3GPP TSG-RAN WG2 Meeting #118 Electronic draftR2-2206505

Elbonia, 9th – 20th of May 2022

**Agenda item: 6.10.3.2.1**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Report from [AT118-e][106][NTN] CP issues – fourth round (Nokia)**

**WID/SID: NR\_NTN\_solutions-Core - Rel-17**

**Document for: Discussion and Decision**

# 1 Introduction

The scope of this paper is as follows:

**[AT118-e][106][NTN] CP issues (Nokia)**

Final scope: continue the discussion on assistance information for SMTC/measurement gap adjustments. During the discussion, proponents of the propagation delay difference approach and of the (coarse) UE location information approach should provide a Stage 3 TP to describe the details of the triggering events, etc.

Final intended outcome: Summary of the offline discussion with list of proposals

Deadline (for companies' feedback):  Wednesday 2022-05-18 18:00 UTC

Deadline (for rapporteur's summary in R2-2206505):  Wednesday 2022-05-18 20:00 UTC

Status: ongoing

The CHO, SMTC and neighbour cell information are summarized and discussed in the following sections.

# 2 Conditional Handover for NTN

This subsection tries to summarize the remaining issues for CHO in NTN. The following has been agreed and discussed at RAN2#117:

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| 2. If the CHO is not executed at T2 (timer associated with this candidate CHO cell) the UE continues to operate in the source cell and evaluates other CHO execution conditions (if configured).  Proposal 5-5: Discuss further what happens with the CHO configuration after T2 expiry (i.e. UE releases the configuration or maintains the configuration for potential failure recovery). Discuss if the UE can use also the CHO configuration for which T2 has expired. |

## 2.1 On CHO Recovery after T2

One of the unresolved issues for NTN CHO is what happens with CHO configurations at T2 if the UE was configured with CHO recovery. As usual, there are different views presented. The authors of [1] argue candidate cell may no longer be valid beyond T2 or the target cell is not detectable beyond T2. As a consequence, the failure may occur when the UE attempts to access such CHO candidate after T2. Also the authors of [5] claim the CHO configs “can” be released at T2. On the contrary, there are numerous papers (e.g. [6][9][13]), where it is emphasized that a legacy behavior would be to allow the UE to use any of those configurations if selected cell is a CHO candidate. That, in the simplest approach, may actually not require any specification changes (as suggested in [7]), while the CHO configurations may be reconfigured by the NW, while not released by the UE at time T2. It is worth noting that it was commonly agreeable at RAN2#117 that CHO Recovery should be supported in NTN, if CHO is already a functionality to be used by NTN-capable UEs. Please also consider that if NTN UEs are not allowed to access via CHO the selected cell in CHO Recovery process, the UEs will be forced to continue the reestablishment and this may be more costly in terms of the delay data interruption period. What some companies seem to be missing is that the cell, which may be potentially accessed using CHO configuration, beyond T2, is still a selected cell (i.e. highest ranked cell in cell selection which is a first part of actions the UE takes upon failure), so not a cell which was chosen randomly, but still the best cell in terms of DL quality/signal strength.

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| **Question 1: Can the NTN-capable UE use CHO configuration if during CHO recovery a selected cell is a CHO candidate, even though the timer T2 has expired?** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | Yes | As we have argued at the last meeting and in our TDoc (e.g. in [13]), it is pointless to delete the configurations at T2, as then the UE is forced to perform the legacy reestablishment (i.e. without any recovery actions). On the contrary, if we allow to use CHO configs the UE may access one of the prepared cells ONLY IF that cell was selected during cell selection process (so it is not the randomly chosen cell, but still the best ranked cell, even if beyond timer T2). That is how CHO recovery works. Timer T2 will be set by the network, so its expiry does not necessarily mean the cell disappears immediately. It is, however, important to ensure the network keeps the resources, considering potential recovery (as discussed below, in the next questions). |
| OPPO | Yes |  |
| Lenovo | No | For time-based CHO UE is allowed to evaluate measurement-based condition within the time duration, and it seems unnecessary for the UE to evaluate after it. In our understanding NW may consider the validity of a candidate cell when configuring T2. Therefore when T2 expires, a candidate cell is expected to be unavailable. UE can release the configuration when T2 expires. |
| MediaTek | Yes |  |
| Sony | Yes | This is a legacy behaviour and we have reached agreement that CHO recovery should be supported. |
| Lockheed Martin | Yes |  |
| Qualcomm | No | Network can configure very large value of duration-r17 so this is not needed.  Otherwise why T2 is configured by network? If this is allowed, network may release the reserved resources after T2 and UE’s attempt will fail.  If this is to allow, we propose T2 be optional, meaning make duration-r17 optional. |
| Apple | No | Agree with the views expressed by Lenovo and QC |
| vivo | No | Just wonder if the CHO configuration can still be used after associated T2 expiry whether T2 is actually of any use, and why we introduced T2 at all. |
| Xiaomi | Yes | Agree with Nokia. The cell used for recovery is selected by cell selection in RRC re-establishment procedure. In R16 CHO recovery, even though the leaving condition is fulfilled, UE can also trigger CHO for recovery when the associated candidate target cell is the selected cell. So, if the selected cell is the candidate cell and *attemptCondReconfig* is configured, CHO configuration after T2 can also be applied. |
| Transsion | No | After T2, the network reserved resource is released. That is, UE is not available to use CHO configurations. |
| ZTE | Yes | We understand T1-T2 is the valid time for a CHO candidate cell but does not necessarily equal to the valid time for this cell to be configured for CHO recovery.  If the cell is not valid anymore for time based CHO or CHO recovery, NW should update the CHO recovery configuration or release the CHO configuration.  Thus, it is preferred not to specify any automatic release at UE side or any limitation on the usage of CHO recovery configuration, should be configured and controlled by NW. |
| Samsung | No | The NW configures time-based CHO in a way that the UE can only hand over to the candidate cell and apply associated configuration before T2. For recovery, UE can select the candidate cell before T2 for the same reason. However, after T2, the UE cannot assume the candidate cell and associated configuration is valid for handover or recovery. |
| Ericsson | No | CHO recovery can only work if the reserved cell resources (and UE configuration) are retained in the candidate target cell after expiry of T2, and since the network is not required to keep the resources after T2, there is no guarantee the CHO recovery will work in the candidate target cell. In fact, as described in [11], it may even result in an increased access delay time for the UE compared to a case where the UE would have sent an *RRCReestablishmentRequest* message in the first place.  Referring to legacy behaviour is not correct since expiration of T2 is a new scenario without a matching legacy scenario. A scenario that will match the CHO legacy behaviour is rather if the UE fails to execute CHO, initiates the re-establishment procedure, and converts it into a CHO attempt, all before T2 expiry. |
| Google | No | Not sure what T2 aims to achieve if this is allowed. If we want to allow UE to access a prepared cell using the CHO configuration during the recovery phase, T2 should be made optional for that cell. |
| Huawei, HiSilicon | No | Same view as Lenovo that NW may consider the validity of a candidate cell when configuring T2 and when T2 expires the candidate cell is expected to be unavailable. In other words, the candidate cell will not become the selected cell as mentioned by Nokia. |
| ITRI | Yes | If during CHO recovery a selected cell is a CHO candidate only when the CHO candidate cell meets cell selection criteria. UE should be able to use CHO configuration for CHO recovery even after T2 expiry. |
| NEC | No | Different from other CHO trigger which does not have validity time, Time-based CHO is only valid during T1 to T2, after T2, we assume that the prepared gNB will release the corresponding configuration and consequently CHO recovery will fail. gNB should configure T2 enough long.  If the time-based CHO configuration can be used for recovery after T2, then T2 should not be in time-based CHO trigger definition at first place. |
| Panasonic | No | Question is, if T2 marks the end in time of the geographical overlap of serving cell and candidate/target cell(s) or if it marks the end of the availability of candidate/target cell(s). The first case makes more sense.  Nonetheless assuming the latter, after T2 expiry the former candidate cell is not available anymore. Otherwise the related signalling would have been erroneous. |
| CATT | Yes with comment | We agree that UE can use CHO configuration for CHO recovery. If most companies choose to release CHO configurations at T2, we can accept it. |
| LGE | No | RAN2 does not allow the UE to conduct the CHO after T2 expiry as agreed in RAN2#117-e meeting. The network may release the reserved resources of the candidate cells after T2 expiry. In this case, the UE cannot conduct CHO recovery. The network can configure the T2 later than *t-Service* of serving cell to support CHO recovery of UE. |

Summary for Q1:

* 9 companies out of 21 would like to allow using CHO configurations for recovery even after T2, a slight majority (12 out of 21) thinks this should be prohibited
* Even though we think allowing CHO configurations for recovery after T2 makes sense, we respect what the slight majority wants.
* This has not been asked within this question, but a similar decision shall be perhaps taken regarding the distance-based CHO triggering condition.
* The following is suggested:

**Proposal 1: During CHO recovery in NTN the UE checks if the timer T2 has not expired before it can use CHO configuration for recovery. FFS if the same principle applies to location-based CHO triggering event.**

If the dominant response to Question 1 would be “NO”, e.g. due to the reasons highlighted in [11], where it is argued the resources at the NW side may not be kept beyond T2, then RAN2 is asked to consider additional means to ensure the UE can still safely execute CHO as a part of recovery beyond T2 and the network will admit such a UE.

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| **Question 2: Is there a need for NW coordination to ensure the UE can attempt to access a CHO candidate selected during recovery even after timer T2 expires?** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | Maybe | Clearly this is not entirely a RAN2 topic, while RAN3 has completed their NTN work. But in principle, the source cell configuring the UE with CHO, including window [T1, T2], shall know how the T2 relates to the actual resource reservation at the NW side. |
| OPPO | No | In Rel-16, We don’t have any NW coordination for failure handling via CHO. We don’t need any also for NTN. |
| Lenovo | See comments | We are not quite sure about what “UE can attempt to access a CHO candidate selected during recovery even after timer T2 expires” means. If it means that UE may still reselect to a candidate cell which was configured with time-based conditions after T2 expiring, we think it would be a rare case as NW may consider the validity of a candidate cell when configuring T2. Therefore when T2 expires, a candidate cell is expected to be unavailable e.g. due to satellite movement.  For NW coordination, on the contrary we think source gNB may need to inform target gNB upon T2 expiring, so that gNB can release the sources reserved for the UE. |
| Sony | Yes | Network can choose to keep those configurations. |
| Qualcomm | Yes | Network should make sure to reserve the resources far beyond T2. |
| Apple | No | Seems like an optimization and can be pushed to R18 |
| vivo | No | See our reply for Q1, if associated T2 is expired for a candidate cell, the cell can’t be the target cell for CHO recovery. Even if No is selected for Q1, there is no NW coordination that needs to be specified as in Rel-16. |
| Xiaomi | No | Can be discussed in R18 |
| Transsion | No | Network can prepare for an new CHO configuration as legacy behavior, if needed.  After T2 had expired, UE act as legacy. |
| Samsung | No | As commented in Q1, UE should not select a candidate cell whose T2 is expired for recovery. No additional means is needed to help UE recovery from a candidate cell with T2 expired. |
| Ericsson | Yes, but… | We think that a predictable network behaviour in which the UE knows if the reserved network resources are retained in the target cell after expiration of T2 benefits both UE and network performance and robustness.  This could potentially be useful in a quasi-earth fixed cell scenario deployment; however, we are not sure whether it needs to be supported in Rel-17. |
| Google | No | Can be further discussed in R18. |
| Huawei, HiSilicon | No | We share the similar view with Lenovo and Vivo that the time-based CHO candidate cell is unlikely to become the target cell for recovery after T2, so answering No to Q1 does not mean another mechanism is needed. |
| ITRI | No | It could be an optimization and can be discussed in Rel-18. |
| NEC | Yes | At least the prepared gNB should agree to keep the configuration longer than T2 implicitly or explicitly. |
| Panasonic | See answer to Q1. | Widely agree with Lenovo. |
| CATT | No |  |
| LGE | No | The network can configure the T2 later than *t-Service* of serving cell to support CHO recovery of UE, as same with the Q1. |
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Summary for Q2:

* There is no major support for such coordination. And the question is not very relevant anymore, considering what majority prefers for Q1.
* It is anyway expected that the target node will keep the resources at least until T2.
* No proposal is made

Obviously, it needs to be considered that the WI is completed and no new functionalities should be pursued. Nevertheless, it should be acceptable to design a proper NTN CHO functionality, including the recovery aspects, even if it does require some extra work. If so, and if Question 2 is responded positively, then perhaps also the UE needs to know for how long the network guarantees the resources beyond time T2.

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| **Question 3: Shall the UE also know how far beyond T2 it can try to safely access the CHO candidate cell (considering how long the resources are kept at the NW side)?** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | Maybe | That could be one option – to tell the UE how long beyond T2 it can safely attempt to recover using CHO configurations. |
| OPPO | No | UE simply tries CHO and if it fails, UE tries RRC re-establishment. That’s it and let’s not over optimize. |
| Lenovo | No | We think such optimization is not necessary in this release. |
| Sony | Maybe not | This can leave to network side. |
| Lockheed Martin | No |  |
| Qualcomm | Yes | Now its getting complicated. Simply stop using CHO after T2. |
| Apple | No | Can be considered for R18 |
| vivo | No | We don’t agree to allow UE to access to a CHO candidate cell after associated T2 expires. |
| Xiaomi | No | Can be discussed in R18 |
| Transsion | No | Can be considered in later release. UE’s behavior is just act as RAN#2 had agreed so far for time-based CHO. |
| ZTE | No | As we mentioned above, if NW does not update the configuration for CHO recovery, UE would consider the current configuration to be valid and would be allowed to perform Cho recovery accordingly. No more spec impact is needed. |
| Samsung | No | It should be clear to the UE that after T2 the candidate cell cannot be selected since T2 is defined in this meaning. |
| Ericsson | Yes | A potential solution in line with our comments to Q2, would require the network to somehow inform the UE that, (1) the reserved resources are kept in the candidate target cell after T2 expiry, and (2) the time when the reserved resources are released in the candidate target cell. |
| Huawei, HiSilicon | No |  |
| ITRI | No | It could be an optimization and can be discussed in Rel-18. |
| NEC | See comment | That is exact meaning of T2 in our understanding, so we should not define another time point. |
| Panasonic | Depends … | … on the precise definition of T2 (see our answer to Q1). If T2 marks the end of the availability of the candidate/target cell, it hardly makes sense to define a time period beyond the point of time the candidate/target cell became unavailable. |
| CATT | No |  |
| LGE | No |  |

Summary for Q3:

* Not relevant anymore, considering what has been stated above, for Q1 and Q2

As the Rel-17 is on the verge of finalization, a Stage-3 impact of these Proposals need to be pursued once we reach the consensus on the issues discussed above.

# 3 SMTC for IDLE/INACTIVE

In this subsection we try to summarize and resolve the pending issues for SMTC in NTN. There are several topics to consider. At RAN#117 the following agreements have been taken:

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| SMTC offset and change rate is needed to assist UE-based SMTC adjustment in idle and inactive mode (FFS on the signalling details, e.g. whether to broadcast feeder link delay difference or something different)  RAN2 assumes that in addition to the ephemeris information, assistance information is needed for UE-based SMTC adjustment in idle and inactive mode. (FFS on the option to enable this) |

and the following Options have been considered:

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| * Option 1: feeder link delay of neighbor cells * Option 2: Common TA parameters of neighbor cells * Option 3: SMTC offset or change rate of neighbor cells * Option 4: Reference time of the SMTC of neighbor cells * Option 5: Delay difference between the serving and neighbor cell |

Let’s try to check first which Option is preferred for representing this assistance information.

## 3.1 On what SMTC assistance information is provided for IDLE/Inactive

In [4] it is proposed to broadcast SMTC offset, SMTC offset drift and SMTC offset drift variation, but it is not stated how the UE applies this information and what is the meaning of these fields. It is also stated that the component responsible for the feeder link delay does not have to be explicitly labelled and the UE does not need to know which delay component is related to which link. In [8] it is proposed to use common TA parameters and Kmac of the neighbour cells to support IDLE/Inactive UEs in adjusting SMTC. It is also suggested that epoch time and validity duration of the serving cell can be reused. In [12] it is proposed to use the SMTC offset, its drift and drift variation, which would be location-specific. The UE assesses its location and performs SMTC adjustment. The authors of [18] argue it is not realistic to rely on UE location assessment in IDLE mode for UE autonomous SMTC adjustments. Thus, it is suggested to use the timing threshold derived from the delay difference between the serving and neighbor cell. On this basis the UE determines if the SMTC window should be shifted (if the SSB is received out of the window, UE moves the SMTC window by configurable threshold value).

As can be seen above, the views are still largely different, so it is difficult to suggest one agreeable way forward. Thus, it is suggested to respond to the following questions:

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| **Question 4: Please select from the options listed below how the SMTC adjustment in IDLE/Inactive is done:**   1. **NW broadcasts SMTC offset, offset drift and drift variation for a specific location within a cell** 2. **NW broadcasts timing threshold for determining if the SMTC window should be shifted by the UE** 3. **NW broadcasts Common TA and Kmac of the neighbour cell to aid the UE in SMTC adjustments** 4. **Other** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | Option b | It should be enough to inform the UE on the threshold (describing how much the SSB of the neighbour is received outside the window). Then each UE individually offsets its SMTC window. It is not realistic to apply one common solution for all IDLE UEs in the cell. Similarly, relying on UE’s location in IDLE is not the right approach. |
| OPPO | Option a | This is like how UE determines common TA for pre-compensation. SMTC offset refers to the amount UE needs to adjust for the feeder link’s delay difference between serving cell and neighbour cell. The ultimate SMTC adjustment shall also include the amount needed for service link’s delay difference. |
| Lenovo | Option c) or Option b) | For Option a) we may need to divide a cell into multiple locations and the overhead could be large. We think Option c) can be simpler as it can reuse the same format as for the serving cell (ephemeris, common TA & Kmac).  Option b) is also acceptable but we have concerns in its accuracy e.g. how to determine the threshold and how long shall a UE offset if its timing fulfils the threshold. |
| MediaTek | Option a is preferred |  |
| Sony | b) | Timing threshold is enough for the UE to autonomously determine whether a shift is needed nor not. |
| Qualcomm | Option c | Simply broadcast common TA parameters would be helpful in SMTC adjustment. |
| Apple | Option c |  |
| vivo | Option c | Based on the common TA and Kmac of the neighbour cell, UE can calculate the delay of the neighbour cell, and thus can adjust the SMTC to measure the neighbour cell autonomously. |
| Xiaomi | Option c | UE can use the Common TA and Kmac of the neighbour cell to calculate the link’s delay. And it is more simple for UE. |
| Transsion | Option c | The parameters of common TA and Kmac of neighbor cell are relative fixed and can be design while deployment. UE can use them to self adjust SMTC for neighbor cell measurement. |
| Samsung | Option a | For Option b, 1) it’s questionable how to determine the threshold according to propagation delay difference since the NW does not know how much the propagation delay difference a UE is suffering without UE location; 2) how does UE know whether to shift the window forward or backward.  For Option c, the UE needs to know service link delay difference to calculate propagation delay difference, however we are not sure common TA is equal to service link delay, we think it depends on how the NW sets the reference point for the common TA. It may be feasible if the serving cell and neighbour cell are provided by the same satellite and same gNB, but this cannot be guaranteed.  We think for Option a, the NW broadcast SMTC offset, offset drift and drift variation which reflect how the service link delay difference changes over time between the serving cell and a neighbour cell, and UE can determine how the feeder link delay difference changes over time between the serving cell and a neighbour cell using the UE location and ephemeris of the serving and a neighbour cell. With these two component (i.e. service link delay difference changes and feeder link delay difference changes) UE can determine how much to shift the SMTC window. |
| Ericsson | C modified | R2-2205698 by Samsung presents a solution that can be the basis for working out the final solution to be adopted. With a variation, the solution in R2-2205698 can be made to match option C.  R2-2205698 proposes that the network configures a fixed SMTC offset for SMTC valid at the neighbour gNB. This is complemented by broadcasting the difference between the feeder link delay of the neighbour satellite and the feeder link delay of the serving satellite, including drift information. The UE can determine the difference in service link delay itself, and hence the UE determine the complete gNB-UE propagation delay difference and can adjust the broadcast SMTC offset with that propagation delay difference.  This, however, does not fully match any of the listed options. But a variation of the solution would match option c, if the combination of the SMTC at the neighbour gNB and the feeder link delay difference information is replaced by a broadcast SMTC offset, including offset drift information, that represents the difference in timing at the neighbour satellite vs. the serving satellite. This is equivalent to the SMTC offset and feeder link delay difference proposed in R2-2205698. What remains is the difference in service link delay between the neighbour and serving cell and the UE can determine that difference as in R2-2205698 and adjust the broadcast SMTC offset with the service link delay difference. This method matches option c and achieves the same result as the solution proposed in R2-2205698. |
| Google | Option a | For option c), common TA is not equivalent to the feeder link delay, it may contain certain part of service link delay depending on where is the reference point. If the UE adjusts the SMTC first and then applies the common TA on top of the adjusted SMTC, certain part of the service link delay will be counted twice. Therefore we think option c) is not feasible. |
| Huawei, HiSilicon | Option c | Kmac and common TA parameters have already been designed by RAN1. If Option c is feasible, we see no need to pursue other methods.  For option a), we are not sure whether RAN2 has time to determine the details of offset drift and drift variation.  And option b) leaves the complexity to the network configuration, it is unclear whether the network can configure such thresholds accurately, especially for Idle mode UEs located at different locations in the cell coverage. |
| ITRI | Option a | Network has the knowledge of the ephemeris of neighbour cells and could assist UE with the SMTC offset, offset drift and drift variation of neighbour cells to assist UE in determining when to perform SMTC adjustment and the value should be adjusted for the searching and measurements of neighbour cells. |
| CATT | Option c | For service link delay, UE can calculate the delay by the satellite ephemeris, which has agreed to be broadcast. For feeder link delay, which is a cell-specific value, it can be broadcast by common TA parameters. |
| LGE | a), but | RAN2 already confirms that the UE needs the SMTC offset and offset drift for UE-based SMCT adjustment. However, we are not sure about the necessity of the SMTC drift variation. |
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Summary for Q4:

* 8 companies prefer option c), 6 companies prefer option a), 3 companies prefer option b)
* Seems the largest group believe common TA and Kmac of the neighbour cell is sufficient for IDLE/Inactive UE adjustments of SMTC.

**Proposal 2: Common TA and Kmac of the neighbour cell are used to support IDLE/Inactive UEs in NTN to perform SMTC adjustments.**

## 3.2 Where to broadcast assistance information

Another related issue is where such assistance information shall be broadcast. The answer obviously also depends on what kind of assistance information is used (e.g. the existing parameters or completely new content), but at least the following options can be found in the submitted papers:

* Additional NTN-specific SIB for neighbour satellite information [12][10]
* Use SIB19 [14][18][4]

Using the same SIB (i.e. SIB19) has a benefit of not introducing yet another system information block for NTN. However, if the NTN neighbour-related information becomes massive (for multiple neighbours and with multiple parameters, like SMTC offsets, ephemeris, etc., as discussed further in section 4) then it may be challenging to insert everything into SIB19. Thus, each option has its pros and cons. RAN2 needs to take another decision.

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| **Question 5: How is the SMTC assistance information for IDLE/Inactive mode provided?**   1. **Via new NTN SIB for neighbour cells** 2. **Via SIB19** 3. **Other** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | a) | Can be a new SIB, if it is decided to introduce such new block for other neighbour-related information as well. |
| OPPO | b) |  |
| Lenovo | b) or a) | We slightly prefer to include in SIB19, but we can also accept a new SIB if majority support this. |
| MediaTek | a) |  |
| Sony | b) |  |
| Lockheed Martin | a) |  |
| Qualcomm | b) or a) |  |
| Apple | b) or a) | Prefer b) |
| vivo | b | We tent to put all neighbour cell related information in SIB19 with a bit-efficient signalling structure. |
| Xiaomi | b |  |
| Transsion | b) or a) | Prefer b) |
| ZTE | Either is fine, SIB19 is preferred |  |
| Samsung | b |  |
| Ericsson | a) | Using a new NTN SIB for the broadcast of this information is preferable. One advantage is the one mentioned in the text preceding the question, i.e. that otherwise SIB19 may become overloaded with information. Another argument is that that as opposed to the content of SIB19, this information is not needed for accessing the cell and hence it can be broadcast less frequently. And since the information will not be used for calculation of the TA, it has much lower accuracy requirements than the ephemeris and common TA parameters in SIB19 and hence its validity time can be much longer and the UE therefore can re-acquire the new SIB much less frequently. In addition, as the information is only relevant for UEs in RRC\_IDLE and RRC\_INACTIVE state, putting it in a separate SIB in another SI message will ease the burden for RRC\_CONNECTED UEs to repeatedly re-acquire SIB19 when the validity timer requires it. Furthermore, an additional NTN SIB has already been agreed for IoT NTN. |
| Google | b) |  |
| Huawei, HiSilicon | b |  |
| ITRI | a | Prefer to include neighbour cell related information in a new SIB. |
| NEC | a) | we prefer to keep serving cell information and neighbouring cell information in different SIB as we did in legacy, and likely the payload size is not small. |
| Panasonic | a) | It is likely that multiple neighbours each consisting of multiple parameters need to be indicated. |
| CATT | a) | Discuss together with Q7. |
| LGE | b) or a) | We do not have any strong views. But, we slightly prefer to b) due to the minimum impact to the spec. |

Summary for Q5:

* There is no convergence at all whether to use SIB19 or new SIB for providing SMTC assistance information for IDLE/Inactive mode.

**Proposal 3: Discuss further if neighbour’s SMTC assistance information for IDLE/Inactive mode is provided via new SIB or via SIB19.**

# 4 Neighbour cell information

## 4.1 On what neighbour information to provide

One more topic to address at RAN2#118 is where to provide the information concerning the NTN neighbour cells and what kind of information should be provided. This area has been covered e.g. in [2][20][21][22]. In addition, in making the final decisions in RAN2, we shall also consider RAN1 feedback sent in [23]. Based on RAN1 response, it seems we need to include the following neighbour-related information:

1. Ephemeris
2. DL and UL polarization
3. Epoch time of assistance information
4. Validity duration

Please share your opinion on the elements listed above:

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| **Question 6: Do you agree with the aforementioned list of parameters/IEs to provide regarding neighbour cells in NTN? If you find the list incomplete, please suggest what other information needs to be provided.** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | Yes | In line with what RAN1 requests us to do. |
| OPPO | Yes |  |
| Lenovo | Yes | We can follow RAN1’s reply. |
| MediaTek | Yes | We should follow RAN1’ suggestions |
| Sony | Yes |  |
| Lockheed Martin | Yes |  |
| Qualcomm | Yes together with common TA parameters | Agree, we should simply follow RAN1’s reply. |
| Apple | Yes |  |
| vivo | Yes |  |
| Xiaomi | Yes with comments | Common TA parameters (TACommon, TACommonDrift and TACommonDriftVariation) are also included in the RAN1’s reply. So we should follow RAN1’s suggestions. |
| Transsion | Yes | Agree with RAN#1’s suggestions. |
| ZTE | Yes | Follow RAN1’s request |
| Samsung | Yes | Reference location of neighbour cell is needed for ranking in cell reselection. |
| Ericsson | Yes, the list of parameters/IEs suggested by RAN1 is agreeable. | The carrier frequency should also be indicated. And obviously, the neighbour information should also include the SMTC information for UEs in RRC\_IDLE and RRC\_INACTIVE state, as discussed in question 4. |
| Google | Yes |  |
| Huawei, HiSilicon | Yes except c) | By c), does it mean introducing a separate epoch time for neighbour cell information? Why the epoch time for serving cell cannot be reused?  RAN1 only says validity duration may be different without mentioning epoch time.  ***RAN1 answer:*** *Validity duration information should be provided based on neighbor cell since it may be different from the serving cell (e.g. satellite for neighbor cell is different). Further, from RAN1 perspective, the Epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) should be also provided to the UE.* |
| ITRI | Yes |  |
| NEC | Yes |  |
| Panasonic | Yes | Refer to RAN1 response. |
| CATT | Yes | The PCI and frequency should also be included together with the above mentioned neighbour cell information. |
| LGE | Additionally, e) reference location | The UE needs the a) ephemeris information of neighbor cells to calculate the delay difference between the serving cell and neighbor cells. Accordingly, the UE also needs the c) epoch time and d) validity duration of ephemeris information.  The reference location of the neighbor cell is essential as the RAN2 introduces the location-based cell reselection. The UE cannot calculate the reference location of neighbor cells only with the ephemeris information of the neighbor cell. |

Summary for Q6:

* It seems to be widely agreeable to broadcast the IEs listed from a) – d)

**Proposal 4: The following IEs/parameters are broadcast for neighbour cell in NTN:**

* **Ephemeris,**
* **DL and UL polarization,**
* **Epoch time of assistance information**
* **Validity duration**

## 4.2 On where to broadcast assistance information

The format needs to be decided as well. In [20] it is proposed to provide the neighbour cell assistance information in the same SIB (i.e. SIB19) as other NTN-related information. More specifically, a new sequence is proposed to be included into SIB19, which will comprise carrier frequency, PCI and the index to one of the pre-defined NTN configurations.

In [21] it is suggested to use ‘SIBXX’ (allegedly SIB19) and reduce the signalling load by using delta configuration for the ephemeris of the cells from the same satellite constellation. However, it is unclear whether the same satellite is meant (then ephemeris is the same) and whether it related to orbital or PVT part of the ephemeris (for orbital delta can be applied, for PVT not necessarily).

The authors of [22] argue a new SIB (e.g. SIB22) shall be introduced, e.g. as validity timer for serving cell (applicable to SIB19) can be different than the validity timer for neighbour cell information. Thus, a separate SIB is suggested.

|  |  |  |
| --- | --- | --- |
| **Question 7: Where to broadcast the neighbour cell assistance information for NTN:**   1. **In SIB19** 2. **In new SIB (e.g. SIB22)**   **Please also suggest the signalling format, for example, by stating whether you agree with the proposal in [20]** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | b) | Likely a new SIB may be needed to include all neighbour-related info. |
| OPPO | a) |  |
| Lenovo | a) or b) | We slightly prefer to include in SIB19, but we can also accept a new SIB if majority support this. |
| MediaTek | b) | A new SIB is a better choice. |
| Sony | a) |  |
| Lockheed Martin | b) |  |
| Qualcomm | b) or a) | Its better to provide SMTC assistance, neighbor satellite information together. |
| Apple | a) or b) | Prefer to use SIB19 |
| vivo | a | For the specific signalling format, we think the neighbour cell information should be at the cell level, so the carrier frequency info and PCI info need to be included in SIB19 to identify the specific inter-/intra- frequency neighbor cells. Also considering that there may be some neighbour cells that share the same assistance information, a common list of assistance information can be provided in SIB19, with each neighbor cell referring to an entry of the list as its associated information configured. We think this fashion proposed in [20] is more in line with the legacy way to avoid parameter duplication and improve bit efficiency. |
| Xiaomi | a |  |
| Transsion | a) | For the common neighbor cell assistant information can be grouped into the same SIB, i.e. SIB19. |
| ZTE | a), SIB19 |  |
| Samsung | a |  |
| Ericsson | A new SIB. | This new SIB should be the same new SIB as the SMTC for RRC\_IDLE and RRC\_INACTIVE state will be included in (see question 5).  The possible gain from providing the ephemeris as delta information is probably negligible and should not be supported.  And note that the validity time for the neighbour assistance information may be much longer than for the ephemeris and common TA parameters for the serving cell in SIB19, since it will not be used for calculation of the TA, but only for adjustment of SMTC offset and to guide the direction of directional antennas or RX beamforming (for UEs that use this). |
| Google | b) | Information included in SIB19 is more essential and has to be broadcasted periodically by the network. We think the neighbour cell assistance information is not as essential as SIB19 and can be provided upon being requested (i.e., on-demand basis). |
| Huawei, HiSilicon | a |  |
| ITRI | b | We prefer to include neighbour cell related information in a new SIB. |
| NEC | b |  |
| Panasonic | b) | Similar situation as outlined in conjunction with Q5 above. |
| CATT | b) | It can avoid unnecessary signaling cost, and is a clearer way. |
| LGE | a) or b) | We do not have any strong views. But, we slightly prefer to a) due to the minimum impact to the spec. |

Summary for Q7:

* Similarly to Q5, also here there is no consensus. So this is suggested to be further discussed, jointly with Proposal 3

**Proposal 5: Discuss further if neighbour cell’s assistance information for NTN is provided via new SIB or via SIB19.**

As the assistance information (including the ephemeris) for neighbour cells can be largely the same (as argued in [21]), it may be desirable to use delta signalling approach, at least for the orbital part of the ephemeris. Do you support such scheme?

|  |  |  |
| --- | --- | --- |
| **Question 8: Do you support using delta signalling approach, at least for the orbital part of the neighbour cell ephemeris, if the cells belong to the same satellite, or satellite orbit?** | | |
| **Company** | **Answer** | **Comments** |
| Nokia | Yes | As we have argued in our paper, this makes sense, at least for the orbital part of the ephemeris, for the cells from the same satellite or orbit. |
| OPPO | Maybe | But this should be consulted with RAN1 as the current ephemeris format was designed by RAN1. |
| Lenovo | Yes | As we have analysed in our contribution, at least there is no need to always indicate the same orbit in each ephemeris of multiple satellites. |
| Sony | No |  |
| Lockheed Martin | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| vivo | Maybe No. | If the intention is to avoid duplication of the parameters with same values, we think the signalling format proposed in [20] is already sufficient and more follows the legacy way. It is more straightforward with better readability, compared with the delta signalling. Also, for the delta configuration, when a parameter is not present, it is confusing whether it means the neighbour shares the same value of the serving or the NW doesn’t configure it at all. So perhaps no delta signalling is needed. |
| Xiaomi | Yes |  |
| Transsion | Yes |  |
| ZTE | Yes |  |
| Samsung | No with comment | Delta signalling can reduce overhead, but we have same concern as OPPO and vivo. Maybe delta signalling can be discussed in Rel-18 for overhead reduction. |
| Ericsson | We support the intention, but not using delta-signalling. | For the neighbour cells that are served by the same satellite as the serving cell, the neighbour information can refer to ephemeris (and epoch time) of the serving cell ephemeris in SIB19. However, an explicit validity time should be provided, since it may be much longer than the validity time in SIB19. This is because it will not be used for calculation of the TA, but only for adjustment of SMTC offset and to guide the direction of directional antennas or RX beamforming (for UEs that use this). The validity time could be the same for the neighbour information of all neighbour cells in the same satellite constellation.  Furthermore, for the neighbour cells that are served by the same neighbour satellite, the same ephemeris (including the epoch time) can be reused, i.e. indicated only once per group of neighbour cells served by the same neighbour satellite. |
| Google | Yes |  |
| Huawei, HiSilicon | Maybe | Agree with Oppo that this is more of RAN1 expertise. |
| ITRI | Yes |  |
| NEC | No strong opinion | Delta signalling could be considered if the gain is estimated big |
| Panasonic | Yes | To be checked, in how far that approach minimises the amount of data. And to be harmonised with RAN1. |
| CATT | No | Considering that the epoch time and validity duration of serving cell can be different from the epoch time and valid duration of neighbour cells, delta signalling will bring problems to parameters update. |
| LGE | Yes, but | Suppose the neighbor cell belongs to the same satellite as the serving cell. In that case, the network removes the neighbor cell ephemeris information in SIB. |

Summary for Q8:

* A clear majority would like to see such signaling improvement happening (not necessarily via delta signaling).
* FFS on the Stage-3 details

**Proposal 6: Support the signaling overhead reduction for the orbital part of the neighbour cell ephemeris, at least for the case of cells belonging to the same satellite, or satellite orbit. FFS on the Stage-3 details.**

# 5 Second round discussion

During the online discussion on 10th of May 2022 the following has been agreed:

|  |
| --- |
| Agreements:  1. During CHO recovery in NTN the UE checks if the timer T2 has not expired before it can use CHO configuration for recovery. FFS if the same principle applies to location-based CHO triggering event. FFS the stage-3 details (i.e. whether the UE releases the configuration)  2. The following IEs/parameters are broadcast per neighbour cell in NTN:  Ephemeris,  DL and UL polarization,  Epoch time of assistance information  Validity duration  FFS how to handle the validity timer for neighbour cell. FFS if epoch time can be same or different. FFS about other parameters |

The remainder of proposals made in [24] was not pursued and shall be further discussed. That will happen within this section.

## 5.1 CHO recovery versus timer T2

It was eventually decided the UE is not allowed to recover via CHO if the timer T2 has expired. However, it remains to be seen how this is handled: does the UE always check if the timer T2 has expired? Shall the UE remove the CHO configurations at T2? In our view, these are two separate questions in fact, so let’s focus on how to ensure CHO is not executed after T2 if recovery occurs. The authors of [1] suggest to handle this in the following way:

|  |
| --- |
| 1> if the cell selection is triggered by detecting radio link failure of the MCG or re-configuration with sync failure of the MCG or mobility from NR failure, and  1> if *attemptCondReconfig* is configured; and  1> if the selected cell is not configured with *CondEventT1*, or the selected cell is configured with *CondEventT1* and leaving condition has not been fulfilled; and  1> if the selected cell is one of the candidate cells for which the *reconfigurationWithSync* is included in the *masterCellGroup* in *VarConditionalReconfig*:  2> set the *choCellId* in the *VarRLF-Report* to the global cell identity and tracking area code, if available, otherwise to the physical cell identity and carrier frequency of the selected cell;  2> apply the stored *condRRCReconfig* associated to the selected cell and perform actions as specified in 5.3.5.3; |

In our view this can be implemented this way, i.e. if *attemptCondReconfig* is present and if the timer T2 has not expired (i.e. leaving condition for *CondEventT1* is not met) the UE may attempt to perform CHO to selected cell. What is your view?

|  |  |  |
| --- | --- | --- |
| **Question 5.1-1: Do agree to cover the CHO recovery versus T2 behavior in the way proposed in [1]? Please suggest any modifications if you find them necessary.** | | |
| **Company** | **Answer** | **Comments** |
| vivo | Yes | Alternatively, if companies believe release of CHO config is needed, TP below looks simple as well (no strong view though):  […]  3> if the *measId* for this event associated with the *condReconfigId* has been modified; or  3> if the *condEventId* is associated with condEventT1, and if the leaving condition(s) applicable for this event associated with the *condReconfigId*, i.e. the event corresponding with the *condEventId(s)* of the corresponding *condTriggerConfig* within *VarConditionalReconfig*, is fulfilled for the applicable cells; or  […]  4> consider the event associated to that *measId* to be not fulfilled;  4> if the *condEventId* is associated with condEventT1:  5> remove the entry with this *condReconfigId* from the *VarConditionalReconfig*;  […] |
| CATT | Yes | If we have the agreement that UE is not allowed to recover via CHO if the timer T2 has expired. |
| Huawei, HiSilicon | Yes | Agree with Vivo’s TP if companies agree that CHO configuration is release after T2. |
| Sony | Yes | If network wants to make use of CHO recovery, it can set a reasonably long T2. |
| Google | Yes |  |
| CMCC | Yes | If T2 expires, it means the corresponding CHO configuration associated the candidate cell becomes invalid. |
| OPPO | No, see comments | We are not sure if the current text (i.e. leaving condition has not been fulfilled) implying that after HO/CHO failure, UE keeps evaluating CHO condition after/during cell selection. We believe this is not the correct UE behaviour as in legacy failure recovery via CHO is not based on CHO condition’s evaluation. |
| Xiaomi | Yes with comments | We agree the TP for the issue on CHO recovery versus timer T2 in principle.  In addition, we suggest to discuss whether UE can use CHO configuration before T1 for recovery.  Similarly, the associated candidate cell may be unavailable before T1. So, during recovery, UE also need to check if the time is less than *Thresh1* (T1).  Overall, we think UE can use CHO configuration for recovery during the time duration between T1 and T2. So, during CHO recovery in NTN the UE checks if the CondEvent T1 is fulfilled before it can use CHO configuration for recovery. So we suggest to change the TP as follows:  1> if the selected cell is not configured with *CondEventT1*, or the selected cell is configured with *CondEventT1* and the event has been fulfilled; and |
| Panasonic | Yes | Agree with vivo. |
| MediaTek | Yes |  |
| Apple | Yes | Fine with Vivo’s proposal too |
| Qualcomm | Yes | Xiaomi’s suggestion can be considered. |
| Samsung | Yes |  |
| Transsion | Yes |  |
| ZTE | Yes | We support the original version provided by the rapporteur. |
| Ericsson | No | We see no point in keeping the CHO configuration after T2 expiry as proposed in [1], thus we prefer the UE to simply delete the CHO configuration at expiry of T2, e.g. as proposed in the TP from Vivo. |
| LGE | Yes |  |
| Nokia | Yes |  |
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|  |  |  |

Summary for Q5.1-1:

* The vast majority is OK with the suggested changes in [1]
* It can be further considered if entering condition (time T1) shall be also checked, assuming such scenario is valid.

**Proposal 5.1-1: Adopt the changes in R2-2204659 to ensure CHO recovery is not executed after timer T2 expires. FFS if the entering condition (timer T1) needs to be considered either.**

A similar decision shall be taken with respect to another event which can be used to trigger CHO execution in NTN, namely *condEventD1*. It seems to be a natural step to define a similar behavior also for location-based CHO triggering.

|  |  |  |
| --- | --- | --- |
| **Question 5.1-2: Do support a similar behavior as agreed for condEventT1 to be adopted for condEventD1 with respect to CHO recovery when condEventD1 expires?** | | |
| **Company** | **Answer** | **Comments** |
| vivo | No | Time based trigger defines a validity period when the CHO reconfiguration is allowed to be used, so it needs a condition like in Q5.1-1. For the location based trigger, no similar validity concept is there, so there’s no need to have a similar behaviour as to the time based trigger. |
| CATT | No | Unlike time-based CHO, in case of earth fixed cell, when the location-based CHO is triggered by UE movement, fulfil the leaving conditions doesn’t mean the corresponding cell is unreachable for UE in future. Since the CHO recovery is a procedure of cell selection, there is no problem to allow UE to recover via CHO even if the leaving condition is fulfilled, and still seem the cell as a candidate cell until the configurations is released by network. There is no need to restrict CHO recovery when the condEventD1 leaving condition is fulfilled. |
| Huawei, HiSilicon | No | In our understanding, time-based CHO is mainly used for quasi-fixed cells and the candidate cell becomes unavailable after T2.  However, location-based CHO can work well for moving cells. The situation is different so we prefer not to duplicate the behaviour. |
| Sony | No |  |
| Google | No | In time-based CHO, the reserved resources at the candidate cell are to be released upon the expiry of the timer T2. That is why we need a mechanism to ensure the CHO recovery is not executed after T2 expires. However, in location-based CHO, the reserved resources are not released (same as the legacy CHO), therefore we don’t need a similar behaviour to prevent UE from executing the CHO recovery. |
| CMCC | No | Location-based solution and time-based solution have their own characteristics. There is no validity duration for location-based, and the UE behaviour should be different. |
| OPPO | No | Similar to **5.1-1**, we don’t think after HO/CHO failure UE keeps evaluating CHO condition after/during cell selection. |
| Xiaomi | Yes with comments | As commented to Q5.1-1, during CHO recovery in NTN the UE needs to check if the CondEvent D1 is fulfilled before it can use CHO configuration for recovery. So we suggest to change the TP as follows:  1> if the selected cell is not configured with *CondEventT1* or *CondEventD1*, or the selected cell is configured with *CondEventT1* or *CondEventD1* and the event has been fulfilled; and |
| Panasonic | Partly yes, partly no. | As far as fulfilment of a condition is concerned, the behaviour is similar, i.e. the UE operates within a certain time period or within a specific geographical region or it doesn’t. The UE behaviour for both cases – within or without – can be the same, see e.g. Xiaomi’s comment above. As far as the release of UE resources is concerned, the UE behaviour is different, see e.g. Googles comment above. |
| MediaTek | No |  |
| Apple | Yes | We think it is cleaner to not use the stored condRRCReconfig for CondEventD1 as well. This is different from legacy behavior but then these conditions (time and location) are new too. In particular we wonder if the network may like to reserve some resources based on location of the UEs and prefer not to have UEs in other locations use those resources. |
| Qualcomm | No | Network would not be aware the UE met the leaving condition for eventD1. |
| Samsung | No | Distance condition is different from time-window condition. For example, if a candidate cell is selected but UE’s distance to *referenceLocation1* (i.e. source cell reference location) is smaller than *Thresh1*, which means the distance condition is not fulfilled, UE should be allowed to recover through this selected cell. NW does not reserve or release resources based on UE location. |
| Transsion | No | For time-based and location-based approaches, there are using for different scenarios |
| ZTE | No |  |
| Ericsson | No | *CondEventD1* is not comparable to *condEventT1* in this aspect. For *condEventD1* the UE may trigger CHO to a candidate target cell at any time without the network knowing when in time it happens. Thus the reserved candidate target cell resources need to be kept until the UE either attempts a CHO (to any candidate target cell) or performs a re-establishment procedure. |
| LGE | No | The expression condEventD1 expiry seems inappropriate because the entering condition of condEventD1 can reoccur even after the leaving condition is met. The release timing of the reserved resource by the candidate cells is ambiguous. Therefore, we need to distinguish the CHO recovery configured with condEventD1 from condEventT1. |
| Nokia | Yes |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Summary for Q5.1-2:

* The vast majority is OK not to pursue similar changes for condEventD1, stating the validity concept does not apply here.
* Hence, the following is proposed:

**Proposal 5.1-2: In case the UE was configured with condEventD1 the UE does not check if the condEventD1 expired when CHO recovery is executed. No specification impact to CHO recovery procedure description.**

## 5.2 NTN Neighbour cell information

The list of parameters for an NTN neighbour was agreed:

|  |
| --- |
| 2. The following IEs/parameters are broadcast per neighbour cell in NTN:  Ephemeris,  DL and UL polarization,  Epoch time of assistance information  Validity duration  FFS how to handle the validity timer for neighbour cell. FFS if epoch time can be same or different. FFS about other parameters |

As can be seen, the agreement has been garnished with multiple “FFS”, which are inherent part of decision making in 3GPP. So the list is agreeable (and it is in line with RAN1 suggestion), but it remains to be decided if:

1. Validity duration is the same or different as in the serving cell, which may stem from whether neighbour cell information is provided via the same SIB as the serving cell information for NTN
2. Epoch time is the same or different. RAN1 in [23] apparently has not restricted that in any way.

The discussion on point a) can be postponed until we decide whether the neighbour assistance information is broadcast via new SIB or SIB19 (see Question 5.2-2). Regarding point b), it needs to be decided if such flexibility to have the same epoch time for serving and neighbour is feasible and beneficial.

|  |  |  |
| --- | --- | --- |
| **Question 5.2-1: Do see a need to support the signalling for making the epoch time of the serving cell applicable to the neighbour cell’s assistance information?** | | |
| **Company** | **Answer** | **Comments** |
| vivo | Yes | Similar to the validity timer, epoch time of a neighbour cell can be different or the same as that of the serving cell. |
| CATT | Yes |  |
| Huawei, HiSilicon | No | We think the epoch time can simply reuse that of the serving cell. |
| Sony | Yes |  |
| Google | Yes |  |
| CMCC | Yes |  |
| OPPO |  | Not sure what above answering “yes” means. To allow signalling different epoch time for serving and neighbour? Or sometimes can reuse the serving cell’s epoch time for neighbour? |
| Xiaomi | Yes |  |
| Panasonic | Yes | As long as the option of signalling a different epoch time is retained in parallel, this “epoch time sync” indication can save signalling overhead. |
| MediaTek | Yes |  |
| Apple | Yes | We should agree first that neighbor cell epoch times can be different. The signaling details can then be worked out. |
| Qualcomm | Yes | It needs to be clear that there is no restriction for network. It should be possible for network to signal same or different value for the neighbor cells. |
| Thales | Yes |  |
| Samsung | Yes | If the serving cell and neighbour cell are provided by the same satellite, then for neighbour cell NW can configured the same epoch time as serving cell. |
| Transsion | Yes |  |
| ZTE | Yes |  |
| Ericsson | No | The epoch time for the neighbour cells’ assistance information should be different from the epoch time of the serving cell’s assistance information. Note that the nature of the assistance information for the neighbour cells is quite different from that of the assistance information for the serving cell. The assistance information for the serving cell must be accurate enough to allow the UE to calculate a sufficiently accurate timing advance. In contrast, the broadcast assistance information for the neighbour cells will only be used for UE autonomous SMTC adjustment in RRC\_IDLE and RRC\_INACTIVE state and (for some UEs) to guide the UE’s direction of a directional antenna or RX beam. These usages can be managed with much less accurate assistance information. This allows much longer validity times for the assistance information for the neighbour cells than for the assistance information for the serving cell. Consequently, it also allows less frequent updates of the assistance information for the neighbour cells. And this in turn means that it would be suboptimal to reuse the epoch time of the serving cell’s assistance information for the neighbour cells’ assistance information.  For these reasons, and for the additional reason that the neighbour cells’ assistance information is not needed for a UE to access the serving cell, the neighbour cells’ assistance information does not have to be broadcast as frequently as the serving cell’s assistance information, and therefore it would be beneficial to put the neighbour cells’ assistance information in another SIB than SIB19, e.g. SIB22, and this other SIB should be included in an SI message broadcasted with longer periodicity than SIB19. |
| LGE | Yes | The neighbor cell epoch time can be identical to that of a serving cell if the neighbor cell's satellite orbit is the same as that of the serving cell. The serving cell broadcasts the neighbor cell epoch time as the serving cell epoch time. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Summary for Q5.2-1:

* Nearly all companies would like to see such signaling possibility.

**Proposal 5.2-1: RAN2 signalling supports having the epoch time of the serving cell applicable to the neighbour cell’s assistance information (i.e. the same epoch time can be used for both cells).**

It shall be also decided where to broadcast this assistance information for the NTN cell, including SMTC assistance information. In the first round of the discussion, the views were split, so it is perhaps pointless to repeat the same question and just count how many companies support a or b. So we would like to ask the companies to provide motivation why certain option is better and whether they have a strong view:

|  |  |  |
| --- | --- | --- |
| **Question 5.2-2: Where to broadcast the neighbour cell assistance information for NTN, including SMTC assistance information:**   1. **In SIB19** 2. **In new SIB (e.g. SIB22)**   **Please indicate whether you have a strong preference towards one of these options and why your selected option is a better approach.** | | |
| **Company** | **Answer** | **Comments** |
| vivo | a) | If all cells’ assistance info is included in SIB19, we don’t need to further complicate the Spec by which cell’s timer expiry leads to which SIB’s re-acquisition. |
| CATT | b) |  |
| Huawei, HiSilicon | a) | We think adding a new SIB is not something to be pursued after the WI is declared completed. |
| Sony | a) |  |
| Google | a) | We prefer the SMTC assistance information to be placed in SIB19 and other neighbour cell parameters to be placed in SIB22. But if they have to be placed together, we prefer SIB19. |
| CMCC | Both are ok |  |
| OPPO | a) |  |
| Xiaomi | a) | From implementation perspective, UE needs to re-acquire only one SIB when the validity timer is expired, and network also need to maintain only one NTN specific SIB. |
| Panasonic | b) | Separating serving cell information from neighbour cell information by using different SIBs for both seems to be the cleanest solution. |
| MediaTek | Open to both |  |
| Apple | a | We should really not be defining a new SIB at this stage as Huawei commented |
| Qualcomm | a) or b) | New SIB22 can be mostly for neighbor cell measurement in IDLE mode. So it does not have to acquire the SIB19 frequently as required by serving satellite instantaneous ephemeris.  But if validity duration is differently signalled for serving and neighbor satellites, a) is also fine. |
| Thales | b)preferred a) possible | New SIB is preferred to avoid having too much data in SIB19. However due to time limitation, SIB19 may be reused and we are opened to a). |
| Samsung | a | SIB19 may be simpler and a single validity timer is enough. |
| Transsion | a) | For common assistance information can be group into the same SIB. |
| ZTE | a) |  |
| Ericsson | b | As commented in more detail on question 5.2-1, the nature of the neighbour cells’ assistance information is quite different than that of the serving cell’s assistance information. Its use is different, resulting in much lower accuracy requirements, much longer validity times and a lower update and broadcast frequency. These circumstances – in particular the lower broadcast frequency – points in the direction of using another SIB than SI19, e.g. SIB22, for the neighbour cells’ assistance information, where this other SIB should be included in an SI message broadcasted with longer periodicity than SIB19. An additional reason is that the neighbour cells’ assistance information may optionally be broadcasted on-demand, whereas this is not appropriate for SIB19, which contains information that is necessary for a UE to access the serving cell. This is our strong view. |
| LGE | a) or b) | We are slightly prefer the SIB19 due to minimum spec impact. |
| Nokia | Either option is fine |  |
|  |  |  |
|  |  |  |
|  |  |  |

Summary for Q5.2-2:

* There is a nearly balanced split of opinions. There are also multiple companies with the view both options are OK.
* We share the motivation raised by Ericsson (lower periodicity of broadcasting, etc.), but we also think the companies who say we should minimize the specs impact, are right.
* Thus, having no clear support for a new SIB, we suggest to stick to SIB19

**Proposal 5.2-2: Neighbour cell assistance information for NTN, including SMTC assistance information, is provided via SIB19.**

## 5.3 Other

The following two proposals were also sent to further offline handling:

|  |
| --- |
| Proposal 2: Common TA and Kmac of the neighbour cell are used to support IDLE/Inactive UEs in NTN to perform SMTC adjustments.   * Continue offline   Proposal 6: Support the signaling overhead reduction for the orbital part of the neighbour cell ephemeris, at least for the case of cells belonging to the same satellite, or satellite orbit. FFS on the Stage-3 details.   * Continue offline |

It does not make sense to repeat the company feedback gathering and there is scarce time. Additionally, the WI is declared to be closed, so this shall be resolved rather quickly. Thus, two simple questions:

|  |  |  |
| --- | --- | --- |
| **Question 5.3-1: Do you support P2, i.e. Common TA and Kmac of the neighbour cell are used to support IDLE/Inactive UEs in NTN to perform SMTC adjustments?**  **Please comment only if you are strongly against P2 and explain why.** | | |
| **Company** | **Answer** | **Comments** |
| vivo | Yes |  |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Sony | Yes |  |
| Google | Revised P2 | If the intention is to inform UE of the feeder link delay difference, common TA doesn’t serve for that purpose as common TA is not equivalent to the feeder link delay (depending on where is the reference point). Since so far there is no parameter that can represent the feeder link delay, we prefer to use the new terms **offset** and **change/drift** **rate** agreed in RAN2#117-e, to signal the feeder link delay difference. The new terms can have the same value range and format as the Common TA does. |
| CMCC | Yes |  |
| OPPO | Yes | If we are allowed to indicate “Yes” as we are not strongly against P2 :) |
| Xiaomi | Yes |  |
| Panasonic | Yes |  |
| MediaTek | Yes |  |
| Apple | Yes |  |
| Qualcomm | Yes with revision | We agree with Google. Here RAN1 recommendation of “common TA pramaters” and RAN2 agreement of “offset change rate” is missing.  Agreement is to provide “common TA parameters” not only “common TA”. |
| Samsung | Yes with comment | We are fine with common TA parameters (common TA, common TA drift, common TA drift variation) and Kmac. |
| Transsion | Yes | Same view with Google. |
| ZTE | Yes, acceptable |  |
| Ericsson | Yes | But this must be complemented by a definition of the SMTCs point of validity (reference point), which for this to make sense should be the neighbour cell’s gNB or possibly the neighbour cell’s satellite. |
| LGE | Yes with comment | We agree with Samsung. The common TA drift must be included. |
| Nokia | Yes |  |
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Summary for Q5.3-1:

* Almost all companies are OK with this proposal.
* There was a suggestion to represent somehow feeder link delay. In our understanding, this was considered few times and did not gain support in RAN2 (even if we think it may be a valid suggestion).

**Proposal 5.3-1: Common TA parameters and Kmac of the neighbour cell are used to support IDLE/Inactive UEs in NTN to perform SMTC adjustments.**

and regarding P6:

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| **Question 5.3-2: Do you support P6, i.e. The** **signaling overhead for the orbital part of the neighbour cell ephemeris is reduced, at least for the case of cells belonging to the same satellite, or satellite orbit. FFS on the Stage-3 details.?**  **Please comment if you are strongly against P6 and explain why.**  **If you are supportive, please indicate how would you see that captured in Stage-3 specification.** | | |
| **Company** | **Answer** | **Comments** |
| vivo | Yes | This can be realized by including a common list of assistance information in SIB19 and making the cells sharing the same parameter values point to the same entry of the list. Again, this is the legacy way we adopted to avoid the unnecessary overhead to duplicate the same set of parameters. |
| CATT | No | The applicable scenario is very limited, this mechanism is applicable only for the cells belong to the same satellite and the cells ephemeris have the same epochtime and validity duration. Considering ASN.1 will freeze, we prefer not to introduce this mechanism in R17. |
| Huawei, HiSilicon | Yes |  |
| CMCC | Yes | With serving cell ephemeris and some delta information corresponding to neighbour cell is enough to obtain the entire neighbour cell ephemeris. |
| Xiaomi | No | There may be some efforts on the description when some ephemeris data IEs are not present, and it will lead the spec more complicated, and considering the use case is rare the optimization, we prefer not to consider the optimization at this stage. |
| Panasonic | Yes | Could be realized with “reference values” applicable to one satellite in one particular orbit and “deltas” (differences) for the other satellites in the same orbit. To be analysed in more detail, how parallel orbits can be handled from a signalling overhead saving point of view. We’re talking about regular, frequent cases rather than exceptions. |
| MediaTek | No | Not needed, as mentioned by CATT |
| Apple | No | Prefer to keep things simple for this release |
| Qualcomm | Yes |  |
| Samsung | No | Share the same view as CATT and Xiaomi. |
| Transsion | No | It can be optimized in later release. |
| ZTE | Yes |  |
| Ericsson | Yes | In the RRC specification this can be captured as a CHOICE structure in the ASN.1 code:  NeighAssInfoList-r17 :: = SEQUENCE (SIZE (1..maxNeighCells)) OF NeighAssInfo-r17  NeighAssInfo-r17 ::= SEQUENCE {  smtc SSB-MTC4,  neighEphemComTaKmac CHOICE {  lowAccuracyEphComTaKmac LowAccuracyEphComTaKmac,  useServingEphComTaKmac BOOLEAN  }  } |
| LGE | No | We agree with CATT and Xiaomi. |
| Nokia | Yes |  |
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Summary for Q5.3-2:

* 8 companies are in favour, 7 are against.
* We agree the change is probably not essential, while we also think it is rather simple (as shown by vivo or Ericsson) and can bring signalling benefits.

**Proposal 5.3-2: Discuss further if to reduce and how to reduce the signaling overhead for the orbital part of the neighbour cell ephemeris, at least for the case of cells belonging to the same satellite, or satellite orbit.**

One more aspect from RAN1 LS [23] needs to be decided, namely how to signal UL/DL polarization information. Based on [23], it seems the following agreements were made in RAN1:

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| **RAN1#106-e Agreement**:  Support polarization signalling for target serving cell in handover command message.  **RAN1#106-e Agreement**:  Support polarization signalling for non-serving cell in RRM measurement configuration |

It would be good to clarify where in NR RRC specification these two RAN1 agreements need to be reflected:

Agreement 1 is implemented via providing ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in NTN-Config-r17 included in RRCReconfiguration comprising reconfigurationWithSync

Agreement 2 is implemented via providing ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in measurement configuration in CONNECTED mode, e.g. directly in MeasObjectNR

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| **Question 5.3-3: Do you agree with the interpretation regarding polarization information for neighbour NTN cell, outlined above? If you do not agree, please explain how this shall be captured.** | | |
| **Company** | **Answer** | **Comments** |
| Huawei, HiSilicon | Agree |  |
| Panasonic | Yes |  |
| MediaTek | Agree |  |
| Apple | Yes |  |
| Qualcomm | Yes |  |
| Samsung | Yes |  |
| vivo | Yes | For Agreement 2, directly putting them in am MO sounds like implementing a per-frequency configuration; if the information is agreed as a per cell configuration, perhaps better to add them into the cell list in each MO. This can be left to CR implementation phase. |
| Transsion | Yes |  |
| ZTE | Agree |  |
| Ericsson | partly | RAN2 has agreed to broadcast NTN-Config and to give it in RRCreconfig with sync.  RAN2 has not agreed to include it in measurement object. In fact, it seems not needed as serving cell is agreed to broadcast neighborcell SI and UE can get the same information in there. |
| LGE | Agree |  |
| Nokia | In general agree | But also Ericsson has a point – the UE may anyway have the neighbour’s SI, where this is provided. |
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Summary for Q5.3-3:

* Most companies OK with the understanding presented prior to the question.
* Good point raised about the presence of neighbour’s SI, which may make it not needed to introduce the polarization information into measurement config for the neighbours.

**Proposal 5.3-3: Target cell’s polarization information is provided via ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in NTN-Config-r17 included in RRCReconfiguration comprising reconfigurationWithSync.**

**Proposal 5.3-4: Discuss if the polarization information for RRM measurement purposes is provided via ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in measurement configuration or can be known from the neighbour’s system information (where NTN-Config is provided).**

# 6 Third round discussion

The following has been agreed in the second phase of discussion within [106] thread:

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| **Agreements via email – from offline 106 – second round:**  1.     Adopt the changes in R2-2204659 to ensure CHO recovery is not executed after timer T2 expires. FFS if the entering condition (timer T1) needs to be considered either.  2.     In case the UE was configured with condEventD1 the UE does not check if the condEventD1 expired when CHO recovery is executed. No specification impact to CHO recovery procedure description.  3.     RAN2 signalling supports having the epoch time of the serving cell applicable to the neighbour cell’s assistance information (i.e. the same epoch time can be used for both cells).  4.     Neighbour cell assistance information for NTN, including SMTC assistance information, is provided via SIB19.  5.     Common TA parameters and Kmac of the neighbour cell are used to support IDLE/Inactive UEs in NTN to perform SMTC adjustments.  6.     Target cell’s polarization information is provided via ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in NTN-Config-r17 included in RRCReconfiguration comprising reconfigurationWithSync. |

In this section we try to resolve few other, remaining aspects, e.g. those listed by RAN2 VC and discussion rapporteur in the summary for second round of [106]:

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| Proposals for discussion:  Proposal 5.3-2: Discuss further if to reduce and how to reduce the signaling overhead for the orbital part of the neighbour cell ephemeris, at least for the case of cells belonging to the same satellite, or satellite orbit.  Proposal 5.3-4: Discuss if the polarization information for RRM measurement purposes is provided via ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in measurement configuration or can be known from the neighbour’s system information (where NTN-Config is provided). |

## 6.1 CHO Recovery against condition T1 checking

During the second round of the discussion, it was raised that CHO configuration cannot be used for recovery also before time T1 (defining the beginning of the time window within which the UE can handover to associated candidate CHO cell). Even though it is perhaps not an extremely typical use case (that selected cell during recovery will be a CHO candidate, prior to time T1), we would like to ask for companies views:

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| **Question 6.1-1: Do you think the UE should be prevented from using CHO configurations for recovery, if this happens before time T1? Shall it be covered in the specification (if so, please describe how)?** | | |
| **Company** | **Answer** | **Comments** |
| vivo | No with comment | We think it may not be a typical case, since UE may not find the candidate cell yet before T1. So perhaps it is not necessary to specify.  But we do not have a strong view on this issue. If RAN2 in the end agrees to consider this case, we think the related Spec change should be clear enough. A tentative TP may be as follows (on top of the changes agreed in R2-2204659) by considering both the entering condition and the leaving condition:  1> if the selected cell is not configured with *CondEventT1*, or the selected cell is configured with *CondEventT1* and the entering condition is fulfilled but leaving condition has not been fulfilled; and |
| OPPO | Yes | But this may already be covered by the spec as before time T1 is considered as meeting the leaving condition. |
| Qualcomm | No | It seems this case is supported even if we make no further change. |
| Samsung | Yes | We consider similar reason as the case of T2, a candidate cell may not be ready to take over the UE or the UE cannot detect the cell before T2. So it’s better to allow recovery only in the time window. |
| ASUSTeK | Comment | Agree with Qualcomm. No change is needed. |
| Xiaomi | Yes | In RAN2#115 meeting, RAN2 agreed that *“UE is allowed to perform HO only during T1 to T2”*. In failure recovery, UE also need to use the CHO configuration and perform handover. Hence, UE only can perform CHO recovery during T1 to T2 and UE is not allowed using CHO configurations for recovery before T1. So we suggest to change the TP as follows:  1> if the selected cell is not configured with *CondEventT1*, or the selected cell is configured with *CondEventT1* and ~~leaving condition has not been fulfilled~~ the event has been fulfilled; and |
| Transsion | Yes | It should consistent with decision for CHO beyond T2. Network may not be ready to reserved resource for CHO before T1. |
| Google | Yes | We share the same view as Samsung, and think the specification change suggested by vivo is valid. |
| ITRI | No | If a CHO candidate could be found and is qualified to be selected by a UE before T1, it is not necessary to prevent UE from using the CHO configuration for recovery. |
| Intel | No | In case of recovery, if this CHO candidate cell is selected during cell selection phase, it could be used and no need to prevent. And it’s already allowed by current spec. |
| CATT | Yes | Agree with the TP suggested by vivo. |
| Huawei, HiSilicon | Yes | We think the candidate cell is only available during [T1, T2]. Vivo’s TP is ok. |
| Panasonic | No | Agree with vivo – also with regards to the concrete text proposal for the RRC spec. |
| LGE | Yes | We prefer to follow the design principle of the time-based CHO. We agree with Xiaomi’s TP change. |
| Nokia | No | Agree with vivo, it is not a typical case. But even if there is such cell selected before T1, it should be fine to allow the UE to recover via CHO. |
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Summary for Q6.1-1:

* 7 companies think such changes are not needed, 8 are supportive of such changes.
* Due to the lack of clear preference and nearly no time left for this meeting, we suggest not to pursue such change.

**Proposal 6.1-1: No specification changes are pursued to prevent the UE from using CHO configurations for recovery, if this happens before time T1.**

## 6.2 Assistance information for SMTC in CONNECTED

SMTC adjustments for IDLE mode have been covered in the preceding round of the discussion, but it was forgotten to consider the topic last addressed at RAN2#116:

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| 1. RAN2 will decide which option to choose for NTN assistance information for SMTC/MG once SA3 feedback on user consent is received.  2. If propagation delay based UE assistance information for NTN SMTC is agreed, it is defined in the form of propagation delay difference. |

Thus, we would like to quickly ask RAN2 whether there is finally a unified view on the form of such assistance information (during the discussions few months ago, there were supporters of propagation delay and supporters of UE location information). Even though we did not get a clear response from SA3, in our understanding it is already supported to report UE location information in CONNECTED mode, so perhaps that should also be possible for the SMTC/measurement gap assistance information.

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| **Question 6.2-1: In what form the UE reports assistance information for SMTC/measurement gap adjustments in CONNECTED mode? Choose from the following options and please state the Stage-3 details:**   1. **Propagation delay** 2. **UE location information** 3. **Other** | | |
| **Company** | **Answer** | **Comments** |
| vivo | a) | We haven’t concluded reporting of UE location yet in NTN, so to make the conclusion for the time being, we prefer UE reporting of propagation delay difference between UE-serving cell delay and UE-neighbour cell delay for SMTC/measurement gap adjustments. |
| OPPO | a) | Propagation delay difference is the only left choice as location reporting has been excluded in R17 based on SA3’s response. |
| Qualcomm | b) and a) | We already have existing mechanism to report UE location in measurement report. What we need is the initial trigger mechanism. This is the first option.  Option a) is alternate option for the network. But this is very inaccurate solution and may not work as intended. |
| Samsung | a | Only one from a and b is sufficient. Propagation delay difference report is a better choice for now as the uncertainty of UE location report, e.g. user consent, accuracy, etc. |
| ASUSTeK | b) | In NTN, the coverage of a cell is large and the range of propagation delay difference would vary largely at different UE’s locations. Since the UE can report its location in RRC connected mode, it is simple for the UE to report location information as assistance information for SMTC reusing existing signaling (e.g. reportConfig). |
| Xiaomi | b) | In RAN2#117 meeting, the following agreement has been reached:   1. Send a new LS to SA3 indicating that if NTN specific User Consent for sending fine UE location information (full GNSS coordinates) will not be available in Rel-17, RAN2 will consider the solution where, upon network request, after AS security/connected mode is established, a UE can report its coarse UE location information (coarse GNSS coordinates) to the NG-RAN, with a possible reported value referring to "no coarse GNSS location available" (which the UE can set if it cannot/does not want to provide its coarse GNSS coordinates); and asking SA3 to come back to RAN2 if they have any concerns."   Reporting coarse UE location without user consent has been supported. So, coarse UE location can be used as assistance information for SMTC/measurement gap adjustments.  For a), if UE report too much propagation delay or propagation delay difference from different satellites, NW can also calculate UE location based on these propagation delay information. There are some UE privacy issues. Similar to UE location report, it also need user consent to support UE to report propagation delay information.  Hence, coarse UE location (coarse GNSS coordinates) may be better. |
| Transsion | a) and b ) | Regarding b), RAN#2 115e had agreed UE to report location information while network requested. |
| Google | b) | We prefer to report UE location, as the propagation delay reported by the UE may become out-of-date at the time when the NW receives the report. |
| ITRI | a) | It seems propagation delay difference between serving cell and neighbour cell is the only option for Rel-17. |
| Intel | b) |  |
| CATT | a |  |
| Huawei, HiSilicon | b) | If the discussion on UE location reporting can be concluded, no need to report other information. |
| Panasonic | a) | For the same reasons as mentioned by vivo and OPPO. |
| LGE | a) | Agree with Samsung on uncertainty of UE location report. |
| Nokia | b | Our preference is to report UE location, which is anyway supported in RRC CONNECTED, upon NW’s configuration. |
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Summary for Q6.2-1:

* There is unfortunately a split of opinions between propagation delay and UE location reporting
* There is still a lack of alignment whether the UE can be requested to report its location in CONNECTED (some companies claiming this is not allowed by SA3). It would be good to finally clarify it.

**Proposal 6.2-1: Discuss if the Connected mode UE reports assistance information for SMTC/measurement gap adjustments in the form of a propagation delay or UE assistance information. Clarify if the UE can be requested to report its location in CONNECTED mode.**

And a related question is how such reporting is triggered (e.g. event-triggered or periodical).

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| **Question 6.2-2: How is the reporting of** **assistance information for SMTC/measurement gap adjustments in CONNECTED mode triggered? Choose from the following options and please state the Stage-3 details:**   1. **Event-triggered** 2. **Periodic** 3. **Other** | | |
| **Company** | **Answer** | **Comments** |
| OPPO | a) | To adopt the similar event for TA reporting, i.e. when the current propagation delay difference between serving cell and neighbour cell changed more than a threshold compared to the last reported one, UE triggers the report of propagation delay difference.  As NW is aware of feeder link delay difference, all UE needs to report is the service link’s propagation delay difference between serving cell and neighbour cell. |
| Qualcomm | a) and c) | Triggering based on UE’s mobility.  Option c) We think it is also ok to report upon request from network. |
| Samsung | a | Agree with OPPO on event-triggered propagation delay difference report. |
| ASUSTeK | a) | When the UE moves a long distance from the location where SMTC configuration is received, NW needs to be informed of the UE’s new location. |
| Xiaomi | a) and b) | Reuse UE location report trigger for the reporting of assistance information. |
| Transsion | a) | To prevent signaling overhead |
| Google | a) | UE should report the assistance information whenever the SMTC/gap adjustment configuration becomes invalid. In addition to the triggering conditions mentioned by the companies above, we think the SMTC/gap adjustment configuration can be associated with a validity timer, and UE may send the assistance information upon (or before) the expiry of the validity timer. |
| ITRI | a) | UE triggers the repot of assistance information when the propagation delay difference compared to the last report exceeds a threshold. |
| Intel | a) | Event D1 can be used to trigger this report. |
| CATT | a) and b) | a) is preferred. |
| Huawei, HiSilicon | a) | Same view as Intel |
| Panasonic | a) | Agree with OPPO. |
| LGE | b) | If the majority view for question 6.2-1 is the propagation delay as the assistance information, we would like to discuss the change of the propagation delay difference. Let us consider that the serving and neighbor cells are moving at 8 km/s from 2000 km above the earth’s surface. The propagation delay difference has several tens of seconds while the change is only 1 ms. Therefore, the periodic reporting with long report interval is sufficient to report the updated propagation delay difference. |
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Summary for Q6.2-2:

* Irrespective of which type of assistance information is preferred, the majority wants to support event-based triggering, e.g. using distance-based event.

**Proposal 6.2-2: Assistance information for SMTC/measurement gap adjustments in CONNECTED mode is event-triggered. Stage-3 details to be resolved when the type of assistance information is decided.**

## 6.3 Polarization information for RRM measurements

The following has been proposed in the second round of the discussion:

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| Proposal 5.3-4: Discuss if the polarization information for RRM measurement purposes is provided via ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in measurement configuration or can be known from the neighbour’s system information (where NTN-Config is provided). |

It has been raised that it may not be needed to configure the UE within measurement configuration with neighbour cell DL/UL polarization information, as the UE may know that already from neighbour’s system information, where NTN-Config is provided. Do you agree with such approach?

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| **Question 6.3-1: Do you agree the polarization information for RRM measurements of the neighbour cells does not have to be included in the measurement configuration as it can be known from the neighbour’s system information (where NTN-Config is provided)?** | | |
| **Company** | **Answer** | **Comments** |
| vivo | No | Since RAN1’s agreement about polarization signalling is that “Support polarization signalling for non-serving cell in RRM measurement configuration”. In our understanding, *MeasObjectNR* contains the measurement configuration for the connected state, so neighbour cell polarization information should be added to the *MeasObjectNR*. |
| OPPO |  | Neighbour’s system information mainly works for idle/inactive UEs. Not sure if connected RRM configuration can totally rely on that, e.g. NW may not provide some neighbour satellite information in SIB but may want connected UE to do RRM measurement towards it, in which case, RRM measurement configuration may need to include the polarization information for that neighbour cell. |
| Qualcomm | No | Seems we already have this agreement.   1. The following IEs/parameters are broadcast per neighbour cell in NTN:   Ephemeris,  DL and UL polarization,  Epoch time of assistance information  Validity duration  Neighbour cell assistance information for NTN, including SMTC assistance information, is provided via SIB19. |
| Samsung | No | In case measurement on cells without info broadcast in SI, it should be explicitly included in measurement configuration. As the polarization information is only 1 bit, it should be fine. |
| Xiaomi | No | Suggest to follow RAN1 agreement that provide the polarization information in RRM measurement configuration. |
| Transsion | No |  |
| Google | No | We share the same concern as OPPO. |
| ITRI | No | Network may configure different neighbour cells for CONNECTED UE and for IDLE/INACTIVE UE for RRM measurement. We prefer the polarization information for RRM measurement to be included in measurement configuration. |
| Intel |  | If this information is provided in NTN-Config, it seems unnecessary to provide it again in measurement configuration. |
| CATT | No |  |
| Huawei, HiSilicon | No | Providing it in MeasObject is more aligned with RAN1 request. |
| Panasonic | No | Polarization information for RRM measurements of the neighbour cells to be included in the measurement configuration. |
| LGE | No | The UE does not have to do any procedure to update the DL/UL polarization information when the polarization information change if the network includes the DL/UL polarization information in the measurement configuration. |
| Nokia | No strong view | Can work either way. |
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Summary for Q6.3-1:

* A clear majority thinks adding polarization information to measurement configuration is more in line with the RAN1 requirements than assuming the UE can obtain neighbour’s SIB19.

**Proposal 6.3-1: Polarization information for RRM measurement purposes is provided via ntn-PolarizationDL-r17 and ntn-PolarizationUL-r17 in measurement configuration.**

## 6.4 Signalling orbital part of the neighbour ephemeris

In the previous rounds there was a slight majority for supporting some form of the signalling improvement for the ephemeris of the neighbours from the same satellite/orbit. Among the others, the following options were proposed:

1. Ericsson:

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| In the RRC specification this can be captured as a CHOICE structure in the ASN.1 code:  NeighAssInfoList-r17 :: = SEQUENCE (SIZE (1..maxNeighCells)) OF NeighAssInfo-r17  NeighAssInfo-r17 ::= SEQUENCE {  smtc SSB-MTC4,  neighEphemComTaKmac CHOICE {  lowAccuracyEphComTaKmac LowAccuracyEphComTaKmac,  useServingEphComTaKmac BOOLEAN  }  } |

1. vivo:

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| --- |
| This can be realized by including a common list of assistance information in SIB19 and making the cells sharing the same parameter values point to the same entry of the list. Again, this is the legacy way we adopted to avoid the unnecessary overhead to duplicate the same set of parameters. |

1. Nokia (R2-2205529):

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| **Proposal 2: The satellites and neighbour cells which may reuse at least a sub-set of the orbital parameters from *EphemerisInfo-r17 of the serving cell are indicated in SIB3 (*for intra-frequency neighbours*) or SIB4 (*for inter-frequency neighbours*)*.**  The associated signalling may look as follows:  IntraFreqNeighCellInfo-v1700:: = SEQUENCE {  reuseServingCellEphemeris:: = SEQUENCE {  physCellID PhysCellId,  satelliteIndex INTEGER (1..maxNumSatellites)  } |

1. Other

So please indicate whether any of these options is acceptable to you.

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| **Question 6.4-1: Which option above do you support for reducing the signalling overhead for the orbital part of the neighbour cell ephemeris, at least for the case of cells belonging to the same satellite, or satellite orbit?** | | |
| **Company** | **Answer** | **Comments** |
| vivo | b) | Proponent. Also, now that this legacy way already extensively adopted in the Spec can already be reused to avoid redundant signalling overhead, we think any creative solution specific to NTN may not be needed any longer. |
| OPPO |  | In some case, neigbhor cell may not reuse all the ehpemeris-commonTA-Kmac from serving cell. Maybe we should consider reuse part of serving cell information and allow for signalling flexibility. |
| Qualcomm | c) | The approach in option c) looks clear and simple. |
| Samsung | b | a) seems not saving overhead, c) only considers not to duplicate info of serving cell, b) works to reuse conventional structure |
| Xiaomi | b |  |
| Transsion | c) | It’s consistent with TN network system information design. |
| ITRI | a) | We’re OK to introduce an indication of whether to reuse the serving cell orbital information.  The ephemeris parameters are only applicable to NTN UE that would be preferable to be included in NTN specific IE/SIB. |
| Intel | c) |  |
| CATT |  | We still think the applicable scenario is very limited, it is not essential to consider enhancement at this stage. |
| Huawei, HiSilicon | d) | Neighbour cell ephemeris information can be provided in the form of delta values compared with the serving cell ephemeris.  E.g. for any parameter in the EphemerisInfo, the actual value of neighbour cell = the field value provided in neighbour cell ephemeris + the field value provided in serving cell ephemeris. |
| Panasonic |  | First of all, the flagging for of a set of parameters for the neighbouring cell that is identical to those applicable to the serving cell makes sense to us.  As far as deviating parameter sets are concerned for – in particular – the same orbit, it should in most cases be sufficient to indicate the distance between the serving satellite and the neighbouring one – either in terms of an angle (on the common orbit), time the neighbouring satellite needs for reaching the same position as the serving one at current epoch time or geometrical distance (on the orbit or straight). |
| LGE | b) | We prefer to reuse the legacy principle. |
| Nokia | c | Proponent. c) is actually not far from option a) |
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Summary for Q6.4-1:

* The views are still very diverse, so it seems it will be difficult to reach consensus at this stage of the WI.
* In principle, the high-level choice is between:
  + Using an indication within the configuration for each neighbour whether it can reuse the serving’s ephemeris (option a and c above)
  + Using a list of configurations and each cell having a pointer to a specific position in the list (option b above)
* We can have one more try online and in case of no consensus, the topic will likely have to be postponed out of Rel-17.

**Proposal 6.4-1: Discuss which option to choose for reducing the signalling overhead for the orbital part of the neighbour cell ephemeris, at least for the case of cells belonging to the same satellite, or satellite orbit:**

* 1. **Using an indication within the configuration for each neighbour whether it can reuse the serving’s ephemeris**
  2. **Using a list of configurations and each cell having a pointer to a specific position in the list**

# 7 Fourth round discussion

As indicated in the introduction, the goal of this phase is to consider Stage-3 details of the assistance information for SMTC/measurement adjustments in CONNECTED. During the online session on 17th of May the following was agreed:

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| * Working Assumption: Propagation delay difference between serving cell and neighbour cell can be used as assistance information for SMTC/measurement gap adjustments. We come back on Thursday to see if proponents can provide a TP with all Stage 3 details. If this is not possible we will reconsider whether other methods can be used (e.g. coarse UE location info). |

As stated in the Introduction, the proponents of both types of assistance information are kindly asked to submit Stage-3 details of their preferred solution. Especially the new event for propagation delay difference seems to require work from scratch.

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| **Question 7.1: If you support the assistance information in the form of a propagation delay difference between the serving cell and the neighbour, please show how the corresponding event should be defined in Stage-3 specification (both in the procedural text and ASN.1).** | |
| **Company** | **Stage-3 proposal** |
| OPPO | We think reporting propagation delay difference can be triggered when it has changed more than a threshold and UE can report using UAI message. In more details, upon triggered by any neighbour cell, propagation delay difference for all neighbour cells (configurable by the NW) can be reported to the NW. In this way, it can reduce the frequency of sending UAI messages.  Based on above, the TP for TS38.331 is given as following.  -------------------------------------------------------------------------------------------------------  **In section 5.7.4.1 General:**  The purpose of this procedure is for the UE to inform the network of:  ……..  - change of its fulfilment status for RRM measurement relaxation criterion;  - propagation delay difference between serving cell and neighbour cell(s).  -------------------------------------------------------------------------------------------------------  **In section 5.7.4.2 Initiation:**  ….  A UE capable of providing an indication of fulfilment of the RRM measurement relaxation criterion in connected mode may initiate the procedure upon change of its fulfilment status for RRM measurement relaxation criterion for connected mode.  A UE capable of providing propagation delay difference between serving cell and neighbour cell shall initiate the procedure upon being configured to do so, upon determining that propagation delay difference between serving cell and a neighbour cell has changed more than *offsetThresholdPropagationDelay* compared with the last reported value.  Upon initiating the procedure, the UE shall:  …….  1> if configured to provide propagation delay difference between serving cell and neighbour cell;  2> if the UE did not transmit a *UEAssistanceInformation* message with *propagationDelayDifference* since it was configured to provide propagation delay difference between serving cell and neighbour cell; or  2> for any neighbour cell in *neighbourcCellInfoList,* if the propagation delay difference between serving cell and the neighbour cell has changed more than *offsetThresholdPropagationDelay* since the last transmission of the *UEAssistanceInformation* message including *propagationDelayDifference* :  3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3 to provide propagation delay difference between serving cell and each neighbour cell included in the *neighbourcCellInfoList*;  -------------------------------------------------------------------------------------------------------  **In section 5.7.4.3 Actions related to transmission of UEAssistanceInformation message:**  The UE shall set the contents of the *UEAssistanceInformation* message as follows:  **……**  1> if transmission of the *UEAssistanceInformation* message is initiated to provide the propagation delay difference between serving cell and neighbour cell according to 5.7.4.2;   1. set the *propagationDelayDifference* to include the current service link propagation delay difference between serving cell and each neighbour cell in the *neighbourcCellInfoList*;   ------------------------------------------------------------------------------------------------------- **In section 6.3.4 Other information elements:**– *OtherConfig* The IE *OtherConfig* contains configuration related to miscellaneous other configurations.  ***OtherConfig* information element**  -- ASN1START  -- TAG-OTHERCONFIG-START  ……  OtherConfig-v1700 ::= SEQUENCE {  ul-GapFR2-PreferenceConfig-r17 ENUMERATED {true} OPTIONAL, -- Need R  musim-GapAssistanceConfig-r17 SetupRelease {MUSIM-GapAssistanceConfig-r17} OPTIONAL, -- Need M  musim-LeaveAssistanceConfig-r17 SetupRelease {MUSIM-LeaveAssistanceConfig-r17} OPTIONAL, -- Need M  successHO-Config-r17 SetupRelease {SuccessHO-Config-r17} OPTIONAL, -- Need M  maxBW-PreferenceConfigFR2-2-r17 ENUMERATED {true} OPTIONAL, -- Cond maxBW  maxMIMO-LayerPreferenceConfigFR2-2-r17 ENUMERATED {true} OPTIONAL, -- Cond maxMIMO  minSchedulingOffsetPreferenceConfigExt-r17 ENUMERATED {true} OPTIONAL, -- Cond minOffset  rlm-RelaxationReportingConfig-r17 SetupRelease {RLM-RelaxationReportingConfig-r17} OPTIONAL, -- Need M  bfd-RelaxationReportingConfig-r17 SetupRelease {BFD-RelaxationReportingConfig-r17} OPTIONAL, -- Need M  scg-DeactivationPreferenceConfig-r17 SetupRelease {SCG-DeactivationPreferenceConfig-r17} OPTIONAL, -- Need M  rrm-MeasRelaxationReportingConfig  -r17 SetupRelease {RRM-MeasRelaxationReportingConfig-r17} OPTIONAL, -- Need M  propagationDelayDifferenceReportingConfig-r17 SetupRelease {PropagationDelayDifferenceReportingConfig-r17} OPTIONAL -- Need M  }  ……  PropagationDelayDifferenceReportingConfig-r17 ::= SEQUENCE {  offsetThresholdPropagationDelayDifference ENUMERATED {ms0dot5, ms1, ms2, ms3, ms4, ms5, ms6 ,ms7, ms8, ms9, ms10} OPTIONAL, -- Need M  neighbourcCellInfoList-r17 SEQUENCE (SIZE (1.. 4)) OF NeighbourCellInfo-r17 OPTIONAL -- Need M  }  NeighbourCellInfo-r17 ::= SEQUENCE {  epochTime-r17 EpochTime-r17,  ephemerisInfo-r17 EphemerisInfo-r17  }  -- TAG-OTHERCONFIG-STOP  -- ASN1STOP   |  | | --- | | ***OtherConfig* field descriptions** | | ***propagationDelayDifferenceReportingConfig***  Configuration for the UE to report propagation delay difference between serving cell and neighbour cell(s). | | ***offsetThresholdPropagationDelay***  offset for propagation delay difference report as specified in 5.7.4.2 |   -------------------------------------------------------------------------------------------------------  **In section 6.2.2 Message definitions:** – *UEAssistanceInformation* The *UEAssistanceInformation* message is used for the indication of UE assistance information to the network.  Signalling radio bearer: SRB1, SRB3  RLC-SAP: AM  Logical channel: DCCH  Direction: UE to Network  *UEAssistanceInformation message*  -- ASN1START  -- TAG-UEASSISTANCEINFORMATION-START  ……  UEAssistanceInformation-v1700-IEs ::= SEQUENCE {  ul-GapFR2-Preference-r17 UL-GapFR2-Preference-r17 OPTIONAL,  musim-Assistance-r17 MUSIM-Assistance-r17 OPTIONAL,  overheatingAssistance-r17 OverheatingAssistance-r17 OPTIONAL,  maxBW-PreferenceFR2-2-r17 MaxBW-PreferenceFR2-2-r17 OPTIONAL,  maxMIMO-LayerPreferenceFR2-2-r17 MaxMIMO-LayerPreferenceFR2-2-r17 OPTIONAL,  minSchedulingOffsetPreferenceExt-r17 MinSchedulingOffsetPreferenceExt-r17 OPTIONAL,  rlm-MeasRelaxationState-r17 BOOLEAN OPTIONAL,  bfd-MeasRelaxationState-r17 BIT STRING (SIZE (32)) OPTIONAL,  nonSDT-DataIndication-r17 SEQUENCE {  resumeCause-r17 ResumeCause OPTIONAL  } OPTIONAL,  scg-DeactivationPreference ENUMERATED { scgDeactivationPreferred, noPreference } OPTIONAL,  uplinkData-r17 ENUMERATED { true } OPTIONAL,  rrm-MeasRelaxationFulfilment-r17 BOOLEAN OPTIONAL,  propagationDelayDifference-r17 PropagationDelayDifference-r17 OPTIONAL,  nonCriticalExtension SEQUENCE {} OPTIONAL  }  ……  PropagationDelayDifference-r17 ::= SEQUENCE (SIZE (1..4)) OF INTEGER (1..270)  }  -- TAG-UEASSISTANCEINFORMATION-STOP  -- ASN1STOP   |  | | --- | | ***UEAssistanceInformation* field descriptions** | | ***propagationDelayDifference***  Indicates the service link propagation delay difference between serving cell and each neighbour cell included in *neighbourCellInfoList* in number of ms. First entry in *propagationDelayDifference* corresponds to first entry in *neighbourCellInfoList*, second entry in *propagationDelayDifference* corresponds to second entry in *neighbourCellInfoList*, and so on. | |
| CMCC | Considering the uncertainty of UE location reporting in R17 NTN, to help SMTC/gap enhancements, it is better to support the assistance information in the form of a propagation delay difference between the serving cell and the neighbour in R17 at least.  Then, we could add the assistance information configuration about propagation delay difference in the *RRCReconfiguration* message and add propagation delay difference reporting information in *UEAssistanceInformation*. And the TP is as following.  Change For *RRCReconfiguration* as follows:  ⁝  RRCReconfiguration-v1700-IEs ::= SEQUENCE {  otherConfig-v1700 OtherConfig-v1700 OPTIONAL, -- Need M  ul-GapFR2-Config-r17 SetupRelease { UL-GapFR2-Config-r17 } OPTIONAL, -- Need M  sl-L2RelayUEConfig-r17 SetupRelease { SL-L2RelayUEConfig-r17 } OPTIONAL, -- Cond L2RelayUE  sl-L2RemoteUEConfig-r17 SetupRelease { SL-L2RemoteUEConfig-r17 } OPTIONAL, -- Cond L2RemoteUE  dedicatedPagingDelivery-r17 OCTET STRING (CONTAINING Paging) OPTIONAL, -- L2U2NRelay  needForNCSG-ConfigNR-r17 SetupRelease {NeedForNCSG-ConfigNR-r17} OPTIONAL, -- Need M  needForNCSG-ConfigEUTRA-r17 SetupRelease {NeedForNCSG-ConfigEUTRA-r17} OPTIONAL, -- Need M  musim-GapConfig-r17 SetupRelease {MUSIM-GapConfig-r17} OPTIONAL, -- Need M  scg-State-r17 ENUMERATED { deactivated } OPTIONAL, -- Need S  appLayerMeasConfig-r17 AppLayerMeasConfig-r17 OPTIONAL, -- Need M  needForPDDiffNeighborServing-r17 SetupRelease {NeedForPDDiffNeighborServing-r17} OPTIONAL,  nonCriticalExtension SEQUENCE {} OPTIONAL  }  ⁝  Then the following IE *NeedForPDDiffNeighborServing-r17* contains the trigger event related to the propagation delay difference information for SMTC/gap in NTN.  NeedForPDDiffNeighborServing-r17 ::= SEQUENCE{  reportType CHOICE {  periodical PeriodicalConfigDiff OPTIONAL,  eventTriggered EventTriggerConfigDiff OPTIONAL,  ...  }  }  PeriodicalReportConfigDiff ::= SEQUENCE {  periodicalReportInterval ENUMERATED {ms10, ms20, ms30, ms40, ms50,  ms60, ms70, ms80, ms120, ms160, ms240,  ms480, ms640, spare3, spare2, spare1} OPTIONAL,  reportAmountDiff ENUMERATED {r1, r2, r4, r8, r16, r32,  r64,infinity} OPTIONAL  }  EventTriggerConfigDiff ::= SEQUENCE {  pDDiff-Threshold ENUMERATED {ms1, ms2, ms3, ms4, ms5, ms10, ms20, ms30, ms40, ms50, ms60, ms70,ms80, ms90,ms100,spare1} OPTIONAL,  physCellId PhysCellId OPTIONAL  }  Change For *UEAssistanceInformation* as follows:  ⁝  UEAssistanceInformation-v1700-IEs ::= SEQUENCE {  ul-GapFR2-Preference-r17 UL-GapFR2-Preference-r17 OPTIONAL,  musim-Assistance-r17 MUSIM-Assistance-r17 OPTIONAL,  overheatingAssistance-r17 OverheatingAssistance-r17 OPTIONAL,  maxBW-PreferenceFR2-2-r17 MaxBW-PreferenceFR2-2-r17 OPTIONAL,  maxMIMO-LayerPreferenceFR2-2-r17 MaxMIMO-LayerPreferenceFR2-2-r17 OPTIONAL,  minSchedulingOffsetPreferenceExt-r17 MinSchedulingOffsetPreferenceExt-r17 OPTIONAL,  rlm-MeasRelaxationState-r17 BOOLEAN OPTIONAL,  bfd-MeasRelaxationState-r17 BIT STRING (SIZE (32)) OPTIONAL,  nonSDT-DataIndication-r17 SEQUENCE {  resumeCause-r17 ResumeCause OPTIONAL  } OPTIONAL,  scg-DeactivationPreference ENUMERATED { scgDeactivationPreferred, noPreference } OPTIONAL,  uplinkData-r17 ENUMERATED { true } OPTIONAL,  rrm-MeasRelaxationFulfilment-r17 BOOLEAN OPTIONAL,  pDDiffNeighborServingList-r17 ::= SEQUENCE (SIZE (1..maxNeighborCell)) OF pDDiffNeighborServing-r17  pDDiffNeighborServing-r17 ::= SEQUENCE{  neighPhysCellId PhysCellId OPTIONAL,  propaDelayDiff INTEGER (-30720..30719) OPTIONAL  }  }  nonCriticalExtension SEQUENCE {} OPTIONAL  }  ⁝ |
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Similarly for (coarse) UE location reporting, it needs to be decided how the corresponding event shall be defined. One exemplary implementation could be to use *eventD1* for this purpose and each time the NW reconfigures the UE with new SMTC/measurement gap, it also provides a new *eventD1* with updated *referenceLocation1/referenceLocation2.* Please share your view below.

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| **Question 7.2: If you support the assistance information in the form of a (coarse) UE location reporting, please show how the corresponding event should be defined in Stage-3 specification (both in the procedural text and ASN.1).** | |
| **Company** | **Stage-3 proposal** |
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# 8 Conclusion

The following proposals have been made in this document:

**Proposals for agreement:**

**Proposals for discussion:**

# References

1. R2-2204659 Time-based CHO after T2 Qualcomm Incorporated
2. R2-2204660 Assistance information for IDLE mode measurements in NTN Qualcomm Incorporated
3. R2-2204663 SMTC and MG configuration Qualcomm Incorporated
4. R2-2204715 Discussion on assistance information for IDLE mode and CONNECTED mode measurement
5. R2-2204964 Remaining details of UE assistance reporting and CHO Lenovo
6. R2-2205225 Remaining issues of NTN CHO Xiaomi Communications
7. R2-2205235 Further Discussion on CHO CATT
8. R2-2205304 Discussion on SMTC and gaps Huawei, HiSilicon
9. R2-2205341 CHO configuration after T2 expiry Sony
10. R2-2205372 Assistance information for neighbour cell measurement
11. R2-2205436 RIL: M404, V318, Z550 CHO configuration discarded or retained after T2
12. R2-2205438 SMTC for RRC\_IDLE and RRC\_INACTIVE state in NR NTN Ericsson
13. R2-2205529 Resolving open NTN issues for CONNECTED mode Nokia, Nokia Shanghai Bell
14. R2-2205589 SMTC Offset and Change Rate Google Inc.
15. R2-2205697 Discussion on CHO open issues Samsung Research America
16. R2-2205698 Discussion on SMTC open issues Samsung Research America
17. R2-2205957 Time-based CHO configuration after T2 InterDigital
18. R2-2205530 Assistance information for UE-based SMTC adjustment in idle and inactive mode Nokia
19. R2-2206029 UE based SMTC adjustment LG Electronics Inc.
20. R2-2204561 [V319][V305][V310] Remaining issues on signalling design and corresponding procedures for neighbour cell assistance information in NR NTN
21. R2-2204963 Remaining issues of provisioning neighbor cell satellite information Lenovo
22. R2-2205233 Discussion on Neighbor Cell Satellite Information CATT
23. R2-2204470 Reply LS to RAN2 on NR NTN Neighbour Cell and Satellite Information
24. R2-2206196 [offline-106] CP issues Nokia
25. R2-2206210 Report from [AT118-e][106][NTN] CP issues – second round (Nokia)