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**

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| **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.**

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| **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. |
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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 |  |
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## 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: Cell2/3Target 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: Cell2/3Target 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: Cell2/3/4Target 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. |
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# 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.