3GPP TSG-RAN WG2 Meeting #115 Tdoc R2-2108900

Electronic, August 9th - 13rd 2021

Agenda: 8.10.3.3

Source: Ericsson

Title: [AT115-e][103][NTN] CHO and NTN -TN mobility aspects (Ericsson)

Document for: Discussion, Decision

# 1 Introduction

This feature summary for 8.10.3.3 includes

1. include proposals to further progress on CHO

2. the discussion on TN/NTN service continuity

**[AT115-e][103][NTN] CHO and NTN -TN mobility aspects (Ericsson)**

Updated scope: Continue the discussion on the remaining proposals from [R2-2109056](file:///C:\\Data\\3GPP\\RAN2\\Inbox\\R2-2109056.zip" \o "C:Data3GPPRAN2InboxR2-2109056.zip)

Intended outcome: Summary of the offline discussion with e.g.:

  List of proposals for agreement (if any)

  List of proposals for further discussion

  List of proposals that should not be pursued (if any)

Updated deadline (for companies' feedback): Monday 2021-08-23 1400 UTC

Updated deadline (for rapporteur's summary in R2-2108900): Monday 2021-08-23 1600 UTC

Proposals marked "for agreement" in R2-2108900 not challenged until Tuesday 2021-08-24 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).

Status: Ongoing

SMTC and measurement gap related discussion is not in this summary.

# 2 Conditional HO for NTN

* Agree to limit to A or B and continue discussion between options A and B

1. Option 1: UTC time + duration/timer, e.g. 00:00:01 + 40s
2. Option 2: Two UTC time to indicate the start (T1) and end time (T2) of the candidate cell, e.g. 00:00:01 + 00:00:41

**Question 1 Please state your preference for options a or b?**

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| --- | --- | --- |
| **Company** | **Option a, or option b** | **Comments** |
| MediaTek | Option a | UTC time unnecessarily increases signaling overhead for the UE. It is better to use timer. |
| Lenovo | A | We still see no difference of using absolute time (UTC) or relative time (timer) in accuracy of CHO execution, considering that the NW can acquire knowledge of UE location and propagation delay in connected mode.  Timers have been widely used both in TN and NTN, and UE/satellite movement does not change synchronized understanding of configured timers between UE and NW.  If majority would like to use UTC for T1 and discuss between A and B, for T2 we prefer to use timer for less signaling overhead. |
| OPPO | Option a | Option a is preferred if it can save signaling overhead. Otherwise, both are ok. |
| CATT | Option a/b | Both ok. |
| Apple | A or B | Either option is ok. |
| ITRI | Option a or b | Both options are OK. |
| Qualcomm | Option a |  |
| BT | Option a |  |
| vivo | Option a | Compared to option b, option a is better from the perspective of signaling overhead. |
| ZTE | A or B |  |
| Xiaomi | Option a | Option a has a lower signaling overhead. |
| ER | a |  |
| NEC | Slightly perfer a, ok with b | Functionally we do not see difference between two option, but b may need less bits to indicate. |
| Nokia | A | Option B is too cumbersome in terms of signalling. |
| InterDigital | B | Prefer B as it is can better leverage predictive movement of satellites (i.e. SAT1 is valid from T1 to T2, SAT B is valid from T2 to T3 etc…), but can accept majority. |
| LG | Option B | We think option b is better for the specification implementation. For option a, starting timer and timer expiry should be descirbed in the specification. |
| Intel | a |  |
| ETRI | Option a/b | No strong view on this. |
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Conclusion Q1

Majority votes for option a thus it is prposed to have email agreement on that

* RAN2 adopts Option 1: UTC time + duration/timer, e.g. 00:00:01 + 40s for representing T1 and T2 for CHO time event.

### 2.3 CHO trigger combinations

* Continue discussing whether the flexible CHO trigger configuration can be supported for NTN operation.

Clarification is that this question is for CHO only and not for RRM. Second clarification is that if RAN2 does not allow configurable CHO conditions in the CHO configuration it means it is mandated in the RRC specification as a network requirement that if network configures CHO with location or time event, network has to configure the same target cell also with RSRP event. Whereas, the configurability means network can choose to configure location or time as event, or location+RSRP or time+RSRP based on what works in real life.

**Question 2 Please give your view on whether to support configurable CHO conditions for NTN operation such that A: location, B: time,** **C: location + RRM or D: time + RRM can be optionally configured?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Comments** |
| MediaTek | Yes for C and D  No for A and B | Location and time events should not be configured as stand alone, as it makes no sense if the measurement of the target cell is itself poor. |
| Lenovo | Yes | We would like it to be configurable at NW for flexibility. Both standalone and combined condition can be configured. |
| OPPO | No | If network configures CHO with location or time event, network has to configure the same target cell also with RSRP event. |
| CATT | Same view with MTK | RRM should be the most essential event to trigger the CHO, while the time based info/location based info could be used as the assistance info. Time/location based info are both to improve the RRM measurement procedure, but not the basic event. |
| Apple | Same view as MTK | RRM should be the essential criteria. With ephemeris timer is sufficient and from our view A should be completely de-prioritized. |
| ITRI | Yes for C and D | To be selected as a target cell, the signal strength and quality of a candidate cell shall be qualified. We think RRM measurements should always be configured. Location or time could be optional. |
| Qualcomm | Yes C and D | If time and location information are very precisely configured, RRM requirement may always be met. But we also need to consider that RRM requirement for the target cell may not be met. |
| vivo | Yes for C and D,  No for A and B | As what we clarified in Phase-1 discussion, It makes no sense for the UE to trigger CHO only based on location based or time based conditions, if the radio measurement is actually not acceptable, because finally the UE will face HO failure. From this perspective, configuring only location based or time based conditions is not reliable enough, and thus should not be supported. |
| ZTE | Yes | As we mentioned in the first round discussion, it is hard to say which standalone condition or combination would be better than others as this is the first release of NR NTN. We can start with full flexibility and leave the configuration to NW. |
| Xiaomi | Yes | We prefer a flexible framework for CHO trigger configuration and any standalone triggering events and trigger combinations can be considered in NTN. |
| Ericsson | A,b,c,d | Network should flexibly be able to configure the options |
| NEC | Yes for all | We should leave it to network implementation how to combine the conditions or whether to use any condition alone. It is not good to have unnecessary restrictions in specification unless there is problem. |
| Nokia | Yes for C and for D |  |
| InterDigital | Yes for C/D  No for A/B | The primary trigger may be time or location, however there needs to be a minimum radio link quality to avoid RLF. |
| LG | Support only C, D | The cell quality condition should be mandatory. |
| Intel | Yes |  |
| ETRI | Yes for C and D | We prefer the combined conditions. |
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Conclusion Q2

6 companies vote for flexible configuration

10 companies vote for limiting configuration to C and D

It is concluded to try email agreement for only supporting C and D

* RAN2 adopts supporting options C: location + RRM and D: time + RRM to be configuration options for CHO

# 3 TN NTN mobility

### Connected mode

Clarification that this question is NOT about downprioritizing the feature itself but whether we spend time on additional enhancements. For connected mode, network configures UE’s measurements and if NTN network configures UE to measure TN the UE will measure TN and vice versa. Similarly with mobility, if network gives HO/CHO command from TN to NTN or NTN to TN the UE follows the command.

**Question 3 Please give your view whether further enhancements to NTN-TN mobility for connected mode should be down-prioritized from this release? If a company does not want to down prioritize, proposed enhancement needs to be given as we are late in the release.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Proposed enhancement** |
| MedaTek | Yes | For this Release, as shown in [R2-2108329](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs//R2-2108329.zip) existing connected mode mobility procedures, including those defined for NTN are sufficient to deal with TN-NTN mobility. |
| Lenovo | Yes | After conclusion on NTN-NTN mobility enhancements, we can check if applicable to NTN-TN mobility. NTN-TN-specific further enhancements can be down-prioritized at this time point. This does not exclude further enhancements for NTN-TN mobility if further issues are identified. |
| OPPO | Yes |  |
| CATT | Yes | Scenrio 1: NTN to TN  In this case, the target cell is TN cell. Thus, the mechanism of handover from NTN cell to TN cell can reuse the legacy handover procedure, including HO and CHO based on RRM measurement with no location and time trigger condition.  Scenrio 2: TN to NTN  On the contrary, the network should handover the UE from TN to NTN cell when a UE move out of the TN network coverage. In this case, the target cell is NTN cell. Since Intra-NTN measurement adds the time-based and location-based event. The current TN network don’t broadcast time and reference location information. UE seems unable to execute the location and time trigger condition based on the current TN network.  If the mechanism of handover from TN to NTN cell follows the Intra-NTN handover, it would be a major impact on TN, like system information of the TN cell should align with the NTN network. Considering the minor influence on TN, it is proposed that the mechanism of handover from NTN cell to TN cell can reuse the legacy handover procedure based on RRM measurement with no location and time trigger condition.  In a word, we suggest TN-NTN mobility can reuse the legacy handover procedure without any enhancements. |
| Apple | No strong view. |  |
| ITRI | No | RAN2 agreed the same CHO trigger conditions and RRM events can be used within NTN and NTN-TN mobility, at least the triggering of TN cell measurements for NTN-TN CHO should be discussed in this release. |
| Qualcomm | Yes |  |
| BT | No | NTN to TN:  Idle measurements for cell reselection need to be optimized to avoid an unnecessary increase of the UE power consumption. |
| vivo | Yes | We think that the typical scenario for NTN-TN mobility in this release should be that NTN and TN are deployed on different bands/frequencies, so that the UE can directly identify the NW type deployed on a frequency and behave accordingly. The main enhancements on this NTN-TN mobility should be more towards the intra-frequency deployments of NTN and NT, which should be a scope that needs to be investigated in the next release. |
| ZTE | Yes |  |
| Xiaomi | Yes |  |
| Ericsson | yes | TN-NTN and NTN-TN mobility should work based on what is available as of UE capability and network capability. What is actually used is network decision. E.g. for NTN to TN we assume time and location CHO trigger is still possible as these are configured by NTN network to NTN capable UE. E.g., for location, candidate target cell reference point would not be used but only serving cell reference point. For time trigger, there should not be a limitation as what is configured is simply time. |
| NEC | Yes | For connected mode mobility, with the knowledge of UE’s coarse or fine location, we believe network can make proper measurement/CHO configuration (including measurement object). Extra enhancement is not needed. |
| Nokia | Yes, due to limited time | We see some value in enhancing also this area, but we are afraid it is not doable in R17 timeframe. |
| InterDigital | Yes |  |
| LG | Yes | For connected mobility, time/location-based CHO is enough for NTN-TN mobility. |
| Intel | Yes |  |
| ETRI | Yes |  |
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Conclusion Q3

15 companies vote for down prioritizing further enhancements for TN-NTN connected mode mobility

2 companies would like to discuss further enhancements with oine connected mode suggestion on CHO from NTN to TN. Note that this question was for connected mode only.

It is concluded to try email agreement down prioritizing further enhacnements for connected mode for Rel-17 for TN-NTN mobility

* RAN2 down priorities further enhacnements for connected mode for Rel-17 for TN-NTN mobility

### Idle mode

It is noted that the previous question did not address well the earlier RAN2 agreement

Related agreement from RAN2114:

1. For idle mode reselection, based on configuration NTN UE can prioritise TN over NTN. Configuration details FFS

In company responses the following suggestions and observations are made(the last one has separate question 4):

*Network should make the UE aware of when to start performing the measurements on TN cells and not apply the serving cell criteria, when moving from an NTN cell towards a TN cell.*

*We think location condition is needed for NTN-TN idle mobility to prioritize TN to UEs at certan area.*

*UE needs to determine the starting of performing TN cell measurements, also needs to alleviate power consumption of searching all the TN frequencies when prioritizing TN over NTN.*

**Question 4 Please express support on suggested items or suggest another way to prioritize TN over NTN ?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Network should make UE aware when to start TN meas. E.g. have TN priorization in SI w/wout freq informtion** | **Use location condition to prioritize TN to Ues at certain area** | **Other suggestion** |
| MediaTek |  | No | Such priorities already exist in R-16 inter-frequency cell reselection and can be easily used.  UE’s Location information should not be used in Idle mode as it will increase UE’s power consumption in idle mode. |
| Lenovo |  |  | Prioritising TN over NTN can be implemented by legacy cell reselection mechanism. E.g. NW can configure the frequency used by TN cells with higher priority, or configure TN and NTN cells with different values of offsets. To make UE aware when to start TN measurement, it is also possible to configure UE with proper threshold for triggering neighboring cell measurement. |
| OPPO | No | No | We can consider these enhancements in later release. As miminum, UE can do prioritization of TN over NTN during cell reselection. |
| CATT | No strong view | No | Use location condition to prioritize TN to Ues at certain area：  In current state，NTN network don‘t know the TN cell coverage. If this option can work, it needs further discussed in later release. |
| Apple | No strong view | No |  |
| ITRI | Yes | Yes |  |
| Qualcomm | No | Similar | This is not straight forward as SIB broadcast is for all UEs in the coverage of cell. There can be multiple coverage holes in a satellite beam.  One solution is to provide TN coverage approximate location (center, radius) and leave to UE to search TN cell when it is in that area. |
| BT | Yes | No | When the UE is offshore with only NTN coverage, but that NTN cell has TN neighbours, it is important to limit UE idle measurements to minimize power consumption.  On the other hand, NTN – TN prioritization can be done using legacy mechanisms, i.e., frequency prioritization. |
| vivo | No | No | Relying on the existing cell reselection priority is already sufficient since the typical case in Rel-17 NTN would be the TN and NTN deployed on different bands. Therefore no additional enhancement is needed to realize the TN prioritization in this release. |
| ZTE | - | - | * We understand the dedicated cell reselection priority can be used to prioritize TN over NTN in some areas if the cell specific common reselection priority is not sufficient. * Some frequency or PCIs of TN cells can be provided to UE via RRCRelease message if NW wants UE to prioritize these TN frequency or cells in certain area during cell reselection. * If NTN and TN cells are deployed in different frequencies, the cell reselection priority can be used to prioritize TN cells but if NTN and TN cells are deloyed in the same frequency. Some enhancement is needed. |
| Xiaomi | No strong view | No | The existing inter-frequencey priority can be reused to indicate TN frequncy with high priority. If TN and NTN has the same frequency, the TN priorization indication in SI can be considered. |
| ER | yes |  |  |
| Nokia | No | No | Existing idle mode prioritization per frequency carrier can be used. More advanced schemes – beyond R17. |
| InterDigital | - | - | Can use existing prioritization mechanisms as baseline. |
| LG | Yes.  The network could configure certain reference point at TN area and a distance threshold from the reference point. The UE can trigger TN measurement if the distance between UE and the reference point is shorter than the distance threshold. |  |  |
| Intel | Yes | No |  |
| ETRI | No | No | No additional mechanisms are needed. |

Conclusion Q4

There was no clear support for the schemes suggested and some additional schemes were presented like prioritization in cell reselection process. As there is already agreement to prioritize TN over NTN and only solution missing RAN2 shoud continue discussing the exact solution

* RAN2 continue discussing the exact solution for TN priorization over NTN

One of the issues is related to the fact that the coverage area of a satellite cell may cover a large amount of TNs. This causes issues with the number of cells needed to be evaluated and the signaling overhead to signal neighbouring cells.

**Question 5 Please state whether enhancements are needed to address power consumption issues and signaling in case an NTN covers multiple TNs? If yes, give the suggested enhancement.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Proposed enhancement** |
| MediaTek | No | We need to resolve other problems to get a working solution first. |
| Lenovo | Neutral | We can check if applicable to NTN-TN after finishing cell reselection enhancements for NTN-NTN. |
| OPPO | No | This can be considered in later release. |
| CATT | Neutral | We can agree with majority view. |
| Apple | No strong view | We are ok with doing something here but can go with the majority view. |
| ITRI | Yes | Reference location(s) could be used for triggering the measurements of TN neighbor cells. |
| Qualcomm | May be | See our response in Q4. |
| BT | Yes | Offshore is a clear example where a NTN cell has multiple TN cells but none of them provide UE coverage. With legacy mechanisms, a UE will waste its power performing periodic TN measurements. |
| vivo | Yes | We think the power consumption issue at the UE side may be worth carefully considering, as it may lead to critical impacts on whether the solution developed in this release is really workable in practice.  As an NTN-specific aspect, a beam-specific solution can be considered based on RAN1 agreements. Since the structure of multiple beams simlutaneously serving one cell is supported by related agreements in RAN1, the NW can configure beam-specific information for cell reselection purposes to reduce power consumption. |
| ZTE | Maybe | We understand some frequency or PCIs of TN cells can be provided to UE via RRCRelease message if NW wants UE to prioritize these TN frequency or cells in certain area during cell reselection. |
| Xiaomi | No | The power consumption issue can be considered in later release. And in Rel-17, it is sufficient that the UE can reselect to TN with priority based on the network indication. |
| Ericsson | neutral | If there is solution that can be relatively easily adopted in this release we would support it |
| NEC | Yes | Since an NTN cell has huge coverage, it may cover many regions or countries. Consequently, an NTN cell will need to broadcast a big number of neighboring RATs/frequencies/cells. as explained in [R2-2108234](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108234.zip), these neighboring RATs/frequencies/cells used in a region/country is not relevant to a given UE which is far from that region/country. Scanning all these irrelevant frequencies/cells would cause unnecessary power consumption.  A very simple solution would be to broadcast neighboring RATs/frequencies/cell in group, Neighboring RAT/frequencies/cell from a certain region will be broadcasted in one group, hence a UE has detected neighbors in one group does not need to search neighbors indicated by another group.  This solution is simple and no need of UE location to assist. |
| Nokia |  | Similar view to Ericsson, CATT, Apple. |
| InterDigital | No | This can be studied in a later release. |
| LG | No | We need to concentrate other issues on the table first. This issue can be discussed in later release. |
| Intel | Neutral |  |
| ETRI | No | It can be discussed in the next release. |
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Conclusion Q5

The votes were as follows:

6 no

8 neutral, more or less “yes if good solution found”

4 yes

One clear solution was presented as:

A very simple solution would be to broadcast neighboring RATs/frequencies/cell in group, Neighboring RAT/frequencies/cell from a certain region will be broadcasted in one group, hence a UE has detected neighbors in one group does not need to search neighbors indicated by another group.

This solution is simple and no need of UE location to assist.

It is suggested to discuss online the above solution.

# 4 Conclusions

Agree over email:

* RAN2 adopts Option 1: UTC time + duration/timer, e.g. 00:00:01 + 40s for representing T1 and T2 for CHO time event.
* RAN2 adopts supporting options C: location + RRM and D: time + RRM to be configuration options for CHO
* RAN2 down priorities further enhacnements for connected mode for Rel-17 for TN-NTN mobility
* RAN2 continue discussing the exact solution for TN priorization over NTN for idle mode

Discuss online:

A very simple solution would be to broadcast neighboring RATs/frequencies/cell in group, Neighboring RAT/frequencies/cell from a certain region will be broadcasted in one group, hence a UE has detected neighbors in one group does not need to search neighbors indicated by another group.

This solution is simple and no need of UE location to assist.