**3GPP TSG-RAN WG2 Meeting #121bis-e draft R2-2304247**

**Online, Apr 17th-26th, 2023**

**Source: Samsung**

**Title: Report of [AT121bis-e][107][NR NTN Enh] NW type information (Samsung)**

**Agenda item:** **7.7.4.1.1**

**Document for:** **Discussion and Decision**

# Introduction

This document records the discussion and outcome for the following offline discussion.

* [AT121bis-e][107][NR NTN Enh] NW type information (Samsung)

Initial scope: discussion p4 and p5 from [R2-2303766](file:///C:\Data\3GPP\Extracts\R2-2303766.docx) and p1 from [R2-2303736](file:///C:\Data\3GPP\Extracts\R2-2303736%20-%20TN%20NTN%20mobility%20enhancements.docx)

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: Monday 2023-04-24 12:00 UTC

Deadline for rapporteur's summary (in R2-2304247): Monday 2023-04-24 18:00 UTC

Proposals marked "for agreement" in R2-2304247 not challenged until Tuesday 2023-04-25 08:00 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online in the Tuesday CB session).

Rapporteur encourages the participating delegates to provide their contact information in this table.

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# Discussion

As specified in TS 38.101-5 [1], NTN satellite operating band is assigned with different frequency band numbers than TN frequency band numbers: n255 and n256. Even though the frequency bands used for TN and NTN are overlapped, i.e. n255 overlaps with n24, n256 overlaps with n65, UE can know a neighbour cell is NTN by the indicated frequency band in SIB3/4*.*

For HAPS, frequency band n1 can be applied as specified in TS 38.104 [2]. Both TN and HAPS can operate on frequency band n1. In this case, UE cannot distinguish TN and NTN (HAPS) neighbour cells by the frequency band number, which may have impacts on neighbour cell measurement for cell reselection.

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| NR *operating band* | Uplink MHz / NR-ARFCN  (First – <Step size> – Last) | Downlink MHz / NR-ARFCN (First – <Step size> – Last) |
| n1 | 1920 MHz – 1980 MHz  384000 – <20> – 396000 | 2110 MHz – 2170 MHz  422000 – <20> – 434000 |
| n24 | 1626.5 MHz – 1660.5 MHz 325300 –< 20 >– 332100 | 1525 MHz – 1559 MHz 305000 –< 20 >– 311800 |
| n255 | 1626.5 MHz – 1660.5 MHz  325300 – <20> – 332100 | 1525 MHz – 1559 MHz  305000 – <20> – 311800 |
| n65 | 1920 MHz – 2010 MHz 384000 –< 20 >– 402000 | 2110 MHz – 2200 MHz 422000 –< 20 >– 440000 |
| n256 | 1980MHz – 2010 MHz  396000 – <20> – 402000 | 2170 MHz – 2200 MHz  434000 – <20> – 440000 |

R2-2303736 and R2-2303766 discussed this issue.

**Case 1: when camping on a TN cell**

When camping on an TN cell, idle/inative UE obtains its neighbour cell information only from SIB3/4. TN cell does not broadcast SIB19. Without NTN-specific assistance information, a UE may not be able to measure an NTN neighbour cell leading to restricted TN to NTN mobility in RRC\_IDLE/INACTIVE. Therefore, a TN cell needs to provide satellite assistance information in System Information. The proposed solution is that TN cell broadcasts *NTN-config-r17* in SIB3/SIB4 for NTN neighbour cells.

**Q1) Do you agree in TN cell SIB3/SIB4 NTN-config-r17 is provided for NTN neighbour cells?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | NTN-config-r17 has to be provided by a TN serving cell for NTN neighbour cell measurement, otherwise UE cannot measure NTN neighbour cells. TN cell does not need to broadcast SIB19, NTN-config-r17 in SIB3/4 works. |
| MediaTek | Yes | This is needed if TN-NTN mobility needs to be supported in overlapping bands. |
| Ericsson | Yes | This information is needed for a UE to measure NTN cells. |
| Transsion | Yes | From TN-NTN mobility perspective, it need another means to identify whether a neighor cell is HAPS or TN. |
| Google | Neutral | If UE always prioritizes TN over NTN, then we don’t think UE needs to constantly measure the NTN cells while camping on a TN cell. If a NTN-capable UE is under the NTN coverage while losing its TN connectivity, the UE can perform cell selection from the scratch and then will be able to camp on the NTN cell. |
| Thales | Yes | This information is needed for NTN-capable UEs to measure NTN cells when camping on a TN cell. |
| Panasonic | Yes | Agree to Samsung’s comment. |
| CMCC | Yes |  |
| vivo | No with comments | We think the above solution is an optimization. As what Google commented above, the UE can move from TN to NTN based on the existing mechanism: If no TN neighbour cell fulfils the reselection criteria, UE will enter any cell selection state and NTN neighbour cell may be detected. That means, even though NTN neighbour cells may not be measured during the cell reselection procedure, they will be detected later.  Considering that as per the WID for NR\_NTN\_enh -Core, TN-NTN mobility enhancement in IDLE/INACTIVE mode is a lower priority than NTN-TN, this TN-NTN specific enhancement may not be concluded before NTN-TN design is completed. |
| OPPO | Yes | TN cell cannot broadcast SIB19 in order to distinguish TN serving cell and NTN serving cell, therefore it seems that the only choice for IDLE/INACTIVE UE in TN cell to measure NTN neighbour cell is to broadcast NTN-config-r17 of NTN neighbour cells in SIB3/4.  As we agreed on satellite assistance information for NTN neighbour cell in SIB19, the NTN-config-r17 provided in SIB3/4 should also not trigger the system information update notification, and it is up to UE implementation to decide when to update them. |
| Lenovo | Yes | In cases of TN-NTN mobility this is needed. |
| CATT | See the comment | Another approach is to provide the assistance info of NTN cell in a new SIB, to avoid impact on TN-only UE.  Another issue is that the validity of the NTN-config is short, and the validity is control by timer from UE side, so the update mechanism for NTN-Config is different from the legacy SIB3/4, it is not suitable to include it in the SIB3/4. |
| Xiaomi | Yes | It could help UE to quickly measure the NTN cell. |
| Nokia | Not essential | The proposed scheme can work, but we agree with those who indicate this is an optimization which can be circumvented. OK to follow the preference of the majority. |
| TCL | Yes |  |
| Sony | Yes |  |
| Apple | Yes | It would be helpful for TN->NTN mobility, the validity of the NTN-config needs further discussion. |
| DOCOMO | Yes |  |
| ITRI | No | If TN is prioritized over NTN, UE would start measuring of NTN neighbour cells when moving out of TN coverage. It is supposed that UE could find a suitable NTN cell upon successfully detected the CD-SSB of the cell, and determine the camped cell is a NTN cell upon the SI of the cell is obtained. |
| Huawei, HiSilicon | No | “TN-NTN mobility” is deprioritized according to the WID:  *Specify cell reselection enhancements for RRC\_IDLE/INACTIVE UEs to reduce UE power consumption (NTN-TN mobility is prioritized). [RAN2, RAN3, RAN4]* |
| Intel | No | Same view with Google. |
| ZTE | See comments | UE need such information to measure NTN neighbor cell when camps in TN but also wonders if it is part of WID. |
| Qualcomm | See comments | What is the problem if TN cell instead broadcast SIB19? Is this prohibited? |
| ETRI | No | We agree with ITRI |
| Spreadtrum | Yes |  |
| FGI | Yes |  |
| Sequans | Prefer No (see comments) | Similar view as QC.  If this scenario needs to be supported, why not just reuse SIB19 while not including the serving NTN-config? What would be the issue? (obviously the UE could not start T430 in that case, so the mentioned issue does not exist, but it could easily be clarified as well) |
| NEC | Neutral | We sympathize with Google’s views, UEs should not need to measure NTN cells if they are camping on a TN cell, although we understand that this could be helpful as an optimization in the context of service continuity. |
| LGE | No | As the TN cell is prioritized to NTN cell, there is no need to measure the NTN cell while UE camps on TN cell. |

Summary:

Totally 29 companies have replied.

- 16 companies explicitly agree with the proposal. 7 companies disagree with the reasons: 1) there is no issue even without providing NTN-config in TN cell, when moving out of TN coverage UE can enter any cell selection state and perform cell selection (e.g., measure cells from the scratch); 2) “TN-NTN mobility” is deprioritized according to the WID; 3) TN cell can provide SIB19 without starting T430.

- 3 companies are neutral and think this is an optimization which is not essential.

- 3 companies think the proposal is workable but

- wonder if alternative solution (e.g., TN cell broadcast SIB19 or a new SIB) is better

- not sure this is in WID scope.

**(16/29) Proposal 1: in TN cell SIB3/SIB4, NTN-config-r17 is provided for NTN neighbour cells.**

If Q1 is agreed, for a neighbour cell is indicated in SIB3/4, NTN-config-r17 allows UE to know this is an NTN cell, so that UE can measure it if needed or does not measure it if not supporting NTN. However, on frequency band n1, if neither NTN-config-r17 nor TN coverage information is provided for a neigbor cell, UE cannot know whether the neighbour cell is TN or NTN (HAPS).

If Q1 is not agreed, on frequency band n1, if TN coverage information is NOT provided for a neighbour cell, UE cannot known whether the neighbour cell is TN or NTN (HAPS).

**Case 2: when camping on an NTN cell**

When camping on an NTN cell, UE obtains its neighbour cell information from SIB3/4/19: SIB3 contains intra-frequency information, SIB4 contains inter-frequency information, and SIB19 provides NTN-config-r17. Frequency and PCI are used to associate neighbour cell information in SIB3/4 with NTN-config-r17 in SIB19.

For a neighbour cell indicated in SIB3/4, if the associated NTN-config-r17 is provided in SIB19, UE knows this is an NTN cell and can measure it if needed. However, on frequency band n1, if neither NTN-config-r17 nor TN coverage information is provided for a neigbor cell, UE cannot know whether the neighbour cell is TN or NTN (HAPS).

In summary, on frequency band n1, if neither NTN-config-r17 nor TN coverage information is provided for a neigbor cell, UE cannot know whether the neighbour cell is TN or NTN (HAPS). In this case, UE has to determine whether the neighbour cell is TN or NTN: if the neighbour cell is TN UE should perform TN cell measurement, if the neighbour cell is NTN UE can skip measure it without NTN assistance information. Futhermore, an NTN UE can prioritize TN cell measurement (e.g., by UE implementation) if it can distinguish TN and NTN neighbour cells; an non-NTN UE can skip measuring NTN neighbour cells for power saving if it can distinguish TN and NTN neighbour cells.

**Q2) Do you agree on frequency band n1, if neither NTN-config-r17 nor TN coverage information is provided for a neigbor cell, UE needs to determine whether the neighbour cell is TN or NTN (HAPS)? If not, please explain the reason in comment.**

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| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes |  |
| MediaTek | Yes, but | We think this is a corner case (neither NTN-config-r17 nor TN coverage information is provided for a neigbor cell). In such corner cases the UE implementation can take care of it. |
| Ericsson | No | If neither *NTN-config-r17* nor TN coverage information is provided for a neighbour cell, UE can safely determine the neighbour cell is TN.  There is no ambiguity.  From 38.300: “For a UE in Idle/Inactive mode it's up to UE implementation whether to perform NTN neighbour cell measurements on a cell indicated in SIB4 but not included in SIB19”  Network is aware of this limitation. Thus, it will not include an NTN frequency in SIB3/4, unless *NTN-config-r17* is provided in SIB19. |
| Transsion | No | We should identify if there exist such scenario firstly，i.e. neither NTN-config-r17 nor TN coverage information is provided for a neigbor cell. |
| Google | No | Not sure what we want to achieve by letting a NTN-capable UE know if a neighbour cell is a TN cell or a HAPS cell? To us, it seems they have similar cell reselection priority. |
| Thales | No | Not sure there exist such scenario and if so, share Ericsson’s view. |
| Panasonic | Yes |  |
| CMCC | See comments | It may be unusual that both the NTN-config-r17 and TN coverage information are absent, and network should provide correct configuration to UE. |
| vivo | No | For a given neighbour cell, UE measures the frequency of the cell according to the configuration of the NW (e.g., SMTC configuration), UE can perform cell reselection criteria evaluation for this frequency regardless of whether this cell is detected since other cells in this frequency may be detected. No problem is identified even though UE doesn’t know whether this cell is TN or NTN. |
| OPPO | No | We doubt why NW provide neither NTN-config-r17 nor TN coverage information for a neighbour cell. For frequency band n1, it is up to network implementation to avoid the ambiguity between TN and NTN (HAPS), i.e., if NW does not expect UE to miss the measurement of HAPS neighbour cell, it should always provide NTN-config-r17 for HAPS neighbour cell in SIB19. |
| Lenovo | No | For the only conner case wherein neither is configured, agree with Ericsson that UE can take the cell as a TN cell. |
| CATT | No | The other offline (106) is ongoing, which is discussing which SIB to broadcast the TN coverage information. If the TN coverage information together with the TN frequency information is broadcast in a separate SIB, e.g. a new defined SIB, the issue will not occur. UE can assume the neighbour cell is TN cell if the frequency is present in the new defined SIB. And if it present in SIB4/5, UE can assume the neighbour cell is a NTN cell. |
| Xiaomi | No | UE don’t need to distinguish the neighbour cell type when performs neighour cell measurement. |
| Nokia | No | If this scenario is realistic then we think the UE should assume this is an TN cell. |
| TCL | No | Share with Ericsson’s view. |
| Sony | Yes |  |
| Apple | No | We share Ericsson’s view. If UE cannot acquire the explicit TN or NTN neighbor cell info on n1, UE should assume the neighbor cell is TN cell by default. |
| DOCOMO | Yes |  |
| ITRI | No | Assuming TN cell and NTN cell (served by HAPS) would not be overlapped deployed on band n1 for interference consideration, UE could perform cell reselection based on frequency priorities and cell ranking regardless of the cell type of TN or NTN cell. |
| Huawei, HiSilicon | No | HAPS was not specifically discussed in RAN2 in R17.  From our perspective, HAPS works more similar to TN rather than NTN, e.g. ephemeris information is not needed and pre-compensation is not needed. We believe that’s why RAN4 simply reuses the TN band. |
| Intel | No |  |
| ZTE | See comments | Current SIB19 allows configuring location/time based cell reselection in SIB19 without providing NTN-Config, wonders if it is also applicable for HAPS?In our understanding, this requirement is specific to NTN (including HAPS), if UE assumes the cell is a TN cell when no NTN-Config is provided, wonders if the configured location/time trigger will still be applied for HAPS. |
| Qualcomm | Yes | Network has to make sure UE has no such issue in determining the cell type. Even though n1 is overlapping band number, it should just indicate in band indicator list, whether it is NTN band or TN band but not both, if such information is missing. |
| ETRI | No |  |
| Spreadtrum | Yes | Either the NTN-config-r17 or TN coverage information for a neighbor cell can be used for determining whether the cell is TN or NTN. If such information is not provided, the cell can be treated as a TN cell. |
| FGI | Yes with comment | The situation of “neither *NTN-config-r17* nor TN coverage information is provided for a neighbour cell” is more like an operational issue. We think it happens only when the SIB content are not configured properly and believe that this is a corner case.  We feel something confused by the question. In our view, UE will always need to determine (or, says, assume) whether a neighbour cell is TN or NTN (HAPS) and proceed, with or without sufficient information. So our response on Q2 is Yes. |
| Sequans | No | Not sure why it would be a problem if UE considers it is a TN cell from meas pov. |
| NEC | Yes, but | Since TN coverage information will not be perfectly accurate due to signalling overhead, the NW could decide to not signal some TN cells.  Similarly, the question is whether NTN HAPS could also require too heavy signalling overhead and the NW could decide not to include them in *NTN-config-*r17, although they have been signalled in SIB3/4.  This might be a corner case, but in that case we believe the ambiguity can exist. |
| LGE | No | We think that the network should handle that the TN cell’s frequency is different from the NTN cell’s frequency even they share the same frequency band. Then UE can distinguish them accordingly. Even though they are deployed within the same frequency, we cannot see the reason of distinguishing the cell type, i.e., TN cell or NTN cell. |

Summary:

Totally 29 companies replied. For the case of network providing neither NTN-specific nor TN-specific information for a neighbour cell on band n1:

- 9 companies think UE needs to determine (or, says, assume) whether a neighbour cell is TN or NTN (HAPS) and proceed, with or without sufficient information.

- Among the other companies:

- 10 companies comment this is a corner case, network should provide correct configuration to UE for neighbour cell measurement on band n1.

- 9 companies think no need to distinguish because 1) UE can anyway perform cell reselection without determining whether a neighbour cell is TN or NTN; 2) HAPS cell and TN cell are similar

- 1 company wonder whether location/time-base measurement trigger can be applied to HAPS.

**Q3) If yes to Q2, do you agree to introduce an explicit cell type indiation for UE to determine whether a neighbour cell is TN or NTN (HAPS)? If not, please provide other solutions in comment.**

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| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes |  |
| MediaTek | No strong opinion | We think this is possibly not needed. As mentioned in our response to Q2), this is a corner case and not likely to happen. However, we are open to go with the majority. |
| Transsion | No | As commnet as above. |
| Panasonic | Yes | We shouldn’t leave the UE in limbo here. An explicit or implicit indication of TN/NTN would be helpful - maybe with something like a RAT subtype (RAT is identical we understand). |
| CMCC | No | Pls. See our comment to Q2, and implicit indication with existing information is enough. |
| vivo | No | See our reply to Q2, UE doesn’t need to know whether a cell is TN or NTN. |
| OPPO | No | Even for frequency band n1, it can also be up to NW implementation to support UE distinguishing a neighbour cell between TN and NTN(HAPS), according to the existing system information, i.e., SIB3/4/19, for both cases of camping on TN/NTN cell. |
| Lenovo | No | Same as in Q2. |
| CATT | No | See our comments in Q2. |
| Xiaomi | No | See comments in Q2. |
| Nokia | No | See our response to Q2. |
| Sony | Yes | In order to avoid any ambiguity, an explicit indication is better. |
| DOCOMO | Yes |  |
| ITRI | No | See comments in Q2. |
| Huawei, HiSilicon | No |  |
| ZTE | Yes | Explicit indication can avoid possible ambiguity. |
| Qualcomm | Yes | Explicit may be better to avoid any future issues as well. |
| Spreadtrum | No | Implicit indication is sufficient. |
| FGI | No strong opinion | We agree the explicit indication will be helpful. But as our response in Q2, we think this is the corner case of when SIB content are not configured properly. Note that, in this situation, the indication itself may also be mis-configured. |
| Sequans | No strong view | As detailed in Q2, maybe there is no need. But ok to go with majority. |
| NEC | No strong view | In the possibly corner case where there is ambiguity, since the UE is NTN-capable, it should have cell selection priority in place to choose between TN and NTN HAPS. This is more an optimisation issue and can be left up to UE implementation. |

Summary:

Totally 21 companies have replied. For the case of network providing neither NTN-specific nor TN-specific information for a neighbour cell on band n1:

- 6 companies think an explicit cell type indication is useful in such case to avoid ambiguity and prevent any future issues. 11 companies disagree with reasons same as Q2.

- 4 companies have no strong view.

- the other companies think explicit cell type indication is not needed.

**(6/21) Proposal 2: on a frequency band number shared by TN and NTN (e.g., n1), an explicit cell type indication is used to determine whether a neighbour cell is TN or NTN (HAPS) when no NTN/TN specific information is provided.**

**Q4) If no to Q2, do you agree on a frequency band number shared by TN and NTN (e.g., n1), if NTN-specific assistance information is NOT provided for a neighbour cell in SIB3/SIB4, UE consider this is a TN neighbour cell.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes | Even for frequency band n1, it can also be up to NW implementation to support UE distinguishing a neighbour cell between TN and NTN(HAPS), according to the existing system information, i.e., SIB3/4/19, for both cases of camping on TN/NTN cell.  HAPS neighbour cell using band n1 should always provide NTN-config-r17 in SIB19. Otherwise, the cell using band n1 is considered as a TN neighbour cell. |
| Ericsson | Yes | Up to network implementation. As mentioned earlier, network needs to provide *NTN-config-r17* in SIB19 to ensure UE can measure an NTN neighbour. Thus, for a frequency band number shared by TN and NTN included in SIB3/4, UE can consider it a TN neighbour cell when *NTN-config-r17* is not provided. |
| Lenovo | Yes | Same as in Q2. |
| Xiaomi | No | Even if there is no NTN specific information for a neighbour cell in SIB3/SIB4, NTN UE still can perform cell selection and select the cell for NTN access. |
| Nokia | Yes | This is what the UE should assume. |
| Apple | Yes | Same as in Q2. |
| ITRI | Yes | Same as in Q2. |
| Huawei, HiSilicon | Yes |  |
| Intel | Yes | Same understanding as Ericsson |
| ETRI | Yes |  |
| Spreadtrum | Yes |  |
| FGI | Yes | This is straightforward to UE. |
| Sequans | Yes |  |
| LGE | Yes | Same as in Q2. |
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Summary:

14 companies have replied. For the case of network providing neither NTN-specific nor TN-specific information for a neighbour cell on band n1:

- 13 companies think that UE should assume the neighbour cell is TN.

**(13/14) Proposal 3: on a frequency band number shared by TN and NTN (e.g., n1), if NTN-specific assistance information is NOT provided for a neighbour cell configured in SIB3/SIB4, UE assumes this is a TN neighbour cell.**

# Conclusions

**For agreement:**

**For discussion:**

**(16/29) Proposal 1: in TN cell SIB3/SIB4, NTN-config-r17 is provided for NTN neighbour cells.**

**(6/21) Proposal 2: on a frequency band number shared by TN and NTN (e.g., n1), an explicit cell type indication is used to determine whether a neighbour cell is TN or NTN (HAPS) when no NTN/TN specific information is provided. (No need to discuss this if Proposal 3 is agreed.)**

# References

1. 3GPP TS 38.101-5, User Equipment (UE) radio transmission and reception, Part 5: Satellite access Radio Frequency (RF) and performance, Release 17, V17.2.0.
2. 3GPP TS 38.104, Base Station (BS) radio transmission and reception, Release 17, V17.8.0.