3GPP RAN WG2 Meeting #111e R2-2008214

August 17th – 28th, 2020

Agenda Item: 8.10.2.1

Source: InterDigital (email discussion Rapporteur)

Title: Summary of [AT111][107][NTN] Pre-compensation and other MAC issues Phase 2

Document for: Discussion, Decision

# Introduction

This document is a continuation of offline discussion [AT111][107][NTN] Pre-compensation and other MAC issues. Companies are encouraged to refer to the Phase 1 summary in R2-2008188 for further background on the contents of this discussion. Phase 2 has been given the following scope:

* [AT111][107][NTN] Pre-compensation and other MAC issues (InterDigital)
* Updated scope: Continue the discussion on proposals in [R2-2008188](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip) and specifically:
  + - Check whether the "FFS for UL" in meeting agreement #4 can be resolved. Also check whether an LS can be sent to RAN1 regarding RAN2 agreements on disabling HARQ feedback (proposal 23 in [R2-2008188](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip))
    - Check whether a "RAN2 Working Assumption" (to be further checked with RAN1) can be reached on (a revision of) proposals 1, 2 and 3 in [R2-2008188](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip)
    - Check whether any other proposals can be agreed from the lists "Seems agreeable" and "Require discussions" in [R2-2008188](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip)
* Final intended outcome: summary of the offline discussion with e.g.:
  + - List of proposals for agreement
    - List of proposals that require online discussions

Please note the following deadlines have also been provided:

* Final deadline (for companies' feedback): **Thursday 2020-08-27 00:00 UTC**
* Final deadline (for rapporteur's summary in R2-200814):  **Thursday 2020-08-27 06:00 UTC**

The following deadline is also provided by the Chair regarding agreements made by email:

* Proposals marked "for agreement" in R2-2008214 not challenged until **Thursday 2020-08-27 18:00 UTC** will be declared as agreed by the session chair. For the rest the discussion might continue in the CB online session on Friday 2020-08-28.

# Discussion

## FFS on agreement regarding disabling HARQ feedback

The following objective has been listed for Phase 2:

*Check whether the "FFS for UL" in meeting agreement #4 can be resolved. Also check whether an LS can be sent to RAN1 regarding RAN2 agreements on disabling HARQ feedback (proposal 23 in* [***R2-2008188***](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip)*)*

From TR 38.821, Section 7.2.1.4, the following clarification is made regarding disabling HARQ feedback:

*For NTN the network could disable uplink HARQ feedback for downlink transmission at the UE receiver e.g. to support long propagation delays. Even if HARQ feedback is disabled, the HARQ processes are still configured. Enabling / disabling of HARQ feedback is a network decision signalled semi-statically to the UE by RRC signalling. The enabling / disabling of HARQ feedback for downlink transmission should be configurable on a per UE and per HARQ process basis via RRC signalling.*

*For NTN the network could disable HARQ uplink retransmission at the UE transmitter. Even if HARQ uplink retransmissions are disabled, the HARQ processes are still configured. The enabling / disabling of HARQ uplink retransmission could be configurable on a per UE, per HARQ process and per LCH basis. Details can be decided in a normative phase.*

Therefore considering the clarification provided by the TR, companies are asked to provide input on the following:

**Question 1: Do you agree with the following clarification to Agreement 4?:**

***“From a RAN2 perspective, HARQ feedback for downlink transmission and HARQ uplink retransmission can be enabled/disabled at UE receiver in Rel-17 NTN, but HARQ processes remain configured. The criteria and decision to enable/disable HARQ feedback is under network control and is signalled to the UE via RRC in a semi-static manner.”***

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Additional Comments |
| MediaTek | Agree | This was already discussed and agreed during the Study Item |
| Huawei | Agree | In the current NR mechanism, there’s no “DL HARQ feedback” for UL transmission. Therefore, HARQ disable for UL transmission means “disabling retransmission” rather than “disabling feedback”. |
| Lenovo | Agree | We better stick to the TR description to avoid confusion, i.e. the disable/enable is for:  (1)Uplink HARQ feedback for downlink transmission at the UE receiver;  (2)HARQ uplink retransmission at the UE transmitter |
| OPPO | Agree for DL,  Agree for UL with clarification | We think the intention for UL is to disable UL HARQ retransmission based on PUSCH decoding result in order to avoid HARQ stalling, i.e. it is not to disable the whole UL HARQ retransmission at all. For a UL HARQ process with disabled UL HARQ retransmission based on the PUSCH decoding, retransmissions of the TB in a bundle or based on blind scheduling should also be supported to lower the residual BLER, which depends on network implementation.  So we suggest to revise the wording as following.  *“From a RAN2 perspective, HARQ feedback for downlink transmission and HARQ uplink retransmission based on PUSCH decoding result can be enabled/disabled at UE receiver in Rel-17 NTN, but HARQ processes remain configured. The criteria and decision to enable/disable HARQ feedback is under network control and is signalled to the UE via RRC in a semi-static manner.”* |
| APT | Agree | As a reference, disabling on HARQ-ACK for DL transmission has been agreed in RAN1. The one for UL retransmission is still pending.  **Agreement** in RAN1#102-e:  Enabling/disabling on HARQ feedback for downlink transmission should be at least configurable per HARQ process via UE specific RRC signalling |
| Nokia | Agree for DL | In DL, gNB may schedule HARQ retransmission relying on UE's HARQ feedback.  In UL, as the retransmission usually depend on gNB's PUSCH decoding result of initial transmssion (instead of any feedback from UE), gNB may schedule HARQ retransmission replying on the reception of previous PUSCH transmission in the same HARQ process.  So, we propose the agreement should cover DL and UL in seperate way:   * From a RAN2 perspective, for DL, HARQ feedback can be enabled/disabled in Rel-17 NTN, but HARQ processes remain configured. The criteria and decision to enable/disable HARQ feedback is under network control and is signalled to the UE via RRC in a semi-static manner. * From a RAN2 perspective, for UL, HARQ retransmission replying on the reception of previous PUSCH transmission in the same HARQ process can be enabled/disabled in Rel-17 NTN, but HARQ processes remain configured. The criteria and decision to enable/disable HARQ retransmission replying on the reception of previous PUSCH transmission in the same HARQ process is under network control and is signalled to the UE via RRC in a semi-static manner. |
| Sony | Agree | “receiver” in “UE receiver” is ambiguous so we suggest to remove it |
| LG | Agree | Same view as Lenovo. |
| Qualcomm | Agree | At this point, we suggest to keep it high level as proposed by rappeurter. Details need further discussion. We are fine to remove “UE receiver” as this is not necessary. |
| Samsung | Agree | We suggest a minor change from “at UE receiver” to “for the UE” (because the UE will “transmit” HARQ feedback and HARQ UL retransmissions). |
| ZTE | Agree for DL | It is unclear to us how to understand the disabling of retransmission in UL. According to current specs, when slot aggregation is configured, there will be follow-up HARQ retransmissions after initial transmission. Does it disabling HARQ retransmission also means no slot aggregation is allowed in the UL? We think the uplink case needs further discussion, and prefer to postpone it to next meeting. |
| Panasonic | Agree | We agree with Lenovo:   * HARQ feedback for downlink transmission can be enabled/disabled at UE receiver * HARQ uplink retransmission can be enabled/disabled at UE transmitter |
| ETRI | Agree for DL | We think it should be separated into a enabling/disabling feedback for DL and retransmission scheme (e.g. slot agreegation) for both DL and UL. |
| Nomor | Agree, but | From our perspective, HARQ uplink retransmission is related to UE transmitter, therefore we would delete “receiver” in “UE receiver”.  We are also fine with Nokia’s proposal to cover DL and UL in a separate way. |
| Apple | Agree for DL | Agree with Nokias views. |
| Loon/Google | Agree |  |
| Ericsson | Agree for DL | Similar view as ZTE. For UL there is probably no change neede besides not starting drx-HARQ-RTT-TimerUL. |

**Question 2: Do companies support sending an LS to RAN1 regarding RAN2 agreements on disabling HARQ feedback?**

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| --- | --- | --- |
| Company | Yes/No | Additional Comments |
| MediaTek | Yes | RAN2 should send an LS to RAN1 regarding RAN2 agreements on disabling Dl HARQ feedback and UL HARQ retransmissions semi-statically. |
| Huawei | Yes | RAN1 is also discussing disabling HARQ, it’s better to inform them. |
| Lenovo | Yes | RAN1 should be informed. |
| OPPO | Yes with comments | RAN2 should inform RAN1 of RAN2 agreements on configuration of disabling HARQ feedback for DL and HARQ retransmission for UL. |
| APT | Yes | RAN1 should be informed to progress on HARQ UL retransmission |
| Nokia | No stroing view |  |
| Sony | Yes |  |
| LG | No strong view | RAN1 may refer the RAN2 decision. |
| Qualcomm | Yes | Ok but this LS can also include any other relevant agreements. |
| Samsung | Yes |  |
| ZTE | No | RAN1 is the leading WG for HARQ discussion, and as point ou t by APT they’ve already make the following agreements:  Enabling/disabling on HARQ feedback for downlink transmission should be at least configurable per HARQ process via UE specific RRC signalling  It seems an LS is unnecessary at this stage. |
| Panasonic | No strong view |  |
| ETRI | No strong view |  |
| Nomor | No strong view |  |
| Apple | Yes |  |
| Loon/Google | No |  |
| Ericsson | No strong view |  |

## RAN2 working assumption on pre-compensation

A second objective listed for Phase 2 is the following:

*Check whether a "RAN2 Working Assumption" (to be further checked with RAN1) can be reached on (a revision of) proposals 1, 2 and 3 in* [***R2-2008188***](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip)

In the Rel-17 NTN WI, it is assumed that a transparent or “bent-pipe” configuration will be deployed, where the gNB is located on the ground and a satellite relays signalling between the gNB and the UE. This configuration is comprised of two portions of propagation delay: that associated with the connection between the gNB and satellite, defined as the “feeder-link” and that between the UE and satellite, defined as the “service link”. The feeder-link delay component is common to all UEs served by the cell, whereas the **service link delay** **between the UE and satellite** can be further broken down into two components:

* a common delay, representing the minimum delay from the satellite to the ground (i.e. the propagation delay between the satellite and a reference point such as the cell or beam centre) and;
* a UE-specific delay, based on the UE-specific distance to the reference point.

From the reference scenarios listed in the TR, the NTN maximum round trip propagation delay (including service and feeder link) is 27.77ms for LEO with 600km orbit and 541.46ms for GEO. The possible range of differential delay (i.e. difference between UEs at cell/beam edge and cell/beam center) are 3.12ms for LEO with 600km orbit, to 10.3 ms for GEO with 3500 km.

In case gateway precompensates the feeder link delay, i.e., timing reference is at satellite, UE needs to consider only the service link delay, i.e., between UE and satellite.

From the email discussion, the following two solutions for delay compensation had the most support in case gateway doesnot precompensate the feeder link delay:

1. *Common delay compensation*, where the delay includes the feeder link delay + delay from the satellite to a reference point (for example, the center of a beam/cell). This delay is broadcast by the network, and the UE will use this value for timing pre-compensation.
2. *UE-specific delay compensation*, where the delay includes the feeder-link delay + UE specific delay calculated by the UE via e.g. distance from the UE to the satellite. The feeder link delay will be broadcast, and the UE will add the calculated UE-specific value to obtain the full RTD for timing pre-compensation.

Before further discussion, it is beneficial to ensure there are no technical constraints that would preclude one or both of the above methods. Note: in the WID it is assumed that the UE will have GNSS capability.

**Question 3: Do companies agree that both solutions are valid methods of obtaining at least a portion of propagation delay? i.e. is there any technical constraint which prohibits the network from broadcasting either delay value, or in the UE calculating its UE specific delay assuming it has UE location information and satellite ephemeris?**

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| --- | --- | --- |
| Company | Agree/Disagree | Additional Comments |
| MediaTek | Disagree | Option 1 will not work for NTN, as UE-precompensation of Doppler is needed for uplink frequency synchronization. In LEO scenarios, the Doppler due to satellite movement can be several tens of kHz.  Hence, we prefer Option 2, i.e. UE-based pre-compensation, as it enables both delay and Doppler pre-compensation. |
| Huawei | Agree, but | The “both solutions” in the question seem to refer to 1) network broadcasting a delay value, and 2) UE calculating its specific delay.  If this interpretation is correct, then both solutions are valid.  However, in the background statement, the two solutions provided are:  1) a common delay including feeder link + service link, with a reference point, and,  2) a broadcasted delay of the feeder link, plus UE calculated delay for the service link.  If this is the intention, then we are not sure whethter option 1 is workable. It remains unclear how to set the reference point, and how the UE will use the delay associated to reference point to obtain the real delay to be employed in MSG1 transmission. |
| Lenovo | Only agree Option 2 | We see no need to introduce “common” delay which may have different contents and thus different understanding. A better and clear way is Option 2, i.e. to use feeder link delay (indicated by network) and service link delay (calculated by UE from its location and ephemeris).  For Option 1, if common delay includes “feeder link delay + delay from the satellite to a reference point”, both cases are not workable:  If UE uses the indicated value of common delay for pre-compensation, the maximum differential delay in a cell is still out of the range of legacy TA adjustment via RAR.  If UE additionally derives UE-specific service link delay, it needs to know the value of “delay from the satellite to a reference point”, which means that“feeder link delay” and “delay from the satellite to a reference point” should be indicated separately, making it a more complex method than Option 2 (extra indication and calculation). |
| OPPO | Agree | We think both solutions should be supported.  Given that UE may not always obtain its location information based on its GNSS capability, solution 1 should be supported for the UE without capability of TA pre-compensation, while for the UE with capability of TA pre-compensation, solution 2 is preferred which could avoid preamble ambiguity and RAR window extension. |
| APT | Agree | Support Option2. For initial access only, both are valid.  *Common delay compensation* may have less RACH capacity due to the possible range of differential delay, e.g., 3.12ms for LEO-600km. It can be handled by NW implementation, e.g., giving some time gap. |
| Nokia | Depends on RAN1 evaluation | For both proposal1 and proposal2, network has to broadcast common delay (i.e. feeder link delay or feeder link delay+delay from satellite to reference point), which means network has to calculate the delay based on emphmeris data. For proposal2, UE will calculate UE-specific delay based on UE’s GNSS location info and satellite’s emphmeris data.  We think the estimation accuracy need to be addressed first before RAN2 accept the proposals, i.e. whether the information is sufficiently accurate to ensure that nothing is broken when UE attempts to access the system? There are several sources of inaccuracy to be considered, such as: delay (lag) of ephemeris information, precision of ephemeris data, GNSS innacuracy (location), orbit perturbartion and altitude modelling.  We understood the UL timing pre-compensation discussion in RAN1 AI 8.4.2 is ongoing and the solution feasiblity should be decided by RAN1.  Furthermore, the common delay will change consecutively with the movement of satellite, the impact of satellite movement to delay should be addressed as well(e.g. how to broadcast the common delay to UE efficiently). |
| Sony | Agree |  |
| LG | Disagree | Even if it is assumed that the UE supports the GNSS, we do not want to specify the UE-specific delay compensation. This is because geneallly the common delay compensation is applicable to a UE with/without GNSS.  In addition, considering that usually RAN2 specify only one solution in order to solve a issue, we are not sure that two solution for compensation should be consided. With this reason, it is still questionable whether RAN2 should specify two solutions for the compensation issue or not.  Thus, we think that the common delay compensation is enough for the UE with/without GNSS. |
| Qualcomm | Disagree | We assume according to WID, UE with GNSS capability is assumed so UE can calculate distance between UE and satellite. The option1 is simply not mandated by WID.  Now, if timing reference is at gateway, then network should also broadcast common feeder link delay, i.e., Only option 2 is needed.  If timing reference is at satellite, then only UE specific TA is sufficient. |
| Samsung | Agree | We support both (i) the network-centric delay compensation where the network provides delay(s) to the UEs and (ii) the UE-centric delay compensation where the UE estimates overall delay between the UE and the gNB. There could be some components of delay common to (i) and (ii) depending upon exactly what is broadcast and what is pre-compensated. Furthermore, there could be some non-propagation delays (e.g., NTN GW processing delays) which may or may not be reflected in the UE’s estimate or the gNB estimate. This discussion is also influenced by the ephemeris (both long-term and dynamic) information that would be broadcast by the gNB. Hence, we suggest a careful study of end-to-end delays between the UE and the gNB. |
| ZTE |  | We think the technical constraint should be discussed in RAN1. Either way is possible from RAN2’s point of view. |
| Panasonic | Disagree | We interpret the difference of the options are how service link delay is calculated. In both options, our view on the feeder link delay is that actual delay is not compensated by the broadcast information but the delay of the reference point in the network is compensated as the actual feeder link delay varies as LEO satellite moves. For GEO, this could be actual feeder link delay.  For service link delay, our view is option 1 is not sufficient as the service link delay of the reference point and the service link delay of the actual UE location can be so different and likely to be longer than PRACH CP length. Therefore, Option 2 is required based on the calculation using GNSS capability. |
| ETRI | Agree | We think the common delay compensation can be adopted in a network that can handle differential delays between the common delay and actual delays of UEs. |
| Eutelsat | Disagree | Agree with Mediatek: option 2 needed, at least for LEO |
| Nomor | Disagree | We understood, option 1 applies only a network broadcasted delay value and no UE specific delay. This means that Option 1 will not work without modification of legacy TA adjustment via RAR due to the large differential delay in NTN.  Therefore, we support Option 2. |
| Apple | Agree | For initial access only Option 1 is ok but will need UE specific adjustment subsequently. |
| Loon/Google | Agree | Option 1 will work for HAPS. We believe it is beneficial to have both options |
| Ericsson | Disagree | We need RAN1 evaluation of the accuracy of these methods. |

Furthermore, Phase 1 discussed possible scenarios where a common delay may be sufficient, for example, small LEO cells with minimal differential delay.

**Question 4: Does a UE always needs UE-specific pre-compensation to function in an NTN environment, regardless of NTN deployment characteristics (e.g. cell/beam diameter)?**

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| --- | --- | --- |
| Company | Yes/No | Additional Comments |
| MediaTek | Yes | UE always needs UE-specific pre-compensation for delay and Doppler, regardless of NTN deployment characteristics (e.g. cell/beam diameter). |
| Huawei | Yes | UE specific offset can avoid issues caused by differential delay (e.g. preamble ambiguity, extension of RAR window). |
| Lenovo | Yes | The round-trip delay can be more than 6 times as much as the maximum TA compensated via MAC RAR (12.89ms versus 2ms). Even if a common service link TA in an NTN cell can be provided in SIB or compensated at network side, the maximum differential delay within a cell is still out of the range of TA compensation via MAC RAR (3.12ms~10.3ms versus 2ms). |
| OPPO | No | See our reply in Q3. We understand solution 2 can work in all NTN deployment scenarios, as long as UE has available location information. However, this does not require UE to always use solution 2 since UE location may not always be available. |
| APT | Yes | If UE UE-specific pre-compensation can be accurate within 50 𝜇𝑠 for PRACH CP length of 103 , no preamble receiving window is needed for NW. This simplifies gNB implementation. |
| Nokia | Yes if UE has pre-compensation capability | If UE has the pre-compensation capability with enough accuracy, we see no reason why exclude the UE-specific pre-compensation. It’s better to have an unified solution regardless of NTN deployment characteristics. |
| Sony | Yes |  |
| LG | No | The UE-specific pre-compensation can be performed only for the UE with GNSS. Moreover, if the common delay is applied, we do not need to discuss the UE-specific pre-compensation. This is because if the UE receives the common delay from the network, the UE just applies the common delay for TA and offset. |
| Qualcomm | Yes | Agree with MediaTek. |
| Samsung | No | For HAPS, the UE can probably function with only the common delay compensation and without UE-specific pre-compensation, because the existing R16 TA mechanism can help with fine-tuning of the delay. For non-HAPS (including LEOs) scenarios, the UE-specific compensation would be more important, which can be done in a variety of ways (FFS) (e.g., an adjustment relative to the common delay). |
| ZTE | Depends | It depends on the requirement on the accurancy of TA pre-compensation, and this should be discussed in RAN1. |
| Panasonic | Yes | Regardless of NTN deployment charecterisitcs, UE always need UE specific pre-compensation. |
| ETRI | Yes |  |
| Eutelsat | Yes |  |
| Nomor | Yes | Agree with Huawei |
| Apple | Yes |  |
| Loon/Google | No | In some situations, such as HAPS, beam based compensation is sufficient. |
| Ericsson | Yes |  |

It was further pointed out in comments, if only common delay solution is adopted, there may be issues such as preamble ambiguity or necessity for ra-ResponseWindow extension due to large differential delay in GEO deployments.

**Question 5: Do companies agree there are deployment scenarios (e.g. GEO) where compensating only the common delay (feeder link delay + satellite to reference point delay) may not be fully adequate?**

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Additional Comments |
| MediaTek | Agree | Only common delay is not enough. UE always needs to estimate UE-specific delay. |
| Huawei | Agree | As commented in Question 3, we are not sure whether the reference point solution is feasible. |
| Lenovo | Agree | See reply for Question 4. |
| OPPO | Agree | See our reply to Q3. |
| APT | Agree | The maximum differential delay is 10.3 ms for GEO with 3500 km. UE-specific pre-compensation is preferred. |
| Nokia | - | We are not sure what the exact mean of “fully adequate”. Yes, we agree that if UE only pre-compensate common delay, there will have preambole ambiguity and need to extend ra-ResponseWindow due to differential delay. |
| Sony | Agree | We think that network needs to broadcast the common delay and UE will have a compensation capability and may need to perform RA procedure for getting the exact value. |
| LG | Agree | RAN2 would need to estimate an impact, e.g., the extension of the RAR window. |
| Qualcomm | Agree | UE needs to keep tracking the time and frequency offset in service link. |
| Samsung | Agree | The distance difference between the reference point (e.g., cell center) and the current UE location can be used (e.g., via TA or UE-satellite distance) can be used to address this concern. |
| ZTE | Agree | For GEO case only common TA is not sufficient. |
| Panasonic | Agree | UE also needs to consider UE specific delay along with common delay. |
| ETRI | Agree | It is not appropriate due to large differential delays. |
| Eutelsat | Agree | UE needs to estimate UE-specific delay. |
| Nomor | Agree | See our reply to Q3 |
| Apple | Agree | However, common delay only can be useful for initial access and in scenarios of non-GNSS capable UEs. |
| Loon/Google | Agree | Agree that there some deployment scenarios where compensating only the common delay is not sufficient. |
| Ericsson | Agree |  |

**Question 6: If “Agree” to Question 5, would the network be aware of when these scenario(s) occur?**

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| --- | --- | --- |
| Company | Yes/No | Additional Comments |
| MediaTek | No | This complicates the network. We prefer a common solution that works regardless of the deployment scenario and does not depend on satellite parameters, e.g. orbit height, beam footprint size, elevation angle etc. |
| Huawei |  | We should first figure out how to set the reference point, and how the UE will use the delay associated to reference point to obtain the real delay to be employed in MSG1 transmission.  After the whole procedure is clear, if there’s any innate drawback, the network will know beforehand, without being notified. |
| OPPO | Yes | Network can be aware of the deployment scenarios and decide whether common TA compensation or UE-specific TA compensation should be used by the UE. |
| APT | Yes | Beam/cell size shall be aware by NW |
| Nokia | No, but | If this solution is adopted, network will cover all the UEs in the cell no matter of its differential delay, by the extension of ra-ResponseWindow and preamble receiving window. |
| Sony | No | Network and UE can anyway compensate after RACH procedure e.g. in RAR. |
| Qualcomm | No | Not clear on the question but network can assume UE precompensated UL timining as expected. |
| Samsung | Yes | The network, based on “NTN Type” and supporting information such as the altitude, can determine how to support pre-compensation. |
| ZTE | Yes | Network is fully aware of the coverage and deployment of different scenarios. |
| Panasonic | No | We prefer unified solutions regardless of NTN deployment scenario. |
| ETRI | No | UE can notice the deployment scenarios based on information from a network. |
| Eutelsat | No | Agree with Mediatek. |
| Nomor | No | Agree with Nokia |
| Apple | No | Agree with Nokia |
| Ericsson | No | Agree with Nokia |

In Phase 1, the following compromise solution was proposed: Network may broadcast either feeder-link delay or common delay to reference point based on network implementation, possibly considering scenario or deployment (e.g. cell size). Network may as well configure UE to add UE-specific offset, for example, if it is broadcast feeder-link delay. UE-specific offset is calculated by UE based on UE-satellite location, which is then added to feeder link delay broadcast by NW to obtain full RTD compensation. Such a solution would allow NW to support both option 1 and option 2+3 based on implementation.

The following questions are to evaluate the feasibility of this solution:

**Question 7: Assuming the network is capable of determining/broadcasting both feeder-link delay and common delay (feeder link + satellite to reference point), how should broadcasting this value be implemented?:**

* **Option 1: A “delay” value is broadcast, and network selects which value (e.g. feeder link delay or feeder link delay + satellite to reference point delay) to broadcast based on deployment scenario;**
* **Option 2: Two different parameters: one for common delay (feeder link delay + satellite to reference point) and one for feeder link delay only.**
* **Option 3: Other, please describe in “Additional Comments” section**

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| --- | --- | --- |
| Company | Option | Additional Comments |
| MediaTek | Option 1 / Option 2 | We prefer network to broadcast the feeder link delay. Assuming UE-specific precompensation of delay and Doppler, both Option 1 and Option 2 could work, as long as UE ignaling is clarified. |
| Huawei | Option 3 | Still, we are not sure how the reference point solution works. We prefer to let the network broadcast the common delay for feeder link only. |
| Lenovo | Option 3 | We see no need to introduce “common” delay. But if companies insist, we think separate indication is needed. And this introduces extra indication and calculation than the method of “feeder link delay (indicated by network) + service link delay (calculated by UE from its location and ephemeris)”. |
| OPPO | Option 2 | See our reply to Q3. Option 2 is to serve for both solution 1 and 2. |
| APT | Option 2 | Option 2 has a simpler interaction with the UE-specific offset calculated by UE than Option 1. |
| Nokia | Option3 | Due to satellite movement in LEO scenarios, the common delay need to be updated regularly to handle longer and varying delays in different deployments. If network broadcast static “delay value” as proposed by option1 and option2, the common delay update will result in significant control overhead. It is FFS to decide other efficient broadcast signalling (e.g. broadcast delay function/table instead of delay value) |
| Sony | Option 1 | We don’t see a reason for having two values |
| LG | Option 1 | Option 1 is enough. |
| Qualcomm | Option 3 | The service link delay needs to be updated continuously but this is not needed if UE is capable of GNSS. Simply network can provide a common offset (that can also be used for scheduling). |
| Samsung | Other | In principle, we agree that these are important parameters.  We request a careful study of end-to-end delays between the UE and the gNB including processing delays such as non-propagation delays (e.g., NTN GW processing delays). We need to specify what delay is addressed by the gNB and what delay needs to be compensated by the UE. This discussion is also influenced by the ephemeris (both long-term and dynamic) information that would be broadcast by the gNB. We note that “minimum” delays are important in some cases (e.g., for scheduling) and “maximum” delays are important in some cases (e.g., to determine an upper limit for time/timer-based parameters). |
| ZTE |  | For us, this is somehow related to outcome of Q4, we’d like to postpone the discussion until we have clear view on the answers to related questions. |
| Panasonic | Option 1 | Indication of one value would be sufficient. UE just add the indicated value to the TA value calculated based on GNSS and satellite ephemeris. How much compensate for feeder link and/or reference point is up to network implementation. |
| ETRI | Option 3 | We prefer to have two different parameters : one for feederlink delay and one for servicelink delay. We think it is close to a stage 3 issue. |
| Eutelsat | Option 1 or 2 | Option 1 preferred. Study may be needed to avoid disruption when obtaining new feeder link delay in case of hard switchover. |
| Nomor | Option 3 | We prefer the network to broadcast the feeder link delay only. |
| Apple | Option 2 |  |
| Loon/Google | Option 1 | Both options 1 and 2 can be made to work, but option 1 seems more straight forward |
| Ericsson |  | We need to wait for RAN1 evaluation of accuracy of these methods before deciding which to go with. |

**Question 8: If the ability to broadcast both a common delay and feeder link delay is supported, how should a UE know when to add UE-specific compensation (e.g. calculated via UE-satellite location) to the received value?:**

* **Option 1: UE is explictely configured by network to add a UE-specific delay to the feeder link delay.**
* **Option 2: UE determines implicitely (e.g. based on scenario, or broadcast delay type (common or feeder link)).**
* **Option 3: Other, please describe in “Additional Comments” section.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Additional Comments |
| MediaTek | Option 3 | We disagree with the question itself.  As mentioned in response to Question 4, UE always needs UE-specific pre-compensation for delay and doppler, regardless of NTN deployment characteristics (e.g. cell/beam diameter). |
| Huawei | Option 3 | Agree with MediaTek. |
| Lenovo | Option 3 | Agree with MediaTek and Huawei. |
| OPPO | Option 3 | We understand the rapporteur’s assumption is that feeder link delay is not compensated at network side. We think RAN2 should confirm this understanding or whether to consider NW compensated solutions.  Under the assumption that feeder link delay is not compensated at network side:  For a UE which has its location information and satellite ephemeris, if feeder link delay is broadcasted, the UE would add the estimated UE-specific delay to the feeder link delay to obtain the full TA for timing pre-compensation. If feeder link delay is not broadcasted (i.e. only common TA is broadcasted), the UE should use the broadcasted common TA for timing pre-compensation. |
| APT | Option 1 | Option 1 has simpler interaction with the UE-specific offset calculated by UE than option 2. |
| Nokia | Option3 | From network point of view, we don’t understand the background why system need to support Common delay compensation and UE-specific delay compensation simultanesouly if UE has pre-compensation capability. E.g. in this case, network only need to support UE-specific delay compensation.  If the system will support both UE with pre-compensation and without pre-compensation capability, we agree that both Common delay compensation and UE-specific delay compensation should be supported. However, it is too early to decide how to design the signalling. |
| Sony | Option 1 |  |
| LG | Option 1 | The UE just applies the common delay for TA and offset as it is. |
| Qualcomm | Option 3 | We think UE should always calculate UE specific compensation. We are not clear why network needs to control whether UE can apply UE specific TA or not in UL timing. |
| Samsung | 2 and 3 | Since the UE has to contact the network by sending a RA preamble before it can obtain configirations via a dedicated ignalling message, at least some information needs to be broadcast to facilitate the UE’s pre-compensation approach. The “implicit” here, from our perspective, utilizes at least some information based on the broadcast of “System Information.” |
| ZTE |  | As commented in Q7, we think this is related to outcome of other questions related to the whole pre-compensation design. |
| Panasonic | Option 3 | UE always needs UE specific pre-compensation regardless of NTN deployment scenario. |
| ETRI | Option 3 | See our reply in Q.7 |
| Eutelsat | Option 3 | Agree with Mediatek |
| Apple | Option 1 | Which is applicable to initial access. |
| Loon/Google | Option 1 |  |
| Ericsson | Option 3 | Agree with Nokia |

Several companies from Phase 1 also mentioned that satellite movement in LEO scenarios may impact the accuracy fo the common delay value.

**Question 9: Do you agree with the following proposal?:**

***“If the network broadcasts a common delay, FFS the impact of satellite movement in LEO on common delay (i.e. to reference point or feeder-link delay).”***

|  |  |  |
| --- | --- | --- |
| Company | Agree/Disagree | Additional Comments |
| MediaTek | Agree, but | RAN1 is also discussing these FFS aspects. RAN2 should wait for outcomes of RAN1 discussions. |
| Huawei | Disagree | It would be ok if “to reference point or” could be removed. |
| Lenovo | Disagree | As in Question 3 & 7, we see no need to introduce “common” delay with more confusion or complexity. |
| OPPO | Agree |  |
| APT | Agree | FFS |
| Nokia | Agree |  |
| Sony | Agree | We may need to discuss how to update the common delay. |
| Qualcomm | Disagree | The impact on time and frequency compensation should be addressed by RAN1. |
| Samsung | Agree | Both the satellite movement (including quasi-Earth-fixed beam and Earth-moving beam) and the UE’s location relative to the cell center are important. At least some level of UE-specific adjustment would be helpful. |
| ZTE | RAN1 input | Share the same view as MediaTek. |
| Panasonic | Disagree | This is ongoing discussion in RAN1 so RAN2 should wait for feedback from RAN1. |
| ETRI | Agree, but | It is good to wait for RAN1 inputs. |
| Eutelsat | Agree |  |
| Nomor | Agree | Agree with MediaTek |
| Apple | Disagree |  |
| Ericsson | Agree but | Agree with MediaTek |

## Remaining Phase 1 proposals with 20+ supporting companies

Phase two of the email discussion is also tasked with the following objective:

*“Check whether any other proposals can be agreed from the lists "Seems agreeable" and "Require discussions" in* [*R2-2008188*](file:///C:\Data\3GPP\RAN2\Inbox\R2-2008188.zip)*”*

From Phase 1, the following proposals are supported by 20 or more companies:

**Proposal 10: If HARQ feedback is enabled, an offset is applied to the start of *drx-HARQ-RTT-TimerDL* and *drx-HARQ-RTT-TimerUL* for both LEO and GEO scenarios. (25/27)**

**Proposal 11: If HARQ feedback is disabled, *drx-HARQ-RTT-TimerDL* and *drx-HARQ-RTT-TimerUL* are not started for both LEO and GEO scenarios. (23/27)**

**Proposal 12: Modifying start of drx-RetransmissionTimerDL(UL) based on network-scheduled offset via PDCCH is not supported at this time. (21/26)**

**Proposal 15: RAN2 to prioritize the case of UE with valid location information and capability to perform pre-compensation in RACH procedure. Discussion regarding UEs with GNSS but without pre-compensation postponed until further progress in RAN1. (20/27)**

**Proposal 16: For 4-step RACH with pre-compensation at UE side, the following procedure can be used as baseline: (24/26)**

1. **In Msg1 transmission, the UE should apply the estimated TA in the preamble transmission.**
2. **In Msg2 reception, the UE should apply the TA command received in RAR as a delta adjustment to the TA maintained on UE side (i.e. the TA estimated in Msg1 transmission).**
3. **For the UL grant in Msg2 for Msg3 transmission, it is up to gNB implementation to ensure a sufficient processing time on UE side for the Msg3 transmission (e.g. gNB can always assume maximum TA is used on UE side, where the maximum TA can be determined based on the coverage of the NTN cell).**

**Proposal 17: Both 2-step and 4-step RACH are supported in Rel-17 NTN. FFS enhancements to 2-step RACH to accommodate the NTN environment. (24/27)**

**Proposal 18: For 2-step RACH with pre-compensation at UE side, the following procedure can be used as baseline. (22/27)**

1. **In MsgA transmission, the UE should estimate the absolute TA and apply the TA estimated in both the preamble and PUSCH transmission.**
2. **In MsgA transmission, the UE should include the absolute TA value estimated in the payload of MsgA.**
3. **In MsgB reception, the UE should apply the TA command received in RAR as a delta adjustment to the TA maintained on UE side (i.e. the TA estimated in MsgA transmission).**

**Proposal 21: For UE with UE-specific pre-compensation, as a baseline Msg3 scheduling adaptation will be handled by network scheduling/implementation (i.e. no modification necessary) (23/26).**

**Proposal 25: From RAN2 perspective, at least disabling HARQ feedback per-HARQ process is supported (25/27).**

**Proposal 26: At least the following methods to enhance UL scheduling are further studied in NTN: configured grant (21/25) and BSR over 2-step RACH (20/25).**

As it is assumed that companies who originally agreed in Phase 1 maintain their support in Phase 2, companies who do not support one or more of the above proposals are asked to indicate either:

* *Agree with Modification*: company agrees with the intention but not the current wording, or;
* *Disagree*: company does not support the proposal.

Companies who wish to modify the proposal are asked to provide an agreeable wording in the “Additional Comments” section, as well as the reason for such a change.

**Question 10: For companies that *do not agree* with the one or more of the above proposals, please indicate which proposal(s), and select either “Agree with Modification” or “Disagree”. Companies are encouraged to provide an agreeable wording in “Additional Comments” section if possible, and justify the reason for modification.**

|  |  |  |  |
| --- | --- | --- | --- |
| Company | Proposal(s) | “Agree with Modification” or “Disagree” | Additional Comments |
| MediaTek | Proposal 10  Propsoal 16 and Proposal 18 | Agree with Modifications  Wait for RAN1 | As the purpose of these timers is to account for RTD, these timers can be extended, (instead of an offset) to include the pre-compensated RTD value  We expect RAN1 will study the availability and accuracy of TA pre-compensation. RAN1 is already studying it. |
| Huawei | 16 | Agree with modification | On top of the list points, UE should be able to include the estimated Timing advance, either in MSG3 or MSG5. Moreover, since the TA is varying continuously in some scenarios, UE should be able to report the revised TA to the network afterwards. |
| Lenovo | Proposal 25 | Agree with modification | Use “uplink HARQ feedback for downlink transmission at the UE receiver” as in TR instead of “HARQ feedback” to avoid confusion. |
| OPPO | Proposal 15  Proposal 18 | Disagree  Agree with Modification | We should consider both cases, i.e. UEs with and without pre-compensation capability, as indicated in the SID.  As baseline, we think step 2 should be removed. Depending on different deployment scenarios, subsequent UL scheduling can be up to NW implementation, e.g. in the case of small cell where TA differs not much, NW may not need to know the absolute TA for UL scheduling. |
| APT | 21 | Agree with Modification | Proposal 21: For UE with UE-specific pre-compensation, as a baseline, Msg3 scheduling adaptation will be handled by network scheduling/implementation (i.e. no modification necessary in RAN2) (23/26).  A new scheduling offset may be introduced in RAN1  Agreement in RAN1#102-e   * 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. |
| Nokia | Proposal 12  Proposal 15  Proposal 16  Proposal 26 | Agree with modification  Disagree  Agree with modification  Agree with modification | We agree companies comment that, this enhancement should be discussed until the basic functionalities are in place.  However, we think the issue here is valid. If HARQ feedback is disabled, the solution about how to start the DRX retransmissin timer should be addressed. So, we propose to update the proposal as below:  **“ Modifying start of drx-RetransmissionTimerDL(UL) based on network-scheduled offset via PDCCH is not supported at this time. Start of drx-retransmission can be discussed after basic functionalities are ready. “**  And then companies can contribute more about the solutions.  The WID describe one possible type of UE that, UE with GNSS capability but without pre-compensation of timing offset capabilities. We don't want to exclude the case in early phase before any conclusion from RAN1.  One obvious case is that, how should a UE behave if it is “indoor”, but can access the NTN system without problems anyway?  Remove “(e.g. gNB can always assume maximum TA is used on UE side, where the maximum TA can be determined based on the coverage of the NTN cell). **“** in step3 as it is up to gNB’s implementation which should not have any restriction here.  We are not sure Option 4: BSR-indication in SR will really have big specification impact without details discussion, so we think all the options are on table before finalizing the solution.  “At least the following methods to enhance UL scheduling are further studied in NTN: configured grant (21/25) and BSR over 2-step RACH (20/25). Other options can be further discussed before finalizing the solution.” |
| LG | Proposal 11 | Agree with modification | In order to receive the bilnd retransmission, the UE should start the drx-RetransmissionDL even if the drx-HARQ-RTT-TimerDL is not started. |
| LG | Proposal 17 and 18 | Disagree | We think that the discussion for 2-step RACH should be discussed after the completion of the 4-step RACH in NTN. Thus, we propose that the 2-step RACH should be deprioritized in Rel-17. |
| LG | Proposal 10 | Disagree | The proposal 10 is made based on the offset is introduced for the drx-HARQ-RTT-TimerDL/UL. However, RAN2 do not agree whether the offset for the drx-HARQ-RTT-TimerDL/UL is introduced or the value of the drx-HARQ-RTT-TimerDL/UL is extended.  Thus, RAN2 should discuss whether the offset for the drx-HARQ-RTT-TimerDL/UL is introduced or the value of the drx-HARQ-RTT-TimerDL/UL is extended first. |
| Qualcomm | P10/11/12  P16/21 | Agree but | If blind retransmission is supported and DRX retransmission timer needs to be used with offset when HARQ feedback is disabled, then in P10, we wonder why not just apply the offset to the start of DRX retransmission timer when HARQ feedback is enabled.  P16 step 3 should be covered by P21. |
| Samsung | Proposal 26 | Agree with Modification | May we request the addition of the following statement to Proposal 26 text? “New candidate solutions are not precluded.” |
| ZTE | P10,P11  P16,P18 | Agree with modification | P10,P11  We prefer to only keep the proposal in DL, and postpone the discussion in UL to next meeting.  **Proposal 10: If HARQ feedback is enabled, an offset is applied to the start of *drx-HARQ-RTT-TimerDL* ~~and~~ *~~drx-HARQ-RTT-TimerUL~~* for both LEO and GEO scenarios. (25/27)**  **Proposal 11: If HARQ feedback is disabled, *drx-HARQ-RTT-TimerDL* and*~~drx-HARQ-RTT-TimerUL~~* ~~are~~ is not started for both LEO and GEO scenarios. (23/27)**  P16,P18:  an ffs may be put for the exact TA value to be applied in Msg1/MSGA transmission, which is relates how pre-compensation is performed. |
| Panasonic | Proposal 11 | Agree with modification | Whether to start HARQ-RTT-Timer is highly depending on how are we going to handle blind retransmission.  If the intention of blind retransmission is covered by drx-Inactivity timer, then we agree that drx-HARQ-RTT-Timer and drx-RetrasnmissiontTimer are not started.   We don’t agree with the proposal if the intention of blind re-transmission is covered by drx-RetrasnmissionTimer In this case, network has to configure drx-HARQ-RTT-Timer as 0. |
| Eutelsat | Proposal 10  Proposal 16 & 18 | Agree with Modifications  Depends on RAN1 | these timers can be extended, (instead of an offset) to include the pre-compensated RTD value. This may be more robust/flexible than an offset.  RAN1 are discussing this |
| Loon/Google | **Proposal 17/18** | Should be postponed | 4 step RACH work should be prioritized over 2 step RACH for NTN |
| Ericsson | **P10** | Agree with modification | Those timers can be extended with the offset. |
| Ericsson | **P16** | Agree with comment | In step 1, the UE need information to compensate the feeder link delay too. We may need to await RAN1s results on pre-cpompensation.  In Msg3 the used TA need to be included |
| Ericsson | **P25** | Agree with comment | Formulation as in Q1 above |

# Summary

<To be generated by email discussion rapporteur pending company responses>

# Conclusions

<To be generated by email discussion rapporteur pending company responses>

# References

1. R2-2007615 – “Summary of MAC open issues in NTN” InterDigital
2. R2-2007616 – “Pre-compensation and offset calculation in NTN” InterDigital
3. R2-2006928 – “Timing advance for NTN” Intel Corporation
4. R2-2007590 – “Timing Advance, Random Access and DRX aspects in NTN” Nokia, Nokia Shanghai Bell
5. R2-2007784 – “Consideration on MAC enhancements for NTN” ZTE Corporation, Sanechips
6. RP-201256 – “Solutions for NR to support non-terrestrial networks (NTN)” Rel-17 NTN WID
7. TR 38.821 – “Solutions for NR to support non-terrestrial networks (NTN)”
8. TS 38.321 – “Medium Access Control (MAC) protocol specification” v16.1.0
9. TS 38.331 – “Radio Resource Control (RRC) protocol specification” v16.1.0