3GPP TSG RAN WG1 Meeting #110 R1-2206159

Toulouse, France, August 22 – 26, 2022

Agenda Item: 8.14

Source: Moderator (MediaTek)

Title: Maintenance on NB-IoT/eMTC to support NTN: time and frequency

synchronization

Document for: Discussion and Decision

# Introduction

At the RAN#92 meeting, a new Work Item was approved for IoT Non Terrestrial Network (NTN) [1]. In this meeting, company views on UL synchronization for IoT NTN are summarized and observations/proposals on identified issues are made. Observations and proposals in Company’s TDoc contributions are listed in the Appendix.

Identified remaining IoT NTN-specific topics are discussed in Sections 2, 3. Common issues to NR NTN and IoT NTN are discussed in Section 4.

# UL Segmented Transmission

In RAN1#109-e, the following agreements were made on single UE capability and specification in TS 36.211.

**Agreement**

The single UE capability that governs UE behavior w.r.t gaps between segments for PUSCH, PUCCH and NPUSCH, when the UE performs segmented pre-compensation, is as follows:

When a single capability is signalled: UE drops one or more of the following durations of uplink transmission between segments (indicated by the capability):

1 slot (applicable to eMTC)

1 subframe (applicable to eMTC)

1 slot (applicable to NB-IoT)

2 slots (applicable to NB-IoT)

1 symbol (applicable to both eMTC and NB-IoT)

UE follows legacy behaviour at slot boundaries due to TA adjustment

When capability is NOT signalled: UE follows legacy behaviour at slot boundaries due to TA adjustment

**Agreement**

TP#1 (for TS36.211 v17.1.0, clause 5.3.4) in section 5.1 of R1-2203388 is endorsed in principle, with the following note to the editor: the TP proposes entirely new text, the strikeout text is not a deletion of existing text, and the bold text is not intended to be bold.

TP#2 (for TS36.211 v17.1.0, clause 5.4.3) in section 5.1 of R1-2203388 is endorsed in principle, with the following note to the editor: the TP proposes entirely new text, the strikeout text is not a deletion of existing text, and the bold text is not intended to be bold.

TP#3 (for TS36.211 v17.1.0, clause 10.1.3.6) in section 5.1 of R1-2203388 is endorsed in principle, with the following note to the editor: the TP proposes entirely new text, the strikeout text is not a deletion of existing text, and the bold text is not intended to be bold.

## Company views

OPPO proposed draft CR on UE pre-compensation in segment. The draft CR is included in Section 5.2 in the FL summary.

Reason for change:

1. In RAN1 meeting #107e, the following agreement on UE pre-compensation in segment was made and was not reflected in the specification.

Agreement

For UL Segmented transmission during RRC\_CONNECTED:

• If a segment duration is configured, the UE is expected to adjust the value for pre-compensation for a segment.

2. The contents of section 16.1.2 in the agreed CR R1-2205665 are missing.

Summary of change:

1. Reflect the missing agreement on UE pre-compensation in segment.

2. Comprise the missing contents of section 16.1.2 in R1-2205665.

Consequences if not approved: Incomplete specification.

Nokia proposed draft CR#1 to TS 36.211 for extension of legacy UE behavior on dropping for PRACH/NPRACH. The draft CR is included in Section 5.3 in the FL summary.

Reason for change: Clarify definition of segment for NPRACH and PRACH when the UE performs segmented pre-compensation

Summary of change: Segment size is configured for the NPRACH transmission and PRACH transmission for BL/CE UE.

Consequences if not approved: Release 17 eMTC/NB-IoT UEs cannot communicate via NGSO NTNs

Nokia proposed draft CR#2 to TS 36.213 on correction of IoT NTN with dropping in pre-compensation per segment in 36.213. The draft CR is included in Section 5.4 in the FL summary.

Reason for change: Clarify UE behavior of dropping samples for PUCCH/PUSCH of eMTC UE and for NPRACH of NB-IoT UE when the UE performs segmented pre-compensation

Summary of change: For eMTC UE, for both PUCCH and PUSCH, when the UE's uplink transmissions in uplink slot n and uplink slot n+1 are overlapped due to the timing adjustment, the UE shall complete transmission of uplink slot n and not transmit the overlapped part of uplink slot n+1.

For NB-IoT, when the UE's uplink NPRACH transmissions in preamble sequence repetition n and preamble sequence repetition n+1 are overlapped due to the timing adjustment, UE shall complete transmission of preamble sequence repetition n and not transmit the overlapped part of preamble sequence repetition n+1.

Consequences if not approved: Release 17 eMTC/NB-IoT UEs cannot communicate via NGSO NTNs

## 1st Round FL Proposal

The moderator view is that OPPO draft CR on UE pre-compensation in segment is not needed. RAN1 CR R1-2205663 endorsed in RAN1#109-e specifies UE pre-compensation for UL segmented PUSCH / NPUSCH transmission. There seems no need to further specify UL segmented PUSCH / NPUSCH transmission in TS 36.213 in Sections 4.2.3 Transmission timing adjustments for eMTC and Section 16.1.2 Timing synchronization for NB-IoT.

***FL recommendation 2.1-a****: Draft CR to TS 36.213 in Sections 4.2.3 Transmission timing adjustments for eMTC and Section 16.1.2 Timing synchronization for NB-IoT on UE pre-compensation in segment in R1-2206297 (copied in Section 5.2 of FL summary) does not need to be endorsed by RAN1.*

The moderator view on Nokia proposed draft CR#1 to TS 36.211 for extension of legacy UE behavior on dropping for PRACH/NPRACH is that this is needed to capture RAN1#107-e agreement

**Agreement**

For NB-IoT, UE pre-compensation per segment of NPRACH is applied from one segment to the next segment by using one or more of the following methods if supported by UE implementation

UE may drop / Insert samples

UE may blank subframe / repetition unit where UE drops a subframe / repetition unit

The total transmission time is not changed

FFS Details of method(s) to drop / insert samples / blank subframe / repetition unit

FFS Specification impact

***FL recommendation 2.1-b****: Draft CR#1 for PRACH/NPRACHto TS 36.211 in Sections 5.7.1 Transmission timing adjustments for eMTC and Section 16.1.2 Timing synchronization for NB-IoT on UE pre-compensation in segment in R1-2207288 (copied in Section 5.3 of FL summary) can be endorsed by RAN1.*

The moderator view on Nokia proposed draft CR#2 to TS 36.213 on correction of IoT NTN with dropping in pre-compensation per segment is that the issue of overlapping segments for PUSCH/PUCCH/NPUSCH was discussed in the Work Item phase in RAN1#106-e, RAN1#106bis-e and there was no consensus it was needed. There was no specific agreement on this issue and it can be left to the UE implementation. RAN4 are discussing UE pre-compensation requirements and testing in RAN4 Rel-18 IoT NTN Work Item and can further discuss if needed.

***FL recommendation 2.1-c****: Draft CR#2 for PUSCH/PUCCH/NPUSCH to TS 36.213 in Sections 4.2.3 Transmission timing adjustments for eMTC and Section 16.1.2 Timing synchronization for NB-IoT on UE pre-compensation in segment in R1-2207289 (copied in Section 5.4 of FL summary) does not need to be endorsed by RAN1.*

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| Companies | Comments |
| Nokia, NSB | For ***FL recommendation 2.1-b***, we support moderator that CR#1 R1-2207288 (copied in Section 5.3 of FL summary) should be endorsed by RAN1.  For ***FL recommendation 2.1-c***  In RAN1 #109-e meeting, there was already agreement as below for dropping in pre-compensation per segment.  Agreement   * The single UE capability that governs UE behavior w.r.t gaps between segments for PUSCH, PUCCH and NPUSCH, when the UE performs segmented pre-compensation, is as follows: * When a single capability is signalled: UE drops one or more of the following durations of uplink transmission between segments (indicated by the capability):   + 1 slot (applicable to eMTC)   + 1 subframe (applicable to eMTC)   + 1 slot (applicable to NB-IoT)   + 2 slots (applicable to NB-IoT)   + 1 symbol (applicable to both eMTC and NB-IoT)   + UE follows legacy behaviour at slot boundaries due to TA adjustment   When capability is NOT signalled: UE follows legacy behaviour at slot boundaries due to TA adjustment  For “legacy behavior” of dropping, there is only definition for NB-IoT, as in 36.213 16.1.2, “When the UE's uplink NPUSCH transmissions in NB-IoT uplink slot n and NB-IoT uplink slot n+1 are overlapped due to the timing adjustment, the UE shall complete transmission of NB-IoT uplink slot n and not transmit the overlapped part of NB-IoT uplink slot n+1.”  To make the UE behavior clear and complete for supported dropping method dur to TA adjustment with and without UE capability reporting, dropping method similar as NB-IoT dropping the overlapped part should also be added for eMTC PUCCH/PUSCH and NB-IoT NPRACH, providing a clear common understanding between UE and network.  Because of this, we think the CR#2 in R1-2207289 (copied in Section 5.4 of FL summary) should be endorsed by RAN1. |
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# NTN SIB accumulation

This issue of NTN SIB accumulation was discussed in RAN1#109.

The agreement on implicit epoch time indication method was revised in RAN1#108e for NR NTN.

***Agreement***

*Modify second bullet of RAN1#107-e agreement on Epoch time as follows:*

*Otherwise, when Epoch time is not explicitly indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN-specific SIB SI message is transmitted.*

RAN2#118 made the following agreement on implicit Epoch time

*Implicit signalling of epochTime in SIB31 in broadcast signalling is supported. Change the status of RIL C501 to PropReject.*

SI window parameters for NB-IoT and eMTC and a summary of options for SIB accumulation discussions were provided by Ericsson in RAN1#109-e contribution R1-2203632 as copied in tables below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | SI window length | Repetition pattern within SI window | SI periodicity |
| eMTC | {1, 2, 5, 10, 15, 20, 40, 60, 80, 120, 160, 200} ms | Every radio frame or every {2nd, 4th, 8th} radio frame | {8, 16, 32, 64, 128, 256, 512} radio frames |
| NB-IoT | {160, 320, 480, 640, 960, 1280, 1600} ms | Every {2nd, 4th, 8th, 16th} radio frame | {64, 128, 256, 512, 1024, 2048, 4096} radio frames |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Pros | Cons | Spec. impact |
| Option 1: Prohibit NTN SIB accumulation across SI windows | Only meaningful in NTN scenarios where NTN SIB will be updated during each SI window. | Too restrictive for many NTN scenarios where SI window periodicity is shorter than NTN SIB update frequency, e.g., the **maximum** SI periodicity is 5.12 s for eMTC and 40.96 s for NB-IoT which is much shorter than the NTN SIB update frequency in GEO.  Large SI transmission overhead as network may need to configure a larger SI window to support a greater number of repetitions in the cell to compensate for the lack of SIB accumulation.  Coverage-limited UEs cannot access the network if NTN SIB cannot be decoded.  Not synergistic with legacy eMTC/NB-IoT specification which supports SIB accumulation. | Minimal |
| Option 2: Network dynamically indicates if NTN SIB accumulation is allowed in a cell | Network has the flexibility to dynamically allow/disallow NTN SIB accumulation depending on the NTN scenario and the SI configuration:  If allowed, UEs in deep coverage can leverage SIB accumulation to decode the NTN SIB.  When SIB accumulation is not feasible, the network may prohibit SIB accumulation and configure a larger number of repetitions instead.  Lean SI transmission possible since network need not waste additional resources (i.e., longer SI windows with more repetitions) to cater to UEs in deep coverage since such UEs can accumulate NTN SIBs. | 1-bit indication needed in SI. | Low |
| Option 2a: Network dynamically indicates if NTN SIB accumulation is allowed in a cell **AND** indicates a reference time for SIB accumulation window | Same as Option 2.  UEs will know exactly how many SI windows it can accumulate across, e.g., similar to epoch time, a reference time can be signalled to mark the end of the SI accumulation period. | Same as Option 2.  Reference time and/or number of indentical NTN SIBs needs to be indicated in SI. | Low |
| Option 3: Increase SI window size for IoT NTN | Enables the network to configure a larger number of SIB repetitions to provide robust coverage.  Especially useful in scenarios where NTN SIB accumulation is impossible e.g., certain LEO scenarios where network updates the NTN SIB in every SI window.  Can be used in conjunction with Option 2/2a to provide a greater flexibility. | UEs in poor coverage may still require NTN SIB accumulation across multiple SI windows. | Low |

The SIB accumulation options were discussed in RAN1#109-e without consensus. FL recommeandation was made

***RAN1#109-e FL Recommendation:*** ***More discussions will be needed on this topic to further align companies understanding and achieve consensus. Companies are encouraged to take into account the comments from companies above and discuss offline before next RAN1 meeting.***

## Company views

ZTE, Ericsson proposed the number of SI windows used for NTN-specific SIB repetition should be broadcast in SIB1 (ZTE further mentioned if NTN-specific SIB accumulation across SI windows is not prohibited). When Epoch time is not explicitly indicated in SIB, epoch time of assistance information is implicitly known as the end of the last SI window during which the NTN-specific SIB is transmitted.

SONY made similar proposals without mentioning SIB1.

Ericsson further mentioned that when epoch time is not explicitly indicated in SIB, the epoch time of assistance information (i.e., Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the Nth SI window, if parameter N is signalled by the network to indicate the number of windows for which the NTN-specific SIB SI message can be accumulated for decoding. If parameter N is not signalled, the epoch time is implicitly known as the end of the SI window containing the SI message with the NTN-specific SIB. Network can optionally indicate if NTN SIB accumulation across SI windows is allowed or not.

Qualcomm proposed not to support SIB accumulation across multiple SI windows. SI accumulation across multiple SI windows is not supported by the current wording in TS 36.331 (Section 5.2.1.3), as highlighted below.

“*Change of system information (other than for ETWS, CMAS, EAB, UAC, and satellite assistance information parameters and for NB-IoT, other than for AB parameters and satellite assistance information parameters for the serving cell) only occurs at specific radio frames, i.e. the concept of a modification period is used*”

The intention of (originally in NR-NTN) behind it was to allow the network to update this information as frequently as it deems fit for satellite ephemeris and common TA parameters. The network—if it so chooses—can configure the SI window large enough, so that there can be enough repetitions accommodated within one SI window, such that coverage is not an issue at the link budgets that are typical for IoT over NTN.

Nokia proposed only explicit signaling of Epoch time for assistance information shall be specified for IoT NTN. Send an LS to RAN2 to update SIB31 description in RRC specification to make the epochTime a mandatory field.

Apple proposed, UE does not expect that NTN-specific SIB is constant across SI windows, and when epoch time is not explicitly indicated in SIB, epoch time of assistance information is implicitly known as the end of the SI window during which the NTN-specific SIB is transmitted.

## 1st Round FL Proposal

Moderator view is that since RAN2 has agreed implicit Epoch time is supported. A conclusion on SIB accumulation is needed to specify RAN2 agreement. The simplest solution is eNB configures SI window parameters to avoid issue for link budget and RAN1 makes agreement SIB accumulation across SI windows is not supported. Another solution as a possible compromise could be that the number of SI windows used for NTN-specific SIB repetition is broadcast in SIB1. Both solutions can be configured optionally by the network and supported in the device.

***First Round proposal – 3.1: Companies are encouraged to comment on the following options and in particular whether configuration by the network of options is not acceptable and why.***

* ***Option 1: NTN SIB accummulation is not supported.***
* ***Option 2: Number, N, of SI windows for which the NTN-specific SIB SI message can be accumulated for decoding is broadcast in SIB1***

***Network can optionally configure Option 1 or Option 2***

***First Round proposal – 3.2***

***When Epoch time is not explicitly signalled, the epoch time of assistance information is implicitly known***

* ***For Option 1 at the end of the SI window containing the SI message with the NTN-specific SIB.***
* ***For Option 2, at the end of the Nth SI window***

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| Companies | Comments |
| Nokia, NSB | We have concerns on the implicit signaling of both option 1 and option 2 as it may not work well, considering the repetition number needed for UE for the accumulation across the SI window is for coverage of the UE, which is not known by network. Providing flags to indicate whether accumulation is possible and/or indication of number of windows to accumulate are thus not needed. Additionally, we think it is still not clear how the eNB can use the ephemeris decided by satellite control center for implicit signaling to IoT UE with uncertain requirement on accumulation. As satellite control center to decide the epoch time, then the epoch time provided by satellite control center and ending time of any SI window may not be aligned.  Then one way is to maintain the property of the current specification, which allows the UE to accumulate SIBs across SI windows. The simple way forward is to only allow explicit signaling of epochTime (which is possible via the IE in SIB31) and omit any enhancements related to implicit signaling. |
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# Synchronization aspects common to IoT NTN and NR NTN

## SFN ambiguity for Epoch time

ZTE proposed a draft CR to resolve Epoch time ambiguity when explicitly signalled. The draft CR is included in Section 5.1 in the FL summary.

Reason for change: How to interpret explicitly indicated SFN for epoch time is not clear and there is ambiguity on the interpretation of the validity duration for configured parameters.

How to indicate epoch time under NTN SIB accumulation is not clear.

Summary of change: Add the interpretation method for epoch time.

Clarify the validity time period for configured parameters.

Consequences if not approved: The definition of epoch time is not clear and the incorrect pre-compensation will be done with invalid parameters

## 1st Round FL Proposal

Moderator view on issue 4.1 SFN ambiguity for Epoch time is that since RAN1#109-e made agreement to re-use NR NTN solution for SFN indicating Epoch time and since SFN ambiguity is an on-going discussion in Rel-17 NTN in AI 8.4, moderator view is to wait for this issue to be discussed further and concluded in Rel-17 NR NTN and re-use solution for IoT NTN.

Agreement

Conclusions and agreements for the following issues as discussed in 8.4 NR NTN can be re-used for IoT NTN

* SFN indicating Epoch time
* Negative TACommonDriftVariation values
* Common Delay formula in TS 36.213
* Reference Frame for Ephemeris Set 2 – Orbital parameters

Feature Lead view: Since RAN1#109-e already agreed to re-use NR NTN solution for IoT NTN for SFN indicating Epoch time, then NR NTN solution for SFN ambiguity can be re-used for IoT NTN. The issue can be further discussed and concluded in NR NTN.

***FL Recommendation – 4.1:***

* ***Re-use solution for SFN ambiguity for Epoch time issue in Rel-17 NR NTN for IoT NTN.***

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| Companies | Comments |
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# Draft CRs from contributing companies

## ZTE Draft CR to TS 36.213 (R1-2206016)

Reason for change: How to interpret explicitly indicated SFN for epoch time is not clear and there is ambiguity on the interpretation of the validity duration for configured parameters.

How to indicate epoch time under NTN SIB accumulation is not clear.

Summary of change: Add the interpretation method for epoch time.

Clarify the validity time period for configured parameters.

Consequences if not approved: The definition of epoch time is not clear and the incorrect pre-compensation will be done with invalid parameters

4.2.3 Transmission timing adjustments

**<Unchanged parts are omitted>**

For a BL/CE UE in a NTN serving cell, using serving satellite higher-layer ephemeris parameters, if configured, the BL/CE UE determines  (defined in [3]) using the serving satellite position and its own position to pre-compensate the two-way transmission delay on the service link. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the BL/CE UE determines (defined in [3]) based on one-way propagation delay which can be obtained as:

where , , and are given by the higher layer parameters *nta-Common*, *nta-CommonDrift*, and *nta-CommonDriftVariation* respectively, and is the epoch time given by the higher layer parameter *epochTime*. The UE assumes that *ta-Common*, *ta-CommonDrift*, and *ta-CommonDriftVariant* and higher-layer ephemeris parameters for a serving satellite are valid in the duration provided by higher-layer parameter *ntn-UlSyncValidityDuration* [6, TS 36.331] from epoch time . When is provided by *epochTime* [6, TS 36.331], refers to the starting time of a DL sub-frame, which is the nearest sub-frame indicated by a SFN and a sub-frame number in *epochTime* to the sub-frame where the last repetition of message indicating *epochTime* is received. When *epochTime* not explicitly indicated in SIB, is implicitly known as the end of the last SI window during which the NTN-specific SIB is transmitted. provides a distance at time between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by .

**<Unchanged parts are omitted>**

16.1.2 Timing synchronization

**<Unchanged parts are omitted>**

For a UE in a NTN serving cell, using serving satellite higher-layer ephemeris parameters, if configured, the UE determines  (defined in [3]) using the serving satellite position and its own position to pre-compensate the two-way transmission delay on the service link. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the UE determines (defined in [3]) based on one-way propagation delay which can be obtained as:

where , , and are given by the higher layer parameters *nta-Common*, *nta-CommonDrift*, and *nta-CommonDriftVariation* respectively, and is the epoch time given by the higher layer parameter *epochTime*. The UE assumes that *ta-Common*, *ta-CommonDrift*, and *ta-CommonDriftVariant* and higher-layer ephemeris parameters for a serving satellite are valid in the duration provided by higher-layer parameter *ntn-UlSyncValidityDuration* [6, TS 36.331] from epoch time . When is provided by *epochTime* [6, TS 36.331], refers to the starting time of a DL sub-frame, which is the nearest sub-frame indicated by a SFN and a sub-frame number in *epochTime* to the sub-frame where the last repetition of message indicating *epochTime* is received. When *epochTime* not explicitly indicated in SIB, is implicitly known as the end of the last SI window during which the NTN-specific SIB is transmitted. provides a distance at time between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by .

**<Unchanged parts are omitted>**

## OPPO Draft CR to TS 36.213 (R1-2206297)

Reason for change:

1. In RAN1 meeting #107e, the following agreement on UE pre-compensation in segment was made and was not reflected in the specification.

Agreement

For UL Segmented transmission during RRC\_CONNECTED:

• If a segment duration is configured, the UE is expected to adjust the value for pre-compensation for a segment.

2. The contents of section 16.1.2 in the agreed CR R1-2205665 are missing.

Summary of change:

1. Reflect the missing agreement on UE pre-compensation in segment.

2. Comprise the missing contents of section 16.1.2 in R1-2205665.

Consequences if not approved: Incomplete specification.

4.2.3 Transmission timing adjustments

<Unchanged parts are omitted>

For a BL/CE UE in a NTN serving cell, using serving satellite higher-layer ephemeris parameters, if configured, the BL/CE UE determines  (defined in [3]) using the serving satellite position and its own position to pre-compensate the two-way transmission delay on the service link. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the BL/CE UE determines (defined in [3]) based on one-way propagation delay which can be obtained as:

where , , and are given by the higher layer parameters *nta-Common*, *nta-CommonDrift*, and *nta-CommonDriftVariation* respectively, and is the epoch time given by the higher layer parameter *epochTime*. provides a distance at time between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by .

For a BL/CE UE in a NTN serving cell, the BL/CE UE is expected to adjust the uplink timing for each of the segments with a transmission duration of time units, if configured, according to section 5.3.4 and section 5.4.3 in [TS 36.211].

<Unchanged parts are omitted>

16.1.2 Timing synchronization

Upon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH, and SR if configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, based on the received timing advance command.

The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16. The start timing of the random access preamble is specified in [3].

In case of random access response, an 11-bit timing advance command [8], *TA*, indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA* = *TA* ×16. *NTA* is defined in [3].

In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format N0 if present [4], *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.

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*.* When the UE's uplink NPUSCH transmissions in NB-IoT uplink slot *n* and NB-IoT uplink slot *n*+1 are overlapped due to the timing adjustment, the UE shall complete transmission of NB-IoT uplink slot *n* and not transmit the overlapped part of NB-IoT uplink slot *n*+1.

If the received downlink timing changes and is not compensated or is only partly compensated by the uplink timing adjustment without timing advance command as specified in [10], the UE changes *NTA* accordingly.

For a UE in a NTN serving cell, using serving satellite higher-layer ephemeris parameters, if configured, the UE determines  (defined in [3]) using the serving satellite position and its own position to pre-compensate the two-way transmission delay on the service link. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the UE determines (defined in [3]) based on one-way propagation delay which can be obtained as:

where , , and are given by the higher layer parameters *nta-Common*, *nta-CommonDrift*, and *nta-CommonDriftVariation* respectively, and is the epoch time given by the higher layer parameter *epochTime*. provides a distance at time between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by .

For a UE in a NTN serving cell, the UE is expected to adjust the uplink timing for each of the segments with a transmission duration of time units, if configured, according to section 10.1.3.6 in [TS 36.211].

<Unchanged parts are omitted>

## Nokia draft CR#1 to TS 36.211(R1-2207288)

Reason for change: Clarify definition of segment for NPRACH and PRACH when the UE performs segmented pre-compensation

Summary of change: Segment size is configured for the NPRACH transmission and PRACH transmission for BL/CE UE.

Consequences if not approved: Release 17 eMTC/NB-IoT UEs cannot communicate via NGSO NTNs

5.7.1 Time and frequency structure

The physical layer random access preamble, illustrated in Figure 5.7.1-1, consists of a cyclic prefix of length and a sequence part of length. The parameter values are listed in Table 5.7.1-1 and depend on the frame structure and the random access configuration. Higher layers control the preamble format.



Figure 5.7.1-1: Random access preamble format

Table 5.7.1-1: Random access preamble parameters

|  |  |  |
| --- | --- | --- |
| Preamble format |  |  |
| 0 |  |  |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 (see Note) |  |  |
| NOTE: Frame structure type 2 and special subframe configurations with UpPTS lengths and only assuming that the number of additional SC-FDMA symbols in UpPTS X in Table 4.2-1 is 0. | | |

The transmission of a random access preamble, if triggered by the MAC layer, is restricted to certain time and frequency resources. These resources are enumerated in increasing order of the subframe number within the radio frame and the physical resource blocks in the frequency domain such that index 0 correspond to the lowest numbered physical resource block and subframe within the radio frame. PRACH resources within the radio frame are indicated by a PRACH configuration index, where the indexing is in the order of appearance in Table 5.7.1-2 and Table 5.7.1-4.

For non-BL/CE UEs there are up to two PRACH configurations in a cell. The first PRACH configuration is configured by higher layers with a PRACH configuration index (*prach-ConfigurationIndex*) and a PRACH frequency offset  (*prach-FrequencyOffset*). The second PRACH configuration (if any) is configured by higher layers with a PRACH configuration index (*prach-ConfigurationIndexHighSpeed*) and a PRACH frequency offset  (*prach-FrequencyOffsetHighSpeed*)*.*

For BL/CE UEs, for each PRACH coverage enhancement level, there is a PRACH configuration configured by higher layers with a PRACH configuration index(*prach-ConfigurationIndex*), a PRACH frequency offset (*prach-FrequencyOffset*), a number of PRACH repetitions per attempt  (*numRepetitionPerPreambleAttempt*) and optionally a PRACH starting subframe periodicity  (*prach-StartingSubframe*). PRACH of preamble format 0-3 is transmitted  times, whereas PRACH of preamble format 4 is transmitted one time only.

For a BL/CE UE communicating over NTN, time and frequency pre-compensation is adjusted per PRACH segment, where the quantity is provided by system information, as specified in 3GPP TS 36.331.

10.1.6 Narrowband physical random-access channel

10.1.6.1 Time and frequency structure

The physical layer random access preamble is based on single-subcarrier frequency-hopping symbol groups. A symbol group is illustrated in Figure 10.1.6.1-1, consisting of a cyclic prefix of length  and a sequence of  identical symbols with total length. The total number of symbol groups in a preamble repetition unit is denoted by . The number of time-contiguous symbol groups is given by .

The parameter values for frame structures 1 and 2 are listed in Tables 10.1.6.1-1 and 10.1.6.1-2, respectively.



Figure 10.1.6.1-1: Random access symbol group

Table 10.1.6.1-1: Random access preamble parameters for frame structure type 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Preamble format |  |  |  |  |  |
| 0 | 4 | 4 | 5 |  |  |
| 1 | 4 | 4 | 5 |  |  |
| 2 | 6 | 6 | 3 |  | 3 |

Table 10.1.6.1-2: Random access preamble parameters for frame structure type 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Preamble format | Supported uplink-downlink configurations |  |  |  |  |  |
| 0 | 1, 2, 3, 4, 5 | 2 | 4 | 1 |  |  |
| 1 | 1, 4 | 2 | 4 | 2 |  |  |
| 2 | 3 | 2 | 4 | 4 |  |  |
| 0-a | 1, 2, 3, 4, 5 | 3 | 6 | 1 |  |  |
| 1-a | 1, 4 | 3 | 6 | 2 |  |  |

The preamble consisting of symbol groups shall be transmitted  times. For frame structure type 2, when an invalid uplink subframe overlaps the transmission of symbol groups without a gap, the symbol groups are dropped. For frame structure type 2, the transmission of symbol groups are aligned with the subframe boundary.

The transmission of a random-access preamble, if triggered by the MAC layer, is restricted to certain time and frequency resources.

For a UE communicating over NTN, time and frequency pre-compensation is adjusted per NPRACH segment, where the quantity is provided by system information, as specified in 3GPP TS 36.331.

A NPRACH configuration provided by higher layers contains the following:

- NPRACH resource periodicity (*nprach-Periodicity*),

- frequency location of the first subcarrier allocated to NPRACH  (*nprach-SubcarrierOffset*),

- number of subcarriers allocated to NPRACH  (*nprach-NumSubcarriers*),

- number of starting sub-carriers allocated to UE initiated random access  *(nprach-NumCBRA-StartSubcarriers*),

- number of NPRACH repetitions per attempt  (*numRepetitionsPerPreambleAttempt*),

- NPRACH starting time  (*nprach-StartTime*),

- Fraction for calculating starting subcarrier index for the range of NPRACH subcarriers reserved for indication of UE support for multi-tone msg3 transmission  (*nprach-SubcarrierMSG3-RangeStart*).

NPRACH transmission can start only  time units after the start of a radio frame fulfilling . For frame structure type 1, after transmissions of  time units for preamble formats 0 and 1, or time units for preamble format 2, a gap of  time units shall be inserted.

NPRACH configurations where  are invalid.

The NPRACH starting subcarriers allocated to UE initiated random access are split in two sets of subcarriers,  and , where the second set, if present, indicate UE support for multi-tone msg3 transmission.

The frequency location of the NPRACH transmission is constrained within  sub-carriers, and within subcarriers when preamble format 2 as described in Table 10.1.6.1-1 is configured. Frequency hopping shall be used within the 12 subcarriers and 36 subcarriers when preamble format 2 as described in Table 10.1.6.1-1 is configured, where the frequency location of the *ith* symbol group is given by  where . The quantity depends on the frame structure.

For frame structure type 1:

- if , for preamble formats 0 and 1 as described in Table 10.1.6.1-1:

## Nokia draft CR#2 to TS 36.213 (R1-2207289)

Reason for change: Clarify UE behavior of dropping samples for PUCCH/PUSCH of eMTC UE and for NPRACH of NB-IoT UE when the UE performs segmented pre-compensation

Summary of change: For eMTC UE, for both PUCCH and PUSCH, when the UE's uplink transmissions in uplink slot n and uplink slot n+1 are overlapped due to the timing adjustment, the UE shall complete transmission of uplink slot n and not transmit the overlapped part of uplink slot n+1.

For NB-IoT, when the UE's uplink NPRACH transmissions in preamble sequence repetition n and preamble sequence repetition n+1 are overlapped due to the timing adjustment, UE shall complete transmission of preamble sequence repetition n and not transmit the overlapped part of preamble sequence repetition n+1.

Consequences if not approved: Release 17 eMTC/NB-IoT UEs cannot communicate via NGSO NTNs

4.2.3 Transmission timing adjustments

Upon reception of a timing advance command or a timing adjustment indication for a TAG containing the primary cell or PSCell, the UE shall adjust uplink transmission timing for PUCCH/PUSCH/SRS of the primary cell or PSCell based on the received timing advance command or a timing adjustment indication.

The UL transmission timing for PUSCH/SRS of a secondary cell is the same as the primary cell if the secondary cell and the primary cell belong to the same TAG. If the primary cell in a TAG has a frame structure type 1 and a secondary cell in the same TAG has a frame structure type 2 or frame structure 3, UE may assume that *NTA* ≥ 624.

If the UE is configured with a SCG, the UL transmission timing for PUSCH/SRS of a secondary cell other than the PSCell is the same as the PSCell if the secondary cell and the PSCell belong to the same TAG.

Upon reception of a timing advance command or a timing adjustment indication for a TAG not containing the primary cell or PSCell, if all the serving cells in the TAG have the same frame structure type, the UE shall adjust uplink transmission timing for PUSCH/SRS of all the secondary cells in the TAG based on the received timing advance command or a timing adjustment indication where the UL transmission timing for PUSCH /SRS is the same for all the secondary cells in the TAG.

Upon reception of a timing advance command or a timing adjustment indication for a TAG not containing the primary cell or PSCell, if a serving cell in the TAG has a different frame structure type compared to the frame structure type of another serving cell in the same TAG, the UE shall adjust uplink transmission timing for PUSCH/SRS of all the secondary cells in the TAG by using *NTAoffset* = 624 regardless of the frame structure type of the serving cells and based on the received timing advance command or a timing adjustment indication where the UL transmission timing for PUSCH /SRS is the same for all the secondary cells in the TAG. *NTAoffset* is described in [3].

The timing adjustment indication specified in [11] indicates the initial *NTA* used for a TAG.The timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG as multiples of 16. The start timing of the random access preamble is specified in [3].

In case of random access response, an 11-bit timing advance command [8], *TA*, for a TAG indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 256 if the UE is configured with a SCG, and *TA* = 0, 1, 2, ..., 1282 otherwise, where an amount of the time alignment for the TAG is given by *NTA* = *TA* ×16. *NTA* is defined in [3].

In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format 6-0A/B if present [4], *TA*, for a TAG indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing for the TAG by a given amount respectively.

For a non-BL/CE UE, for a timing advance command received on

- subframe *n*, the corresponding adjustment of the uplink transmission timing shall apply from the beginning of subframe *n+*5 if the UE is configured with higher layer parameter *shortProcessingTime* and the corresponding PDCCH with CRC scrambled by C-RNTI is in the UE-specific search space, *n+6* otherwise.

- slot *n*, the corresponding adjustment of the uplink transmission timing shall apply from the first subframe boundary no earlier than slot *[n+8].*

- subslot *n*, the corresponding adjustment of the uplink transmission timing shall apply from the first subframe boundary no earlier than

- subslot *[n+16]* if higher layer parameter *proc-TimeAdv-r15*= '*nplus4set1*'*.*

- subslot *[n+18]* if higher layer parameter *proc-TimeAdv-r15*= '*nplus6set1*'or '*nplus6set2*'*.*

- subslot *[n+20]* if higher layer parameter *proc-TimeAdv-r15*= '*nplus8set2*'*.*

For serving cells in the same TAG, when the UE's uplink PUCCH/PUSCH/SRS transmissions in subframe *n* and subframe *n*+1 are overlapped due to the timing adjustment, the UE shall complete transmission of subframe *n* and not transmit the overlapped part of subframe *n*+1.

For a BL/CE UE, for a timing advance command received on subframe *n*, the corresponding adjustment of the uplink transmission timing shall apply for the uplink PUCCH/PUSCH/SRS transmissions in subframe *n+6+Koffset*. When the BL/CE UE's uplink PUCCH/PUSCH/SRS transmissions in subframe *n* and subframe *n*+1 are on the same narrowband and are overlapped due to the timing adjustment, the UE shall complete transmission of subframe *n* and is not required to transmit in subframe *n+1* until the first available symbol that has no overlapping portion with subframe *n*. When the BL/CE UE's uplink PUCCH/PUSCH/SRS transmissions in subframe *n* and subframe *n*+1 are on different narrowbands, and the timing adjustment occurs in the guard period for narrowband retuning, the UE is not required to transmit in subframe *n+1* until the first available symbol that has no overlapping portion with subframe *n* and which does not reduce the guard period. The value of is given by,

- 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,

- .

If the received downlink timing changes and is not compensated or is only partly compensated by the uplink timing adjustment without timing advance command as specified in [10], the UE changes *NTA* accordingly.

For a BL/CE UE in a NTN serving cell, using serving satellite higher-layer ephemeris parameters, if configured, the BL/CE UE determines  (defined in [3]) using the serving satellite position and its own position to pre-compensate the two-way transmission delay on the service link. To pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the serving satellite, the BL/CE UE determines (defined in [3]) based on one-way propagation delay which can be obtained as:

where , , and are given by the higher layer parameters *nta-Common*, *nta-CommonDrift*, and *nta-CommonDriftVariation* respectively, and is the epoch time given by the higher layer parameter *epochTime*. provides a distance at time between the serving satellite and the uplink time synchronization reference point divided by the speed of light. The uplink time synchronization reference point is the point where DL and UL are frame aligned with an offset given by .

For a BL/CE UE in a NTN serving cell, when the UE's uplink PUCCH transmissions in uplink slot *n* and uplink slot *n*+1 are overlapped due to the timing adjustment, the UE shall complete transmission of uplink slot *n* and not transmit the overlapped part of uplink slot *n*+1.

For a BL/CE UE in a NTN serving cell, when the UE's uplink PUSCH transmissions in uplink slot *n* and uplink slot *n*+1 are overlapped due to the timing adjustment, the UE shall complete transmission of uplink slot *n* and not transmit the overlapped part of uplink slot *n*+1.

16.1.2 Timing synchronization

Upon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH, and SR if configured with higher layer parameter *sr-WithoutHARQ-ACK-Config*, based on the received timing advance command.

The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16. The start timing of the random access preamble is specified in [3].

In case of random access response, an 11-bit timing advance command [8], *TA*, indicates *NTA* values by index values of *TA* = 0, 1, 2, ..., 1536, where an amount of the time alignment is given by *NTA* = *TA* ×16. *NTA* is defined in [3].

In other cases, a 6-bit timing advance command [8] or the Timing advance adjustment field in DCI format N0 if present [4], *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.

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*.* When the UE's uplink NPUSCH transmissions in NB-IoT uplink slot *n* and NB-IoT uplink slot *n*+1 are overlapped due to the timing adjustment, the UE shall complete transmission of NB-IoT uplink slot *n* and not transmit the overlapped part of NB-IoT uplink slot *n*+1.

When the UE's uplink NPRACH transmissions in preamble sequence repetition *n* and preamble sequence repetition *n*+1 are overlapped due to the timing adjustment, the UE shall complete transmission of preamble sequence repetition *n* and not transmit the overlapped part of preamble sequence repetition *n*+1.

If the received downlink timing changes and is not compensated or is only partly compensated by the uplink timing adjustment without timing advance command as specified in [10], the UE changes *NTA* accordingly.

# Conclusions

TBA

# References

1. RP-211601, “NB-IoT/eMTC support for NTN”, MediaTek, RAN#92-e, May 2021
2. R1-2206015 Remaining issues on IoT-NTN ZTE
3. R1-2206016 Corrections on IoT-NTN synchronization ZTE
4. R1-2206158 Maintenance on NB-IoT/eMTC to support NTN MediaTek Inc.
5. R1-2206179 Corrections to NB-IoT/eMTC support for Non-Terrestrial Networks Mediatek India Technology Pvt.
6. R1-2206297 Draft CR on UE pre-compensation in segment OPPO
7. R1-2207209 Maintenance on IoT-NTN Qualcomm Incorporated
8. R1-2207288 Draft CR on correction of IoT NTN with dropping in pre-compensation per segment in 36.211 Nokia, Nokia Shanghai Bell
9. R1-2207289 Draft CR on correction of IoT NTN with dropping in pre-compensation per segment in 36.213 Nokia, Nokia Shanghai Bell
10. R1-2207290 Maintenance on NB-IoT/eMTC support for Non-Terrestrial Network Nokia, Nokia Shanghai Bell
11. R1-2207315 Maintenance on IoT NTN Apple
12. R1-2207513 Corrections on NPDCCH monitoring restriction for IoT NTN Huawei, HiSilicon
13. R1-2207569 DRAFT CR on timing relationship enhancements for IoT NTN Ericsson
14. R1-2207602 Maintenance of IoT-NTN Sony
15. R1-2207683 On SIB accumulation and Timing relationship enhancements in IoT NTN Ericsson

# Appendix

In the Table below, company proposals for time and frequency synchronization are listed

|  |  |
| --- | --- |
| Contribution | Observation/Proposals |
| ZTE (R1-2206015) | ***Proposal 1: The number of SI windows used for NTN-specific SIB repetition should be broadcast in SIB1 if NTN-specific SIB accumulation across SI windows is not prohibited.***  ***Proposal 2: When Epoch time is not explicitly indicated in SIB, epoch time of assistance information is implicitly known as the end of the last SI window during which the NTN-specific SIB is transmitted.*** |
| MediaTek (R1-2206158) | ***Proposal 1****: Agree on the capturing RAN1#108e agreement on in TP #1 to TS 36.213 Sections 16.3.1.*   |  | | --- | | ---------------------------------------- Start of TP #1 for 3GPP TS 36.213 ----------------------------------------  **36.213 section 16.3.1**  <Unchanged Text Omitted>  -     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.  <Unchanged Text Omitted>  ---------------------------------------- End of TP #1 for 3GPP TS 36.213 ----------------------------------------- | |
| Qualcomm (R1-2207209) | ***Proposal 1*: SIB accumulation across multiple SI windows is not supported for satellite assistance information parameters, for NB-IoT.** |
| Nokia (R1-2207290) | **Observation 1: Implicit indication of the Epoch time of assistance information in NTN SIB does not work, because the assistance information may not necessarily be updated every SI window.**  **Observation 2: eMTC UE may only apply sample dropping/insertion for segmented transmission of PRACH.**  **Proposal 1: Only explicit signaling of Epoch time for assistance information shall be specified for IoT NTN.**  **Proposal 2: RAN1 send LS to RAN2 to update SIB31 description in RRC specification to make the epochTime a mandatory field.**  **Proposal 3: Dropping method similar as NB-IoT dropping the overlapped part should also be added for eMTC PUCCH/PUSCH and NB-IoT NPRACH, to make complete the common understanding between UE and network.**  **Proposal 4: RAN1 to discuss NB-IoT UE segmented transmission of NPRACH, where network is not aware of the UE capability for dropping during segmented transmission.** |
| Apple (R1-2207315) | ***Proposal 1:*** *In IoT NTN, UE does not expect that NTN-specific SIB is constant across SI windows.*  ***Proposal 2:*** *In IoT NTN, when epoch time is not explicitly indicated in SIB, epoch time of assistance information is implicitly known as the end of the SI window during which the NTN-specific SIB is transmitted.* |
| Ericsson (R1-2207683) | **Observation 1** In eMTC/NB-IoT NTN, there are numerous configurations of the SI window periodicity and the validity timer duration for which the NTN SIB may remain unchanged over many SI windows and can therefore be accumulated.  **Observation 2** NTN SIB may need to be updated much more frequently for LEO than for GEO.  **Observation 3** Without NTN SIB accumulation across SI windows, the network may need to configure longer SI windows to support a larger number of repetitions, resulting in a high signalling overhead.  **Observation 4** For explicit epoch time indication, without introducing additional signalling, the epoch time indication range essentially limits the NTN SIB accumulation to shorter SI periodicities of up to 64 frames.  **Observation 5** Depending on the SI periodicity, the UE may determine whether to accumulate the NTN SIB.  **Observation 6** For explicit epoch time indication, introducing additional signalling can help extend the SIB accumulation to even larger SI periodicities and/or optimize the UE behavior regarding SIB accumulation.  Observation 7 A UE in deep coverage will typically need to accumulate over only a few SI windows to decode the NTN SIB. Therefore, it may be sufficient if the network indicates the number of SI windows that can be accumulated via a 1-bit or 2-bit indication in SIB1.  **Proposal 1** Network to optionally indicate if NTN SIB accumulation across SI windows is allowed or not.  **Proposal 2** For eMTC NTN with explicit epoch time indication, without introducing additional signalling, support NTN SIB accumulation at least for the following SI periodicities: {8, 16, 32, 64} frames.  **Proposal 3** For NB-IoT NTN with explicit epoch time indication, without introducing additional signalling, support NTN SIB accumulation at least for the SI periodicity of 64 frames.  **Proposal 4** With implicit epoch time indication, support NTN SIB accumulation for both LEO and GEO by introducing additional signalling.  **Proposal 5** For implicit epoch time case, network to optionally broadcast a k-bit assistance information in SIB1 to indicate the number of the SI windows, N, that can be accumulated for decoding the NTN SIB, and/or a reference time to mark the start and/or the end of the accumulation period consisting of N SI windows.  **Proposal 6** For IoT NTN, adopt the same definition for explicit epoch time as for NR NTN.  **Proposal 7** For IoT NTN, when epoch time is not explicitly indicated in SIB, the epoch time of assistance information (i.e., Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the Nth SI window, if parameter N is signalled by the network to indicate the number of windows for which the NTN-specific SIB SI message can be accumulated for decoding. If parameter N is not signalled, the epoch time is implicitly known as the end of the SI window containing the SI message with the NTN-specific SIB.  **Proposal 8** Adopt the following TP for TS 36.213 Clause 16.4.2:  -------------------- Start of TP for 3GPP TS 36.213 -------------------- 16.4.2 UE procedure for reporting ACK/NACK <Unchanged Text Omitted>  The UE shall upon detection of a NPDSCH transmission ending in NB-IoT subframe *n* intended for the UE and for which an ACK/NACK shall be provided, start, after the end of  - DL subframe or UL subframe for an NTN serving cell for FDD,  - NB-IoT UL subframes following the end of n+12 subframe for TDD,  transmission of the NPUSCH carrying ACK/NACK response, and SR (if any) if the serving cell is FDD and the UE is configured with higher layer parameter *sr-with-HARQ-ACK-Config*, using NPUSCH format 2 in *N* consecutive NB-IoT UL slots, …  -------------------- End of TP for 3GPP TS 36.213 --------------------  **Proposal 9** Adopt the following proposal for TS 36.213 Clause 16.5.1:  --------------------------------------------3GPP TS 36.213 -------------------------------------------- 16.5.1 UE procedure for transmitting format 1 narrowband physical uplink shared channel <Unchanged Text Omitted>  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* DL subframe or *n+k0+K*offset UL subframe for an NTN serving cell for FDD,  *- k0* NB-IoT UL subframes following the end of *n+*8 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* or UL subframe *n+k0+K*offset for an NTN serving cell for FDD  - *n0* is the first NB-IoT UL slot starting after *k0* NB-IoT UL subframes following the end of *n*+8 subframe for TDD  --------------------------------------------3GPP TS 36.213 --------------------------------------------  **Proposal 10** Adopt the following proposal for TS 36.213 Clause 7.3.1:  --------------------------------------------3GPP TS 36.213 -------------------------------------------- 7.3.1 FDD HARQ-ACK reporting procedure <Unchanged Text Omitted>  For a BL/CE UE with higher layer parameter *ce-PDSCH-14HARQ-Config* configured, for PDSCH transmission in subframe *n-k* or in subframe *n-k-* for an NTN serving cell, if the UE is in half-duplex FDD operation and is configured with CEModeA, and 'PDSCH scheduling delay and HARQ-ACK delay for 14 HARQ' field is present in the corresponding DCI,  - if the HARQ-ACK delay value as defined in [4], in the corresponding DCI indicates value *k*, the UE shall determine the subframe *n* as the HARQ-ACK transmission subframe.  --------------------------------------------3GPP TS 36.213 -------------------------------------------- |
| Sony (R1-2207602) | **Observation 1: TN IoT allows the UE to accumulate SI messages across SI Windows. This functionality is not currently supported in IoT-NTN.**  **Observation 2: IoT-NTN SIBs, especially those containing ephemeris information, may change before the end of the modification period.**  **Observation 3: Transmitting the same SI message for N SI Windows allows the UE to accumulate the SI messages across those N SI Windows to improve coverage.**  ***Proposal 1*: For IoT-NTN, the SI messages do not change for a set of *N* SI windows. The UE may accumulate SI message across the *N* SI Windows.** |