system information modification procedure. Hence, the argument that this can be solved by network implementation is not valid. Also, the UE may not be able to decode the first instance of the updated SIB in the new SIB modification period (potentially due to being in poor coverage). Leaving the gNB in the dark with respect to when various UE in the cell actually starts applying the new cell-specific K\_offset is not an acceptable solution. Either this aspect should be discussed during GTW session or  |
| Panasonic | 1) We support option 2 to reduce signaling overhead in MAC CE. 2) For option 1, the value range for UE specific K\_offset should be same as the one for cell specific K\_offset. 3) For option 2, we would propose 0-63ms (6bits for FR1). Because cell specific K\_offset is used at least for initial access, it should be determined based on the longest RTT (i.e. RTT at farthest position) in a cell. Therefore, the value range of differential K\_offset should cover the difference between RTT at the nearest position and RTT at the farthest position in a cell. For GEO, the value range should cover the maximum differential RTT in a cell which is 20.6ms as written in TR38.821(i.e. nearest UE and farthest UE to the geo-stationary satellite). For LEO and MEO, because feeder link delay varies according to satellite movement, the required value range would also depend on whether the cell specific K\_offset is updated according to satellite movement. If cell specific Koffset is determined based on the maximum RTT in the deployment (i.e. feeder link + service link RTT with elevation angle 10 deg) and **not updated**, the maximum differential UE specific K\_offset value should be the maximum RTT minus the minimum RTT (i.e. feeder link + service link RTT with elevation angle 90 deg). According to our calculation, 0-29ms for LEO and 0-62ms for MEO are necessary. If we assume update of the cell specific K\_offset according to satellite movement, a smaller value range (e.g. half) would be possible because only service link differential RTT needs to be taken into account. But, we prefer to allow operation without updating the cell specific K\_offset and cover the value range of 0-62ms.  |
| CMCC | Q1: We support Option 2 for saving signaling overhead.Q3: Fine with both since the bitwidth is the same.**Additionally**, related to section 1.1.3, there may be a long ambiguity period with duration of about RTT for the MAC-CE determination, as discussed in our company contribution R1-2111605. In this ambiguity period, gNB can NOT assure whether new or old UE specific K\_offset is applied at UE side.In order to address the ambiguity period issue for MAC CE updating UE specific K\_offset, we suggest to **support cell-specific K\_offset can be always used for the additional transmission timings related to fallback DCI format**. In this case, gNB can schedule UL transmission in the ambiguity period via fallback DCI. As a result, cell-specific K\_offset may be used in the ambiguity period up to network implementation to eliminate the uncertainly. |
| Xiaomi | 1) We prefer option 2 for the overhead saving3) The value range should cover the maximum differential RTT, option a is preferred, but it is also accepted for option b given that same overhead is assumed. |
| Ericsson | 1) We prefer Option 2, but can live with Option 1 as well2) a. Same as the value range of cell-specific K\_offset3) 0 – 21 ms |
| ZTE | 1) Firstly the logical timeline between gNB and UE are aligned, that means the gNB and the UE have the same understanding on when the MAC-CE is activated. In this regard, if the MAC-CE is transmitted before the SI update (at gNB side), then the reference value is the cell-specific value in the previous SI. Otherwise the reference value is the cell-specific value in the updated SI. So we share the view of moderator that either option can work.Then we think there is no huge difference between option 1 and option 2 with the consideration that either kind of value is signaled via MAC CE. And the difference is that clear signalling overhead (from MAC CE perspective) can be achieved with the price of simple subtractive operation at UE side.In conclusion we support the option 2.3) Either a or b is fine. Given the 5 bits of signalling overhead, it’s probably to enlarge the value range if needed. As to the negative differential value, in fact, the cell-specific K\_offset is the maximum value in the cell, and It seems the group has common understanding that the cell-specific value should be updated via SI modification procedure. Then maybe a simple way to finalize that is as *UE-specific K\_offset = Cell specific K\_offset - Differential value.* (wherein the Differential value is positive) |
| Spreadtrum | 1). We support Option 1.2). Same as the value range of cell-specific K\_offset. |
| InterDigital | 1. a
2. a
 |
| NTT DOCOMO | 1) We prefer Opt1 for the simplicity.2) a |
| QC | 1). Option 12) a |
| Huawei, HiSilicon  | For 1), we support Option 2 from signaling overhead perspective. For 3), we are OK with either a or c {-21 – 0ms} since there is a sign issue due the description of option 2 in 1).  |
| LG Electronics | 1. Option 1 is preferred due to its simplicity
2. A Same as the value range of cell-specific K\_offset
 |
| Sony | Q1: Support Option 2Q3: Fine with both options because of same bit size. |
| CAICT | For 1)，both Option1 and Option2 are OKFor 3) , we share the view with ZTE that UE specific K\_offset should be set as Cell specific K\_offset - Differential value, considering that Cell specific K\_offset should be set over the maximum value of the UE specific K\_offset.  |
| Samsung | 1. b. This can be seen as an index, not differential value among the possible values for K\_offset.
2. .

C. This depends on the range of K\_offset. `0` means the first value of the range of K\_offset. |
| Baicells | 1. Both are fine. But for Option 2, impact of cell-specific K\_offset update on UE-specific K\_offset should be clarified.
2. a
 |

## 1.3 Summary of 1st round of discussion

Based on companies’ views, the following proposal was made and discussed at the GTW on Nov 12:

For determining UE specific K\_offset, down-select one option from below

* Option 1: MAC CE provides a full UE specific K\_offset value.
	+ [11] sources: [Apple, NEC, Nokia/NSB, Ericsson, Spreadtrum, InterDigital, NTT DOCOMO, QC, LGE, CAICT, Baicells]
* Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the cell specific K\_offset value minus the differential UE specific K\_offset value.
	+ [13] sources: [Lenovo/MM, Intel, OPPO, Panasonic, CMCC, Xiaomi, Ericsson, ZTE, Huawei/HiSilicon, Sony, CAICT, Samsung, Baicells]

The following agreement was made accordingly.

**Agreement**

For determining UE specific K\_offset

* Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the cell specific K\_offset value minus the differential UE specific K\_offset value.
	+ FFS: whether/how to resolve ambiguity of which cell-specific K\_offset value to use during the SIB modification period

## 1.4 2nd round of discussion

There are two remaining issues under this topic:

* Detailed value range for the differential UE specific K\_offset value provided in MAC CE
* FFS: whether/how to resolve ambiguity of which cell-specific K\_offset value to use during the SIB modification period

On the detailed value range for the differential UE specific K\_offset value provided in MAC CE,

* It needs to cover the two-way maximum differential delay in a cell, which is 20.6 ms in GEO, leading to a value range of 0 – 21 ms. This would require 5 bits.
* [Panasonic] brought up an interesting observation that “*If cell specific Koffset is determined based on the maximum RTT in the deployment (i.e. feeder link + service link RTT with elevation angle 10 deg) and not updated, the maximum differential UE specific K\_offset value should be the maximum RTT minus the minimum RTT (i.e. feeder link + service link RTT with elevation angle 90 deg). According to our calculation, 0-29ms for LEO and 0-62ms for MEO are necessary. If we assume update of the cell specific K\_offset according to satellite movement, a smaller value range (e.g. half) would be possible because only service link differential RTT needs to be taken into account. But, we prefer to allow operation without updating the cell specific K\_offset and cover the value range of 0-62ms.*” Considering this, it might be worthwhile to use 6 bits to support a value range of 0 – 63 ms.

Therefore, Moderator suggests that we go for the value range of 0 – 63 ms, unless there is a serious concern with [Panasonic]’s suggestion.

On the “FFS: whether/how to resolve ambiguity of which cell-specific K\_offset value to use during the SIB modification period”, views from companies need to be collected first before making a proposal.

Moderator’s plan is to trigger the discussion on the first issue in reflector directly and collect views from companies on the second issue in this document in the second round.

Based on the above discussion, companies are encouraged to provide views on this proposal.

**Proposal 1.4:**

Companies are encouraged to provide views on “FFS: whether/how to resolve ambiguity of which cell-specific K\_offset value to use during the SIB modification period”.

|  |  |
| --- | --- |
| Company | Comments |
| Lenovo/MM | Our view is that during the SIB modification period, both gNB and UE will assume the new cell-specific K-offset is not applied yet and use the old cell-specific K-offset. As cell-specifi K-offset is transmitted in SIB information, it can be treated similar as other SIB contents, so no special handling is necessary. |
| OPPO | In our point, we think there is no ambiguity problem if the gNB and UE keep the same understanding on application the cell specific K\_offset during the SIB modification period. The key issue is how the UE determines whether to use the old cell specific K\_offset value or the new cell specific K\_offset value. For example, If the DCI is received after the PDSCH which carrys the updated cell specific K\_offset value, the new cell specific K\_offset is used; otherwise, the old cell specific K\_offset is used.  |
| Apple | Since gNB does not know the real-time and accurate UE’s full TA, the ambiguity period may exist that gNB does not know starting from which uplink slot, the uplink reception from a particular UE is based on the new cell-specific Koffset. However, with UE’s TA reporting and gNB’s hypothesis on the new or old cell-specific Koffset, the issue may be addressed by gNB implementation without specification change.  |
| ZTE | W.r.t the value range, we agree with the moderator’s suggestion.For proposal 1.4, we don’t agree that there’s ambiguity here. The time when the new SIB is applied can just follow current NR.  |
| Samsung | It is up to gNB implementation like other SIB configurations. |
| CMCC | In our view, update of system information may be a very low frequent event. Although according to the specification, the modification period may be configured with a minimum value of 640ms, NW may seldomly update it in the terrestrial network.We can understand the concern raised by some company that “there is nothing in specifications that forces a UE to read an updated SIB at a specific time when using the system information modification procedure. Also, the UE may not be able to decode the first instance of the updated SIB in the new SIB modification period (potentially due to being in poor coverage)”, nevertheless, considering SIB modification period is a very low frequent event, it is preferred to leave to gNB implementation, e.g., scheduling restriction, to address the ambiguity issue during the SIB modification period.On the other hand, we would like to suggest for more attention on the ambiguity period issue for MAC CE updating UE specific K\_offset. In line with MAC CE signalling, update of UE specific K\_offset seems not like a low frequency event. As discussed in our contribution R1-2111605, the duration of the ambiguity period is about RTT. In order to address the ambiguity period issue, we suggest to **support cell-specific K\_offset can be always used for the additional transmission timings related to fallback DCI format**. In this case, gNB can schedule UL transmission in the ambiguity period via fallback DCI. As a result, cell-specific K\_offset may be used in the ambiguity period up to network implementation to eliminate the uncertainly. |
| vivo | We think there is no ambiguity problem, if the corresponding scheduling information is earlier than the K\_offset updating SI, the old cell-specific Koffset is used. Otherwise, the new cell-specific Koffset is used. It can be handled by network implementation. |
| NEC | The cell-specific K\_offset value could be applied in the same way as other existing parameters provide in SIB in the current spec.  |
| Panasonic | In our view, optimization for this would not be needed considering the update of cell specific Koffset would be rare event and gNB implementation can handle it similar to other SIB contents. |
| Intel | Same view as Lenovo/MM. There is no issue.s |
| MediaTek | We do not see issue. UE can follow NR SI procedure with SIB update based on on valueTag in schedulingInfoList in SIB1.  |
| Nokia, Nokia Shanghai Bell | The UE-specific K\_offset requires negative values, not only positive ones. Therefore, we cannot support a range that goes from 0-29 or 0-63 ms. The reason is that in one cell, the cell-specific K\_offset is to be set conservatively, to provide connectivity even in the worst-case scenario (UE farthest from the cell). But the UE specific K\_offset may be used to optimize this value.In what regards the FFS, we believe it could be further studied, specially regarding how the application point is defined during the modification period. The ambiguity is on the modification period itself, and it has to be addressed. If this is solved, we believe the UE specific K\_offset will work fine. Reasons for ambiguity: UE may monitor for the modified SIB in several beams – when there are quasi-colocated beams. So the network may not know where the UE will re-acquire the modified SIB. And the UE is not expected to read the very first SIB occasion of a beam in the modification period. *“NOTE 2: The UE is not required to monitor PDCCH monitoring occasion(s) corresponding to each transmitted SSB in SI-window.”* We need to clarify the application point of a modified NTN SIB (for K\_offset purposes only).  |
| NTT DOCOMO | In our understanding, updating cell specific K\_offset may not happen frequently, and it can be handled by gNB implementation. |
| Xiaomi | From UE perspective, we don’t think there is ambiguity issue following the current design. Updating Koffset is the same with updating other parameters in the SIB. From the gNB perspective, it could be up to implementation to resolve the possible issue. So no standard work is required. |
| LG Electronics | We tend to agree with CMCC that ambiguity period issue for MAC CE updating UE specific K\_offset also needs to be discussed. For this issue, rather than restric for use of fallback DCI, we prefer to define some rule to use new K\_offset value. For example, new K\_offset value is appled after transmission of acknowledgement for MAC-CE reception or new K\_offset value is applied after the reception of PDSCH which carrys the updated K\_offset value. |
| Huawei, HiSilicon | First of all updates to the cell-specific K\_offset are rare so the possible ambiguity occasions do not happen that often at all. Secondly, we do not see that there is an ambiguity between the UE and the gNB in the application of the new offset, and it would happen as any other SIB update in the specification. |
| Baicells | In our view, the ambiguity issue exists, because which occasion the UE may detect in SI-window is uncertain. |
| Sony | We think It is up to gNB implementation similar with other SIB configurations.  |

# 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.  |
| Lenovo/MM | For 1), we prefer option 2.For 3), we prefer option c.For 4), we prefer option a.For 5), we prefer option c. |
| Intel | 1) Option 12) Slight preference for a.3) Slight preference for c. 4) Slight preference for a.5) We prefer c. |
| NEC | For 1). Option1. The detailed configuration of the values of K\_offset for different scenarios could be left to NW implementation. For 2). No strong preference.  |
| OPPO | 1) We prefer the option 1. Because the value range of option2 calculated in last meeting were not taken into account the reference point which is located in satellite, the minimum values of K\_offset for different scenarios should be changed like the option b in issue 3). So considering the current value range of the K\_offset for different scenarios, option 2 seems more signalling overhead because it needs more bits to indicate the scenarios.2) We prefer Option b. Compared with option b, option a also requires 10 bits.3) Although we prefer the option 1 in issue 1), we think option b is reasonable for the value range of K\_offset for different scenarios.5) For K\_offset unit in FR2, we have proposed the FDD in FR2 can be discussed further. If it is discussed now, in our view, it should consider the lowest SCS for FR2.  |
| Nokia, Nokia Shanghai Bell | Q1: We prefer Option 1 for simplicity. Specially because the “orbit/scenario determination” was not analyzed in details or carefully enough that can be specified. The K\_offset is a cornerstone of the exchange of data in NTN, the scenario determination may not be left for UE implementation, it has to be specified and we don’t have agreements or previous discussion on the topic yet. Q2: bQ3: c . We do not prefer option 2, but in case this is chosen, the value ranges should be defined set such that both regenerative and transparent cases are covered. Q4: bQ5: a  |
| Panasonic | 1) Option 1 is preferable for K\_offset indication. But, if different signaling design for different scenarios is adopted for other RRC parameters, to align with such design is also fine. 2) we support option a3) we support option b, assuming the minimum elevation angle is 10 degrees as in TR38.821. (If 0 degree is assumed, option c would be needed.)4) we support option b5) we support option c (i.e. lowest SCS, same principle as FR1) |
| CMCC | Q1: Option 2. In our view, a scenario indication can be broadcasted by the network, and it can be used for determining the value range and bit allocation for other NTN parameters, such as, Common TA parameters, satellite ephemeris, etc. Thus, significant signaling overhead reduction can be expected.Q4: Option aQ5: Slight preference for Option c |
| Xiaomi | Q1: option 2 for overhead savingQ3: slightly prefer option cQ5: option a  |
| Ericsson | Q1: Option 1 is straightforwardQ2: Option aQ3: Option cQ4: Option bQ5: Option a |
| ZTE | Q1: We prefer Option 1 and share similar views with Apple. Besides, in RAN2, there’s common understanding that the satellite type can be implicitly indicated via ephemeris in SIB, whereas more discussion in RAN2 may be needed on how to differentiate the ephemeris (assume different ephemeris was used for different scenarios along with same logic of option 2). In our view, if we go with option 2, it’s not easy to finish this issue in the RAN1#107-e meeting given above considerations.Q2: either a or b is fine. Given the 10 bits of signalling overhead, it’s probably to enlarge the value range if needed.Q3: option 2 is not preferred.Q4: b, this system information is not necessary for ATG/HAPS.Q5: a |
| Spreadtrum | For 1), we support option 2.For 3), we prefer option a.For 4), we prefer option b.For 5), we prefer option d. |
| InterDigital | Q1) Option 2Q3) cQ4) bQ5) a |
| NTT DOCOMO | 1) We prefer Option 1 for the simplicity, especially if the scenario indication is only used for the determination of the range of K\_offset/K\_mac.2) a |
| Huawei, HiSilicon | 1) Option 2. The signaling overhead can be reduced. Moreover, there is an even larger benefit if we go with this scenario dependent approach for other parameters.3) b 4) b. We think there is no need to define K\_offset for ATG/HAPS since the UL TA can be covered by exiting values of K1 and K2.5) a |
| LG Electronics | Q1: Option 1 is preferred. Q2: Option aQ5: Option a |
| Sony | 1. Support Option 2.

3) Support Option a. Considering the types of NTN platforms which is defined in TR 38.821, Option a is appropriate value range for Option 2.4) This is related to scenarios. If HAPS supports transparent payload with elevation angle 10 degrees, K\_offset might be needed. |
| Samsung | Q1: Option 2.Q3: C. This can cover all possible elevation angles for a given altitude.Q4: B. gNB can configure that value as its implementation.Q5: D. |
| Baicells | Q1: Prefer Option 1 in R17 for simplicity.Q2: Take the maximum value for a given bitwidth.Q3: No strong preference.Q4: a.Q5: c which is the lowest SCS for FR2. |
| vivo | 1. We support option 2 for overhead saving.
2. We support option b, LEO: 2 – 49 ms; MEO: 47 – 396 ms; GEO: 239 – 542 ms.
3. We prefer option b.
4. We prefer option a.
 |

## 3.3 Summary of 1st round of discussion

Based on companies’ views, the following proposal was made and discussed at the GTW on Nov 12:

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.
	+ Supported by [11] sources: [Apple, Intel, NEC, OPPO, Nokia/NSB, Panasonic, Ericsson, ZTE, NTT DOCOMO, LGE, Baicells]
* Option 2: Different value ranges of K\_offset for different scenarios.
	+ Supported by [9] sources: [Lenovo/MM, CMCC, Xiaomi, Spreadtrum, InterDigital, Huawei/HiSilicon, Sony, Samsung, vivo]

The following agreement was made accordingly.

**Agreement**

For defining value range(s) of K\_offset, specify one value range of K\_offset covering all scenarios

## 3.4 2nd round of discussion

In the 2nd round of discussion, we need to settle down the detailed value range for K\_offset.

On the detailed one value range of K\_offset covering all scenarios, two options were discussed in the first round:

* 0 – 542 ms: [Apple, Intel, Panasonic, Ericsson, ZTE, NTT DOCOMO, LGE]
* 0 – 1023 ms: [OPPO, Nokia/NSB, ZTE, Baicells]

Therefore, Moderator suggests that we go for the option (0 – 542 ms) which received more supports, unless there is a strong preference going for the other option.

The other issue is about the K\_offset unit in FR2. Companies’ views are summarized as follows.

|  |  |
| --- | --- |
| Option | Proponent(s) |
| a. 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) | [9] source: [OPPO, Nokia/NSB, Xiaomi, Ericsson, ZTE, InterDigital, Huawei/HiSilicon, LGE, vivo] |
| b. 15 kHz | [0] sources: [] |
| c. 60 kHz | [6] sources: [Apple, Lenovo/MM, Intel, Panasonic, CMCC, Baicells] |
| d. 120 kHz | [2] sources: [Spreadtrum, Samsung] |

Given that there are a large number of companies holding the view that there is 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), it does not seem helpful to spend online/email effort discussing this topic further. Therefore, Moderator would like to encourage the proponents of defining K\_offset unit in FR2 in Rel-17 to offline convince the other camp to make progress and let Moderator know if there is a possibility for potential consensus.

Moderator’s plan is to trigger the discussion on the detailed one value range of K\_offset covering all scenarios in reflector directly.

# 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\_mac 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 |
| Lenovo/MM | For 6), we prefer option 2.For 8), we prefer c.For 9), we prefer c. |
| Intel | 6) We support Option 17) Slight preference for b.8) Slight preference for b.9) Slight preference for c.  |
| NEC | For 6). We prefer Option 1. This issue is similar to Issue #6. One value covers all scenarios is a simple solution. For 7). No strong preference.  |
| OPPO | 6) We prefer the option 1. Considering the current value range of the K\_offset for different scenarios, option 2 seems more signalling overhead because it needs more bits to indicate the scenarios.7) We prefer Option c. Compared with option c, other options also require 9 bits.8) Although we prefer the option 1 in issue 6), we think option c is reasonable for the value range of K\_offset for different scenarios.9) For K\_offset unit in FR2, we have proposed the FDD in FR2 can be discussed further. If it is discussed now, in our view, it should consider the lowest SCS for FR2.  |
| Nokia, Nokia Shanghai Bell | 6) a (option 1)7) c8) N/A9) a.Our arguments on this matter are the same for K\_offset and K\_mac. We believe they are part of the same signalling framework, and so far we observe no reason they should be treated differently (range may differ, but the other aspects are the same).  |
| Panasonic | 6) the same principle as K\_offset design should be adopted. 7) we support option a8) we support option a9) we support option c (i.e. same as K\_offset) |
| CMCC | Q6: Option 2Q9: Slight preference for Option c |
| Ericsson | 6) a (option 1)7) c8) c9) a |
| ZTE | Similar conclusion as issue #3 is expected. 6) a (option 1)7) c8) N/A9) a. |
| Spreadtrum | For 6), we support option 2.For 8), we prefer option b.For 9), we prefer option d. |
| InterDigital | Q6) Option 2Q8) aQ9) a |
| NTT DOCOMO | 6) We prefer Option 1 for the simplicity, especially if the scenario indication is only used for the determination of the range of K\_offset/K\_mac.7) a/b |
| QC | Q6). Option 1Q7)a or b |
| Huawei, HiSilicon | 6) b. Option 2 is preferred due to the benefit in signaling overhead. In addtion, we think there is a large benefit to go with scenario dependent signaling for other parameters.8) a9) a |
| LG Electronics | Q6: Option 1 is preferred. Q7: Option aQ9: Option a |
| Sony | Q6: Option 2Q8: bQ9: d |
| Samsung | Q6: BQ8: B. The maximum values of c are not necessary and it only makes unnecessary test cases. Q9: D. |
| Baicells | Q6: Prefer Option 1 in R17 for simplicity.Q7: Take the maximum value for a given bitwidth |
| vivo | 1. We support option 2 for overhead saving.
2. We support option b.
3. We prefer Option a.
 |

## 6.3 Summary of 1st round of discussion

Based on companies’ views, the following proposal was made and discussed at the GTW on Nov 12:

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

* Option 1: One value range of K\_mac covering all scenarios.
	+ Supported by [12] sources: [Apple, Intel, NEC, OPPO, Nokia/NSB, Panasonic, Ericsson, ZTE, NTT DOCOMO, QC, LGE, Baicells]
* Option 2: Different value ranges of K\_mac for different scenarios.
	+ Supported by [8] sources: [Lenovo/MM, CMCC, Spreadtrum, InterDigital, Huawei/HiSilicon, Sony, Samsung, vivo]

The following agreement was made accordingly.

**Agreement**

For defining value range(s) of K\_mac, specify one value range of K\_mac covering all scenarios.

## 6.4 2nd round of discussion

In the 2nd round of discussion, we need to settle down the detailed value range for K\_mac.

On the detailed one value range of K\_mac covering all scenarios, three options were discussed in the first round:

* 1 – 271 ms: [Apple, Panasonic, NTT DOCOMO, QC, LGE]
* 1 – 278 ms: [Intel, NTT DOCOMO, QC]
* 1 – 512 ms: [OPPO, Nokia/NSB, Ericsson, ZTE, Baicells]

The first and the third option receive same number of supports. Given the first option is the value range agreed in the previous meeting, Moderator suggests that we go for the first option (1 – 271 ms), unless there is a strong preference going for a different option.

The other issue is about the K\_mac unit in FR2. Companies’ views are summarized as follows.

|  |  |
| --- | --- |
| Option | Proponent(s) |
| a. 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) | [8] source: [OPPO, Nokia/NSB, Ericsson, ZTE, InterDigital, Huawei/HiSilicon, LGE, vivo] |
| b. 15 kHz | [0] sources: [] |
| c. 60 kHz | [5] sources: [Apple, Lenovo/MM, Intel, Panasonic, CMCC] |
| d. 120 kHz | [3] sources: [Spreadtrum, Sony, Samsung] |

Given that there are a large number of companies holding the view that there is 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), it does not seem helpful to spend online/email effort discussing this topic further. Therefore, Moderator would like to encourage the proponents of defining K\_mac unit in FR2 in Rel-17 to offline convince the other camp to make progress and let Moderator know if there is a possibility for potential consensus.

Moderator’s plan is to trigger the discussion on the detailed one value range of K\_mac covering all scenarios in reflector directly.

# 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 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.  |
| Lenovo/MM | We share similar view as moderator that this is a small issue and further optimization is not necessary. |
| NEC  | We share the same view as Moderator. Further optimisation is not needed.  |
| OPPO | Based on the analysis of moderator, if it can be handled by gNB, further optimization may be not necessary. |
| Nokia, Nokia Shanghai Bell | We agree with Apple and Lenovo that no further optimization is needed here.  |
| Panasonic | We share the above Moderator’s view. Optimization for this would not be justified.  |
| CMCC | We share the same view with Moderator. The quantization error can be addressed by network implementation. Further optimisation is not needed. |
| Xiaomi | Agree with moderator’s analysis. |
| Ericsson | We second that no further optimization is needed. |
| Spreadtrum | We agree that further optimisation is not needed. |
| QC | No further optimization is needed. |
| Huawei, HiSilicon | Agree with the FL and other companies that this issue can be solved by gNB implementation. When there is an smaller error between the indicated Kmac and the real value, gNB can sent Msg2 with the corresponding delay. |
| LG Electronics | We share the view with Moderator that such optimization is not needed.  |
| Samsung | No further optimization is needed. |
| Baicells | Agree that no further optimization is needed. Basically the real value of K\_mac applied by the network should be equal to the K\_mac indicated to the UE. Quantization error can be addressed by network. |
| vivo | We share the same view as Moderator. |

## 10.3 Summary of 1st round of discussion

Based on the views provided by companies, it is evident that the group do not consider it necessary to address the small quantization error. Therefore, it is not necessary to discuss issue #10 further at RAN1#107-e.

# 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.  |
| Lenovo/MM | Our view is that the processing time may be quite small than the K-offset, so we prefer ZTE’s version that K-offset is always used, and they are separated from the description of the processing delay. |
| Intel | 1. OK
2. Prefer Option 2
 |
| OPPO | 1) We are OK with the proposal.2) In our view, the current spec has limited the time between the last symbol of the PDCCH order reception and the first symbol of the PRACH transmission is larger than or equal to $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$ msec. Therefore, even if UE determines the next available PRACH occasion after uplink slot $n+K\_{offset}$, it still needs to meet the requirements of the existing spec. |
| Nokia, Nokia Shanghai Bell | 1) Agreed.2) We propose an Option 3: Choose the largest value between the two values at the moment.(But Lenovo may be correct that processing times may be typically smaller than the value of K\_offset – which is used to protect the causality of the DL order.) |
| Panasonic | 1) we support the proposal. 2) we support option 1. Cell specific K\_offset would be larger than $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}.$ Option 2 would not be preferable because always applying additional offset D is not efficient.  |
| Xiaomi | 1) Agree2) UE can determine the available PRACH occasion after UL slot $n+K\_{offset}$, subject to the limitation of processing delay given in the spec.  |
| Ericsson | 1. Support
2. We are fine as long as K\_offset is properly captured in line with existing agreement.
 |
| ZTE | 1) Agreed.2) We share similar view as OPPO. i.e., both following conditions should be met at the same time to determine the available PRACH occaseion: (1) larger than or equal to $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$ msec. (2) after uplink slot $n+K\_{offset}$Meanwhile, we are open to discuss how to reflect the enhancement on timing relationship for PDCCH ordered PRACH in draft CRs. |
| InterDigital | 1. Support
2. Option 1
 |
| QC | 1. We disagree with moderator’s analysis. If UE specific Koffset is outdated, UE’s HARQ-ACK of the MAC-CE that reconfigures UE specific Koffset may not be received by the gNB. Hence if we are not always sure UE-specific Koffset is valid at the time of PDCCH-order PRACH, the order should invalidate the UE specific Koffset.
2. UE can determine the available PRACH occasion after UL slot $n+K\_{offset}$, subject to the limitation of processing delay given in the spec.
 |
| Huawei, HiSilicon | 1. Support

Support 2 (a). Our understanding is similar to OPPO. In terms of the specification change, we prefer Option 1. |
| LG Electronics | 1. Support
2. Prefer option 2. Since this is related to the difference between K\_offset - initial TA and minimum gap(NOT absolute value comparison between K\_offset and minimum gap), there is still some possibility that needs minimum gap for proper PRACH transmission. Besides, option 2 is less specification impact as it just adds one parameter, i.e., K\_offset in current spec.
 |
| Sony | Q1: SupportQ2: a |
| CAICT | 1. Agree

We slightly prefer Option1. Actually, the gap requirement $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$ also should be met in current TN. We can use a more general description like “UE does not expect that the duration from the downlink slot $n$ to the selected PRACH slot is smaller than the processing time $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$” , which covers both TN and NTN.  |
| Samsung | OK for 1), Option 1 for 2) |
| Baicells | 1. OK
2. No strong preference
 |
| vivo | 1. We are ok with the proposal.

Disagree, we think the CR in 38.213 section 8.1 proposes by ZTE can be captured. UE always can select an available PO after the uplink slot n+K\_offset, for which a time between the last symbol of the PDCCH order reception and the first symbol of the PRACH transmission is larger than or equal to  msec. |

## 11.3 Summary of 1st round of discussion

Based on the views provided by companies, the following remarks are in order:

* Regarding Proposal 11.2-1) on always using the K\_offset value signaled in system information for PDCCH ordered PRACH timing relationship, all companies are fine, except [Qualcomm].
	+ [Moderator]: Given that this issue has been debated over several meetings, it does not appear to be helpful continue discussion in this document. Moderator recommends that we take further discussion in the email reflector and/or GTW.
* Regarding Proposal 11.2-2) on how to handle K\_offset with “$N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$”, it appears many companies share the view that UE can determine the available PRACH occasion after UL slot $n+K\_{offset}$, subject to the limitation of processing delay given by “$N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$”.
	+ [Moderator]: This is a reasonable way forward. To facilitate spec editor capturing the agreement, Moderator recommends that we try to agree on a Text Proposal, along the line [ZTE] proposed.

## 11.4 2nd round of discussion

Based on the outcome of the first round of discussion, Moderator plans to trigger direct discussion on the following proposals in the reflector

Proposal 11.3-1-A

Adopt the following TP (38.213, 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. For a PDCCH order received in downlink slot $n$, the available PRACH occasion is after uplink slot $n+K\_{offset}$.

Note: Editor can make further adjustment as appropriate.

Proposal 11.3-2-A

The K\_offset value signaled in system information is always used for PDCCH ordered PRACH timing relationship.

# 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.*

|  |  |
| --- | --- |
| 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.  |
| Lenovo/MM | We think BFR useful at least when a UE is in the overlapping area of two footpoints. We think BFR is a robust scheme to compensate beam configuration by MAC CE.We only need to enhance BFR by adding k-offset to the timing relationship. It is simple and straight forward.We prefer BFR enhancment to be suppored in R17. |
| OPPO | Agree with Apple. |
| Nokia, Nokia Shanghai Bell | It seems there is a significant level of agreement between the companies proposing in this topic, in what regards what enhancements should be applied. Unless any other company has a different view, it seems a low-effort agreement on the horizon that would enable a full feature for NTN (BFR).  |
| InterDigital | It is a little bit strange to see that the companies who mentioned that NTN system works without BFR in beam management discussion in Others AI now support BFR enhancement in timing relationship AI.Although we still think that BFR enhancement is not necessary in Rel-17, we won’t object the proposal to optimize the timing relationship any further for the sake of the progress.If timing relationship enhancement is supported for BFR in Rel-17, PUCCH beam application timing issue should be addressed as well in either way (adding K-offset or clarify the interpretation of current beam application timing).  |
| Huawei, HiSilicon | At least the enhancement of timing relationship is needed as there may still have some application application scenerios that need BFR, for example, UE can swith to the beam with BWP#0.  |
| Baicells | We agree to enable a full feature NTN through a low-effort agreement on BFR enhancement. |
|  |  |
|  |  |
|  |  |
|  |  |

## 12.3 Summary of 1st round of discussion

Considering that [InterDigital] stated that they will not object the proposal to optimize the BFR timing relationship any further for the sake of the progress, Moderator recommends that we continue the discussion on this topic in the 2nd round of discussion at this meeting.

## 12.4 2nd round of discussion

 There are two main discussion points under this topic, which are described below respectively.

**Delay between PRACH and start of PDCCH monitoring**

The delay between PRACH transmission and start of PDCCH monitoring is described in TS 38.213:

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  and according to antenna port quasi co-location parameters associated with periodic CSI-RS resource configuration or with SS/PBCH block associated with index  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  within a window configured by *BeamFailureRecoveryConfig*.

The “slot n” is about PRACH transmission and hence naturally refers to uplink slot. The slot “n+4” is about PDCCH reception and hence naturally refers to downlink slot.

Because the downlink and uplink frame timing may not be aligned at the gNB side, there may be a causality issue if the slot “n+4” is reused. For example, as illustrated in the figure below, the gNB may not have received PRACH in slot “n+4” and thus cannot send a PDCCH response.

Therefore, as several companies have correctly proposed, the slot “n+4” needs to be extended to the slot “n + K\_mac + 4”, as illustrated by the slot marked by green color below.



**Delay between PDCCH reception and application of new PUCCH beam**

The delay between PDCCH reception and application of new PUCCH beam is described in TS 38.213. Below is one example clause:

For the PCell or the PSCell, after 28 symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* for which the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI and until the UE receives an activation command for *PUCCH-SpatialRelationInfo* [11, TS 38.321] or is provided *PUCCH-SpatialRelationInfo* for PUCCH resource(s), the UE transmits a PUCCH on a same cell as the PRACH transmission using

- a same spatial filter as for the last PRACH transmission

- a power determined as described in Clause 7.2.1 with , , and 

Note that in this case, there is no explicit slot numbering, which is unlike the previous case on the delay between PRACH and start of PDCCH monitoring.

Therefore, there may be two interpretations on the “28 symbols”, as illustrated in the figure below.

* Interpretation 1: “28 symbols” is the absolute time between the time UE receives PDCCH and the time UE applies new PUCCH beam
	+ In this case, K\_offset enhancement is not needed
* Interpretation 2: for a PDCCH reception in downlink slot n, “28 symbols” is the time between UE’s uplink slot n and the time UE applies new PUCCH beam
	+ In this case, K\_offset enhancement is needed

In Moderator’s view, Interpretation 1 is more reasonable, whereas Interpretation 2 implicitly adds slot numbering which is not present in the existing specification clause.



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

**Proposal 12.4:**

1. On beam failure recovery procedure, for PRACH transmission in uplink slot n, UE monitors the corresponding PDCCH starting from downlink slot “n + K\_mac + 4” within a corresponding RAR window.
2. On the “28 symbols” delay between PDCCH reception and application of new PUCCH beam in the beam failure recovery procedure, which of the following is your interpretation? And why?
	1. Interpretation 1: “28 symbols” is the absolute time between the time UE receives PDCCH and the time UE applies new PUCCH beam
		1. In this case, K\_offset enhancement is not needed
	2. Interpretation 2: for a PDCCH reception in downlink slot n, “28 symbols” is the time between UE’s uplink slot n and the time UE applies new PUCCH beam
		1. In this case, K\_offset enhancement is needed

|  |  |
| --- | --- |
| Company | Comments |
| Lenovo/MM | 1). Support.2).Our first preference is Interpreation 1. The reason is that there is no DL or UL slot index n in current specification. However, we can also accept Interpretation 2 if the description is clear without ambilguilty. |
| OPPO | 1) Support 2) We understand that 28 symbols are the duration for the UE to confirm a BFR response from the detection of PDCCH. Thus, Interpretation 1 is more in line with our understanding. As long as the UE confirms a reception of the BFR response, the UE can change the PUCCH beam. On the other hand, the current specification has not contained the slot number for the interpretation 2. |
| Apple | We support the first bullet. For the second bullet, our understanding on the current spec. is Interpretation 1. However, we do not agree that in this case, K\_offset enhancement is not needed. Although UE behavior is clear in the current specification, the timing between UE and gNB is not aligned. Specifially, gNB does not know when to expect PUCCH with new beam, since the accurate TA is unknown at gNB side. Timeline  Description automatically generated with medium confidenceIf the specification is updated according to UE‘s uplink slot n (i.e., Interpretation 2), then the timing between UE and gNB could be aligned. Subsequently, we need to enhance the timing relationship by Koffset.  |
| ZTE | 1. Support.
2. We share the view that Interpretation 1 makes more sense. And the gap of 28 symbols from DL slot to UL slot is unchanged from UE behavior perspective. Given the current description of specification and the understanding with interpretation 1, the enhancement is not needed.
 |
| CMCC | Q1: Support.Q2: Interpretation 1 is more preferred. Further enhancement is not needed. Regarding the ambiguity issue caused by accurate TA is unknown at gNB side as raised by some company, we think it can be left to gNB implementation, e.g., via scheduling restriction, since BFR may be a low frequency event. |
| vivo | 1. Agree.
2. We think the “28 symbols” is the absolute time(Interpretation 1), and the K\_offset enhancement is not needed.
 |
| NEC | 1) Support. 2) Our understanding is Interpretation 1. No enhancement is needed. |
| Intel | 1. Support
2. Same view as Apple. Interpretation 1 but with enhancement required.
 |
| Nokia, Nokia Shanghai Bell | 1. Agree
2. Interpretation 1.
 |
| NTT DOCOMO | 1) Support2) Our understanding is Interpretation 1. |
| Xiaomi | 1. Support
2. Interpretion 1. It should be a absolute value
 |
| LG Electronics | 1. If there is consensus to support enhancing BFR, we can support it.
2. Our understanding is Interpretation 1.
 |
| Huawei, HiSilicon | 1. We support the FL proposal
2. Interpretation 1. The 28 symbols delay can be interpreted as an absolute time between PDCCH reception and application of new PUCCH beam. We also acknowledge the issue pointed out the Apple that there will be an ambiguity period at the gNB without knowing when the updated beam will be applied for PUCCH. However, we don’t think changing to UL slot *n* in the specification is the right way to go. It is not clear how this UL slot *n* is defined and its relationship with the downlink slot in which the UE receives PDCCH.
 |
| Baicells | 1. Agree.
2. Interpretation 1.
 |
| Sony | 1. Support
2. Prefer Interpretation 1.
 |

# 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.

|  |  |
| --- | --- |
| 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.  |
| Lenovo/MM | We are generally fine with moderator’s proposal. We only have some concern on the UE location reporting. We prefer the working assumption in d) is not confirmed. |
| Intel | We are fine with the proposal from the Moderator |
| NEC | We are fine with the proposal.  |
| OPPO | 1) We are generally fine with moderator’s proposal. And for the UE location information, we think it is better to wait the response from the SA3.2). We are OK. 3). We are OK. And if the reported TA is not an integer number of slots, we suggest it can be rounded to slot as follows:e.g. assuming the content in TA reporting is $T\_{TA}$, the conversion formula is as follows:$⌈T\_{TA}/(10^{-3}/2\^μ)⌉$**=**$ ( ⌈2^{μ}\*10^{3}\*T\_{TA}⌉)$where, $μ$ is the numerology in TS 38.211 section 4.2. $T\_{c}$ is specified in TS 38.211 section 4.1. |
| Nokia, Nokia Shanghai Bell | We are fine with the moderator’s proposal.  |
| Panasonic | Support the moderator’s proposal |
| CMCC | We are fine with the moderator’s proposal. |
| Xiaomi | Generally fine with the proposals |
| Ericsson | We support the moderator’s proposal. |
| ZTE | 1. Regarding the mechanism of Event-triggers, more efforts in RAN1 is expected, e.g., for example, the values of threshold to trigger the report may be different for different scenarios and need to be evaluated further and RAN may can decide the value its own.

With this consideration, we prefer to discuss a bit more about the alternative mechanism of Network triggering, which is simple from gNB prospective and the work in RAN1 can be finished in RAN1#107-e meeting. But we are also open for the progress based on majority’s view.Regarding the UE location report, we share the same views as others, and further checking on the SA’s inputs is needed.2). Fine. 3). Fine.  |
| Spreadtrum | We are fine with the proposal. |
| InterDigital | We are ok with the moderator’s proposal |
| NTT DOCOMO | We are fine with the FL proposal. |
| QC | Ok with the proposal |
| Huawei, HiSilicon | 1 a),b) We support confirming that from RAN1 point of view, the event-triggers for reporting information about UE specific TA are based on TA values. c) d)We support confirming these aspects from RAN1 point of view.2) Support 3) Support |
| Sony | We are fine with all these RAN2 agreements and the other proposals. |
| CAICT | For b) We generally support to confirm the item. However, RAN2 have agreed to report TA through RACH procedure. If a RACH procedure is triggered only for TA reporting, it would cost large time and signaling. We suggest RAN1 to further discuss network request-based TA reporting and periodic TA reporting methods. From our perspective, RAN2 haven’t excluded the above two methods and needs RAN1’s confirmation.  |
| Samsung | We are fine with the proposal. |
| Baicells | Fine with the proposal. |

## 13.3 Summary of 1st round of discussion

Based on the views provided by companies, the following remarks are in order:

* Regarding Proposal 13.2-1) on confirming RAN2 agreements on UE reporting of information about the UE specific TA pre-compensation, it is evident that the vast majority are fine, despite there are a few detailed comments on what/how/when to confirm.
* Regarding Proposal 13.2-2) on using15 kHz as the reference subcarrier spacing value for the unit of TA reported in FR1, all companies are fine.
* Regarding Proposal 13.2-3) on reporting the least integer number of slots greater than or equal to the corresponding TA value as the reported TA, all companies are fine, except [Apple] made a suggestion on determining whether differential TA value or absolute TA value is reported.
	+ [Moderator]: Regardless of whether differential TA value or absolute TA value, rounding up the TA value to the least integer number of slots greater than or equal to the corresponding TA value is fine.

Based on the outcome of the first round of discussion, Moderator marked these proposals stable for potential endorsement for the check point – before the quiet period (12 Nov 23:59 UTC):

Proposal 1-A

15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1.

Proposal 2-A

The reported TA is the least integer number of slots greater than or equal to the corresponding TA value.

The following agreements were made over email reflector:

**Agreement**

15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1.

**Agreement**

The reported TA is the least integer number of slots greater than or equal to the corresponding TA value.

## 11.4 2nd round of discussion

In the 2nd round of discussion, as suggested by RAN1 VC David Mazzarese that we prepare a draft LS reply to RAN2 based on the responses to Initial proposal 13.2, for discussion in email thread.

Moderator plans to trigger the discussion over reflector directly using the following as a starting point.

------

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

RAN1 inputs for the following RAN2 agreements (*in italic*) are given below:

*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*

[RAN1]: RAN1 confirms that event-triggers for reporting on the information about UE specific TA in connected mode can be supported.

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

[RAN1]: RAN1 confirms that the event-triggers for reporting information about UE specific TA can be based on TA values.

*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]: RAN1 made the following further agreements for the details of the TA value:

**Agreement**

15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1.

**Agreement**

The reported TA is the least integer number of slots greater than or equal to the corresponding TA value.

# 14 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)?

|  |  |
| --- | --- |
| 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.  |
| Lenovo/MM | Our view is that of UL BWP switching is indicated by a DCI scheduling PUSCH, then adding K-offset to the delay is necessary. Otherwise, it can be up to gNB implementation. |
| NEC | We slightly prefer to Option 2, as it is related to RAN 4 spec.  |
| OPPO | It is better to discuss it in RAN4. |
| Nokia, Nokia Shanghai Bell | We agree with Apple and Lenovo. No additional specification effort is needed.  |
| Panasonic | Either option 1 or option 2 is fine.  |
| Ericsson | Up to RAN4 to discuss. |
| ZTE | It’s necessary to clarify that *time duration of TBWPswitchDelay + Y* is the elapsed time from UE DL slot n to a UL slot. (e.g., for UL BWP switch).In our view, there is no necessary to introduce additional K\_offset. |
| InterDigital | Option 2 |
| Huawei, HiSilicon | We are not convinced that the issue can be handled by network implementation without any specification change. The K\_offset is applied for the scheduled PUSCH. However, the issue described here is about when UL BWP switching is completed at both gNB and UE side. Given the current specification has not taken the large TA into account, adding K\_offset to the delay is necessary. One possible way to describe the issue and send an LS to RAN4. |
| LG Electronics | It can be handled by RAN4. |
| Samsung  | Option 2. |
| Baicells | Up to RAN4 to discuss. |

## 14.3 Summary of 1st round of discussion

Based on the views provided by companies, it is evident that the majority it is a RAN4 issue and up to RAN4 to discuss. Given that, Moderator recommends that the proponent bring up the topic in RAN4. With this way forward, it is not necessary to discuss issue #14 further in RAN1.

**Moderator recommendation on Issue #14:**

It is recommended that the proponent bring up the topic in RAN4.

# 15 Proposals for discussion at GTW sessions

## 15.1 GTW on Nov 12, 2021

Proposal 15.1-1-A

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.
	+ Supported by [11] sources: [Apple, Intel, NEC, OPPO, Nokia/NSB, Panasonic, Ericsson, ZTE, NTT DOCOMO, LGE, Baicells]
* Option 2: Different value ranges of K\_offset for different scenarios.
	+ Supported by [9] sources: [Lenovo/MM, CMCC, Xiaomi, Spreadtrum, InterDigital, Huawei/HiSilicon, Sony, Samsung, vivo]

Proposal 15.1-2-A

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

* Option 1: One value range of K\_mac covering all scenarios.
	+ Supported by [12] sources: [Apple, Intel, NEC, OPPO, Nokia/NSB, Panasonic, Ericsson, ZTE, NTT DOCOMO, QC, LGE, Baicells]
* Option 2: Different value ranges of K\_mac for different scenarios.
	+ Supported by [8] sources: [Lenovo/MM, CMCC, Spreadtrum, InterDigital, Huawei/HiSilicon, Sony, Samsung, vivo]

Proposal 15.1-3-B

For determining UE specific K\_offset, down-select one option from below

* Option 1: MAC CE provides a full UE specific K\_offset value.
	+ [11] sources: [Apple, NEC, Nokia/NSB, Ericsson, Spreadtrum, InterDigital, NTT DOCOMO, QC, LGE, CAICT, Baicells]
* Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the cell specific K\_offset value minus the differential UE specific K\_offset value.
	+ [13] sources: [Lenovo/MM, Intel, OPPO, Panasonic, CMCC, Xiaomi, Ericsson, ZTE, Huawei/HiSilicon, Sony, CAICT, Samsung, Baicells]

The following agreements were made at the GTW:

**Agreement**

For defining value range(s) of K\_offset, specify one value range of K\_offset covering all scenarios

**Agreement**

For defining value range(s) of K\_mac, specify one value range of K\_mac covering all scenarios.

**Agreement**

For determining UE specific K\_offset

* Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the cell specific K\_offset value minus the differential UE specific K\_offset value.
	+ FFS: whether/how to resolve ambiguity of which cell-specific K\_offset value to use during the SIB modification period

## 15.2 GTW on Nov 17, 2021

TBA

# References

1. TR 38.821, Solutions for NR to support non-terrestrial networks
2. RP-211784, “Solutions for NR to support non-terrestrial networks (NTN),” 3GPP TSG RAN #93-e, September 2021.
3. R1-2110641, “Feature lead summary#6 on timing relationship enhancements,” Moderator (Ericsson), RAN1#106bis-e, October 2021.
4. R1-2110804, Discussion on timing relationship enhancements for NTN, Huawei, HiSilicon
5. R1-2110899, Remaining timing relation aspects for NR over NTN, Nokia, Nokia Shanghai Bell
6. R1-2111009, Remaining issues on timing relationship enhancements for NR-NTN , vivo
7. R1-2111097, Discussion on timing relationship enhancements for NTN, Spreadtrum Communications
8. R1-2111177, Discussion on timing relationship enhancements for NTN, NEC
9. R1-2111252, Further discussion on timing relationship enhancements for NTN, CATT
10. R1-2111314, Discusson on timing relationship enhancement, OPPO
11. R1-2111353, Remaining issues for timing relationship enhancements in NTN, Zhejiang Lab
12. R1-2111370, Timing relationship enhancements for NR-NTN, MediaTek Inc.
13. R1-2111393, Calculation and application of timing relationship offsets, Sony
14. R1-2111413, On timing relationship enhancements for NTN, Ericsson
15. R1-2111441, Discussion on timing relationship enhancement for NTN, Baicells
16. R1-2111445, Discussions on timing relationship enhancements in NTN, SK Telecom, ETRI
17. R1-2111493, Remaining issues on timing relationships for NTN, Intel Corporation
18. R1-2111570, Discussion on the remaining issues on the timing relationship enhancement for NTN, Xiaomi
19. R1-2111605, Discussion on timing relationship enhancements for NTN, CMCC
20. R1-2111646, Timing relationship for NTN, Panasonic Corporation
21. R1-2111652, Timing relationship enhancements to support NTN , CAICT
22. R1-2111658, Discussion on timing relationship for NR-NTN, ZTE
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:

|  |  |  |
| --- | --- | --- |
| 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.