3GPP RAN WG2 Meeting #118-e R2-2206201

eMeeting May 9th – 20th, 2022

Agenda Item: 6.10.3.1.1

Source: ZTE corporation,Sanechips

Title: Report of [AT117-e][111][NTN] Idle mode

Document for: Discussion, Decision

# Introduction

This document is intended address a subset of remaining idle mode open issues as per the following email discussion guidelines:

* [AT118-e][111][NTN] Idle mode (ZTE)

Initial scope: based on contributions in 6.10.3.1.1 discuss access barring and cell reselection issues

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)

Please note the following deadlines:

* Initial deadline (for companies' feedback): **Friday 2022-05-13 00:00 UTC**
* Initial deadline (for rapporteur's summary in R2-2206201): Friday 2022-05-13 02:00 UTC

Please also note the following chair guidance:

* Proposals marked "for agreement" in R2-2206201 not challenged until Friday 2022-05-13 14:00 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue offline).

# Discussion

## NTN specific cell bar indication

The following working assumption has been made at RAN2#117e:

*To prevent non-NTN capable UE from accessing an NTN cell in Rel-17, for NR-NTN RAN2 follows a similar solution as in IoT-NTN (FFS on the details and whether this is always needed or not).*

Further discussion happened during RAN2#117e and in the post email on UE interpretation of the existing cell bar and the new NTN specific bar bit.

General understanding on UE interpretation is summarized in the following table.

**Table 1: UE interpretation on the bar bit**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cell type** | **Presence and Setting of the cellBarred and cellBarred-NTN** | **UE interpretation on the bar bit** | | **Use case for such setting** |
| **TN only UE** | **UE supporting NTN** |
| TN cell | cellBarred: “barred”;  cellBarred-NTN: absent | The cell is barred. | The cell is barred. | TN cell would like to bar all the UEs. |
| cellBarred: “not barred”;  cellBarred-NTN absent | The cell is not barred. | The cell is barred for NTN access. | TN cell allow UE supporting TN mode to camp. |
| NTN cell | cellBarred: “barred”;  cellBarred-NTN: “barred” | The cell is barred. | The cell is barred. | NTN cell would like to bar all the UEs. |
| cellBarred: “not barred”;  cellBarred-NTN: “barred” | The cell is not barred. | The cell is barred for NTN access. | NTN cell would like to bar NTN capable mode UE but allow access from TN mode UE.  =>Corner case since TN mode UE would not be able to get access to NTN cell but having such setting at least allows UE to camp on a NTN cell without losing coverage. |
| CellBarred: “barred”;  cellBarred-NTN: “not barred” | The cell is barred. | The cell is allowed for NTN access. | NTN cell would like to bar the TN only mode UEs but allow NTN capable UEs to camp. |
| cellBarred = “not barred”;  cellBarred-NTN = “not barred” | The cell is not barred. | The cell is allowed for NTN access. | NTN cell would like to allow all kinds of UE to camp.  =>Corner case since TN only mode UE would not be able to get access to NTN cell but having such setting at least allows UE to camp on a NTN cell without losing coverage. |

Based on the above table, the following rules can be summarized on UE interpretation on the existing bar bit and the new bar bit:

1. UE supporting both TN and NTN consider the cell to be barred for NTN access if cellBarredNTN is not present or set to “barred”.
2. UE supporting both TN and NTN consider the cell to be allowed for NTN access if cellBarredNTN is set to “not barred”.

**Question 1.1) Do companies support the following description of NTN capable UE’s interpretation on the NTN specific bar bit, if introduced?**

* **UE supporting NTN consider the cell to be barred for NTN access if cellBarredNTN is not present or set to “barred”.**
* **UE supporting NTN consider the cell to be allowed for NTN access if cellBarredNTN is set to “not barred”.**

**Note: If a company does not agree with the above description, please elaborate your understanding of UE NTN capable UE’s interpretation on the NTN specific bar bit in the “Comments” row.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| LGE | Yes |  |
| vivo |  | We still prefer relying on other means, e.g. cellReservedForOtherUse, to avoid changing leagcy UE behaviour on handling the cellBarred in MIB. Also, the way based on freqBandIndicatorNR (if it is guranteed that NTN operating bands never share same band number with TN) can also be considered to avoid potentially big Spec impacts. |
| SoftBank | Yes |  |
| OPPO | Yes with comment | We are fine for the cases that cellBarredNTN is set to “barred” or “not barred”, i.e.,   * **UE supporting NTN consider the cell to be barred for NTN access if cellBarredNTN is set to “barred”.** * **UE supporting NTN consider the cell to be allowed for NTN access if cellBarredNTN is set to “not barred”.**   But for the case that cellBarredNTN is not present, UE supporting NTN should follow the legacy cellBarred for TN access. We suggest to add following one:   * **UE supporting NTN follows the legacy cellBarred for TN access if cellBarredNTN is not present.**   In any case, Q1.1 is based on the working assumption @RAN2#117, which needs to be confirmed by RAN2 first. Is that correct? |
| CMCC | No | For the first bullet, when TN cell case, if cellBarredNTN is not present, it means that this network does not intend to distinguish between UE supporting NTN and TN only UE, and handle it uniformly. Therefore UE supporting NTN is better to follow cellBarred indication with cellBarredNTN is not present.  Further RAN2 has agreed that *for idle mode reselection, based on configuration NTN UE can prioritise TN over NTN. Configuration details FFS,* if NW configure this for NTN UE, while cellBarredNTN is not present for TN case, it may cause some problems unpredictable. |
| Xiaomi | No | For the NTN specific bar bit, we have the following understanding:   * UE supporting NTN consider the cell to be barred for NTN access if cellBarredNTN is set to “barred”. * UE supporting NTN consider the cell to be allowed for NTN access if cellBarredNTN  **is not present** or set to “not barred”.   For the TN cell, the cellBarredNTN is not present, and NTN capable UE should follow the cellBarred in the MIB. |
| Huawei, HiSilicon | No | We have similar concern with CMCC that R17 NTN capable UE should follow the setting of the existing cellBarred if cellBarredNTN is not present. |
| Nokia | No | Agree with CMCC, if cellBarredNTN is missing then it means the NW does not differentiate and legacy cellBarred in MIB applies. |
| NEC | Yes | Yes to Q1, which is only about **NTN access**  It seems the concern from CMCC/xiaomi are about **TN access**, which we tend to agree with the comments, for both NTN and TN capable UE, it will follow the cellBarred in the MIB for **TN access**, cellBarredNTN in SIB1 for **NTN access**.  So the answer to Q1 only relevant to NTN access is still Yes |
| CATT | No | Agree with the others on the case of if the cellBarredNTN is not present.  And we also have the same concern of OPPO, we have to confirm the working assumption firstly, and then come to this question.  For the detail solution, we agree with vivo that, the way based on freqBandIndicatorNR can also be considered to avoid potentially big Spec impacts. And for the assumption of (if it is guranteed that NTN operating bands never share same band number with TN), we think RAN4 has had sufficient agreements. |
| Apple | No | We also prefer to use freqBandIndicator to bar TN cells from accessing NTN cells. For barring NTN access in NTN cells, legacy cellBarred – based mechanism can be used. We also have the understanding that RAN4 agreements imply that NTN and TN band numbers will be different even if the bands actually overlap. |
| Qualcomm | Yes | Agree with OPPO.  We think we are just lost in translation of NTN capable UE vs UE wanting to connect to TN or NTN.  We agree “UE should follow the setting of the existing cellBarred if c is not present”, but this is not true if the UE is in NTN mode. This is true only if UE is in TN connectivity mode.  Simply, for UE in TN connectivity mode, follow cellBarred.  For UE in NTN connectivity mode, follow cellBarredNTN.  Therefore, the suggestion from OPPO is clear. |
| Ericsson | No (almost yes) | Almost agree with the logic, with the addition:   * UE supporting NTN consider the cell to be barred for NTN access if cellBarredNTN is set to “barred” or if cellBarredNTN is not present and cellBarred is set to “barred”. * UE supporting NTN considers the cell to be allowed for NTN access if cellBarredNTN is set to “notbarred” or cellBarredNTN is not present and cellBarred is set to ‘notbarred’.   To make things more simple (as suggested by QC) and finalize this discussion, we would also be OK with cellBarred-NTN being being mandatory present in NTN:   * **UE supporting NTN consider the cell to be barred for NTN access if cellBarredNTN is ~~not present or~~ set to “barred”.** * **UE supporting NTN consider the cell to be allowed for NTN access if cellBarredNTN is set to “not barred”.**   We do not see any cost of having cellBarredNTN present at all time for NTN. A TN-only UE should never be allowed to camp or to access an NTN cell. |
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**Question 1.2) With the above understanding of NTN capable UE’s interpretation on the NTN specific bar bit, do companies agree to confirm the working assumption that new bit, e.g. cellBarred-NTN, is introduced for NR-NTN? If Yes, which SIB to include such a new bit? SIB1 or SIB19?**

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| --- | --- | --- | --- |
| **Company** | **Yes/No** | **SIB1 or SIB19?** | **Comments** |
| LGE | Yes | SIB1 | Same with the *cellbarredRedCap*. |
| vivo | Yes | SIB1 | As the new bit, e.g. *cellBarred-NTN* is about cell access, SIB1 is preferred (if the solution in Q1.1 is finally agreed). |
| SoftBank | Yes | SIB1 |  |
| OPPO | Yes | SIB1 | Similar as IoT-NTN. |
| CMCC | Yes | SIB1 | Just like other new cell barred information, e.g. cellBarredRedCap-r17. |
| Xiaomi | Yes | SIB1 |  |
| Huawei, HiSilicon | Yes | SIB1 |  |
| Nokia | Yes | SIB1 |  |
| NEC | Yes | SIB1 |  |
| CATT | No |  | We don’ think the understanding or result of Question 1.1 has any relationship on confirmation of the working assumption. In contrast, we think we should discuss whether we can confirm the working assumption firstly, and then discuss the understanding if we agree to confirm the working assumption.  The arrangement of this discussion is really misleading.  And for the detail solution, we still think, the freqBandIndicatorNR solution can work well without any specification.  We don’t think it is necessary we follow the agreement of IoT NTN. And for another concern of companies on HAPS, we don’t think HAPS has the same or even similar feature of NTN, in contrast, we think HAPS should be treated as TN, when considering the RTT, the coverage of the cell, the mobility of the cell, and the band used. |
| Apple | Maybe | SIB1 | If RAN2 does not agree to use freqBandIndicatorNR, then we need this bit. But we also share CATT’s view that this is unnecessary. |
| Qualcomm | Yes | SIB1 |  |
| Ericsson | Yes | SIB1 |  |

## Location based cell reselection

At RAN2#117e, the following options have been raised on the location based cell reselection:

* **Option 1: Introduce a distance threshold. Cell ranked on R-criterion first and then the distance threshold applies to down scope the candidate cells for reselection.**

- Step 1: UE perform cell ranking based on the R-criterion.

- Step 2: Among the highest ranked N cells:

- For cells provided with reference location: only those whose distance to UE shorter than the distance threshold will be considered by UE as candidate cells.

- For cells not provided with reference location:

Alt.1: Not considered as candidate cell for reselection

Alt.2: Considered as candidate cell for reselection

- Step 3: Among all the candidate cells decided by on the distance threshold in step 2, UE reselect to the highest ranked cell based on R-criterion.

* **Option 2: Introduce a distance threshold. Distance threshold applies to decide the candidate cells and then rank the candidate cells based on R-criterion to decide the target cell for reselection.**

- Step 1:

- For cells provided with reference location: UE evaluate the distance to neighbour cell reference location and only consider cells whose distance to UE are shorter than the threshold to be candidate cells for cell ranking;

- For cells not provided with reference location:

Alt.1: Not considered as candidate cell for reselection

Alt.2: Considered as candidate cell for reselection

- Step 2: UE perform cell ranking on candidate cells decided in step 1 according to R-criterion.

- Step 3: UE reselect to the highest ranked cell.

* **Option 3: Cell ranked on R-criterion first and then the distance criteria applies to decide the target cell for reselection.**

- Step 1: UE perform cell ranking based on the R-criterion.

- Step 2: Among the highest ranked N cells:

- For cells provided with reference location, UE reselect to the cell with the smallest distance to the cell’s reference location.

- For cells not provided with reference location, UE reselect to the highest ranked cell based on R-criterion.

An example is given below to show the cell reselection result of the three options on distance based cell reselection:



**Figure 1: An example of cell deployment and distance based cell reselection**

Assumption of the cell ranking based on the R-criterion: Cell4>Cell2>Cell3>Cell1.

Cell1/2/3 are provided with reference location while cell4 is not.

Distance between UE and cell reference location shorter than the distance threshold: Cell2 and cell 3.

Highest ranked N cells: N=3, cell 4/3/2.

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| --- | --- | --- |
| Option | Expected UE behaviors | Reselection result |
| Option1- Alt.1 | * Cell ranking performed on all the detected cells; * Distance evaluation on the highest ranked N cells which have been provided with reference location;   + If none of the highest ranked N cells are provided with reference location, UE look at other cells who rank lower;   + Among the N cells, UE treat cells with distance to UE shorter than the threshold as candidate target cells and reselect to the highest ranked one. | Candidate cells for reselection: Cell2/3  Target for reselection: Cell2 |
| Option1- Alt.2 | * Cell ranking performed on all the detected cells; * Distance evaluation on the highest ranked N cells which have been provided with reference location;   + If none of the highest ranked N cells are provided with reference location, UE ignore the distance threshold and reselect to the highest ranked cell;   + Among the N cells, UE treat cells with distance to UE shorter than the threshold and cells not provided with reference location as candidate target cells and reselect to the highest ranked one. | Candidate cells for reselection: Cell2/3/4  Target for reselection: Cell4 |
| Option2-Alt.1 | * Distance evaluation on the all the cells which have been provided with reference location; * Cell ranking performed on cells with distance to UE shorter than the threshold.   + If none of the cells provided with reference location are closer to UE than the distance threshold, no cell can be selected following the location based reselection rule.   + Among all the cells whose distance to UE are shorter than the threshold, UE reselect to the highest ranked one. | Candidate cells to be ranked: Cell2/3  Target cell for reselection: Cell2 |
| Option 2-Alt.2 | * Distance evaluation on the all the cells which have been provided with reference location; * Cell ranking performed on cells with distance to UE shorter than the threshold and cells not provided with reference location.   + If none of the cells provided with reference location are closer to UE than the distance threshold, all the cells will be ranked and UE reselect to the highest ranked one.   + Among all the cells whose distance to UE are shorter than the threshold, UE reselect to the highest ranked one. | Candidate cells to be ranked: Cell2/3/4  Target cell for reselection: Cell4 |
| Option 3 | * Cell ranking performed on all the detected cells; * Distance evaluation on the highest ranked N cells which have been provided with reference location:   + For cells provided with reference location, UE reselect to the cell with the smallest distance to the cell’s reference location.   + For cells not provided with reference location, UE reselect to the highest ranked cell based on R-criterion. | Candidate cells for reselection: Cell3/4 and UE have to select one from them as the final decision. |

**Question 2.1) Which option do companies prefer to adopt for location based cell reselection in NTN? If option 1/2 is selected, please further indicate which alternative is preferred on the handling of cells not provided reference location.**

* **Option 1: Introduce a distance threshold. Cell ranked on R-criterion first and then the distance threshold applies to down scope the candidate cells for reselection.**
  + **For cells not provided with reference location:**
    - **Alt.1: Not considered as candidate cell for reselection**
    - **Alt.2: Considered as candidate cell for reselection**
* **Option 2: Introduce a distance threshold. Distance threshold applies to decide the candidate cells and then rank the candidate cells based on R-criterion to decide the target cell for reselection.**
  + **For cells not provided with reference location:**
    - **Alt.1: Not considered as candidate cell for reselection**
    - **Alt.2: Considered as candidate cell for reselection**
* **Option 3: Cell ranked on R-criterion first and then the distance criteria applies to decide the target cell for reselection.**

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| --- | --- | --- | --- |
| **Company** | **Option 1/2/3/other/none** | **Alternative 1/2 if option 1/2 is selected** | **Comments** |
| LGE | Option 2 | Alt. 2 | We understand that the location-based cell reselection aims to use the reference location of neighbor cells efficiently. With this point of view, the UE should consider the neighbor cell not providing the reference location as a candidate cell for reselection. Moreover, Option 2 reduces ranking evaluation by filtering the neighbor cells with a distance threshold.  Meanwhile, RAN2 needs to check whether the network provides the reference location of the neighbor cell to the UE. |
| vivo | none |  | This topic has been discussed several times in previous meetings without any consensus able to be reached. This means companies do not see this feature as an essential one having to be supported. So no such new feature should be introduced after the WI is already closed. |
| OPPO | Option 3 |  | For both Option 1 and Option 2, wherever the distance threshold is applied, the reselected cell is always the candidate cell with best RSRP. We think using an absolute distance threshold to filter candidate cells is problematic because coverage of different NTN cells varies a lot. Using a small distance threshold may undesirably prevent UE from reselecting an NTN cell with large coverage. Besides, since the near-far effect in NTN is not so obvious as TN, a cell with the best RSRP may not be the most suitable cell due to the measurement accuracy issue.  For Option 3, there is no absolute distance threshold, so the issue due to the different NTN coverage does not exist. To some extent, location-based criterion plays the similar role as the legacy beam metrics (i.e., rangeToBestCell and absThreshSS-BlocksConsolidation) in form. Considering RSRP not clearly reflecting the near-far effect in NTN, we should rather consider ranking using the distance information, i.e. cell ranked on R-criterion first and then the distance criteria applies to decide the target cell for reselection. In detail, UE performs cell ranking based on the R-criterion first, and then among the N best cells using RSRP ranking, if there are cell(s) provided with reference location, UE reselects to the target cell with the smallest distance to the cell’s reference location; if there is no any cell provided with reference location, UE reselects to the highest ranked cell based on R-criterion. This can at least prioritize reselection to those quasi-earth fixed cells which is provided with reference location. |
| CMCC | Option 2 | Alt. 1 | Option 2 could help UE to reduce measurement with the candidate neighboring cells narrowed down. However, if alt.2 is supported, the UE is not able to judge the distance criteria, which may lead to invalid measurement. Therefore, option 2 with alt.1 may be more reasonable. |
| Xiaomi | Option 3 |  | For the option 1 and option 2, we have a concern on the distance threshold, we think only one absolute threshold for all neighbour cells is not feasible since the different cells may have different coverage. |
| Huawei, HiSilicon | Option 2 | Alt 1 | We think eventually the determination of target cell should be based on cell quality, and of cource cells too far away should be excluded. That's what Option 2 is talking about. |
| Nokia | Option 1  Or Option 3 | Alt2 | In our opinion, R-criterion should be used first, to comply with the legacy reselection principles. Distance may be checked later, in the second step. The lack of distance threshold from particular cell shall not disqualify it, if R-criterion is met.  But we also share vivo’s opinion – the lack of consensus at this stage of the WI could mean we do not pursue this functionality in Rel-17 |
| NEC | Option1/2 | Alt 2 | In our understanding, option 3 should be excluded at first, because it may be result in two candidate cells to reselect to: 1) the cell with the smallest distance 2) the highest ranked cell but no distance information available.  Option1 and option 2 will not have real difference in term of specification change, i.e., no need to specify the order of down scoping and cell ranking and it is up to UE implementation. see text proposal example in R2-2205740  The cell without distance information should not be excluded in our opinion. |
| CATT | None | Neither | In scenario with different orbits (GEO, MEOs, LEOs), it is not suitable for UE to choose a cell depend on the location information. Choose a cell with shorter distance to the reference point of the neighbor cell might avoid UE from selecting GEO or MEO, which may provide longer serving time for UE. To solve this problem, the network may needs to broadcast the neighbour cells radius additionally, and set more complex cell reselection criteria.  What’s more, in earth fixed scenario, the neighbour cell reference location can avoid UE selecting a faraway cell, but cannot avoid UE selecting a faraway satellite. It is the distance between UE and satellite that can reflect the signal quality but not the distance to cell reference location.  On the other hand, if the cell quality satisfies the RSRP threshold, the distance information is not really meaningful because satisfying the RSRP condition means the UE is already within the effective coverage of the cell.  Considering ASN.1 will freeze very soon, we suggest the legacy cell reselection criteria based on RRM measurement is reused and the neighbour cells reference location is not broadcast. |
| Apple | None | Neither | We also believe that the discussion so far has remained inconclusive and we don’t think it is easy to converge. The points raised by Vivo and CATT seem reasonable to us. We think this topic can be discussed further in R18. |
| Qualcomm | None or Other | neither | The solution is simple.  Before initiating the procedure, UE checks the distance based threshold for cells, having the information available (this is just internal calculation/processing).  Step 1: exclude those cells who are farther than a threshold. Put them in ExcludeList.  Step 2: follow legacy procedure. Only difference is the UE does not need to search/measure the cell in ExcludeList. |
| Ericsson | Option 2 | Alt 2 | The R criterion, which is based on channel quality, is a more important criterion than the distance and should have the final say. Therefore, the distance criterion should only be used for filtering out the candidates to be ranked. This excludes option 3. Option 1 and option 2 will in practice produce the same end result, but option 2 allows the UE to reduce the number of neighbor cells to measure on to determine their R values, and therefore option 2 is slightly better than option 1. If the distance criterion is used, it should be configured for all relevant neighbor cells.  Regarding alternative 1 and 2 for cells without reference location: Again, the channel quality, and thus the R criterion, is a more important criterion than the distance chriterion, and for that reason a neighbor cell should not be excluded from the ranking because it lacks a configured reference location (i.e. by default the distance criterion is regarded as fulfilled). Hence alternative 2 is preferable.  Additional comments:  If no cell fulfils the distance criterion, all cells should be ranked based on the R criterion and the UE should reselect to the cell with the highest R value.  We may consider to introduce a rangeToBestCell parameter with a similar use as the rangeToBestCell in legacy cell re-selection. Among the cells within that range, another selection criterion is applied, e.g. the shortest distance to the reference location or the longest remaining t-Service time. |
|  |  |  |  |

# Conclusions

<To be generated based on company input>

# References

1. R2-2205571 Left over issues in idle and inactive mode in NTN ZTE corporation, Sanechips
2. R2-2204592 Discussion on remaining issue of NTN idel/inactive mode Transsion Holdings
3. R2-2206035 Remaining issues on idle/inactive mode and RRC aspects LG Electronics France
4. R2-2204563 Remaining issue on access barring for NTN vivo
5. R2-2204658 TN NTN barring mechanism Qualcomm Incorporated CR
6. R2-2205237 Discussion on the access barring in NTN CATT discussion Rel-17
7. R2-2205302 Discussion on access barring Huawei, HiSilicon discussion Rel-17 NR\_NTN\_solutions-Core
8. R2-2205753 NTN Access barring and UE behaviour NEC Telecom MODUS Ltd
9. R2-2205865 NR NTN idle mode issues Ericsson
10. R2-2204709 Discussion on location-based cell reselection in NTN OPPO
11. R2-2205029 Discussion on cell reselection CMCC
12. R2-2205094 Remaining issue on idle/inactive mode ITL
13. R2-2205371 Discussion on remaining issues on RRC idle mode Xiaomi
14. R2-2205405 Further Discussion on Cell Reselection CATT
15. R2-2205533 Cell reselection with distance threshold Samsung
16. R2-2205740 Distance based cell reselection NEC Telecom MODUS Ltd.