**3GPP TSG-RAN WG2 Meeting #112-e *R2-201xxxx***

**Online, 2–13 November 2020**

**Agenda item: 8.10.3.3**

**Source: ZTE Corporation, Sanechips**

**Title: Report of [AT112-e][105][NTN] RRC aspect (ZTE)**

**Document for: Discussion and Agreement**

# 1 Introduction

This is to report the result of the following email discussion in RAN2#112-e Meeting [1].

* [AT112-e][105][NTN] RRC aspects (ZTE)

Scope: Discuss remaining proposals from [R2-2009803](file:///C:\Data\3GPP\Extracts\R2-2009803_Report%20of%20%5bPost111-e%5d%20%5b911%5d%20%5bNTN%5d%20Connected%20mode%20aspects%20(ZTE).doc)

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

* + - List of proposals for agreement (if any)
    - List of proposals that require online discussions

Initial deadline (for companies' feedback): Monday 2020-11-09 17:00 UTC

Initial deadline (for rapporteur's summary in R2-2010767): Tuesday 2020-11-10 01:00 UTC

Proposals marked "for agreement" in R2-2010767 not challenged until Tuesday 2020-11-10 12:00 UTC will be declared as agreed by the session chair. For the rest the discussion will continue online.

# 2 Contact Information

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

The following proposals from [R2-2009803](file:///C:\Data\3GPP\Extracts\R2-2009803_Report%20of%20%5bPost111-e%5d%20%5b911%5d%20%5bNTN%5d%20Connected%20mode%20aspects%20(ZTE).doc) [2] will be discussed in this offline:

* NTN specific CHO execution condition

Proposal 2.3a: location based CHO execution condition should be introduced for both moving cell and fixed cell scenario.

Proposal 2.3b: Timer based CHO execution condition should be introduced for moving cell scenario.

* RACH-less HO and DAPS HO

Proposal 3.1: From RAN2’s perspective, RACH-less HO should be introduced in NTN. An LS should be sent to RAN1 to confirm the feasibility of RACH-less HO in NTN.

Proposal 3.2a: DAPS HO for NTN is de-prioritized in this release.

* UE location report

Proposal 5.1: Permission from UE is needed for the network to collect the UE location information for the purpose other than SON/MDT. If the UE location information is collected for other purpose, the UE consent for SON/MDT cannot be reused and a similar but independent procedure for permission should be considered.

Proposal 5.2: The location information report should be supported in NTN for the purpose other than SON/MDT.

* Location-based measurement event

Proposal 6.1: The Location-based measurement event should be supported in NTN for both moving cell and fixed cell scenario.

Proposal 6.2a: For moving cell scenario, a relative area scope expressed as the distance between UE and satellite or cell center will be configured and measurement report will be triggered when UE moves out of or moves in the area scope configured.

Proposal 6.2b: For fixed cell scenario, an absolute area scope will be configured and measurement report will be triggered when UE moves out of or moves in the area scope configured.

## NTN specific CHO execution condition

The following NTN specific execution conditions for CHO has been studied in the SI phase.

* Condition 1: Location-based execution condition
* Condition 2: Timer based execution condition
* Condition 3: Timing advance based execution condition
* Condition 4: Elevation angle based execution condition

During email discussion [Post111-e][911] [NTN] Connected mode aspects (ZTE)[2], 29 companies showed preference for the above four candidate new execution conditions and the views are summarized in the following table.

|  |  |  |
| --- | --- | --- |
| **CHO execution condition** | **Number of supported companies** | |
| **Moving beam scenario** | **Fixed beam scenario** |
| #1 Location-based | 22 | 23 |
| #2 Timer based | 17 | 13 |
| #3 Timing advance based | 5 | 4 |
| #4 Elevation angle based | 1 | 1 |

The execution conditions with more than 50% support (i.e. with >=15 supported companies) is considered to be preferred by the majority: Location based CHO execution condition for both moving cell and fixed cell scenarios and timer based CHO execution condition for moving cell scenarios.

A proposal is given based on the majority’s preference (22/29 and 23/29): ***Proposal 2.3a: location based CHO execution condition should be introduced for both moving cell and fixed cell scenario.***

**Question 1.1**: do you agree with the above proposal:

|  |  |  |
| --- | --- | --- |
| Answers to Question 1.1 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | Yes |  |
| Nokia | No | As commented during the online session, the mechanism cannot rely on the location alone. It needs to employ radio measurements as well (RSRP/RSRQ/SINR). So a combined metric can be used.  BTW, we wonder why CHO execution condition for NTN and measurement event triggering for NTN are actually discussed separately, if they in fact relate to the same part of NR measurement framework? |
| Panasonic | Yes |  |
| ericsson | yes | We also agree with Nokia that this is closely related to RRM and these should be discussed together.  Further, we could make in principle agreement to support and then progress towards next meeting to discuss details as well as CRs for supporting the feature. This can be done tgether with RRM part. |
| Sony | Yes |  |
| MediaTek | No | We think existing measurement based CHO approach is sufficient to address NTN connected mode mobility cases. Note that the difference in signal strength between source and target cell is implicitly a function of location and time and therefore would work for LEO deployments as well. Similarly, “Time to trigger” can be adjusted for Earth fixed vs Earth moving beams. |
| Lenovo | Yes | We also support combined CHO execution conditions e.g. location-based AND/OR measurement-based. |
| Spreadtrum |  | Agree with Nokia. We think that a combined metric is needed for both CHO and Measurement report triggering. |
| Xiaomi | Yes | We think the detail of location based CHO execution condition should be clarified. In the proposal, we are not clear how UE trigger CHO based on location. RAN2 should decide whether the CHO execution condition is based on the distance between UE and cell center or the distance between UE and satellite or other options.  If the location only including the cell coverage information, such as the distance between UE and cell center, we think location based CHO may be not feasible. Since the service interruption may occur due to effect of obstacles. For example, if the UE location triggers the CHO, but the RSRP/RSRQ of the target cell can’t satisfy the requiremnts of UE to connect to it due to the obstacles. So, we think the location information should include both cell coverage information and obstacle information. |
| ZTE | Yes | In our understanding, location based CHO execution condition would be useful in NTN considering the near-far effect.  Also we share the same understanding with Nokia that the RSRP/RSRQ/SINR based CHO execution condition should also be taken into consideration.  Thus, we also prefer to use a combination of location and radio measurement based CHO execution condition and would suggest to re-word the proposal into the following:  ***location based CHO execution condition, in combination with the existing R16 CHO execution condition, should be introduced for both moving cell and fixed cell scenario.*** |
| Qualcomm | Yes | We are not clear on the execution condition. It should be some triggering event. The entering and leaving conditions should be FFS as it has to taken into account TTT and RSRP. We suggest  ***location based CHO triggering event ~~execution condition~~ should be introduced for both moving cell and fixed cell scenario. FFS on details for entering and leaving conditions (including Rel-16 CHO execution condition).*** |
| BT | Yes | We consider location is beneficial as it is not possible to relay only in radio measurements but not only with the position and radio measurements alone.  We agree with Nokia that CHO execution condition for NTN and measurement event triggering for NTN should be treated together. |
| OPPO | Yes | But they are used together with existing CHO execution condition. |
| China Telecom | Yes | We think location information is useful for triggering CHO execution along with radio measurement. |
| Apple | No | Agree with Nokia and Mediatek. A combined metric is more useful here. |
| APT | Yes | Agreew with ZTE’s and QC’s wording. |
| Huawei, HiSilicon | Yes | New trigger condition can be introduced in NTN. |
| Thales | Yes, but | Agree: Note however that it is for FFS what “location” refer to.  Position of the UE is probably not enough for triggering the HO. It may have to be combined with other information (e.g. cell pattern) handled by the NG-RAN.  So we suggest to revise the proposal as follow  ***Location based CHO execution condition should be introduced for both moving cell and fixed cell scenario. FFS how to clarify “location” in this context*** |
| ETRI | Yes | The location condication will be helpful together with the existing conditions for both moving cell and fixed cell scenario. |
| LG | Yes, but | We are fine to discuss location-based solution, but we have concern to say “should be introduced”. What we should do now is to sort which conditions to put on the table. So we suggest to make the proposal:  ***Proposal 2.3a: Discuss location based CHO execution condition for both moving cell and fixed cell scenario.*** |
| ITRI | Yes | We agree to introduce location based trigger event for CHO evalution.  We are not clear whether location based CHO execution is helpful to NTN-to-NTN mobility. The detail of how to utilized the location based information in CHO execution condition need to be discussed. |
| Intel | Yes | Since measurement in NTN is more flatten than in TN, the UE location can help assisting HO. Therefore we believe that location based CHO execution should be introduced for NTN, it can be either standalone or in combination of measurement. |
| InterDigital | Yes | Location based CHO trigger would be beneficial to address the reduced signal strength variation in cells/beams as compared to terrestrial networks.  According to TR 38.821 section 7.3.2.2.2:  “Location (UE and Satellite) triggering: additional triggering conditions based on UE and satellite location can be considered in NTN and may be considered independently or jointly with another trigger (e.g. measurement based).”  We suggest adopting a similar wording for the proposal to provide an option to jointly configure the CHO location trigger with measurement based mechanisms. |
| Samsung | Yes and No! | We suggest the use of combnation triggers.  Existing triggers of R16 are inadequate for an NTN. Companies have suggested different triggers including time/timer and location-based trigger (e.g., distance). Furthermore, we think that the reliability of some new NTN triggers may not be known before deployments or field testing have been carried out. Hence, to provide flexibility and mitigate risks with NTN deployments, we suggest defining flexible combination triggers. Here are a couple of possiblities: (1) Define a set of trigger conditions (TCs) with combination trigegrs and indicate one or more TCs in an RRC signaling message or (2) define a set of individual triggers (ITs) and specify combinations of ITs in an RRC siganling message. |
| Vodafone | Yes | The question is a bit confusing, however if the question is about Intra-NTN handover, then yes a mechanism needs to be in place for Location Based Handover, but this is only for areas where the cell edge is ‘diffused’ and the classic RSRP / RSRQ cannot provide a definite ‘cell edge’ however if the NTN cell is well defined then RSRP/RSRQ can be used, In our view as NTN is a particular type of coverage we need to have an added Geographical location handover solution. |

**Conclusion:**

**To be added**

A proposal is given based on the majority’s preference (17/29): ***Proposal 2.3b: Timer based CHO execution condition should be introduced for moving cell scenario.***

**Question 1.2**: do you agree with the proposal?

|  |  |  |
| --- | --- | --- |
| Answers to Question 1.2 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | Yes |  |
| Nokia | No | Timer could be considered, but only in conjunction with the measurement results fulfilling a configured execution criteria. |
| Panasonic | Yes |  |
| Ericsson | unclear | Time or time could be considered but as with location, together with RSRP/RSRQ or even together with location.  The timer/time based trigger is very close to what is discussed in relation to service/feeder link use case. These should be discussed in one place to avoid duplicate or close to duplicate solutions. |
| Sony | yes |  |
| MediaTek | No | We see this idea as an optimization. It would be better to have a baseline working conditions first and consider such optimizations in a future release. Existing measurement based conditions will still work fine without optimization. |
| Lenovo | Yes | We also support combined CHO execution conditions e.g. timer-based AND/OR measurement-based. |
| Spreadtrum | No. | We think that RSRP combined with location metric is enough. |
| Xiaomi | Yes | We think the “Time(r)” can be used instead of “Timer” in proposal to include both Time and Timer based conditions.  Time(r) based CHO execution condition could be helpful for the feeder link switch. For feeder link switch, the location based CHO execution condition may not be available beacuse the satellite that communicates with UEs have not changed.Within the duration of the feeder link switch, many connected mode UEs need to be handed over. So UEs can trigger CHO based on different timers to avoid signalling storm and network congestion. In details, the timer can be configured to UE in a broadcast manner to reduce signalling overhead and UE could scale the timer based on service requirement or randomly.  We also agree with Ericsson that the timer based CHO execution condition and feeder link switch should be discussed in one place. |
| ZTE | Yes | The time or timer based CHO execution condition would be quite useful for moving cell scenario as the handover triggered by satellite movement would be predictable for this case.  Also, we understand that the RSRP/RSRQ/SINR based CHO execution condition should also be taken into consideration and CHO will be executed when both time and RSRP/RSRQ/SINR based conditions are satisfied.  To avoid limitation on the details of the configuration (time or a timer), we suggest to re-word the proposal as follows:  ***Time or timer based CHO execution condition, in combination with the existing R16 CHO execution condition, should be introduced for moving cell scenario.*** |
| Qualcomm | Yes | Same suggestion as in Q1.1 applies here. |
| BT | Yes | In Q1.1 we express that location alone shouldn’t be enough.  We envision this a combination of radio measurements, location and timing. |
| OPPO | Yes | But they are used together with existing CHO execution condition. |
| China Telecom | Yes | With the help of location and satellite ephemeris information, UE could evaluate the exact time for CHO excecution. |
| Apple | Yes | This is one of the inputs to the measurement and location based CHO. The timer based CHO can provide additional power gains on UE if implemented properly. |
| APT | Yes | But without combination with other conditions, dwell time or timer configuration might not be easy especially when UE mobility cannot be ignored, e.g., for GEO deployment or a flight type of UE with speed of 1200km/hr. |
| Huawei, HiSilicon | Yes | We agree to further discuss the stage-3 detail on how to use this timer. |
| Thales | No | Time(r) -based triggering alone could not work because it depends on the UE position in the cell. UE in different position have different moment to hand-over.  More over, it could not work for mobile UE because the HO moment also depends on UE speed and direction. |
| ETRI | Yes | Timer based CHO exceucion condition will be helpful with the existing condition. |
| LG | Yes | As network knows location information of connected mode UEs and scheduled LEO satellites which will appear to the UE, the network may provide upcoming LEO satellite list in advance to UE. Threrefore, we think time condition may be needed.  Regarding Nokia’s comment: Introducing time condition does not mean RSRP/RSRQ results are excluded. We can can consider and/or condition for triggering CHO, during signalling design phase. |
| ITRI | Yes | Timer based CHO evaluation trigger trigger event can be considered.  Timer based CHO execution could be helpful in earth moving beam case. However, further discussions on measurement based in coorperate with timer based CHO execution condition to cope with both earth moving and earth fixed beam cases would be preferable. |
| Intel | Yes/No | We think that CHO should be good enough for NTN. However we have some sympathy for the timer based CHO where network taking into account of moving cell. |
| InterDigital | Yes | A timer-based CHO condition would be useful in situations where handover of many UEs need to be accurately coordinated. Time can be tracked by the UE internally to a high degree of accuracy and may be useful to address innacuracies in the location estimate (of both UE and satellite) especially when the satellite is moving in LEO. This would be useful for example during a feeder-link switch.  According to TR 38.821 section 7.3.2.2.2:  “Time(r)-based triggering: Several triggering conditions considering the time a region is served can be considered. This may be based on UTC time, or a timer-based solution, and may be considered independently or jointly with another trigger (e.g. measurement based).”  We suggest adopting a similar wording for the proposal to provide an option to jointly configure the CHO time-based trigger with measurement based mechanisms. |
| Samsung | Yes and No! | Same as Q1.1. We suggest the use of combnation triggers.  Existing triggers of R16 are inadequate for an NTN. Companies have suggested different triggers including time/timer and location-based trigger (e.g., distance). Furthermore, we think that the reliability of some new NTN triggers may not be known before deployments or field testing have been carried out. Hence, to provide flexibility and mitigate risks with NTN deployments, we suggest defining flexible combination triggers. Here are a couple of possiblities: (1) Define a set of trigger conditions (TCs) with combination trigegrs and indicate one or more TCs in an RRC signaling message or (2) define a set of individual triggers (ITs) and specify combinations of ITs in an RRC siganling message. |
| Vodafone | unclear | If the timer based handover is introduced, we need Vector (direction) and the velocity to ascertain hand-out or hand-in |

**Conclusion:**

**To be added**

## RACH-less HO and DAPS HO

There has been discussion on whether to support RACH-less HO and DAPS HO in NTN [2].

16 companies see the value in introducing RACH less HO in NTN while13 companies do not see urgent need to support it since 2-step RACH based HO, helpful in reducing the mobility interruption time, will be supported. Some companies show concern that supporting RACH less HO may be challenging in some cases (e.g. inter-satellite handover) and the feasibility should be confirmed by RAN1 first.

A proposal is given based on the majority’s preference (16/29): ***Proposal 3.1: From RAN2’s perspective, RACH-less HO should be introduced in NTN. An LS should be sent to RAN1 to confirm the feasibility of RACH-less HO in NTN.***

**Question 2.1**: do you agree with the proposal?

|  |  |  |
| --- | --- | --- |
| Answers to Question 2.1 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | No | we still doubt the accuracy of the satellite ephemeris for RACH-less HO, anyway 2-step RACH is in the scope, not so urgent now to introduce more optimization in this release. |
| Nokia | No | Agree with CATT. If 2-step RACH is already agreed and pursued then we believe we have no time for yet another solution in the same area. At least not in R17. |
| Panasonic | Yes | We prefer to keep only the first sentence in the proposal, as we are not sure why it is relevant to RAN1 when it comes to the challenge for the inter-satellite handover case. |
| Ericsson | yes | We can ask RAN1 as there is no need to decide now we cannot specify this due to lack of time. |
| Sony | yes |  |
| MediaTek | Yes | With UE-based pre-compensation that needs to be introduced with other user plane aspects, the UE will estimate the required TA for the target gNB. This information can be used to perform RACH-less handovers. |
| Lenovo | Yes |  |
| Spreadtrum | Yes | We have the same doubt on the accuracy of estimation of RTD. But we think it can be used in intra-Satellite handover. |
| Xiaomi | Yes | If the requirement of TA accuracy for RACH-less HO is satisfied, RACH-less HO can be introduced in NTN. |
| ZTE | Yes | Since the main concern for supporting RACH-less HO is the accuracy of full TA pre-compensation, RAN1 input is needed to determine whether to support it in NTN.  If companies are not willing to trigger the discussion in RAN1 by a RAN2 LS, we can modify the proposal into the following and wait for RAN1 progress:  ***RAN2 will only consider introduction of RACH-less HO in NTN after RAN1 confirms the feasibility.*** |
| Qualcomm | No | We agree with CATT and Nokia. After looking at impacts forseen from RACH-less HO and the workload across working groups, we should first prioritize the 2 step RACH over RACH-less HO. |
| BT | Yes | We consider this is beneficial not only due to time constraints but also due to UE power saving. A static UE with a moving beam system will require RACH all the time. Since the closest satellite will be at 600 km, it is worth to avoid UL as much as possible. Therefore, this shouldn’t be seen as an optimization.  We are in favour to send the LS to RAN1. |
| OPPO | No | Agree with CATT and Nokia. We should prioritize 2-step RACH based HO. |
| China Telecom | No | Agree with CATT |
| Apple | No | We should prioritize 2-step RACH as CATT and Nokia have suggested first and issues with baseline identified. |
| APT | YES | Agree to send LS. But we do not see a need to support it.  [Wording suggestion]  From RAN2’s perspective, RACH-less HO should be ~~introduced~~ **beneficial** in NTN. An LS should be sent to RAN1 to confirm the feasibility of RACH-less HO in NTN. |
| Huawei, HiSilicon | No | We suggest to focus on basic mobility procedure at first, and when the RACH procedure in NTN is much clearer we can discuss if RACH-less handover is needed. |
| Thales | Not a priority | **Agree with modifications**: Indeed, RACH-less handover can be used to minimize the user plane data transfer interruption and it can be beneficial for both moving cell and fixed cell deployment. But, the efficiency of the feature is conditional on the accuracy of the TA autonomous acquisition by the UE and on the residual error that the gNB needs to correct in the RAR message.  In our view RACH-less handover may work in case of inter-cell intra-satellite handovers but may be challenging in case of inter-satellite handover.  RAN2 could then send an LS to RAN1 to ask about its feasibility.  So we suggest to revise the proposal as follow:  ***From RAN2’s perspective, RACH-less HO should be considered in NTN at least for intra satellite hand-over but with lower priority. An LS should be sent to RAN1 to confirm the feasibility of RACH-less HO in NTN.*** |
| ETRI | Yes | It can be useful in the limited scenarios. We prefer to send an LS to RAN1 to check the feasibility. |
| LG | Not yet | It can be discussed, but we should confirm the accuracy first. So RAN1 discussion should be done first. We could send LS to RAN1. |
| ITRI | No | We can send a LS to RAN1 and wait for their feedback. |
| Intel | No | RACH-less HO has advantage of reducing the RACH procedure by allocating many grant to the UE either via DCI or RRC. However, during to the propagation delay, the UE will need to continueously monitor for the grant (the UE may not know when it will come) and the network may need to reserve more resource for a particular UE. We think that RACH-less HO is not ideal solution for NTN both in UE and network POV. |
| InterDigital | Yes but, | There are benefits to RACH-less HO (e.g. latency reduction) however we would need a better understanding of TA estimation accuracy from RAN1. Discussion should be deprioritized until at least 2-step RACH in NTN is better defined.  Agree with first sentence of Thales’s wording suggestion, however it is premature to send an LS. |
| Samsung | No | We prefer to prioritize 4-step RA and 2-step RA.  We prefer the 4-step RA procedure for handover due to (i) enhanced signaling reliability of the traditional 4-step RA procedure (a handover error is quite expensive in an NTN due to long delays; note that the UE chooses a 2-step RA procedure when its RSRP exceeds a threshold; otherwise, it uses the traditional 4-step RA procedure due to its reliabilty) and (ii) excessive RA resource consumption due to massive handover expected in an NTN. |
| Vodafone | Yes |  |

13 companies would like to support DAPS in NTN with R16 DAPS mechanism as a baseline while 15 companies are concerned about UE’s capability to simultaneously transmit/receive data from multiple satellites, co-existence of CHO and DAPS, complexity of the DAPS feature as well as impact on other RAN WG groups and would prefer to de-prioritize DAPS for NTN in this release.

A proposal is given based on the majority’s preference(15/28): ***Proposal 3.2a: DAPS HO for NTN is de-prioritized in this release.***

**Question 2.2**: do you agree with the proposal?

|  |  |  |
| --- | --- | --- |
| Answers to Question 2.2 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | Yes | DAPS HO is really beneficial, but for NTN mobility, mobility robustness seems more challenging than service interruption. If we use DAPS HO, that means CHO HO cannot use at the same time, we should focus on key challenge first at this release. |
| Nokia | Yes | Although we agree DAPS could bring benefits to NTN, we think that should not be our primary focus in R17. |
| Panasonic | Yes |  |
| Ericsson | yes | RACHless is a better candidate to use time for. |
| Sony | yes |  |
| MediaTek | No | In the original Email discussion 17 companies were in favour (e.g. “Yes” or “Yes but” or “Nice to have”) for DAPS HO as an optional feature.  We assume that all Rel.16 features are available as a baseline and there is no reason to make NTN-specific restriction in DAPS. |
| Lenovo | Yes |  |
| Spreadtrum | Yes |  |
| Xiaomi | Yes | In R16, DAPS and CHO can not be configured simultaneously. In NTN, CHO is important to reduce the effect of long RTT time. Since it is uncertain whether both DAPS and CHO can co-exist, DAPS HO for NTN should be de-prioritized. |
| ZTE | Yes |  |
| Qualcomm | Yes | We should make good progress on normal handover and CHO within NTN. |
| BT | Yes | There is no need to support DAPS at this stage. RACH-less is preferred. |
| OPPO | Yes |  |
| China Telecom | Yes |  |
| Apple | Yes |  |
| APT | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Thales | Yes | **Agree**: DAPS procedure defined in Rel-16 can be considered as baseline.  Possible enhancements of the DAPS procedure in NTN can be further investigated later in the Rel-17 if there is remaining time |
| ETRI | Yes |  |
| LG | Yes | R16 mechanism can be used, but enhancement for NTN DAPS HO is not necessary. |
| ITRI | Yes | We think mobility robustness is the major focus and would agree to deprioritize DAPS in Rel-17. |
| Intel | No | We are not sure if it can be supported in NTN. We think it may be consider in future release. |
| InterDigital | Yes |  |
| Samsung | Yes |  |
| Vodafone | Yes |  |

## 3.3 UE location report

Whether any permission from UE is needed for the gNB to collect the UE location information for the purpose other than SON/MDT has been discussed via email [2].

29 companies showed preference on this topic. 27 companies agree that permission from UE is needed for the network to collect the UE location information for the purpose other than SON/MDT and the UE consent for SON/MDT cannot be reused if the location information collection is for other purpose, for which a similar but independent procedure for permission should be considered.

1 company consider it to be a SA3 or application layer issue while 1 company is not sure about whether to have such permission with the following consideration that for Aerial height based reporting UE can be configured to report location and it may also be that due to the nature of NTN, reporting location to network is mandatory to support.

A proposal is given based on the majority’s preference (27/29):***Proposal 5.1: Permission from UE is needed for the network to collect the UE location information for the purpose other than SON/MDT. If the UE location information is collected for other purpose, the UE consent for SON/MDT cannot be reused and a similar but independent procedure for permission should be considered.***

**Question 3.1**: do you agree with the above proposal:

|  |  |  |
| --- | --- | --- |
| Answers to Question 3.1 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | Yes | UE privacy concern should be fixed. |
| Nokia |  | Not sure if this is a RAN2 topic, in fact? We should focus on the fact such reporting shall occur in NTN systems. |
| Panasonic | Yes |  |
| Ericsson | no | It is unclear for us why this SON/MDT related permission is relevant here. |
| Sony | No | Agree with Ericsson and Nokia. |
| MediaTek | Yes | Depending on regional policies, UE’s permission may be required for gNB to collect UE location report. |
| Lenovo | Yes | Collecting UE location info needs an independent permission from UE. |
| Spreadtrum | Yes |  |
| Xiaomi | Yes | UE privacy should be protected. |
| ZTE | Yes | Collecting UE location info in NTN for purpose other than SON/MDT requires UE permission and the permission for SON/MDT cannot be reused here. |
| Qualcomm | May be | RAN needs UE location information for various purposes, e.g., UL/DL scheduling, measurement configuration, mapping cell ID to geo-graphical area etc.  Now we think probably this consent should be based on UE’s GNSS capability. Since Rel-17 already assumes UE with GNSS capability, the consent can also be implicit. Otherwise, if UE does not give consent, UE’s experience in NTN would be worse. |
| OPPO | Yes |  |
| China Telecom | Yes | Since SON/MDT is optional, NTN should have independent permission for location. |
| Apple | Yes |  |
| APT | Yes |  |
| Huawei, HiSilicon | Yes | UE consent is quite important, without this Network cannot collect UE private information. |
| Thales | Yes | **Agree**: The network should not be able to collect UE location information without permission from UE unless mandatory by regulations. |
| ETRI | Yes | UE permission is required to collect the location information. |
| LG | Yes | We agree that of course UE permission is needed . However, we have similar view with Ericsson that why SON/MDT is relevant here? |
| ITRI |  | It is unclear to us that whether permission from UE is required eveytme for collecting UE location information, or is taken as a part of UE capability. We think user concent is out of RAN2 scope. |
| Intel | Yes/No | We think one time permission is good enough for location reporting. i.e. MDT can be reused. |
| InterDigital | Yes |  |
| Samsung | Yes and No | We are fine getting a permission from UE. However, it may be more appropriate for such permission exchange to be between UE and core network. The AMF can then provide such permission info to gNB. It is good to decouple the location usage for SON/MDT and the location usage in an NTN. |
| Vodafone | Yes |  |

**Conclusion:**

**To be added**

Whether to support UE location report in NTN for purpose other than SON/MDT has also been discussed.

15 companies see the need for UE location report and the location information may be used in the following cases:

* Mobility and service continuity handling
* Measurement configuration
* Registration area management and paging
* Enforce country-specific policies
* Scheduling

14 companies do not see the benefit for UE reporting the location information for purpose other than SON/MDT in NTN and would like not to support it.

A proposal is given based on the majority’s preference (15/29):***Proposal 5.2: The location information report should be supported in NTN for the purpose other than SON/MDT.***

**Question 3.2**: do you agree with the above proposal:

|  |  |  |
| --- | --- | --- |
| Answers to Question 3.2 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | Yes | At least for mobility optimization, UE location report is benefitial. |
| Nokia | Yes |  |
| Panasonic | Yes |  |
| Ericsson | yes |  |
| Sony | Yes |  |
| MediaTek | No |  |
| Lenovo | No | We see no need of UE location info via report. |
| Spreadtrum | No |  |
| Xiaomi | Yes | Location information will be helpful for HO decision and measurement event.  Considering that gNB cannot locate UE through existing schemes, RAN2 should support UE report location information.  But, we think UE will only report location information when NW has received the permission from the UE. |
| ZTE | No | There is no clear need for UE to report its accurate location information (e.g. coordinates) in NTN. |
| Qualcomm | Yes | As mentioned before, UE location information is needed for various purposes including measurement configuration, scheduling as well as mapping cell ID to geo-graphical area. |
| BT | Yes | Supported not mandated. |
| OPPO | No | we don’t see the need for UE location report. |
| China Telecom | Yes |  |
| Apple | No | There is no clear need for UE location information. |
| APT | Yes | For LEO, UE mobility can be ignored. Reporting UE location information would have long term value and may provide benefits on mobility. |
| Huawei, HiSilicon | No | Not sure how this location information is used in network side. Current GNSS information is only used in UE side. |
| Thales | Yes | **Agree**: the network should have the possibility to know the UE location especially to support regulated services that have to comply with country-specific policiers. It may have to combine different schemes based on UE reported location and LCS to capture such UE location. |
| ETRI | No | We share the view that there is no clear need for the UE location information report. |
| LG | Yes |  |
| ITRI | Yes | UE location report is helpful for mobility management. |
| Intel | Yes | We think that it may be useful for the network for handover and measurement configuration if needed. |
| InterDigital | Yes |  |
| Samsung | Partial Yes | The UE location can be used to optimize the TAI List (=Registration Area). In case the benefit to convey the UE location to the gNB is clearly identified (e.g., for mobility management), we can discuss it further. |
| Vodafone | Yes | for a Hand-in scenarios, where the UE is approaching a Terrestrial coverage, the NTN Cell coverage is diffused and there is no definite say -3db point, we would need mechanism other than the RF measurements such as RSRP/RSRQ to initiate and hand-in , and therefore for the purposes of handing-in we would need the UE’s location in the NTN cell. |

## 3.4 Location based measurement event

There has been discussion on the location based measurement and 30 companies has shown preference [2].

27 companies agreed that the Location-based measurement event should be supported in NTN as complementary to pure RSRP/RSRQ based triggering condition for both moving cell and fixed cell scenario.

1 company state that the location based measurement event can only be configured for UE to report location information via measurement report. 1 company prefer to rely on the existing measurement events and prefer not to introduce location based measurement event while 1 company emphasize that location shall not be the only factor used in measurement triggering and the measurement triggering should still primarily based on radio measurements.

A proposal is given based on the majority’s preference (27/30)**: *Proposal 6.1: The Location-based measurement event should be supported in NTN for both moving cell and fixed cell scenario.***

**Question 4.1**: do you agree with the above proposal?

|  |  |  |
| --- | --- | --- |
| Answers to Question 4.1 | | |
| Company | Yes/No | Comments  (Suggestions on the wording are also welcome if you agree with this proposal.) |
| CATT | No | At least A4 event is still workable, so we think it’s not so urgent to optimize this feature in the first NTN release. So for RRM purpose, the enhancement is not needed.  As for UE location info reporting, the Location-based measurement event can be considered. |
| Nokia | No | But this is tightly related to the question concerning CHO execution triggering (which is also based on the measurement event), so why is it asked separately?  We believe location-based event could be defined, but only in conjunction with radio measurement-based. Alternatively, the UE could just report its location (as argued by CATT). |
| Panasonic | Yes |  |
| Ericsson | yes | Actually event A4, neighbour becomes better than threshold may not work with same reason that A3 may not work. The RSRP level drops so slowly for an NTN beam.  For this reason a location triggered report should be considered. Whether ins conjunction with RSRP based even or not can be further discussed. |
| Sony | Yes | It’s better to rephase the proposal as “The location-based measurement reporting should be supported in NTN for both moving cell and fixed cell scenario” in order to make it clearer. |
| MediaTek | No | As explained in Question 1.1, measurement based approach can be viewed as a function of location. Thus, we think there is no need of any new measurement event. The existing measurement based CHO approach is sufficient to address NTN connected mode mobility cases. For example, difference in signal strength between source and target cell is implicitly a function of location and time and therefore would work for LEO deployments as well. Similarly, “Time to trigger” can be adjusted for Earth fixed vs Earth moving beams. |
| Lenovo | Yes | We also support combined measurement event e.g. location-based AND/OR measurement-based. |
| Spreadtrum | No | We think that a combined metric is needed instead of single location metric. |
| Xiaomi | Yes | In the earth fixed cell scenario, the speed and direction of UE should also be considered for high speed UE.  Location-based measurement could be combined with measurement based on signal strength, and RAN2 should discuss the ’AND/OR’ association between two measurement event. |
| ZTE | Yes | Considering the near-far effect in NTN, location based measurement event, in combination with the existing RSRP/RSRQ/SINR based measurement event, would be more effective in NTN.  Thus, we suggest to modify the proposal into the following:  ***The Location-based measurement event, in combination with the existing measurement event in NR, should be supported in NTN for both moving cell and fixed cell scenario.*** |
| Qualcomm | Yes | It can be similar to CHO enhancement. See response to Q1.1. |
| BT | Yes | We envision this similar to CHO. Our answer here aligns with our answer in Q1.1. |
| OPPO | Yes | Measurement report and CHO enhancement should be discussed together. |
| Apple | Yes | In combination with measurement based similar to Q1.1. Agree to ZTEs proposal. |
| APT | Yes | Agree with ZTE |
| Huawei, HiSilicon | unclear | We would like to ask RAN1 to evalutate if near-far effect is still valid in NTN, then discuss if location based measurement is needed. We have provided the same comments in offline-104. |
| Thales | Yes, but | Agree with modification:  for Earth moving cell scenario, Location-based measurement event is especially needed. However, in such case, the he knowledge of UE position may not be sufficient to trigger the location measurement. It may have to also take into account coverage information (e.g. Cell pattern)  For earth fixed beam, existing measurement based HO procedure could work fine because the UE speed is relatively small compared to measurement validity. This depends on measurement periodicity, UE speed and satellite capability to maintain constant power in serving cells while it is moving.  We therefore suggest to modify the proposal as follow:  ***The Location-based measurement event should be supported in NTN for both moving cell and fixed cell scenario. Enhancements are needed in the case of moving cell scenario*** |
| ETRI | Yes | Location based measurement event can be useful for mobility in NTN. |
| LG | Yes | We think measurement event based on absolute UE location can be used. |
| ITRI |  | We think a location-based measurement trigger event is useful. However, introducting location-based measurement report may not be necessary. |
| Intel | Yes | We think that legacy measurement reporting is not ideal for NTN due to the long propogation delay and the measurement distribution is more flatten than TN, therefore, location based reporting will be a good solution to trigger measurement report. |
| InterDigital | Yes | Similar to CHO enhancement – see Q1.1 |
| Samsung | Yes | We prefer to have a combination trigger for flexibility and reliability as mentioned inour response to Q1.1. We also like to discuss exactly the meaning of “location-based” measurement. For example, can the UE use its GNSS-based location to estimate distance to the serving cell and possibly distance to the neighbor cell? Do companies have any other candidate triggers based on the UE location? |
| Vodafone | Yes | Please see answer in the above question. Also Ericsson confirm our view. |

**Conclusion:**

**To be added**

If location-based measurement event is supported, a measurement report will be triggered when UE moves out of or moves in the area scope configured. Regarding how to configure the area scope, the following alternatives have been discussed via email [2].

* Alt1: A relative area scope, in which case the area scope will change as the movement of satellite.
  + Alt1-1: The area scope is configured as the relative distance between UE and satellite.
  + Alt1-2: The area scope is configured as the relative distance between UE and the center of a cell.
* Alt2: An absolute area scope, in which case the area scope will not change unless new configuration is received.
  + Alt2-1: The area scope can be expressed as single reference location (represented by location coordinates) and a radius associated to the reference location.
  + Alt2-2: A list of location coordinates.
  + Alt2-3: A list of TAI (PLMN + TAC) of TN cells. As shown in Figure 2, a list of TAI of TN cell (e.g. TAI#1 and TAI#3) can be configured to represent the cell edge of the serving NTN cell and UE trigger measurement report when it moves in to this area.

Companies’ preference have been summarized in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Alternatives for configuring the area scope** | | **Number of supported companies** | | | |
| **Moving beam scenario** | | **Fixed beam scenario** | |
| **Alt.1: A relative area scope** | Alt1-1 | 15 | / | 11 | / |
| Alt1-2 | 7 | 5 |
| **Alt.2: An absolute area scope** | Alt2-1 | 11 | 8 | 13 | 10 |
| Alt2-2 | 2 | 3 |
| Alt2-3 | 2 | 2 |
| **Other** | | 5 | | 4 | |

A proposal is given based on the majority’s preference (15/28) for moving cell scenario: ***Proposal 6.2a: For moving cell scenario, a relative area scope expressed as the distance between UE and satellite or cell center will be configured and measurement report will be triggered when UE moves out of or moves in the area scope configured.***

**Question 4.2a**: do you agree with the above proposal?

|  |  |  |
| --- | --- | --- |
| Answers to Question 4.2a | | |
| Company | Yes/No | Comments  (Suggestions on the wording is also welcome if you agree with this proposal.) |
| CATT | No | A4 event is still workable, no enhancement is needed at this early release. |
| Nokia | No | This relates to our answer to the previous question. We do not see a need to use such criteria alone for measurement event triggering. |
| Panasonic | Yes |  |
| Ericsson | No | Proposal 6.2a expresses one example of configuring the event entry condition. It is also possible to define the event entry condition with respect to the target cell such that event entry condition is fulfilled when UE steps in the area. Further, in addition to circle, especially for fixed beam case, an elliptic shape might describe the actual area better. The radius, or in case of elliptic shape one or both of the radius may change as the satellite moves/elevation angle changes. |
| Sony | No | We think Alt.2-1 is more reasonable and can be based on UE’s location measurement. |
| MediaTek | No | We don’t see any need to configure location based measurement report. Please see our comment on 4.1 |
| Lenovo | No | We would like a unified solution for moving and fixed cell scenarios. If the area scope is broadcasted periodically or configured intime, an absolute area scope can work for moving cell as well. While for a relative area scope expressed as the distance between UE and satellite or cell center, the UE needs to calculate the distance all the time and thus more power consumption. |
| Spreadtrum | No | We think that a combined metric is needed instead of single location metric. |
| Xiaomi | Yes,but | Since the distance between UE and satellite is same for different cells in intra-satellite mobilty scenario, the area scope expressed as distance between UE and cell center should be considered with first priority. |
| ZTE | Yes | This proposal is mainly about how to configure a location based measurement event if it is supported in NTN, e.g. in combination with the existing measurement events in NR.  We understand that a relative area scope expressed as the distance between UE and satellite or a reference point or an absolute area scope expressed as single reference location (represented by location coordinates) and a radius associated to the reference location, a list of location coordinates or a list of TAC or TAI (as the TA is fixed on earth) can be considered. |
| Qualcomm | Yes but | It should be further discussed whether there will be frequent move in and move out measurement reports. |
| BT | No | Agree with Nokia and Ericsson. |
| OPPO | Yes |  |
| Apple | No | If it is a combined metric with measurements then we can utilize this. By itself location metric is not needed. |
| APT | Yes |  |
| Huawei, HiSilicon | No | Same comments as for the previous question. |
| Thales | No | **Disagree**: None of this could work. A satellite may provide several beams of different size and shape and therefore, the cells will be of different size.  Both UE position and cells pattern are needed for accurate triggering of HO.  Information about cells pattern and satellite ephemeris may have to be provided to the UE so that it can compute the cell edge at any time.  FFS how and under which format information about cell pattern and satellite ephemeris shall be delivered to UE.  We therefore sugest alternative proposal:  ***For moving cell scenario, measurement report should be triggered when UE determines the mobility conditions using information about UE position, satellite ephemeris and cells pattern. FFS how and under which format information about cell pattern and satellite ephemeris shall be delivered to UE.*** |
| ETRI | No | The shape of beam will be various depending on the deployment. We think that a relative area scope is not useful. |
| LG | Yes | We do not think such relative location(distance) is not accurate enough to trigger measurement report properly. LEO satellites are dynamically moving with more than hundreds of kilometres per hour in the space, and cell center of moving beam also dynamically moves on the ground. We wonder it will increase too much power consumption of UE. |
| ITRI | No | We don’t prefer measurement reporting triggered by UE calculated distances. |
| Intel | Yes | Alt1-1 seems the simpliest choice. |
| InterDigital | Yes | The variation of beam/cell size of the satellite would not preclude this solution as the network configures the relative area scope anyways so can accommodate per deployment scenario.  Unnecessary triggering of the measurement report based on location could be reduced by making measurement event-based reporting conditional on location (e.g. report is triggered by measurement event, however would only transmit report conditional on being within relative area scope)  Agree with Ericsson comment that there are several ways of defining the event entry condition |
| Samsung | No | This metric/trigger by itself is not helpful and may even be counter-productive, because the UE can be near the cell border of the serving cell and may trigger a measurement event but it is too early for such UE. A UE that is near the incoming neighbor cell but away from the center of the serving cell can benefit from the distance-based trigger (along with RSRP). We suggest to discuss canddiate combination triggers and relevant scenarios. |
| Vodafone | No |  |

In fixed cell scenario, considering that the number of supported companies for Alt2 is 13, a proposal is also given to see how far we can go: ***Proposal 6.2b: For fixed cell scenario, an absolute area scope will be configured and measurement report will be triggered when UE moves out of or moves in the area scope configured.***

**Question 4.2b**: do you agree with the above proposal?

|  |  |  |
| --- | --- | --- |
| Answers to Question 4.2b | | |
| Company | Yes/No | Comments  (Suggestions on the wording is also welcome if you agree with this proposal.) |
| CATT | No | A4 event is still workable, no enhancement is needed at this early release. |
| Nokia | No | Same as above. |
| Panasonic | Yes |  |
| Ericsson | No | Proposal 4.2a expresses one example of configuring the event entry condition. It is also possible to define the event entry condition with respect to the target cell such that event entry condition is fulfilled when UE steps in the area. Further, in addition to circle, especially for fixed beam case, an elliptic shape might describe the actual area better. The radius, or in case of elliptic shape one or both of the radius may change as the satellite moves/elevation angle changes. |
| Sony | Yes |  |
| MediaTek | No | Please see our comment on 4.1. |
| Lenovo | Yes | Absolute area scope is straight forward and workable. |
| Spreadtrum | No | Same as above. |
| Xiaomi | Alt2-1 | For fixed cell scenario, we prefer Alt2-1. The single reference location can be represented by cell center and the radius can be represented by the distance threshold between UE and the cell center.  For proposal 6.2a and proposal 6.2b, if the area scope is expressed as the distance between UE and cell center, it is not necessary to represent the area scope configurations of moving cell and fixed cell as two proposals.  We think that proposal 6.2a and proposal 6.2b can be expressed as “Proposal 6.2: For fixed and moving cell scenarios, a area scope expressed as the distance between UE and cell center will be configured and measurement report will be triggered when UE moves out of or moves in the area scope configured.” |
| ZTE | Yes | This proposal is mainly about how to configure a location based measurement event if it is supported in NTN, e.g. in combination with the existing measurement events in NR.  We understand that a relative area scope expressed as the distance between UE and satellite or a reference point or an absolute area scope expressed as single reference location (represented by location coordinates) and a radius associated to the reference location, a list of location coordinates or a list of TAC or TAI (as the TA is fixed on earth) can be considered. |
| Qualcomm | No | See above Q4.2a. We should try to have a unified solution for both moving cell and fixed cell. For example, UE to satellite distance can be baseline for both moving and fixed cells. |
| BT | No | Agree with Nokia and Ericsson. |
| OPPO | Yes |  |
| Apple | No | We need a unified solution for Earth fixed and Earth moving beams. |
| APT | Yes |  |
| Huawei, HiSilicon | No | Same comments as for the previous question. |
| Thales | Yes | **Agree with modification**: Information about the coverage (e.g. cell pattern) should be provided to the UE.  We suggest modifications to the proposal as follow:  ***For fixed cell scenario, information about the coverage information (e.g. cell pattern)*** ***~~an absolute area scope~~ will be configured and measurement report will be triggered when UE determines the need for mobility based on the coverage information (e.g. cell pattern) ~~moves out of or moves in the area scope~~ configured*** |
| ETRI | Yes, but | For earth fixed cell scenario, it can be one of solutions to configure the area scope. We are not clear if it is essential information. |
| LG | Yes |  |
| ITRI | No | We don’t prefer measurement reporting triggered by UE calculated distances. |
| Intel | No | It would be great if we use the same solution for moving cell and fixed cell. Last email discussion has concluded that we should not separate moving cell and fixed cell cases. |
| InterDigital | Yes | Unnecessary triggering of the measurement report based on location could be reduced by making measurement event-based reporting conditional on location (e.g. report is triggered by measurement event, however would only transmit report conditional on being within area scope)  Also agree with Ericsson comment |
| Samsung | No | Let’s discuss this further. We think that different scenaros (e.g., truly Earth-fixed beams (GEOs), quasi-Earth-fixed beams (LEOs with steerable beams), and Earth-moving beams) would require different combination triggers. Hence, if we build a common flexible framework of triggers, the gNB can choose one or more of such combination triggers to suit its needs. |
| Vodafone | No |  |

# 4 Conclusion

**TBD**

# 5 References

[1] RAN2-112e - R16 eMIMO-CLI-PRN-RACS - R17 NTN-REDCAP (Sergio)\_2020\_11\_04\_1300.docx

[2] R2-2009803 Report of [Post111-e] [911] [NTN] Connected mode aspects (ZTE) ZTE corporation, Sanechips