**3GPP TSG-RAN WG2 Meeting #119bis-e R2-2210855**

**Online, 10th-19th October, 2022**

**Agenda Item: 6.10.4.2**

**Source: Samsung**

**Title: Summary of [AT119bis-e][113][NR-NTN] epoch time and validity timer (Samsung)**

**Document for: Discussion and Decision**

# Introduction

* [AT119bis-e][113][NR NTN] epoch time and validity timer (Samsung)

Initial scope: Discuss proposals on Epoch time and validity timer handling, apart from those handled in offline 114

Initial intended outcome: Summary of the offline discussion with e.g.:

* List of proposals for agreement (if any)
* List of proposals that require online discussions
* List of proposals that should not be pursued (if any)

Deadline (for companies' feedback): Thursday 2022-10-13 14:00 UTC

Deadline (for rapporteur's summary in R2-2210855): Thursday 2022-10-13 16:00 UTC

Proposals marked "for agreement" in R2-2210855 not challenged until Friday 2022-10-14 10:00 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online).

This document is to summarize main proposals from the following contributions submitted under the A.I. 6.10.4.2 on NR NTN RRC connections, mainly covering aspects related to epoch time and validity timer.

|  |
| --- |
| 1. R2-2210466 Discussion on Epoch Time Samsung Research America discussion Rel-17 NR\_NTN\_solutions-Core 2. R2-2209799 Clarification on validity of the UL sync info Apple discussion Rel-17 NR\_NTN\_solutions-Core 3. R2-2210411 Discussion on epoch time Huawei, HiSilicon discussion Rel-17 NR\_NTN\_solutions-Core 4. R2-2210729 NTN Configuration at Handover and CHO Sequans Communications discussion Rel-17 38.331 NR\_NTN\_solutions-Core R2-2208659 5. R2-2209528 On timer T430 for Rel-17 NR NTN Ericsson discussion Rel-17 6. R2-2209850 Discussion on configuration of satellite information for handover ASUSTeK discussion Rel-17 38.331 NR\_NTN\_solutions-Core 7. R2-2209851 Discussion on T430 handling upon going to RRC\_IDLE ASUSTeK discussion Rel-17 38.331 NR\_NTN\_solutions-Core 8. R2-2209852 Clarification on validity timer for serving cell ASUSTeK discussion Rel-17 38.331 NR\_NTN\_solutions-Core |

# 2. Contact information

|  |  |
| --- | --- |
| Company | Delegate contact |
| COMPANY\_NAME | NAME ([email@address.com](mailto:email@address.com)) |
| Xiaomi | xiaowei jiang (jiangxiaowei@xiaomi.com) |
| vivo | Xiao XIAO (xiao.xiao@vivo.com) |
| Lenovo | Min Xu (xumin13@lenovo.com) |
| Huawei, HiSilicon | Lili Zheng (zhenglili4@huawei.com) |
| Sequans | Olivier Marco (omarco@sequans.com) |
| Samsung | Shiyang Leng (shiyang.leng@samsung.com) |
| ASUSTeK | Erica Huang (Erica\_Huang@asus.com) |
| Apple | Fangli XU (fangli\_xu@apple.com) |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# Discussion

## 3.1 Serving cell

### Epoch time in the future

In the current TS 38.331, the procedure related to SIB19 acquisition is specified as follows.

|  |
| --- |
| 5.2.2.4.21 Actions upon reception of *SIB19*  Upon receiving *SIB19*, the UE shall:  1> start or restart T430 for serving cell with the timer value set to *ntn-UlSyncValidityDuration* from the subframe indicated by *epochTime*;  NOTE: UE should attempt to re-acquire *SIB19* before the end of the duration indicated by *ntn-UlSyncValidityDuration* and *epochTime* by UE implementation. 5.2.2.6 T430 expiry The UE shall:  1> if T430 for serving cell expires and if in RRC\_CONNECTED:  2> inform lower layers that UL synchronisation is lost;  2> acquire *SIB19* as defined in clause 5.2.2.3.2;  2> upon successful acquisition of *SIB19*:  3> inform lower layers that UL synchronisation is obtained; |

One issue discussed related to this procedure is that upon the UE acquires SIB19, the UL sync info (i.e., ephemeris, common TA parameters) may be invalid for a period of time before the SFN/subframe indicated by the epochTime, if the indicated epochTime is in the future. Then if T430 expires before the indicated epoch time, UE could be stuck with no valid UL sync info between the expiring time and the indicated epoch time. This issue was discussed in RAN2#119-e, and RAN2 agreed to wait for RAN1’s related discussion on backward propagation, i.e. whether the UL sync information is applied by the UE upon SIB19 acquisition or upon the indicated epoch time if the indicated epoch time is in the future. However, there is no consensus in RAN1 after extensive discussion.

[1] and [2] discuss this issue and propose to solve/avoid this issue by NW/UE implementation. In [2], the issue is discussed for connected UE and idle/inactive UE separately. And it is proposed that for the IDLE/INACTIVE UE, it’s up to UE implementation to acquire the SIB19 before T430 expiry.

Also note that in RAN2#119-e, the following agreement was already made.

Agreements:

1. It is left to UE implementation on how UEs in RRC\_IDLE/RRC\_INACTIVE re-acquire SIB19 for serving cell’s satellite assistance information.

**Question 1: Do companies agree that for the IDLE/INACTIVE UE, it’s up to UE implementation to acquire the SIB19 before T430 expiry?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Disagree | There is no need to ask UE to acquire SIB19 before T430 expiry. UE can by implementation to decide to acquire SIB19 after T430 expiry if the measurement requirement is met. |
| Qualcomm | Disagree | It may be more accurate to say it is up to UE implementation to use T430 in IDLE/INACTIVE mode. |
| vivo | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Disagree | According to the agreement from previous meeting, it is up to UE implementation whether to main T430 for UEs in Idle/Inactive, but “before T430 expiry” gives the hint that T430 is always maintained.  We think the agreement from last meeting is enough. |
| Sequans | Disagree | In our understanding there is no requirement to maintain valid UL sync info in IDLE/INACTIVE. |
| Samsung | Disagree | For idle/inactive UE, no requirement for UE to keep UL sync. Last meeting’s agreement is sufficient. |
| ASUSTeK | Disagree | For the IDLE/INACTIVE UE, it’s up to UE implementation to maintain SIB19. |
| Apple | See comment | We are fine to keep the last meeting’s agreement and avoid the T430 operation description for IDLE/INACTIVE UE. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

It is also stated in [2] that for the IDLE/INACTIVE UE,

* If there is no attempt to initiate the RRC connection, this issue will not cause any problem;
* If the UE intends to initiate the RRC connection, if the gap length, i.e. duration between T430 expiry and epoch time in the future, is small then the issue could be ignored; if the gap length is big, we can leave it to UE implementation about whether UE could assume the UL sync is valid or not.

**Question 2: Do companies agree that for the IDLE/INACTIVE UE, it’s up to UE implementation whether UE assumes the UL sync info (i.e. ephemeris, common TA parameters) is valid during the gap between T430 expiry and the indicated epoch time in the future?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | See comment | After T430 expiry, the SIB19 is invalid. But it is UE implementation to decide when to reacquire SIB19, even after epoch time. |
| Qualcomm | Disagree | The epoch time has to be followed regardless of state. |
| vivo | Disagree | We think that the UE should assume the UL sync info (i.e. ephemeris, common TA parameters) is valid, upon receiving the updated assistance information. In our understanding, the current procedure of reception of SIB19 and T430 expiry can already reflect this. |
| Lenovo | Disagree | Based on the definition UE cannot assume the UL sync info (i.e. ephemeris, common TA parameters) to be valid after T430 expiry. However we do not think this is a big issue as UE implementation may either acquire SIB19 earlier before T430 expire or suspend initiating RRC connection until the epoch time of reacquired SIB19. |
| Huawei, HiSIlicon | Disagree | This is related to whether backward propagation is allowed, which is discussed in [Offline-114].  If backward propagation is feasible, and UE re-acquires SIB19 before the old one expires, there is no issue. |
| Sequans | Disagree | This is about whether backward propagation is possible or not. We believe it should be discussed/decided and not left to UE implementation. |
| ASUSTeK | Disagree | The satellite information should not be considered as valid when T430 is not running. |
| Apple | See comment | We can wait for the discussion in [Offline-114].  But if the IDLE/INACTIVE UE cannot assume the UL sync is valid during the gap, UE cannot initiate the RRC Connection Request/resume procedure before the timepoint indicated by the epochTime. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

For the CONNECTED UE, it is stated in [2] that since NW can provide the NTN UL sync config via the RRC dedicated signaling (via ReconfigWithSync or the dedicated SIB19 delivery), this case can be avoided by the appropriate NW implementation. For connected UE, if the UE cannot acquire SIB19 due to no common search space configured with an active BWP, the NW sends UL sync info via dedicated RRC signal. In this case, the NW can ensure that the UL sync info is valid upon UE receives the dedicated RRC signal, so that the issue of future epoch time can be avoided.

**Question 3: Do companies agree that for the CONNECTED UE, if the UE cannot acquire SIB19 due to no configured common search space** **with an active BWP, it is up to the NW implementation to ensure the UL sync info is always valid by providing the NTN UL sync info to UE via dedicated signaling, i.e., no gap between T430 expiry and next epoch time?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| Qualcomm | Agree |  |
| vivo | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Sequans | Disagree | As per RAN1 agreement, the epoch time may in the future.  RAN2 has not yet agreed backward propagation. In such case it is not correct to say " UL sync info in the dedicated RRC message is valid upon UE receives the message" because it would be valid only upon epoch time (in the future).  The agreement should be "It is up to the NW to ensure that UE has always a valid UL sync info" (can still be achieved whether backward propagation is agreed or not).  Moderator: the question is updated to make it more clear. |
| Samsung | Agree |  |
| ASUSTeK | Agree |  |
| Apple | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

In another case for connected UE, i.e., if the UE can acquire SIB19, it is also proposed in [1] that the gap duration between T430 expiry and epoch time in the future can be avoided by by appropriate NW and UE implementation. The NW can indicate the epoch time for the start of the next validity duration that is no later than the end of the current validity duration. On the other hand, as captured in the NOTE, a smart UE should attempt to reacquire SIB19 before T430 expiry in a way that the epoch time of the new assistance information is before the expiry time.

**Question 4: Do companies agree that for the CONNECTED UE, if the UE can acquire SIB19 by itself, which of the following options is agreeable to solve the issue of epoch time in the future?**

* **Option 1: It is up to the NW implementation to ensure the UL sync info is always valid by providing the NTN UL sync info to UE via dedicated signaling?**
* **Option 2: It is up to NW and UE implementation that the epoch time of the next validity duration acquired in SIB19 is before the current T430 expiry.**
* **Option 3: other**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Xiaomi | Option 3 | We can only assume that NW by implementation to ensure that new SIB19 is provided before the expiry of T430. The epoch time could be after the expiry of T430. This is the intention of RAN1 to point epoch time to the future instead of past, i.e. to maximize the validity duration. If we use option 2, the validity duration is actually reduced. |
| Qualcomm |  | Question is unclear.  As long as current T430 is running, UE can continue use the old stored ephemeris. The newly acquired ephemeris can be used at the new epoch time. It is not always guaranteed there will not be gap between expiry of old T430 and start of new T430, and this is ok as expected. |
| vivo | Option 2 |  |
| Lenovo | Option 2 | We think UE implementation can handle this. |
| Huawei, HiSIlicon |  | This is related to whether backward propagation is allowed, which is discussed in [Offline-114].  If backward propagation is feasible, and UE re-acquires SIB19 before the old one expires, there is no issue. |
| Sequans | None | We don't see the issue to be solved.  RRC already captures  " NOTE: UE should attempt to re-acquire *SIB19* before the end of the duration indicated by *ntn-UlSyncValidityDuration* and *epochTime* by UE implementation.  " |
| Apple | Option 1 | The gap of invalid UL sync is not expected and for the CONNECTED UE.  To avoid the gap, we can assume NW implementation can provide the information to the CONNECTED UE via the dedicated signalling. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Clarification for 5.2.2.4.21

In the current TS 38.331, the UE sets the length of T430 for serving cell to the value of *ntn-UlSyncValidityDuration* and(re)start the T430 from the subframe indicated by *epochTime*.

|  |
| --- |
| 5.2.2.4.21 Actions upon reception of *SIB19*  Upon receiving *SIB19*, the UE shall:  1> start or restart T430 for serving cell with the timer value set to *ntn-UlSyncValidityDuration* from the subframe indicated by *epochTime*;  NOTE: UE should attempt to re-acquire *SIB19* before the end of the duration indicated by *ntn-UlSyncValidityDuration* and *epochTime* by UE implementation. |

However, the UE could receive multiple ntn-UlSyncValidityDuration and epochTime in SIB19, i.e., for serving cell and for neighbour cells. It is proposed in [8] to clarify in clause 5.2.2.4.21, ntn-UlSyncValidityDuration and epochTime for the serving cell (receiving in SIB19) are applied for T430 for serving cell.

**Question 5: Do companies agree in clause 5.2.2.4.21, clarification is needed that *ntn-UlSyncValidityDuration* and *epochTime* for the serving cell are applied for T430 for serving cell?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| Qualcomm |  | Why for serving cell T430, UE will apply validity duration from neighbor cell list and not from the serving cell? |
| vivo | Agree | In order to make which parameters (i.e., *epochTime* and *ntn-UlSyncValidityDuration*) are used for T430 associated with serving cell clear, the clarification is necessary. |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Sequans | Disagree | That clarification is not needed…It is obvious that serving cell parameters should be used. |
| Samsung |  | Seems obvious for UE. No strong view, we can follow majority. |
| ASUSTeK | Agree |  |
| Apple |  | We donot think current spec has any ambiguity, and it’s obvious that the T430 for serving cell is configured based on the serving cell’s configuration.  But we can follow majority view. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

The text proposal to TS 38.331 is proposed in [8] for the clarification on UlSyncValidityDuration and epochTime for serving cell T430.

|  |
| --- |
| 5.2.2.4.21 Actions upon reception of *SIB19*  Upon receiving *SIB19*, the UE shall:  1> start or restart T430 for serving cell with the timer value set to *ntn-UlSyncValidityDuration* for the serving cell from the subframe indicated by *epochTime* for the serving cell;  NOTE: UE should attempt to re-acquire *SIB19* before the end of the duration indicated by *ntn-UlSyncValidityDuration* and *epochTime* by UE implementation. |

**Question 6: If Q5 is agreed, do companies agree to adopt the TP in R2-2209852?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| vivo | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Agree |  |
| ASUSTeK | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### T430 upon entering RRC\_IDLE

In [7], T430 upon entering RRC\_IDLE is discussed as follows. Currently, the UE would stop running timers including T430 upon going to RRC idle mode as following text in TS 38.331.

|  |
| --- |
| 5.3.11 UE actions upon going to RRC\_IDLE  The UE shall:  […]  1> stop all timers that are running except T302, T320, T325, T330, T331 and T400;  […] |

This means the UE does not maintain T430 upon entering RRC idle mode even the satellite assistance information is still valid. The satellite assistance information provided in SIB19 would be applied in both RRC idle/inactive mode and RRC connected mode. The UE would perform UE-based SMTC adjustment based on the satellite assistance information in RRC idle mode. In the last RAN2 meeting, it was agreed to left UE implementation on how to re-acquire SIB19 for serving cell in RRC idle/inactive mode and how to re-acquire SIB19 for neighbour cells. The T430 should be handled in RRC idle/inactive mode by UE implementation. Therefore, it is proposed that the UE should not stop T430 upon going to RRC idle mode.

**Question 7: Do companies agree that UE should not stop T430 upon going to RRC\_IDLE.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| Qualcomm | Agree |  |
| vivo | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Sequans | Disagree | If the UE goes to IDLE in a different cell we believe the timer should be stopped.  So it looks better to keep the existing text and let the UE do this by implementation if it wishes to do so. |
| Samsung | Agree | No need to force UE to stop T430 upon entering idle mode. It can leave to UE implementation. |
| ASUSTeK | Agree |  |
| Apple | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Neighbour cell

### Clarification on epoch time

In [3], the epoch time for neighbour cell is discussed. In the current TS 38.331, the field description for *epochTime* is as follows.

|  |
| --- |
| ***epochTime***  Indicate the epoch time for the NTN assistance information. When explicitly provided through SIB, or through dedicated signaling, *EpochTime* is the starting time of a DL sub-frame, indicated by a SFN and a sub-frame number signaled together with the assistance information. The reference point for epoch time of the serving satellite ephemeris and Common TA parameters is the uplink time synchronization reference point. If this field is absent, the epoch time is the end of SI window where this SIB19 is scheduled. This field is mandatory present when provided in dedicated configuration. If this field is absent in *ntn-Config* provided via *NTN-NeighCellConfig* the UE uses epoch time from the serving satellite ephemeris, otherwise the field is based on the timing of the serving cell, i.e. the SFN and sub-frame number indicated in this field refers to the SFN and sub-frame of the serving cell. In case of handover, this field is based on the timing of the target cell, i.e. the SFN and sub-frame number indicated in this field refers to the SFN and sub-frame of the target cell. This field is excluded when determining changes in system information, i.e. changes to *epochTime* should neither result in system information change notifications nor in a modification of *valueTag* in SIB1. |

Based on previous agreements and the field description, it is clear that:

1. If epoch time for neighbour cell is absent in *ntn-Config* provided via *NTN-NeighCellConfig*, the UE uses epoch time for serving cell;
2. If epoch time for serving cell is absent, the epoch time is the end of SI window where this SIB19 is scheduled;

However, if both epoch time for serving cell and epoch time for neighbour cell are absent, it is unclear whether the UE can use the end of SI window where this SIB19 is scheduled as the epoch time for the neighbouring cell.

**Question 8: Do companies agree that if both epoch time for serving cell and epoch time for neighbor cell are absent, the epoch time for neighbor cell is the end of SI window where this SIB19 is scheduled?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| Qualcomm | Agree | Neighbor cell anyway has to follow the serving cell epoch time. This seems already clear. |
| vivo | See comments | Based on the current field description, if epoch time for serving cell is absent, the epoch time is the end of SI window where this SIB19 is scheduled; if epoch time for neighbour cell is absent in *ntn-Config* provided via *NTN-NeighCellConfig*, the UE uses epoch time for serving cell. So, if we concatenate these two descriptions, it is equivalent to saying that if both epoch time for serving cell and epoch time for neighbour cell are absent, the UE uses epoch time for serving cell i.e., the end of SI window where this SIB19 is scheduled as the epoch time for the neighbouring cell.  Therefore, we think the UE behaviour if both epoch time for serving cell and epoch time for neighbour cell are absent has already been clear according to the current field description of *epochTime*. No additional clarification is needed. |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Sequans | Agree | Already clear to us |
| Samsung | Agree | Current field description is already clear. |
| ASUSTeK | Agree |  |
| Apple | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

In RAN1 #110, the following agreements were achieved:

|  |
| --- |
| **Agreement**  For serving cell if EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the current SFN or the next upcoming SFN after the frame where the message indicating the Epoch time is received.  For neighbor cell if EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the frame nearest to the frame where the message indicating the Epoch time is received. |

In RAN2#119bis-e, the following agreement is made.

Agreements:

1. In the field description of epochTime, include RAN1’s agreement on the interpretation of the SFN indicating the epoch time for serving cell and neighbor cell

The issues raised for neighbor cell epoch time in [3] is that if epoch time for neighbor cell is absent, and the epoch time for serving cell is reused, which rule will the UE follow to determine the SFN? For this issue, it is stated in [3] that since the serving cell epoch time is reused, the UE should comply with the SFN determination for serving cell.

**Question 9: Do companies agree that if epoch time for neighbor cell is absent, and the serving cell epoch time is reused for neighbor cell, UE considers the indicated SFN to be current SFN or the next upcoming SFN after the frame where the message indicating the Epoch time is received?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| Qualcomm | Agree |  |
| vivo | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Sequans | Agree |  |
| Samsung | Agree |  |
| ASUSTeK | Agree |  |
| Apple | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## 3.3 Target cell

### Epoch time for target cell

The interpretation of explicit epoch time, i.e. the indicated SFN and subframe number, for the target cell in HO/CHO is discussed in [1], [2], and [3]. In [3], it is noted that in RAN2#118-e, the following agreement was made.

|  |
| --- |
| Agreement:   1. During HO, the target cell’s epoch time (i.e. SFN and subframe number) is based on target cells’ timing. |

This means the epoch time (SFN and the subframe number) refers to the SFN and sub-frame of the target cell. UE can read the MIB message of the target cell to obtain the SFN during handover. Considering the SFN wraps around every 10.24s, the association between the SFN indicated by the epoch time and the SFN where the MIB is acquired is ambiguous for the UE. This is similar to the ambiguity for serving/neighbour cell epoch time, for which RAN1 agreement was made.

Then for the target cell, the SFN indicated by the epoch time may be same as the SFN where the MIB of target cell is acquired; the SFN indicated by the epoch time may be previous frame of the SFN where the MIB is acquired; the SFN indicated by the epoch time may be next frame of the SFN where the MIB is acquired. Or UE can directly read the SIB19 of the target cell during the handover and ignore the epoch time in HO command.

It is also proposed in [2] that UE considers the target cell as the neighbor cell to decide the reference frame/SFN of the epochTime, so that potential delay in waiting UL sync info to be valid can be avoided.

**Question 10: In case of HO, which of the following options is preferred?**

* **Option 1: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the current SFN or the next upcoming SFN after the frame where the MIB of target cell is firstly acquired.**
* **Option 2: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the current SFN or the previous SFN before the frame where the MIB of target cell is firstly acquired**
* **Option 3: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the frame nearest to the frame where the MIB of target cell is firstly acquired.**
* **Option 4: the UE directly read the SIB19 of the target cell and ignore the epoch time in HO command.**
* **Option 5: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers the frame to be the frame nearest to the frame where the message indicating the Epoch time is received**
* **Option 6: other**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Xiaomi | Option 1 | Given that the target cell will become serving cell very soon, we should adopt the understanding of this frame for serving cell. |
| Qualcomm | Option 5 | When UE receives the HO message, UE needs to remember the time t1 where message is received. Now when UE executes the HO at time t2, it knows what was target SFN at t1. So epoch time is closest to SFN at t1. That’s the RAN1 agreement. |
| vivo | Option 5 | We think upon receiving the assistance information, UE can apply the information and consider itself synchronized with the target cell. The reference SFN/subframe of the epoch time for the target cell can follow the interpretation of the neighbor cell. |
| Lenovo | Option 5 | We think this option is the same as RAN1’s agreement. |
| Huawei, HiSilicon | Option 3 | Note that for HO/CHO, the epochTime is based on target cell’s timing, and the UE cannot obtain target cell’s timing unless MIB is acquired. |
| Sequans | Option 5 | Same understanding as QC. |
| Samsung | Option 5 | We think target cell can follow principle of neighbour cells. Option 5 is workable as QC mentioned, in that way the target cell SFN is followed. |
| ASUSTeK | Option 5 |  |
| Apple | Option 5 |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Question 11: In case of CHO, which of the following options is preferred?**

* **Option 1: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the current SFN or the next upcoming SFN after the frame where the MIB of target cell is firstly acquired.**
* **Option 2: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the current SFN or the previous SFN before the frame where the MIB of target cell is firstly acquired**
* **Option 3: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers this frame to be the frame nearest to the frame where the MIB of target cell is firstly acquired.**
* **Option 4: the UE directly read the SIB19 of the target cell and ignore the epoch time in HO command.**
* **Option 5: if target cell EpochTime is indicated explicitly by a SFN and subframe number, the UE considers the frame to be the frame nearest to the frame where the message indicating the Epoch time is received**
* **Option 6: other**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Xiaomi | Option 1 | Similar as Q10 |
| Qualcomm | Option 5 | Same as Q10. For CHO, it may be possible UE would need to acquire SIB19 from target if it turns out validity duration expired. But that is ok in some cases it can happen only if network sets the validity duration too short. |
| vivo | Option 5 | Refer to our reply to Q10. |
| Lenovo | Option 5 | We think this option is the same as RAN1’s agreement. |
| Huawei, HiSilicon | Option 3 | Note that for HO/CHO, the epochTime is based on target cell’s timing, and the UE cannot obtain target cell’s timing unless MIB is acquired. |
| Sequans | Option 5 | Same as Q10. |
| Samsung | Option 5 |  |
| ASUSTeK | Option 5 |  |
| Apple | Option 5 |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Validity duration for target cell

In the current TS 38.331, ntn-UlSyncValidityDuration-r17 is mandatory present for SIB19, and optionally present otherwise. This means, validity duration can be absent in dedicated RRC configuration, which can be reconfigurationWithSync for target cell. In this case, the UE needs to know how to set T430 upon handover even when ntn-UlSyncValidityDuration is absent. In [6], it is proposed to reuse the validity duration for the serving cell in SIB19.

**Question 12: Do companies agree that if validity duration is absent in reconfigurationWithSync for target cell, serving cell validity duration in SIB19 is reused?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree | It is related to the discussion whether neighbor cell NTN-config for target cell exists in serving cell’s SIB19. Solution should be aligned. From simplicity point of view, directly following serving cell’s NTN config, irrespective of whether neighbor cell NTN-config for target cell exists, is much simpler. |
| Qualcomm | Agree | We made this comment before, the validity duration should be present even for dedicated signalling case and we should not have the cond SIB19. |
| vivo | Disagree | Since *epochTime* is mandatory present when provided in dedicated configuration, it makes no sense for the network to not provide *ntn-UlSyncValidityDuration*. So, it’s up to NW implementation to ensure *ntn-UlSyncValidityDuration* is present if *epochTime* is present in the dedicated signaling. |
| Lenovo | Agree | Agree with Xiaomi’s view. |
| Huawei, HiSilicon | Disagree | We wonder whether the case really exists, i.e., the NW provides epochTime but no validity duration. |
| Sequans | Disagree | Same view as vivo. |
| Samsung | Disagree | NW should indicate validity duration for target cell in dedicated RRC signalling for UE to start target cell T430. We think same as epoch time, validity duration should be mandatory in dedicated signalling. |
| ASUSTeK | Agree | It could up to NW implementation whether to provide ntn-UlSyncValidityDuration in reconfigurationWithSync. If it’s not provided for target cell, UE could reuse serving’s form SIB19, similar to neighbor cell. |
| Apple | See comment | We have the same question as Huawei, NW should provide the epochTime and *ntn-UlSyncValidityDuration* together. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Use SIB19 for HO/CHO

In [4], whether UE can use SIB19 for HO/CHO is discussed. It is pointed out that at RAN2#119e meeting, the following related agreements related to target cell were reached.

Agreements:

1. During HO/CHO execution upon applying target cell configuration, UE should:

a. Stop the current T430 (if it is running);

b. Start T430 for the target cell as indicated by ntn-UlSyncValidityDuration and epochTime of the target cell

2. RAN2 understands that the UE can use assistance information of neighbour cells in SIB19 for mobility purposes in RRC Connected. FFS if this needs to be captured in Stage2 and whether something needs to be captured for RRC idle

For CHO, the NW has no knowledge of when the actual handover will take place. Typically, the validity of NTN-config might be around 1minute, while the CHO might be executed much later. It is then generally not possible for the NW to provide a NTN-config that be valid at the time of CHO execution in the HO message. Without valid target cell NTN-config, the UE has to acquire SIB19 of target cell, or the UE can use neighbour cell assistance information from serving cell SIB19 if the target cell is part of the neighbour cells listed in SIB19.

In the HO case, it can be expected that the target NTN-config is included in the HO message. However, there seems no reason to restrict this for CHO only and it would simplify specification and device implementation to keep common behaviors between CHO and HO.

Based on these considerations, it is proposed in [4] that UE should be able to use the target cell NTN-config IE from SIB19 for HO purpose.

**Question 13: Do companies agree that UE can use the target cell NTN-config IE from SIB19 for HO and CHO?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Disagree | It would complicate things, given that there might not be target cell NTN-config IE in serving cell’s SIB19, then we need also to specify whether to use serving cell’s NTN-config. For simplicity, if NTN-config is absent in reconfiguarationWithSync,UE always use serving cell’s NTN configuration. |
| Qualcomm | Disagree | NTN-config is absent means it is intra-satellite HO, the satellite is same and UE can use the stored one.  See our response in Q10, there is no issue in providing ntn-Config in CHO. |
| vivo | Disagree | It is an optimization. It is a corner case that the UE continues to perform reconfiguration with sync after T430 expiry since the maximum duration of T304 is only 10s which is far less than the duration of T430. It is up to NW implementation to ensure the termination time of T430 is after T304. |
| Lenovo | Disagree | We think UE using serving cell NTN-config until HO complete is more reasonable. |
| Huawei, HiSilicon | Disagree | If the NTN-config in RRCReconfiguration is outdated, the NW can update the configuration. |
| Sequans | Agree (Proponent) | We fail to understand the above comments.  The target cell ntn-config can be provided to UE in HO/CHO message but also in SIB19.  In case of CHO, it is likely the ntn-config from CHO message would be quite old/invalid at the time of CHO execution. It is also likely the UE would have a more recent one from receiving SIB19 (that it is using to measure the target cell).  We don't see the rationale to mandate the UE to use the old ntn-config from CHO message while it already has a more recent one.  In general, we believe it is likely the ntn-config from CHO would be invalid at the time of CHO execution, so the UE would have to read SIB19, leading to HO interruption. This is unfortunate as the UE had already all the info required to avoid that. |
| Samsung | Disagree | Seems there is nothing to stop UE use the target cell NTN-config IE from SIB19 for HO and CHO, if the target cell is one of the neighbour cells with fresher assistance info provided in SIB19.  But the case that target cell ntn-config from CHO configuration is invalid is rare. The validity duration can be up to 900s, and time window for CHO can be up to 600s. NW can ensure target cell ntn-config is valid for HO execution by configuration or even update by modify conditional config.  We agree with Xiaomi and vivo that this optimization would complicate things and introduce more potential spec impacts. The current procedure can work. |
| ASUSTeK | Agree with comment | For CHO, if NTN-config in reconfiguarationWithSync becomes invalid at the time of CHO execution, the UE could use NTN-config from SIB19.  For HO, since the UE executes the HO upon receiving the HO command, NTN-config in the HO command should be valid. But if it is absent in reconfiguarationWithSync, it should be for intra-satellite HO and the UE can use serving cell’s NTN-config from SIB19 directly. |
| Apple | Disagree | To make it simple, we can assume that NW implementation always provide the NTN-config in reconfiguarationWithSync in handover case.  The absence of the NTN-config in reconfiguarationWithSync can only be used for the intra-satellite case, in which the UE always use serving cell’s NTN configuration. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Furthermore, in CHO framework, the UE needs to decode the HO message only upon CHO execution. It might be preferable to keep this behavior and avoid a requirement to read the HO message before execution. In such case, it could be up to NW/UE implementation to provide/keep reading SIB19 up to date so that the target NTN-config is valid at the time of CHO execution.

**Question 14: If Q13 is agreed, do companies agree that it is up to NW/UE implementation to provide/keep SIB19 up to date so that the target cell NTN-config in SIB19 is valid at the time of CHO execution?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | See comment |  |
| Sequans | Agree (Proponent) | That means, no new requirement, just allow the UE to use the information it has already acquired. |
| ASUSTeK | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

In the current TS 38.331, T430 for the target cell is captured as follows, wherein the validity duration and epoch time included in reconfigurationWithSync is applied by UE for target cell T430.

|  |
| --- |
| 5.3.5.5.2 Reconfiguration with sync  The UE shall perform the following actions to execute a reconfiguration with sync.  1> stop timer T430 if running;  1> start timer T430 with the timer value set to *ntn-UlSyncValidityDuration* from the subframe indicated by *epochTime*, if included in the *reconfigurationWithSync* for serving cell;  1> if the AS security is not activated, perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with the release cause '*other*' upon which the procedure ends; |

If UE can use target cell NTN-config in SIB19 for HO/CHO, the following TP is proposed.

|  |
| --- |
| 5.3.5.5.2 Reconfiguration with sync The UE shall perform the following actions to execute a reconfiguration with sync.  1> stop timer T430 if running;  1> start timer T430 with the timer value set to *ntn-UlSyncValidityDuration* from the subframe indicated by *epochTime*, according to the target cell NTN-config;  1> if the AS security is not activated, perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with the release cause '*other*' upon which the procedure ends;  NOTE: target cell NTN-config might be from *reconfigurationWithSync* or SIB19 |

**Question 15: If Q13 is agreed, do companies agree to adopt the TP in R2-2210729 for TS 38.331 clause 5.3.5.5.2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Qualcomm |  | Within Reconfiguration with sync, it should be for target cell. |
| Sequans | Agree (Proponent) |  |
| ASUSTeK | Agree with comment | The Note can be combined into the normative text. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### T430 related to HO

In [5], T430 handling related to HO failure is discussed as follows. If UE ends up performing re-establishment procedure due to HO failure, at this point the T430 timer has been started for the target cell as it was started in 5.3.5.5.2 when executing reconfiguration with sync. Thus, when initiating the re-establishment procedure, the UE needs to stop T430 for the target cell and, after the cell selection procedure, restart T430 with the timer value from the source cell or from the new serving cell depending on which cell is selected in the cell selection procedure.

**Question 16: Do companies agree that when initiating the re-establishment procedure due to HO failure, the UE stops T430 for the target cell?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Qualcomm | Disagree | Why the timer has to be stopped if UE has stored it. |
| vivo | Disagree | The procedure of stopping T430 for target cell when initiating the re-establishment procedure and restarting T430 with the timer value from source cell will extend the length of the T430, this is not acceptable for us.  Furthermore, in our understanding, there is no problem that the T430 continues running in re-establishment procedure, if the serving cell is not changed, T430 continues running, if UE selects another cell, a new T430 will be started. |
| Lenovo | Disagree | Considering its functionality, there is no reason of stopping T430 for the target cell in this case. |
| Huawei, HiSilicon | Disagree | Since UE only maintains T430 for the serving cell (neighbour cell validity timer is up to implementation and not captured in the spec), the UE will start a new T430 if another cell is selected. Nothing is broken in the current spec. |
| Sequans | Agree | It seems cleaner. |
| Samsung | Disagree | Agree with vivo and HW |
| ASUSTeK | Agree | When a re-establishment procedure is triggered, the satellite information for source cell (e.g. received in SIB19 of source cell) or target cell (e.g. received in HO command) could not be suitable for the UE to access a selected cell. |
| Apple | Disagree | Agree with vivo and HW. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Upon UE selecting a suitable cell in RRC re-establishment procedure (e.g. due to HO failure), the UE has to acquire SIB19 if the selected cell is an NTN cell and start T430 timer for the serving cell. The following two options are proposed in [5] to specify this UE behaviour.

**Question 17: Which option is preferred to specify UE behaviour upon UE selecting a suitable NTN cell in RRC re-establishment procedure?**

**Option 1: specify procedural text in in Clause 5.3.7.3.**

|  |
| --- |
| 5.3.7.3 Actions following cell selection while T311 is running Upon selecting a suitable NR cell, the UE shall:  1> ensure having valid and up to date essential system information as specified in clause 5.2.2.2;  1> if the selected cell is an NTN cell:  2> acquire SIB19 as defined in clause 5.2.2.3.2;  1> stop timer T311;  **…**  **<<omitted>>** |

**Option 2: capture in the note in Clause 5.2.2.4.21**

|  |
| --- |
| 5.2.2.4.21 Actions upon reception of *SIB19* Upon receiving *SIB19*, the UE shall:  1> start or restart T430 for serving cell with the timer value set to *ntn-UlSyncValidityDuration* from the subframe indicated by *epochTime*;  NOTE: UE should attempt to re-acquire *SIB19* before the end of the duration indicated by *ntn-UlSyncValidityDuration* and *epochTime* or if timer T430 is stopped by UE implementation. |

**Option 3: other**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Xiaomi | Option 3 | For both establishment procedure and reestablishment procedure, UE needs to ensure have valid essential system information before initiating the procedure. RAN2 has agreed that SIB19 is essential, a note can be captured in essential system information missing section to clearly say that SIB19 is essential, We think it would be enough: 5.2.2.5 Essential system information missing ...  NOTE: SIB19 is essential system information.  With the above note, there is no need to adopt option 1/2. |
| Qualcomm | None | Agree with Xiaomi. |
| vivo | See comments | The current procedure of T430 handing in RRC re-establishment procedure is sufficient; perhaps no change is needed. |
| Lenovo | None | Agree with Xiaomi’s solution. |
| Huawei, HiSilicon | None | Agree with Xiaomi. |
| Sequans | Option 1 | We believe SIB19 being essential is not sufficient.  It just means UE shall have a valid version of SIB19 (as per SI framework). This does not mean the UE shall have a valid ntn-config. |
| Samsung | None | This relates to SIB19 is essential SI. Agree with Xiaomi. |
| ASUSTeK | Option 1 |  |
| Apple | None | Agree with Xiaomi. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Furthermore, the timer table in clause 7.1.1 needs to be updated to capture the new starting and stopping conditions for T430 in HO/CHO.

**Question 18: To update the start and stop condition of T430, do companies agree to adopt the following TP in R2-2209528?**

|  |  |  |  |
| --- | --- | --- | --- |
| T430 | Start or restart from the subframe indicated by *epochTime* upon reception of SIB19, or upon reception of *RRCReconfiguration* message including *reconfigurationWithSync*, or upon conditional reconfiguration execution i.e. when applying a stored *RRCReconfiguration* message including *reconfigurationWithSync* | Upon reception of *RRCReconfiguration* message including *reconfigurationWithSync* , or upon conditional reconfiguration execution i.e. when applying a stored *RRCReconfiguration* message including *reconfigurationWithSync* | Perform the actions as specified in 5.2.2.6. |

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| Qualcomm | See comments | Why stop condition is same as start condition? |
| vivo | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Disagree | NTN-config is optional in HO command/ CHO configuration. If not included, how will the UE start the T430 for target cell? |
| Sequans | See comments | Maybe this can be done after the other questions are agreed upon. |
| Samsung | Agree with comment | Agree to update the T430 start/stop condition, but exact wording needs discussion. The start should be from indicated epoch time. |
| ASUSTeK | Agree |  |
| Applge | Agree with the intention | The table needs to be updated, but the wording needs further discussion. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# 4. Summary and Proposals

This section summarizes the main proposals:

# 5. References

1. R2-2210466 Discussion on Epoch Time Samsung Research America discussion Rel-17 NR\_NTN\_solutions-Core
2. R2-2209799 Clarification on validity of the UL sync info Apple discussion Rel-17 NR\_NTN\_solutions-Core
3. R2-2210411 Discussion on epoch time Huawei, HiSilicon discussion Rel-17 NR\_NTN\_solutions-Core
4. R2-2210729 NTN Configuration at Handover and CHO Sequans Communications discussion Rel-17 38.331 NR\_NTN\_solutions-Core R2-2208659
5. R2-2209528 On timer T430 for Rel-17 NR NTN Ericsson discussion Rel-17
6. R2-2209850 Discussion on configuration of satellite information for handover ASUSTeK discussion Rel-17 38.331 NR\_NTN\_solutions-Core
7. R2-2209851 Discussion on T430 handling upon going to RRC\_IDLE ASUSTeK discussion Rel-17 38.331 NR\_NTN\_solutions-Core
8. R2-2209852 Clarification on validity timer for serving cell ASUSTeK discussion Rel-17 38.331 NR\_NTN\_solutions-Core