**3GPP TSG RAN WG2 #119bis-e *draft R2-2210848***

**Online, 10 - 19 Oct, 2022**

**Source:** Huawei, HiSilicon

**Title:** Report of [Offline-107][IoT NTN] RRC corrections (Huawei)

**Agenda Item:** 7.2.4.1

**Document for:** Discussion and decision

# Introduction

This document is a report of the following offline discussion:

* [AT119bis-e][107][IoT NTN] RRC corrections (Huawei)

Initial scope: Discuss RRC corrections in AI 7.2.4.1

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 R2-2210848): Thursday 2022-10-13 16:00 UTC

Proposals marked "for agreement" in R2-2210848 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).

1. Contact Information

To make it easier to find the contact delegate for potential follow-up questions, delegates are encouraged to provide their contact information in the following table:

|  |  |  |
| --- | --- | --- |
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# Discussion

## Neighbour cell ephemeris

In the previous meeting, RAN2 discussed whether to broadcast satellite assistance information for neighbour cells for measurement/mobility purposes, and the conclusion was to wait for RAN4 feedback to reopen the discussion.

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| *(7/12) Proposal 5: In this release, the NW will not broadcast satellite assistance information for neighbour cells for measurement/mobility purposes.*  - HW indicates that RAN4 thinks that ephemeris information is needed for NR NTN and did not discuss for IoT NTN only due to lack of time so there is a risk we need to come back to this. QC agrees with HW  - QC thinks that broadcasting of assistance information for neighbour cell is already possible  - ZTE suggests to reword as: “in R17, neighbour cell ephemeris information would not be introduced in SIB31”. Oppo supports this   * Discussion on the introduction of cell ephemeris information in SIB31 is on hold until we receive feedback from RAN4 on this, if any |



In [1], it is proposed that neighbour cell ephemeris information is not broadcast in Rel-17 IoT NTN. The technical reasons include the limited size of SIB in IoT NTN, which would only allow information from a single satellite to be included, a previous agreement from RAN2#115-e, and the possible specification impact due to the ASN.1 freeze. In [2], it is proposed to add neighbour satellite ephemeris list in SIB31 to facilitate inter-satellite measurements.

**Q1: Do you agree to introduce satellite assistance information (e.g. ephemeris, common TA parameters) for neighbour cells in SIB31?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | But it should be added in a backward compatible manner.  Besides, frequency list and cell list should be added considering a satellite may serve multiple frequencies and multiple cells. |
| MediaTek | Yes | Agree with Huawei’s comments |
| Xiaomi | Yes | The detailed IE should follow the NR NTN. |
| OPPO | No | Although neighbour cell ephemeris information can help to perform measurements more efficient, as Rel-17 has already been frozen, we should not introduce neighbour cell ephemeris information in SIB31 since it is an optimisation and the benefit is limited by the size of SIB31. |
| Qualcomm | Yes | Agree with Huwaei. |
| Ericsson | No | We do not think RAN2 should introduce satellite assistance information for neighbour cells in SIB31 since this was discussed in RAN2 earlier in RAN2#115-e and majority thought that this was an optimization which can be discussed in Rel-18. In addition to that, as mentioned in the comment above, RAN4’s agreement does not tell RAN2 to include this information.  Then regarding the technical aspects: One should consider that the size for SIB is limited, which would mean that satellite assistance information can be provided only for 1 neighbour cell in NB-IoT. Although this can be useful to inform the UE about the upcoming satellite which will replace the serving cell in quasi earth fixed cells, early deployments might experience discontinuous coverage. Then, UEs can use SIB32’s ephemeris information to assist measurements. For those reasons, there seems to be little benefit given the specification impact considering that ASN.1 is frozen.  [HW2] On SIB size:  For BL UEs and UEs in CE, the maximum SIB and SI message size is 936 bits. For NB-IoT, the maximum SIB and SI message size is 680 bits. According to the current IE design, the total bits of the satellite information is about 263 bits. Therefore the maximum number of satellites for which assistance information can be provided is 3 for eMTC and 2 for NB-IoT, including serving satellite. So the maximum number of neighbour satellites for which assistance information can be provided is 2 for eMTC and 1 for NB-IoT.  However, considering one satellite may serve multiple frequencies and multiple neighbor cells, we think the ephemeris info of 1 neighbour satellite is still beneficial.  [Ericsson2] On SIB size:  We agree that a satellite may serve multiple frequencies and neighbour cells. Still, we consider the benefit is rather limited, especially given the specification impact at this late stage.  Let’s consider the following scenario, a NB-IoT UE camping in the serving cell’s centre and 2 neighbour satellites. The benefit for the UE would be very limited if only 1 satellite can be provided. Thus, we suggest to continue the discussion in Release 18 when RAN2 has more time to discuss a more optimal way forward. |
| ZTE | No | We also disagree to introduce neighbour cell ephemeris information in SIB31 in this late R17 CR stage. It is foreseeable that a lot of discussion would be needed on how to use such neighbour cell ephemeris information (usage/benefit) for idle mode UEs and how to introduce it (e.g., must it be in SIB31 or can it be incorporated in SIB3~SIB5?)  We agree with Ericsson that it cannot deduce from the RAN4 agreements that introduction of neighbour cell ephemeris information is needed. Even RAN4 has mentioned “*provided that valid information for the neighbour/target cell is made available to the UE*”, we understand the existing neighbour cell information in SIB3~SIB5 already can be seen as “*valid information for the neighbour cell*”.  Moreover, even HW gives reference to NR NTN agreements, it is still unclear which agreement parts apply to the connected mode mobility and which apply to idle mode mobility. Then it’s also unclear which agreement (s) can be the background support for introducing neighbour cell ephemeris in SIB31. |
| Lenovo | Yes | Agree with Huawei |
| Apple | Yes | Agree with Huawei. |
| Nordic | Yes but | Would prefer having this level of changes in R18. |
| CATT | No strong view. | But agree with Nordic, prefer to discuss this in Rel18. |
| Nokia | No | Agree with OPPO and Ericsson on the need for this CR. This is not an essential correction. |

## Epoch time in SIB31

In RAN1 #110-e, the following was agreed for NR NTN:

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| 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. |

RAN1 also agreed that IoT NTN will reuse the same solution:

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

In [3], it is proposed to add the following clarification corresponding to RAN1 agreement:

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| ***epochTime***  Epoch time of the satellite ephemeris data and common TA parameters, see TS 36.213 [23]. The reference point for epoch time of the serving satellite ephemeris and Common TA parameters is the uplink time synchronization reference point.  *epochTime* is the starting time of a DL subframe indicated by *startSFN* and *startSubframe*. The *startSFN* indicates the current SFN or the next upcoming SFN after the frame where the message indicating the *epochTime* is received.  If the field is absent, the UE uses the starting time of the DL subframe corresponding to the end of the SI window during which the SI message carrying SIB31 is transmitted.  E-UTRAN always includes *epochTime* when *SystemInformationBlockType31* is provided through dedicated signalling. |

[2] proposes a similar change on this aspect, which takes neighbour cell *epochTime* into account as well. Since there is no conclusion on whether neighbour cell ephemeris will be provided, the moderator thinks the above changes in [3] can be taken as a baseline.

**Q2: Do you agree with the above changes?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| MediaTek | Yes, but | Agree in principle, but it should be captured that this refers to epochTime for serving cell only. |
| Xiaomi | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes but | Agree with MediaTek. We suggest to capture according to RAN1 agreement.  For serving cell, the startSFN indicates the current SFN or the next upcoming SFN after the frame where the message indicating the epochTime is received. For non-serving cell, the startSFN indicates the closest SFN to the frame where the message indicating the epochTime is received. |
| Ericsson | Maybe | This is also being discussed in NR NTN. We suggest waiting until the discussion is concluded there with the intention to align the text. |
| ZTE | Yes |  |
| Qualcomm | Yes | Agree with MediaTek. |
| Apple | See comments | Agree with Qualcomm |
| Nordic | Yes |  |
| CATT | Yes |  |
| Nokia | Yes | Agree with QC and MediaTek on applicability for serving cell only and aligned with RAN1 agreements. |

The RAN1 agreement on SFN ambiguity has not considered HO/CHO cases, and [3] proposes the following:

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| **Proposal 2: It’s suggest to confirm the understanding that, when receving dedicated SIB31 in RRC reconfiguration message, UE also considers SFN in *epochTime* to be the current SFN or the next upcoming SFN after the frame where RRC reconfiguration message is received.** |

The moderator would like to list all possible solutions into the question. Under each option, “MIB of target cell” is mentioned as the second sub-option, because for HO/CHO the *epochTime* is based on the timing of target cell, and the UE cannot acquire target cell’s timing before acquiring the MIB.

**Q3: In case of HO/CHO, how the UE will interpret the SFN indicate by *epochTime*:**

* **Option 1: current or next upcoming SFN**
  + **1-1: after the frame where RRC reconfiguration message is received**
  + **1-2: after the frame where the MIB of target cell is firstly acquired**
* **Option 2: the frame nearest**
  + **2-1: to the frame where RRC reconfiguration message is received**
  + **2-2: to the frame where the MIB of target cell is firstly acquired**
* **Option 3: current or previous SFN**
  + **3-1: before the frame where RRC reconfiguration message is received**
  + **3-2: before the frame where the MIB of target cell is firstly acquired**

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| **Company** | **Option** | **Comments** |
| Huawei, HiSilicon | 2-2 |  |
| MediaTek | 1-2 or 2-2 |  |
| Xiaomi | 2-2 |  |
| OPPO | 2-1 | To be more precise, it should be “to the target cell’s frame where RRC reconfiguration message is received” |
| Qualcomm | 2-1 | RAN1 agreement for neighbor cell applies to target cell as well.  2-2 may not work as it is not sure when UE reads MIB of the target cell. |
| Ericsson | 2-2 | We suggest following NR NTN. From TS 38.331: “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” |
| ZTE | 1-1 or 2-1 | Based on the definition/structure of SIB31 itself, we think it’s straightforward to consider the *epochTime* in SIB31 as the *epochTime* for serving cell. But if majority have the view that dedicated SIB31 is for “neighbour cell”, we are also fine with 2-1.  No matter to choose 1-1 or 2-1, the more important thing is to keep consistent understanding between UE and NW.  Moreover, we tend to agree with Qualcomm that 2-2 may not work. And we are not clear what the difference between Option 3 and Option 2 is. We understand for option 2, the nearest SFN can be a previous SFN. |
| Lenovo | 2-2 |  |
| Apple | 2-1 with modification  See comments | This issue also exists in NR NTN. We should better have the same agreement to both.  According to our understanding, for target cell in HO, the neighbour cell agreement should be applied, meaning EpochTime should be the nearest frame.  Regarding the interpretation of frame, we think it refers to the target cell’s SFN at the exact time point when UE receives the RRCReconfiguration message from serving cell.  So, we suggest to change it to be “**the frame with target cell’s SFN indicated by EpochTime, nearest to the frame where RRC reconfiguration message is received**”. |
| Nordic | 1-1 or 2-1 |  |
| CATT | Wait the ongoing discussion of NR NTN | The same question is also discussed in [AT119bis-e][113][NR NTN] epoch time and validity timer, we can use the same solution adopted in NR. |
| Nokia | X-2 But | This does not (always) work because it cannot be predicted when the UE will read the target cell MIB. Thus the SFN link to the target cell is ambiguous |

There is another issue related to HO/CHO. In RAN2 #119-e, it was proposed in R2-2208681 that for CHO SIB31 may not be provided in *RRCConnectionReconfiguration* (i.e., change “mandatory present” to “optional”), and the conclusion is to postpone the discussion.

In [4][5], the issue is mentioned, and both contributions propose to keep the current conditional presence, i.e., the SIB31 in *RRCConnectionReconfiguration* is mandatorily present in case of handover to a NTN cell. Arguments include:

1) If changed to optional, it is difficult to for the NW to determine whether to provide the field. Besides, with the current spec, the NW implementation can still update the CHO configuration if outdated.

2) If the SIB31 is present in CHO message, UE could identify this candidate target cell is a NTN cell, and prioritize TN target cells if both TN and NTN cells satisfy the CHO condition. Therefore it’s beneficial to include SIB31.

**Q4: Do you agree to keep the existing conditional presence for SIB31 in *RRCConnectionReconfiguration* (i.e., no spec change)?**

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| *NTN* | The field is mandatory present in case of handover to a NTN cell. Otherwise the field is optionally present, Need ON, in a NTN cell. |

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | NBC changes should be avoided. |
| MediaTek | Yes | Agree with Huawei |
| Xiaomi | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Lenovo | Yes |  |
| Apple | Yes |  |
| Nordic | Yes |  |
| CATT | Yes |  |
| Nokia | Yes |  |

## Update of SIB32

In RAN2 #118-e, the following agreements were achieved on SIB32, but it is still not crystal clear whether the NW is allowed to use the legacy SI modification procedure to update SIB32. [6][7] propose to discuss this issue.

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| * 8: Once a UE receives a SIB32, the UE is allowed to estimate out of coverage and to not do Idle mode tasks when out of coverage. * 9a: The prediction error limit is up to UE implementation (it is up to UE impl when to consider a stored SIB32 obsolete). * 11: Leave it to UE implementation to store old SIB32s and keep track of known ephemerides, even when new SIB32s are received. * UE is expected to re-acquire SIB32 based on its own decision (regardless SI modification state). Can CB next meeting if needed |

**Q5: Which is the intended behaviour for SIB32 update?**

* **Option 1: Network uses the SI modification to update SIB32, but it is up to UE implementation whether to re-acquire the new SIB32.**
* **Option 2: Network does not use the SI modification to update SIB32. Network can update SIB32 at any time (not bound to BCCH modification period). The UE decides whether and when to re-acquire SIB32.**

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| **Company** | **Option** | **Comments** |
| Huawei, HiSilicon | Option 1 | In option 1, the network can use the *systemInfoValueTagSI* to inform the UE whether the SIB32 is updated. And then the UE can determine whether to re-acquire SIB32 based on its own decision. Some companies may argue that the UE still need to read the SIB1 to know whether the change of system information is caused by updating of SIB32. However, the change of SIB32 would not be frequent, the ephemeris will be updated only before they become too inaccurate. Therefore the SI modification procedure will not bring serious issue on the power consumption.  In option 2, we wonder how the UE know whether the change of SIB32 considering there is no validity timer for SIB32. If the UE does not know and only blindly to re-acquire the SIB32, it will also waste the UE power. Also in some cases, if the UE does not get the new SIB32 timely, the UE cannot correctly predict the out of coverage. In that cases the UE may still deactivate the AS function even if there is coverage.  Also, please note that the current spec is aligned with Option 1. |
| MediaTek | Option 1 | Agree with Huawei that SIB 32 has no validity timer and it contains long-term (mean) ephemeris, which will remain valid for some weeks. |
| Xiaomi | Option 1 | We don’t see any issues that the legacy SI modification mechanism is used for updating SIB32 when the mean ephemeris data is used in SIB32. |
| OPPO | Option 1 | SIB32 does not have timer to keep it valid. If it does not follow SI modification procedure, UE would have to re-acquire SIB32 blindly since there is not any way to let UE know the change of SIB32, which leads to unnecessary power consumption. Therefore, it would be better that the network is allowed to use the SI modification procedure. |
| Qualcomm | Option 1 |  |
| Ericsson | Option 1 | We think that changes to SIB32 will rarely occur because mean ephemeris can hold valid for weeks. Thus, the power impact is negligible. In addition, if there happens to be a change in SIB32, UEs should be aware of it. If SIB32 is not bound to the SI modification period, a UE has no means to know if or when the content has changed |
| ZTE | Option 1 | Agree with the above analysis. It’s beneficial to let network use the value tag to inform the UE whether the SIB32 is updated. |
| Lenovo | Option 1 | SIB32 including mean ephemeris does not change frequently, and we think using value tag for update is reasonable. |
| Apple | Option 1 | We agree with Huawei, mainly because the ephemeris data in SIB32 is not changed frequently. |
| Nordic | Option 1 |  |
| CATT |  | Can follow the majority, if companies think that the UE has to read SIB1 even the UE doesn’t to read SIB32.  And for the agreement:  UE is expected to re-acquire SIB32 based on its own decision (regardless SI modification state).  A note has been added in 5.2.1.3 of TS 36.331 as:  NOTE 4: UE connected to NTN is expected to re-acquire SIB32(-NB) based on its own decision regardless of *systemInfoValueTag* change.  it seems like only RRC-CONNECTED UE was covered. Actually, it has little on the power consumption for the connected UE to read SIB32 when there is a notification. Maybe we should also consider covering the UE in IDLE or INACTIVE in this note. E.g.  NOTE 4: UE served by NTN is expected to re-acquire SIB32(-NB) based on its own decision regardless of *systemInfoValueTag* change. |
| Nokia | Option 1 |  |

In [8], some corrections to SIB32 field descriptions are proposed, mainly to refer to cells rather than satellites.

| ***SystemInformationBlockType32* field descriptions** |
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|  |
| ***footprintInfo***  Satellite footprint.  E-UTRAN may configure *elevationAngles* and/or *radius* for satellite with earth moving cell.  E-UTRAN may configure *referencePoint* and *radius* for quasi-earth fixed cell. |
| ***serviceInfo***  Information on when the satellite will provide coverage.  E-UTRAN always configures *tle-EphemerisParameters* for a satellite with earth moving cell(s) and always configures *t-ServiceStart* for a satellite with quasi-earth fixed cells. |
| ***t-ServiceStart***  Time information on when the incoming satellite is going to start serving the area for quasi-earth fixed cell. |

**Q6: Do you agree with the above changes?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | Not critical though. |
| MediaTek | Yes |  |
| Xiaomi | Yes |  |
| OPPO | No | Only change “earth moving satellite” to “earth moving cell” and “quasi-earth fixed satellite” to “quasi-earth fixed cell”. |
| Qualcomm |  | Agree with OPPO. |
| Ericsson | Yes | Not critical |
| ZTE | Yes |  |
| Lenovo | Yes |  |
| Apple | Not essential |  |
| Nordic | Yes | Not critical, though. |
| CATT | Not critical |  |
| Nokia | Yes | Proponent |

## Other

In [2], it is proposed to add the following clarification:

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| – *EphemerisOrbitalParameters* The IE *EphemerisOrbitalParameters* provides satellite ephemeris in format of orbital parameters in ECI.  NOTE: The ECI and ECEF coincide at Epoch time (e.g. x,y,z axis in ECEF are aligned with x,y,z axis in ECI) |

This was based on RAN1 agreement and discussed in RAN2 #119-e with some other modifications to several field descriptions (R2-2207310). Since it was recommended by some companies to mention the ECI in IE description rather than in individual fields, the conclusion of the offline discussion was formulated as follows and agreed via email:

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| **Proposal 11: Changes in R2-2207310 are replaced by adding “ECI” in the description of the IE *EphemerisOrbitalParameters*.** |

**Q7: Do you agree with adding the following note in the description of IE*****EphemerisOrbitalParameters* (R2-2209440)?**

NOTE: The ECI and ECEF coincide at Epoch time (e.g. x,y,z axis in ECEF are aligned with x,y,z axis in ECI)

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| MediaTek | Yes |  |
| Xiaomi | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| Ericsson | Yes | Not critical |
| ZTE | Yes |  |
| Lenovo | Yes |  |
| Apple | Yes |  |
| Nordic | Yes |  |
| CATT | Not critical |  |
| Nokia | Yes |  |

In [9][10], the following changes are proposed:

Change 1:

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| 5.3.3.21 UE actions upon indication of invalid GNSS position in NTN Upon indication that the GNSS position has become out-of-date while in RRC\_CONNECTED, the UE shall:  1> perform the actions upon leaving RRC\_CONNECTED as specified in 5.3.12, with release cause 'other'. |

Change 2:

| Timer | Start | Stop | At expiry |
| --- | --- | --- | --- |
| T317  NOTE1 | Upon acquisition of *SystemInformationBlockType31* |  | In RRC\_CONNECTED mode, initiate acquisition of *SystemInformationBlockType31* in accordance with 5.3.18. |

**Q8: Do you agree with the above changes (R2-2210698)?**

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes with Change 2 | Change 1 looks not essential. There are many features/IEs introduced for NTN, there is no need to mention the restriction to NTN for every feature. |
| MediaTek | Yes with Change 2, but out-of-date is preferred | We prefer the word “out-of-date” over “invalid”, as it implies GNSS was valid before and is not valid at this moment.  Change 2 could be pursued. |
| Xiaomi | Yes with Change 2 | We think the word “out-of-data” is more in line with the real situation. |
| OPPO | Yes with change 2 | For Change 1, “out-of-date” is used in the text of this clause, so for the title it would be better to use the same term. |
| Qualcomm | Yes with change 2 only |  |
| Ericsson | Yes to change 2 |  |
| ZTE | Yes with change 2 only |  |
| Lenovo | Yes to Change 2 |  |
| Apple | Yes with Change 2 |  |
| Nordic | Yes for Option 2 |  |
| CATT | Yes for option 2 |  |
| Nokia | Yes for option 2 |  |

In [11], it is proposed to add a new field for indicating the RRC protocol release or version applicable for the current UE configuration. However, this is not an IOT-NTN specific issue, and the WI code in the CR is TEI17. Therefore, it will not be discussed in this offline.

# Conclusion

To be completed

# Reference

1. R2-2210736, Discussion on neighbour cell information, Ericsson
2. R2-2209440, Miscellaneous corrections to TS 36.331 for IoT NTN, MediaTek Inc.
3. R2-2210530, Clarification on epochTime in SIB31, ZTE Corporation, Sanechips
4. R2-2210531, Clarification on dedicated SIB31, ZTE Corporation, Sanechips
5. R2-2210747, Discussion on the NTN configuration at CHO, CATT
6. R2-2210413, Discussion on the update of SIB32, Huawei, HiSilicon
7. R2-2210746, Corrections on SIB32 update notification in 36.331, CATT
8. R2-2210079, Miscellaneous corrections for IoT-NTN, Nokia Solutions & Networks (I)
9. R2-2210706, Discussion on RRC corrections for IoT NTN, Samsung R&D Institute UK
10. R2-2210698, CR for RRC corrections for IoT NTN, Samsung R&D Institute UK
11. R2-2210704, Add a new field for access stratum release Google Inc.