**3GPP TSG RAN WG1 #107-e R1-211xxxx**

**e-Meeting, November 11th – 19th, 2021**

Agenda Item: 8.4 - Solutions for NR to support non-terrestrial networks (NTN)

Source: WI rapporteur (Thales)

Title: 3GPP TSG-RAN WG1 Agreements under 8.4 up to eMeeting RAN1#107-e

Document for: Information

# Content

[Content 1](#_Toc88552582)

[1 Introduction 2](#_Toc88552583)

[2 WID Objective 2](#_Toc88552584)

[3 3GPP TSG RAN WG1 Meeting #102-e 5](#_Toc88552589)

[3.1 Timing relationship enhancements 5](#_Toc88552590)

[3.2 Enhancements on UL time and frequency synchronization 5](#_Toc88552591)

[3.3 Enhancements on HARQ 5](#_Toc88552592)

[3.4 Others 6](#_Toc88552593)

[4 3GPP TSG RAN WG1 Meeting #103-e 6](#_Toc88552594)

[4.1 Timing relationship enhancements 6](#_Toc88552595)

[4.2 Enhancements on UL time and frequency synchronization 7](#_Toc88552596)

[4.3 Enhancements on HARQ 8](#_Toc88552597)

[4.4 Others 8](#_Toc88552598)

[5 3GPP TSG RAN WG1 Meeting #104-e 9](#_Toc88552599)

[5.1 Timing relationship enhancements 9](#_Toc88552600)

[5.2 Enhancements on UL time and frequency synchronization 9](#_Toc88552601)

[5.3 Enhancements on HARQ 10](#_Toc88552602)

[5.4 Others 10](#_Toc88552603)

[6 3GPP TSG RAN WG1 Meeting #104-bis-e 11](#_Toc88552604)

[6.1 Timing relationship enhancements 11](#_Toc88552605)

[6.2 Enhancements on UL time and frequency synchronization 12](#_Toc88552606)

[6.3 Enhancements on HARQ 13](#_Toc88552607)

[6.4 Others 13](#_Toc88552608)

[7 3GPP TSG RAN WG1 Meeting #105-e 13](#_Toc88552609)

[7.1 Timing relationship enhancements 13](#_Toc88552610)

[7.2 Enhancements on UL time and frequency synchronization 14](#_Toc88552611)

[7.3 Enhancements on HARQ 14](#_Toc88552612)

[7.4 Others 15](#_Toc88552613)

[8 3GPP TSG RAN WG1 Meeting #106-e 15](#_Toc88552614)

[8.1 Timing relationship enhancements 15](#_Toc88552615)

[8.2 Enhancements on UL time and frequency synchronization 16](#_Toc88552616)

[8.3 Enhancements on HARQ 18](#_Toc88552617)

[8.4 Others 18](#_Toc88552618)

[9 3GPP TSG RAN WG1 Meeting #106-bis-e 19](#_Toc88552619)

[9.1 Timing relationship enhancements 19](#_Toc88552620)

[9.2 Enhancements on UL time and frequency synchronization 20](#_Toc88552621)

[9.3 Enhancements on HARQ 22](#_Toc88552622)

[9.4 Others 22](#_Toc88552623)

[10 3GPP TSG RAN WG1 Meeting #107-e 22](#_Toc88552624)

[10.1 Timing relationship enhancements 22](#_Toc88552625)

[10.2 Enhancements on UL time and frequency synchronization 24](#_Toc88552626)

[10.3 Enhancements on HARQ 27](#_Toc88552627)

[10.4 Others 28](#_Toc88552628)

[11 Reference 29](#_Toc88552629)

# Introduction

This document summaries RAN1 agreements made for the Rel-17 WI on 8.4 - Solutions for NR to support non-terrestrial networks (NTN).

The Agreements, Working Assumptions and Conclusions achieved in RAN1 meetings up to RAN1#106-bis-e are listed in sections 3 to 9.

Notes:

* The WI objective from the WID is inserted below for convenience.
* The list of submitted feature lead summaries is included.
* Rel-17 RRC parameters for NR to support NTN are summarized in R1-2110624

# WID Objective

|  |
| --- |
| The work item aims to specify the enhancements identified for NR NTN (non-terrestrial networks) especially LEO and GEO with implicit compatibility to support HAPS (high altitude platform station) and ATG (air to ground) scenarios according to the following principles:   * FDD is assumed for core specification work for NR-NTN.   + NOTE: This does not imply that TDD cannot be used for relevant scenarios e.g. HAPS, ATG * Earth fixed Tracking area is assumed with Earth fixed and moving cells * UEs with GNSS capabilities are assumed. * Transparent payload is assumed * Handheld devices in FR1 are supported (e.g. Power class 3) * “VSAT” devices with external antenna (including fixed and moving platform mounted devices) at least in FR2 are supported for the RAN1-3 specifications. “VSAT” characteristics in TR 38.821 can be assumed for the RAN1-3 specifications.   The detailed objectives are to specify enhancing features to Rel-15 & Rel-16’s NR radio interface & NG-RAN as follows: RAN1 Enhancing features to address the identified issues due to long propagation delays, large Doppler effects, and moving cells in NTN, the following should be specified (see TR 38.821):   * Timing relationship enhancements[RAN1,RAN2] * Enhancements on UL time and frequency synchronization [RAN1,RAN2] * HARQ   + Number of HARQ process [RAN1]   + Enabling / disabling of HARQ feedback as described in the TR 38.821 [RAN1&2]   In addition, the following topics should be specified if beneficial and needed   * Enhancement on the PRACH sequence and/or format and extension of the ra-ResponseWindow duration (in the case of UE with GNSS capability but without pre-compensation of timing and frequency offset capabilities) [RAN1/2]. * Feeder link switch [RAN2,RAN1] * Beam management and Bandwidth Parts (BWP) operation for NTN with frequency reuse [RAN1/2]   + Including signalling of polarization mode  RAN2 NOTE: offset based solutions for timer adaptations are assumed.  The following user plane procedures enhancements should be specified (see TR 38.821)   * MAC   + Random access:     - Definition of an offset for the start of the ra-ResponseWindow for NTN.     - Introduction of an offset for the start of the ra-ContentionResolutionTimer to resolve Random access contention     - Solutions for resolving preamble ambiguity and extension of RAR window.     - Adaptation for Msg-3 scheduling       * Only for the case with pre-compensation of timing and frequency offset at UE side)   + Enhancement on UL scheduling to reduce scheduling latency.   + DRX:     - If HARQ feedback is enabled, introduction of offset for *drx-HARQ-RTT-TimerDL* and *drx-HARQ-RTT-TimerUL*.     - If HARQ is turned off per HARQ process, adaptions in HARQ procedure   + Scheduling Request: Extension of the value range of *sr-ProhibitTimer* * RLC   + Status reporting: Extension of the value range of *t-Reassembly*   + Sequence Numbers: extension of the SN space only for GEO scenarios * PDCP   + SDU discard: Extension of the value range of *discardTimer*.   + Sequence Numbers: extension of the SN space for GEO scenarios.   The following control plane procedures enhancements should be specified (see TR 38.821)   * Idle mode:   + Definition of additional assistance information for cell selection/reselection (e.g. using UE location information, satellite Ephemeris information)   + Definition of NTN (satellite/HAPS) cell specific information in SIB * Connected mode   + Enhancement necessary to take into account location information (UE & Satellite/HAPS) and/or ephemeris in determining when to perform hand-over, in order to have a high degree of hand-over control for hand-over robustness and coverage management.   + Enhancement to existing measurement configurations to address absolute propagation delay difference between satellites (e.g. SMTC measurement gap adaptation to the SSB/CSI-RS measurement window) [RAN2/4]. * Service continuity for mobility from TN to NTN and from NTN to TN systems (to be addressed when connected mode mobility has sufficiently progressed) * Identify potential issues associated to the use of the existing Location Services (LCS) application protocols to locate UE in the context of NTN and specify adaptations if any [RAN2/3]   Furthermore the following can be considered with 2nd priority   * Verify the applicability of existing Rel-16 ANR techniques to solve PCI confusion in order to support co-channel operation between HAPS & terrestrial networks and develop enhancements if needed [RAN2/3]  RAN3 The following NG-RAN architecture enhancements should be specified (see TR 38.821)   * to support feeder link switch over in Transparent payload architecture based LEO scenarios * network identities handling * registration update and paging handling * cell relation handling and related features e.g. neighbours, ANR, RAN paging …  RAN4 Study the framework how NTN core requirements are defined.  Specify the following requirements [RAN4] (Note 1)   * + UE RRM core requirements * Study and identify which bands may be potentially relevant to NTN including:   + Analysis of regulations in the spectrum considered   + Adjacent channel co-existence * Considering the potential bands to be used as example for the WID: * Specify needed generic RF core requirements for the network and the UE such that adjacent channel co-existence scenarios are met and performance of other RF parameters (RX performance, TX signal quality etc.) are subject to acceptable minimum requirements * Investigate and specify UE timing & frequency pre compensation accuracy requirements as needed [RAN4].   *Note 1: It is assumed that this work item will be frequency agnostic and therefore we can consider that NTN can operate in FR1 or FR2 ranges. Defining NR bands for NTN should be included as part of dedicated Rel-17 RAN4 led work items including an analysis of regulations in spectrum considered, which bands 3GPP should specify, as well as potential co-existence between NR terrestrial and satellite*  *Note 2: The spectrum usage on the service link for HAPS might be a different spectrum allocation than for Satellite.* |

# 3GPP TSG RAN WG1 Meeting #102-e

## Timing relationship enhancements

Agreement:

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

Agreement:

For Koffset used in initial access, the information of Koffset is carried in system information.

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

## Enhancements on UL time and frequency synchronization

Agreement:

* In Rel-17 NR NTN, at least support UE which can derive based on its GNSS implementation one or more of:
  + its position
  + a reference time and frequency
* And, based on one or more of these elements together with additional information (e.g., serving satellite ephemeris or timestamp) signalled by the network, can compute timing and frequency, and apply timing advance and frequency adjustment at least for UE in RRC idle/inactive mode.
* FFS: Details on additional information signalled from network

Agreement:

In case of GNSS-assisted TA acquisition in RRC idle/inactive mode, the UE calculates its TA based on the following potential contributions:

* The User specific TA which is estimated by the UE:
  + Option 1: The User specific TA is estimated by the UE based on its GNSS acquired position together with the serving satellite ephemeris indicated by the network:
    - FFS: Details on serving satellite ephemeris indication
  + Option 2: The User specific TA  is estimated by the UE based on the GNSS acquired reference time at UE together with reference time as indicated by the network
* The Common TA if indicated by the network:
  + FFS: The need and details of Common TA indication
* FFS: The TA margin, if needed and indicated by the network (in order to account for the TA estimation uncertainty)

## Enhancements on HARQ

Agreement:

Enabling/disabling on HARQ feedback for downlink transmission should be at least configurable per HARQ process via UE specific RRC signaling

Agreement:

The extension of maximal HARQ process number can be considered with following assumptions:

* The maximal supported HARQ process number is up to 32.
* FFS: Support on the maximal HARQ process number is up to UE capability
* Minimizing the impacts on specification and scheduling

## Others

Agreement:

One-beam per cell and multiple-beam per cell are supported in existing NR specifications and are baseline for NR NTN.

* FFS: The need for potential enhancement for beam management
* FFS: The need for potential enhancement on association of SSBs, beams and BWPs

Agreement:

Potential enhancements for support of polarisation signalling in NR NTN can consider at least the following:

* Configuration of DL and UL transmit polarization including Right hand and Left hand circular polarizations (RHCP, LHCP)
* Network broadcast DL and UL transmit polarization configuration
* UE polarization capability (RHCP, LHCP, Linear)
* Dependence of polarisation signaling on deployment scenarios. For example,
  + Resource reuse mode with/without polarization for the beam management enhancement
  + Fixed polarization per cell/beam for polarization reuse and circular polarisation with intra-UE and inter-UE multiplexing (intra-UE and inter-UE) signalling

# 3GPP TSG RAN WG1 Meeting #103-e

## Timing relationship enhancements

Agreement:

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

Agreement:

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

Working Assumption:

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

Conclusion:

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

Agreement:

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

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

## Enhancements on UL time and frequency synchronization

Agreement:

An NTN UE in RRC\_IDLE and RRC\_INACTIVE states is required to at least support UE specific TA calculation based at least on its GNSS-acquired position and the serving satellite ephemeris.

Agreement:

An NR NTN UE in RRC\_IDLE and RRC\_INACTIVE states shall be capable of at least using its acquired GNSS position and satellite ephemeris to calculate frequency pre-compensation to counter shift the Doppler experienced on the service link.

Agreement:

* In NTN, the network may broadcast
* A common timing offset value
  + FFS details of the common timing offset
* FFS: A common timing drift rate
* Before Msg1/MsgA transmission, the NR NTN UE in idle/inactive mode calculates its TA as follows:



Where:

is derived from the User specific TA self-estimation



is derived at least from the common timing offset value if broadcasted by the network. The granularity of and whether is indicated as a Timing Advance or as a Timing Offset value [unit] are FFS. Upon resolving the FFS, one of the X in the equation will be removed.



* depends on band and LTE/NR coexistence and is specified in TS 38.213 section 4.2.



* is specified in TS 38.211 section 4.1.



* Note: UE will not assume that the RTT between UE and gNB is equal to the calculated TA for Msg1/Msg A.

Working assumption:

It is assumed that the requirement on UL time pre-compensation for Msg1/MsgA transmission of an NR NTN UE in idle/inactive mode will be defined such that the existing TAC 12-bit field in msg2 (or msgB) can be reused without any extension.

Agreement:

An NR NTN UE in RRC\_CONNECTED states shall be capable of at least using its acquired GNSS position and satellite ephemeris to perform frequency pre-compensation to counter shift the Doppler experienced on the service link.

## Enhancements on HARQ

Agreement:

For a DL HARQ process with disabled HARQ feedback, the UE is not expected to receive another PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process that starts until [X] after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process.

* FFS: value of X and units in which it is defined.
* FFS: Whether TB of the two PDSCHs needs to be different

Agreement:

* Enhanced HARQ process ID indication is supported for DCI 0-2/1-2 and DCI 0-1/1-1 by at least one of following:
  + Option 1: Slot index as the MSB
  + Option 1-a:Slot index as the LSB
  + Option 2: Reusing one bit from other bit field
  + Option 3: Extending the HARQ process ID field up to 5 bits
* FFS: DCI 0-0/1-0
* Note: 32 is taken as maximal supported HARQ processes number for both UL and DL

Agreement:

HARQ codebook enhancement is supported as:

* For Type-2 HARQ codebook:
  + Option-1: Reduce codebook size with:
    - HARQ-ACK codebook only includes HARQ-ACK of PDSCH with feedback-enabled HARQ processes
      * FFS: the details of C-DAI and T-DAI counting for DCI of PDSCH with feedback-enable/disabled HARQ processes
    - FFS: at least DCI for SPS release/SPS PDSCH
  + Option-2: No enhancement
  + Other options are not precluded.
* For Type-1 HARQ codebook, further discuss is needed with down selection among following options:
  + Option-1: No enhancement;
  + Option-2: Report NACK on disabled process
  + Option-3: Reduce codebook size with criteria
* FFS: Enhancements for Type-3 HARQ codebook

## Others

Agreement:

Indication of polarization information for DL and UL by the network is supported.

* FFS: Signaling details

# 3GPP TSG RAN WG1 Meeting #104-e

## Timing relationship enhancements

Agreement:

Confirm the following working assumption:

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

Agreement:

Update of K\_offset after initial access is supported

Agreement:

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

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

Working assumption:

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

## Enhancements on UL time and frequency synchronization

Agreement:

An NTN UE in RRC\_CONNECTED state is required to support UE specific TA calculation based at least on its GNSS-acquired position and the serving satellite ephemeris.

FFS: Operation of closed loop and open loop TA control

Agreement:

For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops shall be supported for NTN.

FFS: Details of the combination of open and closed loop TA control

Conclusion:

It is up to RAN4 to decide whether interruptions or measurement gaps are required for GNSS measurements during NTN operation

Agreement:

RAN1 should send an LS to RAN4 with the following questions:

Question 1: RAN1 would like to ask RAN4, to indicate what are the NTN UL time synchronization requirements?

* For initial access (i.e. PRACH transmission)
* For UL transmissions in RRC Connected State

Question 2: RAN1 would like to ask RAN4, to indicate what are the NTN UL frequency synchronization requirements?

* For initial access (i.e. PRACH transmission)
* For UL transmissions in RRC Connected State

Conclusion:

If DL frequency compensation for the service link Doppler is applied, indication of the amount of frequency compensation is necessary.

* FFS: support of DL frequency compensation for the service link Doppler.

Agreement:

* RAN1 to support satellite ephemeris broadcast based at least on one of the following format options:
  + Option 1: Ephemeris format based on satellite position and velocity state vectors
    - FFS: Details on state vectors formats
    - FFS: Details on time reference provisioning/format
  + Option 2: Ephemeris format based on orbital elements
    - FFS: Details on orbital elements formats
    - FFS: Details on time reference provisioning/format
* FFS: Whether down-selection is needed or both options are supported

## Enhancements on HARQ

Agreement:

For a DL HARQ process with disabled HARQ feedback, the UE is not expected to receive another PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process that starts until X after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process.

* Working assumption: X = T\_proc,1
* FFS: Whether X should be changed to X = max(T\_proc,1, K1) where K1 is the minimum k1 if it is configured, otherwise k1 = 0
* Note: The TB of the two PDSCHs can be either same or different

Agreement:

For Type-2 HARQ codebook in NTN: Reduce codebook size with HARQ-ACK codebook only including HARQ-ACK of PDSCH with feedback-enabled HARQ processes

* FFS: The details of C-DAI and T-DAI counting for DCI of PDSCH with feedback-enable/disabled HARQ processes

## Others

Agreement:

Support at least explicit indication of polarization information for DL by the network

* FFS: whether the indication is done by SIB, other RRC signaling, DCI.
* FFS: Whether separate signaling is needed for the UL and if so, whether or not a same polarization is indicated for DL and UL

Conclusion:

Discuss whether or not at least following issues are valid and decide whether or not enhancements are needed in addition to current NR specification for supporting NTN beam management:

* Issue 1: NR BWP is not directly associated with a beam. Thus, when using TCI to change beam from beam 1 to beam 2, it does not trigger NR BWP switching. However, in NTN FRF>1 case, beam switching may result in a BWP switching.
* Issue 2: NR BWP switching in UL and DL are not jointly triggered for FDD. However, in NTN FRF>1 FDD scenario, beam switching may result in a BWP switching in both DL and UL.
* Issue 3: NR dynamic BWP switching requires data scheduling. While in NTN FRF>1 scenario, we may need a fast BWP switching triggering without data scheduling.
* Issue 4: NR BWP switching does not require re-synchronization. However, in NTN FRF>1 scenario, when a satellite beam switching is triggered, UE may need to perform re-synchronization in the switched BWP.
* Issue 5: Since satellite beam switching can be frequent and often highly predictable, mechanisms of configured BWP switching (can be a sequence of BWPs) may be preferred but current NR does not allow it.
* Issue 6: How to deal with BWP switching triggered by bwpInactivityTimer, RA procedure, or simply a need to increase throughput instead of for beam-level mobility.
* Issue 7: NR BWP switching/beam switching is done with UE specific signalling due to UE movement’s. However, in NTN scenario, a satellite BWP/beam switching is common for set of UEs, we may need to a common BWP/beam switching mechanism to save the signalling overhead.

Conclusion:

Discuss the necessity of reporting UE polarization capability considering at least following aspects,

* Deployment scenarios.
* UE implementation aspects with respect to polarization.
* Satellite implementation aspects for switching between polarization states.
* Satellite implementation aspects for realizing multiplexing of UEs having different polarization capabilities.

# 3GPP TSG RAN WG1 Meeting #104-bis-e

## Timing relationship enhancements

Agreement:

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

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

FFS: Other options

Agreement:

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

Agreement:

Confirm the following working assumption:

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

Agreement:

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

Agreement:

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

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

## Enhancements on UL time and frequency synchronization

Agreement:

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

Where:

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

Note-1: Definition of  is different from that in RAN1#103-e agreement.

Note-2: UE might not assume that the RTT between UE and gNB is equal to the calculated TA for Msg1/Msg A.

Note-3:  is the common timing offset X as agreed in RAN1 #103-e.

Agreement:

Support serving-satellite ephemeris broadcast based on one or more of the following:

* Set 1: Satellite position and velocity state vectors:
  + position X,Y,Z in ECEF (m)
  + velocity VX,VY,VZ in ECEF (m/s)
* Set 2: At least the following parameters in orbital parameter ephemeris format:
  + Semi-major axis α [m]
  + Eccentricity e
  + Argument of periapsis ω [rad]
  + Longitude of ascending node Ω [rad]
  + Inclination i [rad]
  + Mean anomaly M [rad] at epoch time to
    - FFS: Whether pre-provisioned ephemeris based on orbital elements can be used as reference. Thereby, only delta corrections can be broadcast in order to reduce the overhead
* FFS: The field size for each parameter
* FFS: The impact on signaling due to the required accuracy of serving-satellite ephemeris
* FFS: Whether down-selection is needed or both sets are supported

Conclusion:

The orbital propagator model to be used at UE side can be left to implementation.

## Enhancements on HARQ

*not be handled during this e-meeting*

## Others

*not be handled during this e-meeting*

# 3GPP TSG RAN WG1 Meeting #105-e

## Timing relationship enhancements

Agreement:

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

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

Agreement:

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

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

Note 1: The UE’s TA is based on the RAN1#104bis-e agreement on Timing Advance applied by an NR NTN UE given by  . 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.

Agreement:

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

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

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

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

## Enhancements on UL time and frequency synchronization

Agreement:

Specifications should support delivery of ephemeris information using both ephemeris formats, i.e., state vectors and orbital elements.

Agreement:

RAN1 should send an LS to SA3, SA1 and possibly SA3-LI to get more inputs regarding the security/regulatory aspects if the NTN GW/gNB position is broadcast or possible to be derived by the UE with assistance information from the network, and on any aspects related to accuracy of the position.

Conclusion:

The Doppler shift over the feeder link and any transponder frequency error for both Downlink and Uplink is compensated by the GW and satellite-payload without any specification impacts in Release 17.

[**R1-2106305**](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2106305.zip)LS on broadcast of NTN GW or gNB position

Final LS endorsed in [R1-2106332](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2106332.zip) with removal of the sentence, “Such assistance information from the Network might also be used by the UE to derive the position of the NTN GW or the position of gNB.”

## Enhancements on HARQ

Agreement:

For enhancement on the HARQ process indication, extend the HARQ process ID field up to 5 bits for DCI 0-2/1-2

Agreement:

For Type-2 HARQ codebook in NTN,

* For the DCI of PDSCH with feedback-enabled HARQ processes, the C-DAI and T-DAI are the count of only feedback-enabled processes
* FFS: Whether DCI for SPS release and any other DCIs are included in counting of C-DAI and T-DAI

Agreement:

Confirm the previous working assumption for X = T\_proc,1 where X is defined from the end of the reception of the last PDSCH or slot-aggregated PDSCH for a given HARQ process with disabled feedback to the start of the PDCCH carrying the DCI scheduling another PDSCH or set of slot-aggregated PDSCH for the given HARQ process.

Agreement:

For enhancement on the HARQ process indication at least for DCI 0-1/1-1, the Option-1 and Option-1a are lower priority for further discussion.

Agreement:

Discussion of enhancement(s) on the aggregated transmission (including repetition) is prioritized to improve the performance in NTN.

## Others

Agreement:

Same beam layout in BWP#0 and BWP#x (Option 1) and hierarchical beam for BWP#0 (Option 2) should be supported by the specifications for NR-NTN.

* FFS: Whether any specification changes are needed specifically to support this functionality

Agreement:

For explicit indication of polarization information for DL by the network, support indication in SIB

* FFS: Signaling details for indication in SIB

Agreement:

* Polarization information for UL may be indicated in SIB by the network
* UE assumes a same polarization for UL and DL, when the UL polarization information is absent.
* FFS: Signaling details for indication in SIB

# 3GPP TSG RAN WG1 Meeting #106-e

## Timing relationship enhancements

Agreement:

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

Agreement:

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

* Note: The UE’s TA is based on the RAN1#104bis-e agreement on Timing Advance applied by an NR NTN UE given by  , where is assumed for PDCCH ordered PRACH.
* FFS: Which value of should be applied
* FFS: Whether the timing relationship is impacted by UE behavior within or after the validity duration.

Agreement:

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

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

Agreement:

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

Agreement:

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

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

Agreement:

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

Agreement:

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

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

## Enhancements on UL time and frequency synchronization

Agreement:

* A validity duration configured by the network for satellite ephemeris data indicates the maximum time during which the UE can apply the satellite ephemeris without having acquired new satellite ephemeris.
  + FFS: Associated UE behaviour if the UE does not read the ephemeris within the validity duration.
* FFS: Whether the same validity duration can be applied for Common TA.

Conclusion:

Indication of common post-compensation frequency offset for Uplink is not needed.

Agreement:

Confirm the working assumption on non-extension of TAC 12-bit field in msg2 (or msgB) and that the UE follows the requirements on UL time pre-compensation for Msg1/MsgA transmission as defined by RAN4.

Agreement:

Serving satellite ephemeris Epoch time is implicitly known as a reference time defined by the starting time of a DL slot and/or frame.

* FFS: Whether this starting time is given by predefined rule or it is indicated by the Network

Agreement:

In NTN, to avoid that the UE over pre-compensates its TA during RACH procedure, down-select one option from below:

* Option 1: PRACH transmission is delayed by
* Option 2: TA margin can be considered, and it is explicitly indicated to the UE
* Option 3: TA margin can be considered, and it is included within the Common TA
* Option 4: UE handles it via implementation

Agreement:

In NR NTN, NTA update based on TA Command field in msg2/msgB and MAC CE TA command is used for UL timing alignment correction as follows:

* When TAC ( in msg2/msgB is received, UE receives the first adjustment and is updated as follows:

 , FFS: the value of ,

* When TACs ( provided within the MAC CE is received, is updated as follows:

,

Working assumption:

Common TA may include parameter(s) indicating timing drift.

* The UE will apply common TA according to the parameters provided by the network (if any). No offset between the common TA according to the parameters provided by the network and the actual feeder link RTT is considered when defining UE UL timing error requirements.

## Enhancements on HARQ

Agreement:

For enhancement on the HARQ process indication, extend the HARQ process ID field up to 5 bits for DCI 0-1/1-1 when the maximum supported HARQ processes number is configured as 32.

Agreement:

* For Type-1 HARQ codebook, if DCIs carrying the feedback-disabled and feedback-enabled HARQ processes are detected by UE, one of following options should be supported:
  + Option-1: The UE will report NACK only for the feedback-disabled HARQ process regardless of decoding results of corresponding PDSCH
  + Option-2: The UE will report NACK/ACK for the feedback-disabled HARQ process depending on the decoding results of corresponding PDSCH
* FFS: Other cases, e.g., if only DCI carrying feedback-disabled HARQ process is detected by UE

Agreement:

For enhancement on the HARQ process indication, one of following options for DCI 0-0/1-0 can be considered:

* Option 2: Reusing one bit from other bit field
* Option 4: No enhancement

Agreement:

For Type-1 HARQ codebook, if only DCI carrying feedback-disabled HARQ process is detected by UE, one of following options should be supported:

* Option-1: The UE’s behavior is same as the case if DCIs carrying the feedback-disabled and feedback-enabled HARQ processes are detected by UE
* Option-2: The UE should skip the codebook feedback at least when the feedback is carried by PUCCH
  + FFS: the case that feedback is carried by PUSCH.

Agreement:

The maximum number of supported aggregation factor (i.e., pdsch-AggregationFactor) for DL PDSCH is [X]

* FFS: X = 8, 16 or 32

Agreement:

For the DCI of PDSCH with feedback-disabled HARQ processes, only one of following is supported for Type-2 codebook:

* Option-1: The C-DAI and T-DAI are the count of feedback-enabled processes, despite they are not incremented, and are taken into account by the UE for type 2 codebook generation.
* Option-2: The C-DAI and T-DAI are ignored by the UE regardless of the value for Type 2 codebook generation.

## Others

Agreement:

When polarization signalling is present in SIB

* SIB indicates DL and/or UL polarization information using respective polarization type parameters to indicate: RHCP or LHCP or linear
* FFS: whether polarization signalling is per SSB

# 3GPP TSG RAN WG1 Meeting #106-bis-e

## Timing relationship enhancements

Agreement:

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

Agreement:

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

Agreement:

The granularity of the reported TA is slot.

* FFS how to round TA value to slot level granularity

Agreement:

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

* FFS: FR2

Agreement:

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

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

Agreement:

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

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

Agreement:

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

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

Agreement:

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

Where:

* is defined as 0 for PRACH and updated based on TA Command field in msg2/msgB and MAC CE TA command.
  + FFS: details of NTA update/accumulation.
* is UE self-estimated TA to pre-compensate for the service link delay.
* is network-controlled common TA, and may include any timing offset considered necessary by the network.
* with value of 0 is supported.
  + FFS:  details of signaling including granularity.
* is a fixed offset used to calculate the timing advance.
* In addition, RAN1 has agreed the following for UE TA reporting:

Agreement:

The granularity of the reported TA is slot.

* FFS how to round TA value to slot level granularity
* It is up to RAN2 to decide which component or what combination of the components in the UE’s TA formula to use in TA reporting.

## Enhancements on UL time and frequency synchronization

Agreement:

Confirm the working assumption:

Common TA may include parameter(s) indicating timing drift.

* The UE will apply common TA according to the parameters provided by the network (if any). No offset between the common TA according to the parameters provided by the network and the actual feeder link RTT is considered when defining UE UL timing error requirements.

Agreement:

Common TA Epoch time is implicitly known as a reference time defined by the starting time of a DL slot and/or frame.

* FFS: Whether this starting time is given by predefined rule or it is indicated by the Network
  + Note: “implicitly known” means that UTC is not provided to define the Common TA epoch time.

Agreement:

The UE assumes that it has lost uplink synchronization if new or additional assistance information (i.e. serving satellite ephemeris data or Common TA parameters) is not available within the associated validity duration.

* FFS: details on how to acquire new or additional assistance information

Agreement:

NTN ephemeris validity timer should be started/restarted with configured timer validity duration at the epoch time of the assistance information (i.e. serving satellite ephemeris data)

Agreement:

A single validity duration for both serving satellite ephemeris and common TA related parameters is defined at least if serving satellite ephemeris and common TA related parameters are signaled in the same SIB message.

Agreement:

In NTN, the Network may optionally indicate one or more of the following parameters:

* Common TA , Common TA drift rate and Common TA drift rate variation.
* FFS: Common TA third order derivative.
* FFS: Details of combination of Common TA parameters

Agreement:

* The granularity of Common TA is set to be
* μ is the highest allowed numerology supported for data, for the given Frequency Range

Conclusion:

Do not define a TA margin.

Working assumption:

* Support serving satellite ephemeris format bit allocations for LEO/MEO/GEO based non-terrestrial access network.:
  + Position and velocity state vector ephemeris format [17 bytes payload].
    - The field size for position [m]  is [78 bits]
      * Position range is driven by GEO : +/- 42 200 km
      * The quantization step is [1.3m] for position
    - The field size for velocity [m/s] is [54 bits]
      * Velocity range is driven by LEO@600 km: +/- 8000 m/s
      * The quantization step is [0.06 m/s] for Velocity
  + Orbital parameter ephemeris format [18 byte payload]
    - Semi-major axis α [m] is [33 bits]
      * Range: [6500, 43000]km
    - Eccentricity e is [19 bits]
      * Range: ≤ 0.015
    - Argument of periapsis ω [rad] is [24 bits]
      * Range: [0, 2π]
    - Longitude of ascending node Ω [rad] is [21 bits]
      * Range: [-180o , +180o]
    - Inclination i [rad] is [20 bits]
      * Range: [-90o  , +90o ]
    - Mean anomaly M [rad] at epoch time to is [24 bits]
      * Range: [0, 2π]
* FFS: Additional enhancement to optimize the signalling overhead.
* FFS: Ephemeris format bit allocations for HAPS

## Enhancements on HARQ

Agreement:

For DCI indicating SPS PDSCH release, HARQ-ACK report is as in Rel-16.

Conclusion:

For DCI 0-0/1-0, no enhancement to support indication of more than 16 HARQ processes is considered in Rel-17.

## Others

Agreement:

Support polarization signalling for target serving cell in handover command message.

Agreement:

Support polarization signalling for non-serving cell in RRM measurement configuration.

# 3GPP TSG RAN WG1 Meeting #107-e

## Timing relationship enhancements

**Agreement**

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

**Agreement**

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

**Agreement**

For determining UE specific K\_offset

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

**Agreement**

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

**Agreement**

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

Proposal 3-A is endorsed as a basis to reply to RAN2 LS on TA pre-compensation (R1-2104230).

**Proposal 3-A:**

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

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

* *Event-triggers for reporting on the information about UE specific TA in connected mode is supported. FFS on the details. Confirmation by RAN1 is also needed*

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

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

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

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

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

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

**Agreement**

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

**Agreement**

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

R1-2112652 [DRAFT] LS reply on TA pre-compensation Moderator (Ericsson)

Final LS endorsed in R1-2112766.

**Agreement**

The value range of cell specific K\_offset is 0 – 1023 ms.

**Agreement**

The value range of K\_mac is 1 – 512 ms.

**Agreement**

The value range of the differential UE specific K\_offset provided in MAC CE is 0 – 63 ms.

**Agreement**

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

**Agreement**

Adopt the following TP (38.213, 8.1):

For a PRACH transmission triggered by a PDCCH order, the PRACH mask index field [5, TS 38.212], if the value of the random access preamble index field is not zero, indicates the PRACH occasion for the PRACH transmission where the PRACH occasions are associated with the SS/PBCH block index indicated by the SS/PBCH block index field of the PDCCH order. If UE is provided with *Koffset*, for a PDCCH order received in downlink slot *n*, the available PRACH occasion is after uplink slot *n*+*Koffset*.

Note: Editor can make further adjustment as appropriate.

**Agreement**

On beam failure recovery procedure, for PRACH transmission in uplink slot n, UE monitors the corresponding PDCCH starting from downlink slot “n + K\_mac + 4” within a corresponding RAR window.

## Enhancements on UL time and frequency synchronization

**Agreement**

The serving satellite ephemeris and common TA related parameters are signalled in the same SIB message and have the same epoch time.

**Agreement**

A single validity duration for both serving satellite ephemeris and common TA related parameters is broadcast on the SIB.

**Working assumption**

Higher-layer parameters TACommon, TACommonDrift, TACommonDriftVariation and [TACommonThirdOrder] are indicated with the following range, granularity and bits allocation:

| **Parameter name** | **Value range** | **Granularity** | **Bits allocation** |
| --- | --- | --- | --- |
|  | 0 ...66485757  (i.e: 0… 270.73 ms) |  | **26 bits** |
| **TACommonDrift** | - 261935… + 261935  **(i.e: --53.33 … +-53.33 )** |  | **19 bits** |
| **TACommonDriftVariation** | 0…29470  **(0…0.60 )** |  | **15 bits** |
| **[TACommonThirdOrder]** | -4912…+4912  (-0.015 …+0.015 ) |  | **14 bits** |
| * **Value ranges are given in unit of corresponding granularity** | | | |

**Agreement**

NTN validity duration is configured per cell and indicated to the UE in X bits with:

* Value range { 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240~~, Infinity~~}
* Unit is second
* FFS (to be resolved in current meeting): Additional values for GEO

**Agreement**

Confirm the working assumption made at RAN1#106-bis-e on serving satellite ephemeris bit allocations for LEO/MEO/GEO based non-terrestrial access network:

* Support serving satellite ephemeris format bit allocations for LEO/MEO/GEO based non-terrestrial access network:
  + Position and velocity state vector ephemeris format is 17 bytes payload.
    - The field size for position (m) is 78 bits
      * Position range is driven by GEO : +/- 42 200 km
      * The quantization step is 1.3m for position
    - The field size for velocity (m/s) is 54 bits
      * Velocity range is driven by LEO@600 km: +/- 8000 m/s
      * The quantization step is 0.06 m/s for Velocity
  + Orbital parameter ephemeris format 18 byte payload
    - Semi-major axis α (m) is 33 bits
      * Range: [6500, 43000]km
    - Eccentricity e is 19 bits
      * Range: ≤ 0.015
    - Argument of periapsis ω (rad) is 24 bits
      * Range: [0, 2π]
    - Longitude of ascending node (Ω rad) is 21 bits
      * Range: [0, 2π]
    - Inclination i (rad) is 20 bits
      * Range: [- π/2 , + π/2]
    - Mean anomaly M (rad) at epoch time to is 24 bits
      * Range: [0, 2π]

**Agreement**

The reference point of the epoch time for assistance information (i.e. Serving satellite ephemeris and Common TA parameters) should be known by UE.

* FFS: the definition of the reference point

**Conclusion**

  is UE self-estimated TA to pre-compensate for the service link delay, which is calculated using the UE position and the serving satellite ephemeris.

* How the UE calculates/updates NTA, UE-specific is left to UE implementation.

**Agreement**

Using indicated Higher-layer Common TA parameters, if configured, the UE can determine the one-way propagation time ( used for  calculation as follows:

Where:

* , and
* TACommon, TACommonDrift and TACommonDriftVariation are Common TA parameter defined in RAN1 Meeting #106-bis-e
* is the distance between the satellite and the uplink time synchronization reference point divided by the speed of light. DL and UL are frame aligned at the reference point with an offset given by **.**
* is derived by the UE based on to pre-compensate the two-way transmission delay between the uplink time reference point and the satellite.

**Agreement**

Confirm the Working assumption on granularity and bits allocation for Common TA parameters: Value range, granularity and bits allocation of Higher-layer parameters TACommon, TACommonDrift, TACommonDriftVariation are as follows:

| **Parameter name** | **Value range** | **Granularity** | **Bits allocation** |
| --- | --- | --- | --- |
|  | 0 ...66485757  (i.e: 0… 270.73 ms) |  | 26 bits |
| TACommonDrift | - 261935… + 261935  (i.e: --53.33   … +-53.33 ) |  | 19 bits |
| TACommonDriftVariation | 0…29470  (0…0.60 ) |  | 15 bits |
| * Value ranges are given in unit of corresponding granularity | | | |

**Agreement**

* When explicitly provided through SIB, Epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is the starting time of a DL sub-frame, indicated by a SFN and a sub-frame number signaled together with the assistance information.
* Otherwise, when 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 SI message is transmitted.
* When provided through dedicated signaling, epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is the starting time of a DL sub-frame, indicated by a SFN and a sub-frame number.

**Agreement**

The reference point for epoch time of the serving satellite ephemeris and Common TA parameters is the uplink time synchronization reference point.

Working assumption:

When TAC () in msg2/msgB is received, UE receives the first adjustment and is updated as:

* Option 1: .

Where, is the TAC field in msg2/msgB

**Conclusion**

DL frequency compensation by gNB for the service link Doppler is not supported in Release 17.

## Enhancements on HARQ

**Agreement**

The bit-fields related to the HARQ-ACK feedback (i.e., PRI, PUSCH-to-HARQ\_feedback timing, DAI) are unchanged for the DCI of PDSCH with feedback-disabled HARQ process in Rel-17 with the same interpretation from UE as for feedback-enabled HARQ process

* Note: The interpretation regarding the DAI for Type-2 codebook is up to the progress of codebook design.

**Agreement**

For Type-1 HARQ codebook, the UE will consistently report NACK-only for the feedback-disabled HARQ process regardless of decoding results of corresponding PDSCH.

**Agreement**

For Type-3 HARQ codebook in NTN, the UE should skip the codebook feedback for a feedback-disabled HARQ processes

Note: The Type-3 codebook size is reduced by excluding the bit positions of disabled HARQ processes

**Agreement**

HARQ feedback for SPS activation may be additionally enabled by the network by RRC configuration.

* If enabled, UE reports ACK/NACK for the first SPS PDSCH after activation, regardless of whether HARQ feedback is enabled or disabled corresponding to the first SPS PDSCH after activation
* Otherwise, UE follows configuration of HARQ feedback enabled/disabled corresponding to the first SPS PDSCH after activation,
  + FFS between Alt1 and Alt2
    - [Alt-1: UE follows the per-process configuration of HARQ feedback enabled/disabled for the associated HARQ process
    - Alt-2: UE follows the feedback-enabled/disabled configuration of the SPS PDSCH]

## Others

**Conclusion**

No consensus on the enhancement to support gNB dominant BWP switching based on prediction in NTN-NR R17.

**Conclusion**

Handling inter-service link interference is not considered in NTN-NR R17.

**Conclusion**

Handling inter-feeder link interference is not considered in NTN-NR R17.

**Conclusion**

It is up to gNB implementation to handle BWP\_inactivityTimer function, no enhancement is considered in NTN-NR R17.

**Conclusion:**

No further enhancement is considered for polarization signaling in NTN-NR R17.

No consensus on UE reporting polarization capability.

No consensus on UE behavior for selecting polarization mode for DL reception and UL transmission.

# Reference

|  |  |
| --- | --- |
| 1. RP-211557 Solutions for NR to support non-terrestrial networks (NTN) revised WID 2. 3GPP TSG RAN WG1 Meeting #102-e RAN1 Chairman’s Notes 3. 3GPP TSG RAN WG1 Meeting #103-e RAN1 Chairman’s Notes 4. 3GPP TSG RAN WG1 Meeting #104-e RAN1 Chairman’s Notes 5. 3GPP TSG RAN WG1 Meeting #104b-e RAN1 Chairman’s Notes 6. 3GPP TSG RAN WG1 Meeting #105-e RAN1 Chairman’s Notes 7. 3GPP TSG RAN WG1 Meeting #106-e RAN1 Chairman’s Notes 8. 3GPP TSG RAN WG1 Meeting #106b-e RAN1 Chairman’s Notes 9. 3GPP TSG RAN WG1 Meeting #107-e RAN1 Chair’s Notes 10. R1-2007074 Feature lead summary on timing relationship enhancements Moderator (Ericsson) 11. R1-2007290 Feature lead Summary on enhancements on UL time and frequency synchronization for NR NTN Moderator (Thales) 12. R1-2007311 Summary#3 of AI 8.4.3 for HARQ in NTN Moderator (ZTE) 13. R1-2007233 Summary#4 of 8.4.4 Other Aspects of NR-NTN MediaTek Inc. 14. R1-2009733 Feature lead summary#4 on timing relationship enhancements Moderator (Ericsson) 15. R1-2009697 FL Summary on enhancements on UL time and frequency synchronization for NR NTN Moderator (Thales) 16. R1-2009657 Summary #2 of AI 8.4.3 for HARQ for NTN Moderator (ZTE) 17. R1-2009736 Summary #4 of 8.4.4 Other Aspects of NR-NTN MediaTek Inc. 18. R1-2102078 Feature lead summary#4 on timing relationship enhancements Moderator (Ericsson) 19. R1-2102215 FL Summary on enhancements on UL time and frequency synchronization for NR NTN Moderator (Thales) 20. R1-2102143 Summary#4 of AI 8.4.3 for HARQ in NTN Moderator (ZTE) 21. R1-2102141 Summary #3 of 8.4.4 Other Aspects of NR-NTN Moderator (OPPO) 22. R1-2104099 Feature lead summary#5 on timing relationship enhancements Moderator (Ericsson) 23. R1-2104076 Feature lead summary #5 on enhancements on UL timing and frequency synchronization Moderator (Thales) 24. R1-2106325 Feature lead summary#5 on timing relationship enhancements Moderator (Ericsson) 25. R1-2106290 FL Summary on enhancements on UL time and frequency synchronization for NR NTN Moderator (Thales) 26. R1-2106269 Summary#4 of AI 8.4.3 for HARQ in NTN Moderator (ZTE) 27. R1-2106336 Final Summary of 8.4.4 Other Aspects of NR-NTN Moderator (Oppo) 28. R1-2108555 Feature lead summary#5 on timing relationship enhancements Moderator (Ericsson) 29. R1-2108587 FL Summary #7 on enhancements on UL time and frequency synchronization for NR NTN Moderator (Thales) 30. R1-2108511 Summary#2 of AI 8.4.3 for HARQ in NTN Moderator (ZTE) 31. R1-2108517 Summary #3 of 8.4.4 Other Aspects of NR-NTN Moderator (OPPO) 32. R1-2110602 FL Summary #6 on enhancements on UL time and frequency synchronization for NR NTN (Thales) 33. R1- 2112716 Feature lead summary#5 on timing relationship enhancements (Ericsson) 34. R1-2111127 FL Summary #4 on enhancements on UL time and frequency synchronization for NR NTN (Thales) 35. R1-2112664 Summary#3 of AI 8.4.3 for HARQ in NTN Moderator (ZTE) 36. R1-2112532 RAN1-107-e-NWM-NR-NTN-04 - Version 0.0.5 (OPPO) | |
|  |  |