**3GPP TSG RAN WG1#108-e R1-220xxxx**

e-Meeting, February 21st – March 3rd, 2022

Agenda Item: **8.15.2**

Source: **Moderator (Sony)**

Title: **FL summary 1 of AI 8.14.2: Timing relationships for IoT-NTN**

Document for: **Discussion**

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# Introduction

This the feature lead (FL) summary of contributions for the following discussion:

[108-e-R17-IoT-NTN-02] Email discussion for maintenance on timing relationship enhancements – Sam (Sony)

* 1st check point: February 25
* Final check point: March 3

# Overview of Main Issues from company contributions

Analysis of companies’ contributions to this AI at RAN1#108-e shows that company contributions fall under the following categories:

* General Errata for the current specifications – issues that are mainly editorial in nature
* General omissions - issues that were agreed during the WI but the specifications do not reflect the agreements either in full or in part
* Porting of relevant NR NTN agreements to IoT NTN – the WID indicated that “This Work Item intends to reuse the conclusions and recommendations of FS\_LTE\_NBIOT\_eMTC\_NTN study item, and the NR\_NTN\_solutions Work Item agreements and conclusions”. In areas in which there are not explicit IoT NTN agreements, companies are suggesting the adoption of the relevant NR NTN agreements and consequent reflection in the specifications.
* Proposals of new agreements in areas that companies think are critical but which existing NR NTN agreements either do not cover or for which IoT NTN should be different.

In total, from these categories, FL has identified 15 issues that can be discussed during RAN1#108. In this round, FL makes a recommendation to close Issue#15 on WUS configuration and GNSS measurements. Apart from this, all other issues are under discussion in this round. Companies are encouraged to go through and complete the questionnaires and surveys.

For this first round of email discussions, companies are invited to make their views known on all the remaining 14 issues.

## General Errata

These are issues FL considers as mainly editorial.

### Issue#1: Location of Koffset description in spec

Sub-section 6.1.1 of TS36.213 v17.0.0 covers issues of timing for random access procedure. Many clauses in earlier parts of the sub-section use *Koffset* but derivation/description of *Koffset*  from upper layer parameters ( *CellSpecificKoffset*, *UESpecificKoffset*) only appears towards the end of the sub-section.

#### Companies Views

|  |  |
| --- | --- |
| Huawei | **TP#1 for Clause 6.1.1 of TS36.213**  **Proposal 1:** Adopt TP#1 for Clause 6.1. 1 of TS36.213.  ========= Unchanged Text Omitted ==========  6.1.1 Timing  Throughout this clause, for a BL/CE UE, if the UE is configured with the higher layer parameter CellSpecificKoffset,  - where  is the parameter CellSpecificKoffset provided by higher layers, and  is the parameter UESpecificKoffset provided by higher layers, otherwise  otherwise,  - , .  ======== Unchanged Text Omitted =============== |

#### FIRST ROUND Discussion of Location of Koffset Description in Spec.

Huawei’s proposal is to move these derivations to the top of the sub-section. FL proposes to treat this as an editorial issue. Companies are respectfully invited to make their views known.

FL Proposal 1.1.2-1:

Suggest to spec editor to move the derivation of Koffset from *CellSpecificKoffset*, *UESpecificKoffset* to the beginning of subsection 6.1.1 of TS36.213

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 1.1.2-1 | Comments and Proposal |
| ZTE | Support |  |
| Nokia, NSB | Support |  |
| Intel | Support |  |
| OPPO | Support |  |
| Xiaomi | Support |  |
| Qualcomm | Support |  |
| Huawei, HiSilicon | Support |  |
| CMCC | Support |  |
| Mavenir | Support |  |
| Samsung | Support |  |
| Ericsson | Support |  |
| CATT | Support |  |
| SONY | Support |  |

### Issue #2: Consistent Designation of Kmac

Potential typo in spec with respect to Kmac

#### Companies Views

|  |  |
| --- | --- |
| Ericsson | The following specification text occurs in Clause 9.1.5 in TS 38.213, v17.0.0:  **[Clause 9.1.5, TS 36.213, v17.0.0]**  If the UE has initiated a PUSCH transmission using preconfigured uplink resource ending in subframe *n*, the UE shall monitor the MPDCCH UE-specific search space in a search space window starting in subframe *n+4+Kmac* with duration given by higher layer parameter *pur-MPDCCH-SS-window-duration* where is provided by higher layer parameter *K-mac*, otherwise . Upon detection of a MPDCCH with DCI format 6-0A/6-0B with CRC scrambled by PUR-RNTI intended for the UE within the search space window and the corresponding DCI is for PUR ACK/fallback indication (as defined in [4]), the UE is not required to monitor the MPDCCH UE-specific search space for the remaining search space window duration.  The subscript in the yellow highlighted text should not be in italics.   1. Adopt the following TP for Clause 9.1.5 in TS 36.213 *Kmac* should be replaced by . |

#### FIRST ROUND Discussion of Consistent Designation of Kmac

Ericsson’s proposal is to change the offending ***Kmac*** to in this sub-section. FL proposes to treat this as an editorial issue. Companies are invited to make their views known.

FL Proposal 1.2.2-1:

Suggest to spec editor to change the offending ***Kmac*** to in subsection 9.1.5 of TS36.213

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 1.2.2-1 | Comments and Proposal |
| ZTE | Support |  |
| Nokia, NSB | Support |  |
| Intel | OK |  |
| OPPO | Support |  |
| Xiaomi | OK |  |
| Qualcomm | OK |  |
| Huawei, HiSilicon | Support |  |
| CMCC | Support |  |
| Mavenir | Support |  |
| Ericsson | Support |  |
| CATT | OK |  |
| SONY | Support |  |

## General Omissions

These cover issues that were agreed during the WI but the specifications do not reflect the relevant agreements either in full or in part.

### Issue #3: PUSCH timing relationship for NB-IoT

This is about correcting an oversight in the specs with respect to timing relationship enhancement for NPUSCH in NB-IoT.

#### Companies Views

|  |  |
| --- | --- |
| Sony | <<<< **[TP#1]** START of TEXT PROPOSAL for TS36.213 section 16.5.1 >>>>>>>>>>>>>  16.5.1 UE procedure for transmitting format 1 narrowband physical uplink shared channel  NPUSCH format 1 transmission can be scheduled by a NPDCCH with DCI format N0, or the transmission can correspond to using preconfigured uplink resource configured by higher layers. Transmission using preconfigured uplink resource is initiated by higher layers as specified in [14] , while retransmission of transport blocks transmitted using preconfigured uplink resource are scheduled by a NPDCCH with DCI format N0.  A UE shall upon detection on a given serving cell of a NPDCCH with DCI format N0 ending in NB-IoT DL subframe *n* scheduling NPUSCH intended for the UE, perform, at the end of  *- n+k0+K*offset DL subframe for FDD,  *- k0* NB-IoT UL subframes following the end of *n+*8*+K*offset subframefor TDD,  a corresponding NPUSCH transmission using NPUSCH format 1 in *N* consecutive NB-IoT UL slots *ni* with *i = 0, 1, …, N-1* according to the NPDCCH information where  - subframe *n* is the last subframe in which the NPDCCH is transmitted and is determined from the starting subframe of NPDCCH transmission and the DCI subframe repetition number field in the corresponding DCI; and  - , where the value of is determined by the repetition number field in the corresponding DCI (see Clause 16.5.1.1), the value of is determined by the resource assignment field in the corresponding DCI (see Clause 16.5.1.1), the value of  is the number of NB-IoT UL slots of the resource unit (defined in clause 10.1.2.3 of [3]) corresponding to the  allocated number of subcarriers (as determined in Clause 16.5.1.1) in the corresponding DCI, and the value of is determined by the Number of scheduled TB for Unicast field, if present, in the corresponding DCI,  otherwise  - *n0* is the first NB-IoT UL slot starting after the end of subframe *n+k0+KOffset* for FDD  - *n0* is the first NB-IoT UL slot starting after *k0+KOffset* NB-IoT UL subframes following the end of *n*+8 subframe for TDD  - value of *k0* is determined by the scheduling delay field () in the corresponding DCI according to Table 16.5.1-1 for FDD and Table 16.5.1-1A for TDD  <<<< END of TEXT PROPOSAL for TS36.213 section 16.5.1 >>>>>>>>>>>>> |

#### FIRST ROUND Discussion of PUSCH timing relationship in NB-IoT

The proposal is to change the text by adding the yellow highlighted text above to include +Koffset. Companies are invited to make their views known.

FL Proposal 2.1.2-1:

Adopt TP#1 for TS36.213 section 16.5.1

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 2.1.2-1 | Comments and Proposal |
| ZTE | Support with modification | We support the modification for FDD.  However, for TDD, Koffset should be introduced after n+8, i.e.,  - *n0* is the first NB-IoT UL slot starting after *k0* NB-IoT UL subframes following the end of *n*+8*+KOffset* subframe for TDD  to keep alignment with previous description:  *- k0* NB-IoT UL subframes following the end of ***n+*8*+K*offset** subframefor TDD, |
| Nokia, NSB | Support |  |
| Intel | Support |  |
| OPPO | Support in principle with the modification | Agree with ZTE. |
| Xiaomi | Support ZTE’s update |  |
| Qualcomm | Support ZTE’s update |  |
| Huawei, HiSilicon | Support ZTE’s modification |  |
| CMCC |  | ZTE’s modification seems better. |
| Mavenir | Support with modification | Support ZTE’s modification |
| Samsung | Support ZTE’s update |  |
| Ericsson | Support | Agree with ZTE |
| CATT | Support |  |
| SONY | Support | OK with modification from ZTE. |

### Issue #4: PUSCH timing relationship for eMTC

This is about correcting an oversight in the specs with respect to timing relationship enhancement for PUSCH in eMTC.

#### Companies Views

|  |  |
| --- | --- |
| Sony | <<<< **[TP#2]** START of TEXT PROPOSAL for TS36.213 section 8.0 >>>>>>>>>>>>>  A BL/CE UE shall upon detection on a given serving cell of an MPDCCH with DCI format 6-0A/6-0B scheduling PUSCH intended for the UE, perform a corresponding PUSCH transmission in subframe(s) *ni* = *n+ki+Koffset* if a transport block(s) corresponding to the HARQ process(es) of the PUSCH transmission is generated as described in [8] with *i = 0, 1, …, NTBN-1* according to the MPDCCH, where  - subframe *n* is the last subframe in which the MPDCCH is transmitted;  - the value of is the number of scheduled TB determined by the corresponding DCI if present,  otherwise;  *-*  and the value of  is determined by the *repetition number* field in the corresponding DCI, where  - if the UE is configured with higher layer parameter *ce-pdsch-puschEnhancement-config* with value 'On' are given by {1,2,4,8,12,16,24,32}  - otherwise, are given in Table 8-2b and Table 8-2c; and  - if the UE is configured with higher layer parameter *ce-PUSCH-SubPRB-Config-r15*, and the PUSCH resource assignment in the corresponding DCI is using uplink resource allocation type 5,  where *N* ≤ 32 for CE Mode A and *N* ≤ 2048 for CE Mode B,  is defined in [3] and  is determined according to procedure in clause 8.1.6,  otherwise  - in case *N>1*, subframe(s) *n+ki*+*Koffset* with *i=0,1,…, NTBN-1* are *NTBN* consecutive BL/CE UL subframe(s) starting with subframe *n+x*+*Koffset*, and in case *N=1*, *k0=x*;  <<<< Portion of specification removed >>>>>  - for FDD, *x = 4*;  <<<< END of TEXT PROPOSAL for TS36.213 section 8.0 >>>>>>>>>>>>> |

#### FIRST ROUND Discussion of PUSCH timing relationship for eMTC

The proposal is to change the text by adding the yellow highlighted text above to include +Koffset. Companies are invited to make their views known.

FL Proposal 2.2.2-1:

Adopt TP#2 for TS36.213 section 8.0

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 2.2.2-1: | Comments and Proposal |
| ZTE | Support |  |
| Nokia, NSB | Support |  |
| Intel | Support |  |
| OPPO | Support |  |
| Qualcomm | Support |  |
| Mavenir | Support |  |
| Samsung | Support |  |
| Ericsson | Support |  |
| CATT | Support |  |
| SONY | Support |  |

## Porting NR NTN Agreements into IoT NTN

For issues under this heading, the companies that contributed seek to apply agreements made in NR NTN to IoT NTN in cases in which no contradicting agreement was made in IoT NTN and consequently, to reflect the agreement in the specs.

### Issue#5: NPDCCH ordered NPRACH

The issue here is about which Koffset (cell-specific or UE-specific) should be used for enhancing the timing relationship of NPDCCH ordered NPRACH in NB-IoT.

#### Companies Views

|  |  |
| --- | --- |
| MediaTek | ***Proposal 4****: Utilize only cell-specific Koffset in PDCCH ordered PRACH of NB-IoT NTN.*  ***Proposal 6****: Agree on the updated Pseudo CRs to TS 36.213 Sections 16.3.2 to utilize only cell-specific Koffset in PDCCH ordered PRACH of NB-IoT NTN in the Appendix B.* |
| Ericsson | Proposal 1: Adopt the following TP for Clause 16.3.2 in TS 36.213:  **[Clause 16.3.2, TS 36.213, v17.0.0]**  In case a random access procedure is initiated by a "PDCCH order" ending in subframe *n*, the UE shall, if requested by higher layers, start transmission of random access preamble at the end of the first subframe , , where a NPRACH resource is available. |
| CMCC | ***Proposal 2:*** Support cell-specific K\_offset in the enhanced PDCCH ordered PRACH timing relationship. If UE is provided with K\_offset, for a PDCCH order received in downlink slot n, the available PRACH occasion is after uplink slot n+K\_offset. |
|  |  |

#### FIRST ROUND Discussion of NPDCCH ordered NPRACH

At RAN#107e, the following agreement was made in NR NTN:

**Agreement**

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

No equivalent agreement was made in IoT NTN. FL proposes that the same agreement be made in IoT NTN. Companies are respectfully invited to make their views known.

FL Proposal 3.1.2-1:

In IoT NTN, the Koffset value signalled in system information (cell specific Koffset) is always used for NPDCCH and MPDCCH ordered NPRACH and PRACH timing relationships, respectively.

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 3.1.2-1: | Comments and Proposal |
| ZTE | OK |  |
| Nokia, NSB | Support |  |
| Intel | OK |  |
| OPPO | Support |  |
| Xiaomi | Support |  |
| Qualcomm | Agree |  |
| Huawei, HiSilicon | Support |  |
| CMCC | Support |  |
| Mavenir | Support |  |
| Samsung | OK |  |
| Ericsson | Support |  |
| CATT | Support |  |
| SONY | Support |  |

### Issue#6: NPDCCH ordered NPRACH in Spec

If companies agree to FL Proposal 3.1.2-1, then TS36.213 has to reflect this agreement in sections 16.3.2 (NB-IoT) and section 6.1.1 for eMTC.

#### FIRST ROUND Discussion of Issue #6

In section 6.1.1 of TS36.213 v17.0.0, the text already reflects the use of Kcell\_offset for eMTC:

In case a random access procedure is initiated by a "PDCCH order" reception ending in subframe *n* for BL/CE UEs, the UE shall, if requested by higher layers, transmit random access preamble in the first subframe ,, where a PRACH resource is available.

FL proposes that this be reflected for NB-IoT too in section 16.3.2. Companies are respectfully invited to make their views known.

FL Proposal 3.2.1-1:

Suggest to spec editor to change [Clause 16.3.2, TS 36.213 ] as follows:

In case a random access procedure is initiated by a "PDCCH order" ending in subframe *n*, the UE shall, if requested by higher layers, start transmission of random access preamble at the end of the first subframe , , where a NPRACH resource is available.

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 3.2.1-1: | Comments and Proposal |
| ZTE | OK |  |
| Nokia, NSB | Support |  |
| Intel | OK |  |
| OPPO | Support |  |
| Xiaomi | OK |  |
| Qualcomm | OK |  |
| Huawei, HiSilicon | Support |  |
| CMCC | Support |  |
| Mavenir | Support |  |
| Samsung | OK |  |
| Ericsson | Support |  |
| CATT | OK |  |
| SONY | Support |  |

### Issue#7: Calculation of UE-eNB RTT

In RAN1#105e, the following agreement was made in NR NTN:

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  . The estimate of gNB-satellite RTT is equal to the sum of and K\_mac.  How to treat and 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.

In RAN1#106e, the following conclusion was recorded:

Conclusion:

For IoT NTN, no modifications are needed for the calculation in NR NTN for estimate of UE-eNB RTT.

From these, for IoT NTN, the UE-eNB RTT is calculated as: TTA + *K*mac.

#### Companies Views

|  |  |
| --- | --- |
| MediaTek | ***Proposal 5****: Capture UE-eNB RTT in RAN1’s CR 36.213 Section 6.1, 16.3.1 with UE-eNB RTT provided in an integer number of subframes as UE-eNB RTT = floor(UE’s TA + K\_mac) subframes.* |

#### FIRST ROUND Discussion on Calculation of UE-eNB RTT

The unit of TTA is seconds whilst the unit of *K*mac is currently 1ms subframes. When the UE-eNB RTT is used, it would be necessary to convert TTA into subframes. To avoid ambiguity, MediaTek proposes that the conversion should use the floor(.) function.

FL thinks that this has merit. Companies are respectfully invited to make their views known.

FL Proposal 3.3.2-1:

For IoT NTN, in the calculation of UE-eNB RTT, use the following equation:

Where *Tf* = subframe duration (1ms).

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 3.3.2-1: | Comments and Proposal |
| Nokia, NSB |  | We think to avoid underestimate the RTT, better to use ceiling() instead of floor(). |
| Intel |  | Agree with Nokia |
| OPPO | Not support | It can be left to the UE implementation. |
| Qualcomm | Further discuss/clarify | Is this strictly required in the RAN1 specs? Is this being done for NR specs as well? To me, it seems that RTT calculation for purpose of RAR window determination can also be described in the MAC specs? Would be good to discuss this. |
| Huawei, HiSilicon | Discussion needed | We are not sure whether floor/ceiling function is needed, it is not in the NR spec, either. |
| CMCC |  | Although we don’t think the problem raised by Nokia is a big issue, since the potential underestimate issue on determining the start of RAR monitoring window may be resolved up to network implementation, we still slightly prefer to Nokia’s modification. |
| Mavenir |  | We are Ok with floor() operation, we can align with the NR agreements for the UE-eNB RTT calculation. It doesn’t require separate discussion for IoT-NTN. |
| Samsung |  | OK to use the ceiling function, but further discuss if it is needed to add this in the specifications. |
| Ericsson |  | The choice of using a ceiling or a floor function depends on the context. For instance, using a ceiling function may delay the start of the RA-response window by about a subframe. Conversely, using a floor function may cause an early end to the RA-response window by about a subframe. It may be beneficial to specify one of the two rather than leaving it up to UE implementation. We agree with Qualcomm that it merits further discussion.  In case we need to adopt a definition (e.g., floor), we suggest the following modification to reduce the number of words: |
| CATT | OK | Using floor function will not delay the start of RAR window. |
| SONY | Support | Our preference is for the floor() function. The floor() function tends towards underestimation of the RTT, but this would mean than the UE would not miss a PDCCH sent at the start of the RAR window. |

### Issue#8: Inclusion of UE-eNB RTT in Spec

If companies agree to FL Proposal 3.3.2-1, then TS36.213 has to reflect this agreement in sections 6.1 for eMTC and 16.3.1 (NB-IoT).

#### FIRST ROUND Discussion on Inclusion of UE-eNB RTT in Spec

Calculation of UE-eNB RTT is not reflected in the current version of the spec for both eMTC and NB-IoT:

TS 36.213 v17.0.0 Section 6.1

For BL/CE UEs, detection of a MPDCCH with DCI scrambled by RA-RNTI is attempted during a window controlled by higher layers (see [8], Clause 5.1.4). If detected, the corresponding DL-SCH transport block is passed to higher layers. The higher layers parse the transport block and indicate the Nr-bit uplink grant to the physical layer, which is processed according to Clause 6.2.

TS 36.213 v17.0.0 Section 16.3.1

Detection of a NPDCCH with DCI scrambled by RA-RNTI is attempted during a window controlled by higher layers (see [8], Clause 5.1.4). If detected, the corresponding DL-SCH transport block is passed to higher layers. The higher layers parse the transport block and indicate the Nr-bit uplink grant to the physical layer, which is processed according to Clause 16.3.3

In FL’s view, as suggested by MediaTek, these clauses need to be changed to reflect the calculation of UE-eNB RTT. Companies are respectfully requested to make their views nkown.

FL Proposal 3.4.1-1:

Suggest to spec editor to change the above clauses as follows:

TS 36.213 Section 6.1 (modified text)

-     For BL/CE UEs, detection of a MPDCCH with DCI scrambled by RA-RNTI is attempted during a window controlled by higher layers (see [8], Clause 5.1.4), where UE-eNB RTT is calculated as floor( subframes, where is specified in [TS 36.211, Clause 8.1], is the subframe duration (1ms), and is provided by the higher layer parameter *K-Mac* in unit of 1 ms or if *K-Mac* is not provided. If detected, the corresponding DL-SCH transport block is passed to higher layers. The higher layers parse the transport block and indicate the Nr-bit uplink grant to the physical layer, which is processed according to Clause 6.2.

TS 36.213 Section 16.3.1 (modified text)

-     Detection of a NPDCCH with DCI scrambled by RA-RNTI is attempted during a window controlled by higher layers (see [8], Clause 5.1.4)., where UE-eNB RTT is calculated as floor( subframes, where is specified in [TS 36.211, Clause 8.1], is the subframe duration (1ms), and is provided by the higher layer parameter *K-Mac* in unit of 1 ms or if *K-Mac* is not provided. If detected, the corresponding DL-SCH transport block is passed to higher layers. The higher layers parse the transport block and indicate the Nr-bit uplink grant to the physical layer, which is processed according to Clause 16.3.3.

|  |  |  |
| --- | --- | --- |
| Company | Support/Not Support  FL Proposal 3.4.1-1: | Comments and Proposal |
| Nokia, NSB |  | We think to avoid underestimate the RTT, better to use ceiling() instead of floor(). |
| Intel |  | Same view as Nokia |
| OPPO | Not support | From our perspective, the related text can follow the spec in section 8.2 in TS 38.213. So the related spec is as follows:  ‘…where UE-eNB RTT is calculated as TTA + *K*mac msec where TTA is defined in [TS 38.211] and *K*mac is provided by K-Mac or *K*mac =0 if K-Mac is not provided. …’ |
| Qualcomm | See comment above—good to have clarity as to whether this is required in RAN1 specs. |  |
| Huawei, HiSilicon | Discussion needed | We are not sure whether floor/ceiling function is needed, it is not in the NR spec, either. |
| CMCC |  | Although we don’t think the problem raised by Nokia is a big issue, since the potential underestimate issue on determining the start of RAR monitoring window may be resolved up to network implementation, we still slightly prefer to Nokia’s modification. |
| Samsung |  | OK to use the ceiling function, but further discuss if it is needed to add this in the specifications. |
| Ericsson |  | Please see our response to Issue#7. |
| CATT | Support |  |
| SONY | Support |  |

## Proposals of new Agreements in IoT NTN

For issues under this heading, companies seek either to complete/clarify existing agreements or to propose new agreements in aspects that they feel were not completed during the WI and that may lead to ineffective operation of the IoT NTN system.

### Issue#9: Units of Kmac and Koffset in NB-IoT for 3.75kHz SCS

Agreements were made for the units of Kmac and Koffset when the SCS is 15kHz. Companies are seeking a similar agreement for the case when the SCS is 3.75kHz for NB-IoT.

#### Companies Views

|  |  |
| --- | --- |
| CATT | **Proposal 2: The unit of K\_mac is 1 ms for 3.75 kHz SCS.**  **Proposal 3: The unit of K\_offset is 1 ms for 3.75 kHz SCS.** |
| Marvenir | ***Proposal 2:*** *The unit of K\_offset is subframe for 3.75 KHz subcarrier spacing.*  ***Proposal 3:*** *The unit of K\_mac is subframe for 3.75 KHz subcarrier spacing.* |

#### FIRST ROUND Discussion on Units of Kmac and Koffset in NB-IoT

At RAN1#107e, the following agreements were made:

**Agreement**

For IoT NTN, the unit of K\_offset is subframe based on a 15kHz subcarrier spacing (i.e. 1 ms).

* Further discuss the case where UL is using 3.75 kHz SCS

**Agreement**

For IoT NTN, the unit of K\_mac is subframe based on a 15kHz subcarrier spacing (i.e. 1 ms).

* Further discuss the case where UL is using 3.75 kHz SCS

**Agreement**

Whether/how the “indicated value” of K\_offset is translated into number of slots for different numerologies (i.e., 15 kHz and 3.75 kHz) is left to the spec-editor.

* This resolves the bullet from previous agreement: Further discuss the case where UL is using 3.75 kHz SCS

As the total duration of 14 symbols at 3.75kHz SCS is 4ms, there are 4 x 1ms subframes of 15kHz SCS in a subframe at 3.75kHz. There was no explicit agreement on the units of Koffset and Kmac when SCS is 3.75kHz. Both companies that have brought this issue up at RAN1#108e, suggest that we adopt the unit of 1ms (already adopted for 15kHz SCS) too for 3.75kHz SCS. FL would like to survey the opinion of other companies. Companies are encouraged to make their views heard.

FL Survey 4.1.2-1:

Do you agree that a unit of 1ms be used for both Koffset and Kmac when SCS is 3.75kHz?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  FL Survey 4.1.2-1: | Comments and Proposal |
| ZTE | Yes | How to translate the “indicated value” has been left to spec-editor. And the editor has already adopted 1ms as the unit. |
| Nokia, NSB | Yes |  |
| Intel | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Qualcomm | Probably needs some checking… | In the current specs, whenever it refers to “DL subframes”, it is assumed to be 1 ms by default (since DL subframes always have 1 ms subframe duration) …if there are some places where the Koffset and Kmac are referring to uplink slots (in FDD), the conversion from ms to slots may be relevant. We will try to check; others are welcome to do a double check too. |
| Huawei, HiSilicon | Agree | This should be clear from the previous agreement. |
| CMCC | Yes |  |
| Ericsson | Yes |  |
| CATT | YES |  |
| SONY | Yes | Dealing only in time (ms) is fine. Translating into 3.75kHz subframes / slots does not add clarity. |

### Issue#10: Preamble retransmission Timing relationship of NB-IoT

At RAN1#106bise, the following agreement was made:

Agreement:

For eMTC in IoT NTN, if the UE determines that a preamble retransmission is necessary, the choice of a suitable preamble retransmission subframe shall be delayed by Koffset as compared to current specifications.

This agreement enhances the timing relationship for eMTC. Two companies have raised this issue again at RAN1#108e with regards to the same timing relationship in NB-IoT.

#### Companies Views

|  |  |
| --- | --- |
| CATT | **Proposal 1: For NB-IoT in NTN, timing enhancement of preamble retransmission is needed with an additional K-offset.** |
| CMCC | ***Proposal 1:*** For NB-IoT in IoT NTN, if the UE determines that a preamble retransmission is necessary, further enhancement on the timing relationship as compared to current specifications is not needed. |

#### FIRST ROUND Discussion on Preamble Retransmission Timing Relationship of NB-IoT

Section 16.3.2 of TS36.213 states:

|  |
| --- |
| a) If a NPDCCH with associated RA-RNTI is detected and the corresponding DL-SCH transport block ending in subframe *n* contains a response to the transmitted preamble sequence, the UE shall, according to the information in the response, transmit an UL-SCH transport block according to Subclause 16.3.3.  b) If a random access response is received and the corresponding DL-SCH transport block ending in subframe *n* does not contain a response to the transmitted preamble sequence, the UE shall, if requested by higher layers, be ready to transmit a new preamble sequence no later than the NB-IoT UL slot starting 12 milliseconds after the end of subframe *n*.  c) If no NPDCCH scheduling random access response is received in subframe *n*, where subframe *n* is the last subframe of the random access response window, the UE shall, if requested by higher layers, be ready to transmit a new preamble sequence no later than the NB-IoT UL slot starting 12 milliseconds after the end of subframe *n*.  d) If an NPDCCH scheduling random access response with associated RA-RNTI is detected and the corresponding DL-SCH transport block reception ending in subframe *n* cannot be successfully decoded, the UE shall, if requested by higher layers, be ready to transmit a new preamble sequence no later than the NB-IoT UL slot starting 12 milliseconds after the end of subframe *n*. |

This issue was discussed in detail in both RAN1#106bis and RAN1#107. For cases b, c and d, companies were split on the interpretation of the phrase “be ready to transmit a new preamble sequence no later than the NB-IoT UL slot starting 12 milliseconds after the end of subframe *n”*. The two interpretations by companies were:

* some companies interpreted it to mean that ‘the UE shall, if requested by higher layers, ~~be ready to~~ transmit a new preamble sequence no later than the NB-IoT UL slot starting 12 milliseconds after the end of subframe *n*.” The implication of this interpretation is that enhancement of the timing relationship is needed since preamble transmission has to be time advanced and the TA can be greater than 12ms for NGSO and GEO NTN. Furthermore, as CATT points out, the eNB would then have a definitive preamble reception window that starts from UL subframe n + Koffset and lasts for 12ms.
* Other companies interpreted it to mean that ‘the UE has to be ready within 12ms after the end of DL subframe n to retransmit the preamble’. If the UE has achieved this readiness to transmit within the 12ms as specified, then the actual transmission can happen any time after the 12ms. The implication of this is that the UE can therefore choose any RACH occasion after it is ready to effect the retransmission. As the UE can take account of the TA in this choice of RACH occasion, there is no need to enhance the timing relationship. However, the eNB would then have a preamble reception window that starts 12ms after the end of DL subframe n but then has an undefined duration.

In cases (a) and (d) above, the eNB received the first preamble and so may have some expectations that any retransmissions would happen within a certain window. It seems to FL that the first interpretation has more merit. Nevertheless, these arguments were already discussed in detail over two meetings and no consensus was reached. Indeed, the two companies who brought up this issue at RAN1#108e do not agree! Even though this is a maintenance meeting, if CATT is right about this issue, preamble retransmission will not function efficiently for NB-IoT unless it is fixed. Given the further description/analysis of the issue here, FL wishes to find out if there is any renewed chance for a consensus on this.

FL Survey 4.2.2-1:

In your view, does timing relationship enhancement for preamble retransmission in NB-IoT merit another look?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  FL Survey 4.2.2-1: | Comments and Proposal |
| ZTE | No | The 12 ms offset is w.r.t the DL subframe n. Hence, there is no need to introduce Koffset. |
| Nokia, NSB | No | We still have same view as discussed before, UE is ready, then choose RO taking the TA into account. |
| Intel | No |  |
| OPPO | No | We think the second interpretation is more reasonable. So the current spec is sufficient. |
| Xiaomi |  | This has been extensively discussed, we are fine to follow majority’s view |
| Qualcomm | No | This has been discussed—for NB-IoT, this is written in terms of “physical time”, as opposed to for eMTC, where it was written in terms of “logical time”. The wording for NB-IoT as it stands is OK. |
| Huawei, HiSilicon | No | Timing relationship for preamble retransmission can be solved by UE’s implementation. |
| CMCC | No | It can be observed that the time limit of 12ms is an absolute time, and the subframe n should refer to a DL subframe, thus, additional delayed by K\_offset seems not needed for NB-IoT in IoT NTN. |
| Mavenir | No | In the existing spec, 12 msec is the absolute delay between NPRACH transmission and the end of downlink subframe n. NPRACH preamble will be timing advanced, still UE can schedule the NPRACH retransmission considering the TA effect. No need to make any further changes in the existing spec |
| Samsung | No |  |
| Ericsson | No | We have the same view as before. |
| CATT | Yes | Currently there are two interpretations. If 12ms is absolute time gap, it will not be one issue. However, we think current specification looks one “logical time”, as claimed in QC view. So it can be re-visited. And it imposes the time limitation for PRACH preparation time. |
| SONY | No | This was discussed in previous meetings and RAN1 did not see the need for this. |

### Issue#11: TA Command Activation Timing relationship

This relates to the time at which both the UE and eNB can assume that a TAC has been applied to the TA for UL transmissions.

#### Companies Views

|  |  |
| --- | --- |
| Qualcomm | ***Proposal 3*: Revert the “” term in paragraph on TA command reception in Section 16.1.2 in TS 36.213.** |

#### FIRST ROUND Discussion on TA Command Activation Timing Relationship

In their contribution, Qualcomm argues as follows:

In the latest draft of TS 36.213, Section 16.1.2 on applying the TA command contains the following text (with latest changes tracked):

* “*For a timing advance command reception ending in DL subframe n, the corresponding adjustment of the uplink transmission timing shall apply from the first available NB-IoT uplink slot following the end of n+12+ DL subframe and the first available NB-IoT uplink slot is the first slot of a NPUSCH transmission.*”

We believe this change should be reverted to the legacy text, before the “” change was made. is used to maintain causality in timing relationships where a downlink (e.g., a NPDCCH) triggers an uplink (e.g., NPUSCH, HARQ-ACK, PDCCH order, etc.). The purpose of the in the above setting of the TA command is to give the UE 12 milliseconds of “physical time”. As such, the first available uplink slot after 12 milliseconds have passed, continues to remain the correct interpretation, and is reflected accurately by the legacy text.

FL feels that if there are already UL transmissions pending between the end of UL subframe n+12 and start of UL subframe n+12+Koffset, such transmissions would have been scheduled and their timing relationship enhanced by Koffset on the basis of the previous TA (TA1). If the new TA that results from the TAC is TA2 ≠ TA1, these pending transmissions must be treated by the UE and eNB on the basis of TA1 and not TA2. It therefore seems to FL that the original agreement and consequent change to the specification is well construed. FL invites companies to make their views on this known.

FL Survey 4.3.2-1:

In your view, does timing relationship enhancement for application of TAC merit another look?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  FL Survey 4.3.2-1: | Comments and Proposal |
| ZTE | Yes | We support to remove Koffset since the 12 ms delay is w.r.t DL subframe n. eNB is able to know whether a UL transmission is scheduled after TA command or not. Therefore, for the UL transmissions between end of UL subframe n+12 and start of UL subframe n+12+Koffset, which are scheduled after indication of TA command, eNB and UE can have common understanding on using the new TA. |
| Nokia, NSB |  | The K\_offset is for UL, maybe it can be “*timing shall apply from the first available NB-IoT uplink slot after UL subframe following the end of n+12 DL subframe…”.* |
| Intel | Yes | Agree with ZTE and Moderator |
| OPPO | No | We agree with QC. And the similar logic can be referred to Ericsson’s explanation of PRACH retransmission in section 3.2.2 in the summary at RAN#1 106bis-e. |
| Qualcomm | Yes | We are not sure we agree with the FL. “*First available uplink slot following the end of n+12 DL subframes*” should always suffice. We don’t see why there would be some pending uplink scheduling from “DL subframe” n+12+1 to n+12+Koffset. However, we are open to further discussion and deliberation on this. |
| Huawei, HiSilicon | No | We agree with the moderator’s analysis and no spec change here is needed. |
| CMCC |  | Agree with ZTE. For NB-IoT, subframe n is a DL subframe, thus, delayed by Koffset seems not needed for NB-IoT. |
| Samsung |  | OK to further discuss |
| Ericsson | Yes | We share the same views as ZTE. |
| CATT |  | It needs further discussion. The question point is when is staring point, DL subframe or UL subframe. |
| SONY | No | We would like to avoid changing the timing of pending UL transmissions, as indicated by FL. |

### Issue #12: NPDCCH monitoring in NB-IoT (Case 1- 6)

Companies are proposing modifications to the specifications on the designation of DL subframes with restrictions for NPDCCH monitoring.

Relevant agreements from RAN1#106bis and RAN1#107 were as follows:

**Agreement (**RAN1#106bis-e**)**

NPDCCH monitoring restrictions have been identified for further checking to see if changes for NB-IoT need to be made for the following cases:

* case 1: MTBG NPUSCH
* case 2: 2 NPUSCH HARQ processes scheduled
* case 3: long single NPUSCH when MTBG or 2HARQ configured
* case 4: single NPUSCH scheduled by DCI format N0 or RAR
* case 5: NPUSCH format 2 in response to DCI format N1
* case 6: NPRACH in response to PDCCH order
* case 7: NPUSCH with same HARQ process when 2 HARQ configured
* case 8: subframes after NPUSCH processing
* case 9: subframes after NPUSCH carrying Msg3
* case 10: NPRACH for SR for long NPRACH transmissions
* case 11: NPRACH for SR for short NPRACH transmissions
* FFS: the changes in each case
* FFS: additional cases

**Agreement (**RAN1#107e**)**

Modification of the designation of subframes with NPDCCH monitoring restrictions is needed for at least Cases 1 to 6.

**Conclusion (**RAN1#107e**)**

Leave it to spec editor to formulate in the specs the NPDCCH monitoring restrictions for Cases 1 to 6.

Explanatory Note for editor **(**RAN1#107e**)**

When the UE changes from receiving on the DL to transmitting on the UL (or vice versa), immediately before/after the DL/UL switch the UE is not required to monitor an NPDCCH candidate in some DL subframes. The designation of these subframes in the spec needs to take the “effect” of the TA into consideration. There may be multiple ways to capture this in the specifications for (at least) Cases 1 to 6. Two options (in principle) are described below, to guide the spec editor to capture this as best he/she sees it. Examples of where the changes may apply for cases 1 to 6 can be found as examples in appendix A in R1-2112554**.**

**Option 1**: The DL subframes during which the UE is not required to monitor an NPDCCH candidate are described in terms of downlink subframe timing. This would typically involve inserting a “-TA” term in their indexing.

**Option 2**: The DL subframes during which the UE is not required to monitor an NPDCCH candidate are described in terms of uplink subframe timing using the indexing of the UL subframes that coincide in time with the DL subframes in question.

#### Companies Views

|  |  |
| --- | --- |
| Huawei | **TP#2 for Clause 16.6 of TS36.213**  For a NPDCCH UE-specific search space, if a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig* or *npusch-MultiTB-Config* and if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k* (accounting for uplink transmission timing, *k= k0*+ *K*offset)*,* |
| MediaTek | ***Proposal 1****: It is preferable to utilize* ***Option 1*** *for cases 1-6 in spec editing.*  **Option 1**: The DL subframes during which the UE is not required to monitor an NPDCCH candidate are described in terms of downlink subframe timing. This would typically involve inserting a “-TA” term in their indexing.  ***Proposal 2****: Utilize in spec editing of NPDCCH monitoring Restrictions.*  ***Proposal 3****: Agree on the updated Pseudo CRs to TS 36.213 Section 16.6 in the Appendix A.*  **TS 36.213 Section 16.6 Narrowband physical downlink control channel related procedures**  For a NPDCCH UE-specific search space, if a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig* or *npusch-MultiTB-Config* and if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k,*  - [case 1: MTBG NPUSCH] if the corresponding NPDCCH with DCI format N0 with CRC scrambled by C-RNTI schedules two transport blocks as determined by the Number of scheduled TB for Unicast field if present, the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+1* to subframe *n+k-S(TA)-1*, where S(TA) equals to floor(TA); otherwise [case 2: 2 NPUSCH HARQ processes scheduled] the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+k-S(TA)-2* to subframe *n+k-S(TA)-1*, where S(TA) qeuals to ; and   * [case 3: long single NPUSCH when MTBG or 2HARQ configured] the UE does not expect to receive a DCI Format N0 before subframe *n*+*k-S(TA)*-2 for which the corresponding NPUSCH format 1 transmission ends later than subframe *n*+*k-S(TA)*+255 if the corresponding NPDCCH with DCI format N0 schedules one transport block, where S(TA) equals to.   - for TDD, and if the corresponding NPUSCH format1 transmission ends in subframe *n+m*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+ k* to subframe *n+m-1*.  otherwise  - [case 4: single NPUSCH scheduled by DCI format N0 or RAR]if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n* or receives a NPDSCH carrying a random access response grant ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-S(TA)-1*, where S(TA) equals to .  - for TDD, if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n* or receives a NPDSCH carrying a random access response grant ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission ends in *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k*.  For a NPDCCH UE-specific search space, if a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig* or *npdsch-MultiTB-Config*  - and if the NB-IoT UE detects NPDCCH with DCI Format N1 ending in subframe *n*, and if a NPDSCH transmission starts from *n+k*,  - if the corresponding NPDCCH with DCI format N1 with CRC scrambled by C-RNTI schedules two transport blocks as determined by the Number of scheduled TB for Unicast field if present, the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+1* to subframe *n+k-1*;  - otherwise, the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+k-2* to subframe *n+k-1*;  otherwise  - if the NB-IoT UE detects NPDCCH with DCI Format N1 or N2 ending in subframe *n*, and if the corresponding NPDSCH transmission starts from *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-1*.  If a NB-IoT UE detects NPDCCH with DCI Format N1 ending in subframe *n*, and if the corresponding NPDSCH transmission starts from *n+k,* and  - [case 5: NPUSCH format 2 in response to DCI format N1] for FDD, if the corresponding NPUSCH format 2 transmission starts from subframe *n+m* the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+ k* to subframe *n+m-S(TA)-1*, where S(TA) qeuals to .  - for TDD, if the corresponding NPUSCH format 2 transmission ends in subframe *n+m* the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+ k* to subframe *n+m-1*.  If a NB-IoT UE detects NPDCCH with DCI Format N1 for "PDCCH order" ending in subframe *n*, and  - [case 6: NPRACH in response to PDCCH order] for FDD, if the corresponding NPRACH transmission starts from subframe *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-S(TA)-1*, where S(TA) qeuals to .  - for TDD, if the corresponding NPRACH transmission ends in subframe *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-1*. |
| OPPO | Proposal 1: For NPDCCH monitoring restrictions.  - Adopt following TP#1 for TP 36.213 V17.0.0  \*\*\* < Beginning of TP#1 for TP 36.213 V17.0.0> \*\*\*  16.6 Narrowband physical downlink control channel related procedures  \*\*\* < Unchanged parts are ommitted> \*\*\*  For a NPDCCH UE-specific search space, if a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig* or *npusch-MultiTB-Config* and if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k* (accounting for uplink transmission timing)*,*  - if the corresponding NPDCCH with DCI format N0 with CRC scrambled by C-RNTI schedules two transport blocks as determined by the Number of scheduled TB for Unicast field if present, the UE is not required to monitor an NPDCCH candidate in any subframe starting from downlink subframe *n+1* to downlink subframe overlapping with uplink subframe *n+k-1,* otherwise the UE is not required to monitor an NPDCCH candidate in any subframe starting from downlink subframe overlapping with uplink subframe *n+k-2* to a downlink subframe overlapping with uplink subframe *n+k-1*; and   * the UE does not expect to receive a DCI Format N0 before downlink subframe overlapping with uplink subframe *n*+*k*-2 for which the corresponding NPUSCH format 1 transmission ends later than downlink subframe overlapping with uplink subframe *n*+*k*+255 if the corresponding NPDCCH with DCI format N0 schedules one transport block.   - for TDD, and if the corresponding NPUSCH format1 transmission ends in subframe *n+m*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+ k* to subframe *n+m-1*.  otherwise  - if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n* or receives a NPDSCH carrying a random access response grant ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k* (accounting for uplink transmission timing), the UE is not required to monitor NPDCCH in any subframe starting from downlink subframe *n+1* to downlink subframe overlapping with uplink subframe *n+k-1*.  - for TDD, if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n* or receives a NPDSCH carrying a random access response grant ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission ends in *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k*.  \*\*\* < Unchanged parts are ommitted> \*\*\*  If a NB-IoT UE detects NPDCCH with DCI Format N1 ending in subframe *n*, and if the corresponding NPDSCH transmission starts from *n+k,* and  - for FDD, if the corresponding NPUSCH format 2 transmission starts from subframe *n+m* (accounting for uplink transmission timing), the UE is not required to monitor NPDCCH in any subframe starting from downlink subframe overlapping with uplink subframe *n+ k* to downlink subframe overlapping with uplink subframe *n+m-1*.  - for TDD, if the corresponding NPUSCH format 2 transmission ends in subframe *n+m* the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+ k* to subframe *n+m-1*.  If a NB-IoT UE detects NPDCCH with DCI Format N1 for "PDCCH order" ending in subframe *n*, and  - for FDD, if the corresponding NPRACH transmission starts from subframe *n+k* (accounting for uplink transmission timing), the UE is not required to monitor NPDCCH in any subframe starting from downlink subframe *n+1* to downlink subframe overlapping with uplink subframe *n+k-1*.  - for TDD, if the corresponding NPRACH transmission ends in subframe *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-1*.  \*\*\* < Unchanged parts are ommitted> \*\*\*  \*\*\* < End of TP#1 for TP 36.213 V17.0.0> \*\*\* |
| Qualcomm | **Post-NPUSCH**   * *- …* if the NB-IoT UE has a NPUSCH transmission ending in subframe *n* (accounting for uplink transmission timing), the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+3*.   ***Proposal 1*: Modify the specification for DL monitoring restrictions after NPUSCH transmission to account for uplink transmission timing.**  ***Proposal 2*: Clarify the use of logical/physical time in different places of the specifications.**   * **Option 1: For half-duplex monitoring restrictions (such as Example 1.2 in this contribution), use logical time to index uplink transmissions with UL indices, DL reception with DL indices, and use a TA term to link the two.** * **Option 2: Include a table in the specifications to state which relationships use logical time, and which use physical time.**   + **Currently, only the half-duplex monitoring restrictions appear to use physical time, while other timing relationships use logical time.** |
|  |  |

#### FIRST ROUND Discussion on NPDCCH Monitoring in NB-IoT (Cases 1 – 6)

In general, it seems the specification editor uses the form:

*…* if the NB-IoT UE has a NPUSCH transmission ending in subframe *n* (accounting for uplink transmission timing), the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+3*.

in describing the subframes designated for restriction of NPDCCH monitoring. The spec editor has not clarified what “accounting for uplink transmission timing” means and how it is to be achieved. It therefore seems like the spec editor has chosen Option 2 in the designation of these subframes. Company contributions seem to indicate that:

* The spec editor should add text clarifying how “accounting for uplink transmission” is to be achieved – e.g. Huawei proposes replacing this phrase with “(accounting for uplink transmission timing, k= k0+ Koffset)” where the value of k0 is determined by the scheduling delay field (*Idelay*) in the corresponding DCI
* Companies seem to prefer the use of Option 1 i.e. “The DL subframes during which the UE is not required to monitor an NPDCCH candidate are described in terms of downlink subframe timing. This would typically involve inserting a “-TA” term in their indexing”.

Accordingly, FL would like companies to give their views on the following two proposals:

FL Proposal 4.4.2a-1:

Suggest to spec editor to change to replace “(accounting for uplink transmission timing)” with text of the form “(accounting for uplink transmission timing, k = k0 + Koffset)” and a short description of k0 as necessary in all the relevant clauses in section 16.6.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  FL Proposal 4.4.2a-1: | Comments and Proposal |
| ZTE | No | We think current description is enough. |
| Nokia, NSB | No | No need to change for the CR. “accounting for uplink transmission timing” make it clear like “not monitoring” “from DL subframe… “ “to UL subframe … “ |
| OPPO | Yes | We accept the proposal. |
| Qualcomm | No | The proposal is incorrect. The accounting is due to the “TA”, NOT the Koffset. |
| Huawei, HiSilicon | Yes |  |
| CMCC | No |  |
| Mavenir | YES |  |
| CATT | YES |  |
| SONY | No | We think the current description is OK. |

FL Proposal 4.4.2b-1:

Recommend to spec editor to adopt Option 1: “The DL subframes during which the UE is not required to monitor an NPDCCH candidate are described in terms of downlink subframe timing. This would typically involve inserting a ‘-TA‘ term in their indexing”.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  FL Proposal 4.4.2b-1: | Comments and Proposal |
| ZTE | No | We think current description is enough. |
| Nokia, NSB | No | We think option 2 in the agreement is the best way. |
| OPPO | No | In our understanding, the spec-editor had select the option1 and the thing we need to consider is to distinguish the downlink subframe or the uplink subframe without inserting a ‘-TA‘ term’. For details, please refer to our TPs. |
| Qualcomm | Yes | We have tried to describe this many times before, without much success. The current specs are confusing—as highlighted by the “physical vs logical” timing section in our contribution. In all but these places, we are using “logical time”, whereas for these half-duplex monitoring restrictions, we are using “physical time”, without due clarity (we paste this below, for reference). Many companies agree the specs are unclear, but such a simple clarifying text is getting unduly opposed.  **Example 1.1** (Logical time, referring to an UL index)  “… *In case a random access procedure is initiated by a* ***"PDCCH order" ending in subframe n****, the UE shall, if requested by higher layers, start transmission of random access preamble at the end of the first subframe , , where a NPRACH resource is available.* …”  **Example 1.2** (Physical time, inherently referring to a DL index for an UL transmission)  “… *If a NB-IoT UE detects NPDCCH with DCI Format N1 for* ***"PDCCH order" ending in subframe n****, and*  *- for FDD, if the corresponding NPRACH transmission starts from subframe n+k (accounting for uplink transmission timing), the UE is not required to monitor NPDCCH in any subframe starting from subframe n+1 to subframe n+k-1.* …”  As MTK also proposed, the cleanest and clearest way is to follow legacy spec behaviour to write uplink transmissions in terms of logical uplink indices, while DL monitoring is written in terms of logical DL subframe indices. For NTN, when done this way, there is a “-TA” term that comes in to clarify these monitoring restrictions.  Why such a simple thing—that would clarify all the issues—is so controversial, we fail to understand. |
| Huawei, HiSilicon | No | We should keep the wording of scheduling aligned in a logical way, while TA is a real time value. |
| CMCC | No |  |
| Mavenir | Yes | Agree with Mediatek and QC. It would be prudent to specify NPDCCH monitoring restriction in DL subframe index. |
| Ericsson | No | We have the same views as before. |
| CATT | NO |  |
| SONY | No | Prefer current description |

### Issue #13: NPDCCH monitoring in NB-IoT (Case 7- 11)

From RAN1#106bis, cases 7 – 11 are:

* case 7: NPUSCH with same HARQ process when 2 HARQ configured
* case 8: subframes after NPUSCH processing
* case 9: subframes after NPUSCH carrying Msg3
* case 10: NPRACH for SR for long NPRACH transmissions
* case 11: NPRACH for SR for short NPRACH transmissions

At RAN1#107e, no specific agreements were made on these cases and accordingly, no related spec changes. From contributions, at least two companies think cases 7 – 11 warrant looking at and making specification changes.

#### Companies Views

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| Huawei | ***Proposal 2:*** *For case 7~11, the NPDCCH monitoring should take into consideration the timing offset between the UL and DL frame at the gNB.*  ***Proposal 3:*** *Adopt TP#3 for Clause 16.6 of TS38.213*  **TP#3 for Clause 16.6 of TS36.213**  ====== Unchanged Text Omitted =====================  If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig*  - and if the UE has a NPUSCH transmission ending in subframe *n*,  - the UE is not required to receive transmissions in the Type B half-duplex guard periods as specified in [3]for FDD ; and  - the UE is not expected to receive an NPDCCH with DCI format N0/N1 for the same HARQ process ID as the NPUSCH transmission in any subframe starting from subframe n+1 to subframe n+kmac+3*;*  else if the UE is not using higher layer parameter *edt-Parameters* or if the UE is using higher layer parameter *edt-* and  - if the NB-IoT UE has a NPUSCH transmission ending in subframe *n* , the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+kmac+3*.  otherwise,  - If the NB-IoT UE has a NPUSCH transmission for Msg3 ending in subframe with transport block size , whereas if would have been selected the NPUSCH transmission would have ended in subframe *n*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n'+1* to subframe *n+kmac+3*.  For an NB-IoT UE configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, if the transmission of a narrowband random access preamble for SR ends on subframe *n*,  - in case of frame structure type 1 with NPRACH format 0 and 1 when the number of NPRACH repetitions is greater than or equal to 64, or NPRACH format 2 when the number of NPRACH repetitions is greater than or equal to 16, the UE is not required to monitor NPDCCH UE-specific search space from subframe *n* to subframe *n*+*kmac*+*40*,  - otherwise, the UE is not required to monitor NPDCCH UE-specific search space from subframe *n* to subframe *n*+*kmac*+*3*. |
| Marvenir | **Case 7: NPUSCH with same HARQ process when 2 HARQ configured**  If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig.*  and if the UE has a NPUSCH transmission ending in subframe n,  the UE is not required to receive transmissions in the Type B half-duplex guard periods for FDD  the UE is not expected to receive an NPDCCH with DCI format N0/N1 for the same HARQ process ID as the NPUSCH transmission in any subframe starting from subframe n+1 to subframe n+3;  **Case 8: Subframe after NPUSCH processing**  If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig.*  …  else if the UE is not using higher layer parameter *edt-Parameters* or if the UE is using higher layer parameter *edt-Parameters* and  if the NB-IoT UE has a NPUSCH transmission ending in subframe n , the UE is not required to monitor NPDCCH in any subframe starting from subframe n+1 to subframe n+3.  **Case 9: Subframes after NPUSCH carrying Msg3**  If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig.*  …  else if the UE is not using higher layer parameter *edt-Parameters* or if the UE is using higher layer parameter *edt-Parameters* and  …  otherwise,  If the NB-IoT UE has a NPUSCH transmission for Msg3 ending in subframe with transport block size , whereas if would have been selected the NPUSCH transmission would have ended in subframe n, the UE is not required to monitor NPDCCH in any subframe starting from subframe n'+1 to subframe n+3.  **Case 10: NPRACH for SR for long NPRACH transmission**  For an NB-IoT UE configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, if the transmission of a  narrowband random access preamble for SR ends on subframe *n*,  in case of frame structure type 1 with NPRACH format 0 and 1 when the number of NPRACH repetitions is greater than or equal to 64, or NPRACH format 2 when the number of NPRACH repetitions is greater than or equal to 16, the UE is not required to monitor NPDCCH UE-specific search space from subframe n to subframe n+40,  **Case 11: NPRACH for SR for short NPRACH transmission**  For an NB-IoT UE configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, if the transmission of a  narrowband random access preamble for SR ends on subframe *n*,  …  otherwise, the UE is not required to monitor NPDCCH UE-specific search space from subframe n to subframe n+3,  ***Proposal 1:*** *Modification of the designation of subframes with NPDCCH monitoring restrictions is mentioned for Cases 7 to 11.* |

#### FIRST ROUND Discussion on NPDCCH Monitoring in NB-IoT (Cases 7 – 11)

As only two companies think this warrants another look, FL would like to carry out a survey of companies to see if they see merit in this.

FL Survey 4.5.2-1:

In your view, does a new description of subframes with restricted NPDCCH monitoring for cases 7-11 merit another look?

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| Company | Yes/No  FL Survey 4.5.2-1: | Comments and Proposal |
| ZTE | OK | Introduction of kmac in NPDCCH monitoring may save the energy when UL and DL timing is not aligned at eNB. |
| Nokia, NSB | No | There will be no issue based on current specification. Network can do scheduling based on K\_offset and TA.  NO need for specification modification. |
| Intel | OK | We are open to discuss the Kmac addition as it is additional opportunity for UE power saving. |
| OPPO |  | We agree with case7 proposed by Marvenir. |
| Qualcomm | Yes | This is clearly required “after NPUSCH”, if this is already in place for “before NPUSCH”! The rationale is the same! |
| Huawei, HiSilicon | Yes | According to our analysis, Kmac should be introduced based on the current spec interpretation of timing relationship. |
| Ericsson | Maybe | While introducing K\_mac is not necessary, we acknowledge that Huawei’s proposal avoids unnecessary DL monitoring when uplink time synchronization reference point is not located in the eNB. |
| CATT |  | Need further discussion. |
| SONY | No | This doesn’t seem necessary. In the maintenance phase of a WI that had been considering essential minimum functionality, we shouldn’t be motivated by small amounts of potential energy saving. In any case, these monitoring restrictions were introduced in the first place (in release-13) to bound UE complexity rather than to save energy. |

### Issue #14: TA reporting

At RAN1#107e, the following agreement was made with respect to TA reporting.

**Agreement**

Network can configure UE-specific TA reporting either a TA or UE location for connected mode UE

* In case a TA is configured, NR NTN solutions are a baseline for the following UE-specific TA handling issues,
  + Signaling – quantity (full or delta), range, number of bits
  + Granularity of report
  + Frequency of reporting
  + Means of reporting
  + NOTE: Any changes needed for IoT NTN can be made.
* In case the UE location is configured, RAN2 will design solutions for the UE location information, and it is left to RAN2 to decide whether to support UE location reporting

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| CATT: | **Proposal 4: For UE\_specific TA reporting, both event triggered and periodic methods should be supported.**  **Proposal 5: One threshold is used for TA report triggering.**  **Proposal 6: Reporting differential TA between current TA and previous TA is preferred.**  **Proposal 7: Using RRC signaling or MAC signaling to report TA can be supported.**  **Proposal 8: Utilize ms as the unit of reported TA regardless of subcarrier spacing.** |
| Nokia, NSB | **Observation 1: There are special issues for reporting overhead, impact from HD-FDD and UL resource occupation, validity of the TA reporting for directly reporting TA solution.**  **Proposal 1: Considering special issue of TA reporting for IoT UE, limitation on direct TA reporting should be considered, instead of directly reuse from NR NTN.** |
| Apple | ***Proposal 1:*** *UE reporting of information about its TA in connected mode is supported. The reporting is triggered by an event based on UE’s TA value.*  ***Proposal 2:*** *The reported TA is the least integer number of subframes greater than or equal to the corresponding TA value.* |
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#### FIRST ROUND Discussion on TA Reporting

At RAN1#107e it was agreed to adopt NR NTN solutions with respect to signalling of a TA so it is left to the spec editor to reflect this in the specs when the network configures TA reporting. If the network configures UE location reporting instead, the RAN1#107e agreement leave the design of a solution on TA reporting to RAN2.

FLwould like companies to express their views on this understanding of the FL.

FL Survey 4.6.2-1:

What are your thoughts on further discussions on TA reporting?

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| Company | Comments and Proposal |
| ZTE | We think how to determine the reported TA value should be discussed in RAN1. In IoT-NTN, when repetition number is very large, the applied TA values for different segments of same transmission may cross the boundary. In this case, the TA of last segment should be reported instead of the initial segment, as shown in following figure, in order to avoid incorrect configuration of Koffset. Since segment pre-compensation was discussed and agreed in RAN1, RAN1 should also consider the issue that the TA for which segment should be reported. |
| Nokia, NSB | The detail should be discussed as reference for operators, but it can be in RAN2.  As further work is in RAN2, RAN2 can further discuss the detail for TA reporting, e.g. overhead, frequency, validity, etc. |
| Intel | Same view as Nokia, NSB |
| OPPO | In our view, there can be alternatives in TA reporting. But the existing scheme should still be retained and there is no need to change the existing method. |
| Xiaomi | It can be up to RAN2 to decide. |
| Qualcomm | RAN2 can decide on specifics. |
| Huawei, HiSilicon | Agree that RAN2 can work on this one. |
| Samsung | This can be discussed in RAN2. |
| Ericsson | This can be discussed in RAN2. |
| CATT | It can be discussed in RAN2, but RAN1 can also discuss how to trigger one TA report and if the differential TA reporting is needed. |
| SONY | Most of these issues can be discussed in RAN2. |

### Issue #15: WUS Configuration

CMCC

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| ***Observation 1:*** For sporadic DL traffic, UE may perform GNSS measurements after a paging occasion and only if it has been paged to reduce battery consumption. The existing timers (e.g., T3413/T3415) can be configured large enough to ensure a sufficient gap to accommodate GNSS acquisition after decoding the paging message and before initiating UL transmission.  ***Proposal 1:*** Support the following conclusion.   * Acquisition of GNSS position fix during paging procedure is up to UE implementation and network configuration of paging timers considering GNSS measurement duration (e.g. GNSS Time To First Fix with cold start of typically 10 seconds) impact in NTN scenario. These paging timers are not specified in 3GPP in legacy paging procedure (i.e. T3413 / T3415). |

***Proposal 3:*** Deprioritize further enhancement on WUS configuration.

#### FIRST ROUND Discussion on WUS Configuration

FL thinks the issues of GNSS measurements and when these are done is more for AI 18.14.1. On the issue of WUS configuration, there were no agreements related to configuration of WUS during the WI as power saving was not deemed to be a ‘minimum essential functionality feature’.

FL Recommendation: No further discussions of these issues in this AI at RAN1#108e.

# Referenced Documents

R1-2200942 Maintenance on timing relationship enhancement for IoT in NTN Huawei, HiSilicon

R1-2201218 Timing relationship enhancements for IoT NTN MediaTek Inc.

R1-2201276 Discussion on timing relationship enhancements OPPO

R1-2201343 Remaining issues on timing relationship enhancement for IoT over NTN CATT

R1-2201586 Maintenance of IoT-NTN timing relationships Sony

R1-2201588 Remaining issues of timing relationship enhancements for NB-IoT/eMTC over NTN Nokia, Nokia Shanghai Bell

R1-2201653 Timing relationship enhancements Qualcomm Incorporated

R1-2201790 Remaining Issues of Timing Relationship Enhancement for IoT NTN Apple

R1-2201809 On timing relationship maintenance issues for IoT over NTN Ericsson Hungary Ltd

R1-2201881 Remaining issues on timing relationship enhancements for IoT NTN CMCC

R1-2202211 Remaining issues of timing relationship for IoT-NTN ZTE

R1-2202480 Timing relationship enhancements Mavenir