**3GPP TSG RAN WG2#121bis-e R2-23xxxx**

**e-Meeting, 17th April – 26th April 2023**

**Source: ZTE Corporation, Sanechips**

**Title: [Post121][106][NR NTN enh] NTN-NTN cell reselection (ZTE)**

**Agenda item:** **8.7.4.1.2**

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

# Introduction

This document is intended continue the discussion on NTN-NTN cell reselection open issues as per the following email discussion guidelines:

* [POST121][106][NR NTN Enh] NTN-NTN cell reselection (ZTE)

Scope: Continue the discussion on NTN-NTN cell reselection aspects (triggers for measurements, derivation of trajectory of serving cell reference location, cell reselection criteria enhancements, etc.)

Intended outcome: report of the email discussion

Deadline: Long

Please note the following deadlines:

* Deadline for companies' feedback:  **Friday 2023-03-31 12:00 UTC**

Companies providing input to this email discussion are requested to leave contact information below.

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| **Company** | **Name** | **Email Address** |
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# Discussion

In RAN2#121 NTN-NTN cell reselection open issues were discussed in offline [At121][104] with summary report in [1] to summarized companies’ views in cell reselection trigger, criteria and etc. Some of the proposals were discussed with no conclusions while some of them were not discussed due to limited time. For both cases, the proposals will be continued to discussed in this post-meeting email discussion.

## Trigger for measurements

### Location based trigger

The following agreements have been made on RAN2#121:

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| Agreements 1st online  1.In R18, for earth-moving system, satellite with steerable beam is not considered as part of mobility enhancement in NTN.  2.A serving cell reference location and a distance threshold/radius will be broadcast for earth-moving cell. FFS on whether the R17 IEs are reused or not. FFS on whether additional information needs to be broadcast to inform the UE how the reference location moves over time or if this can be derived from other information (e.g. Epoch time and ephemeris).  3.For cell selection/reselection, location-based measurement initiation is supported in earth-moving cell |
| Agreements 2nd online  1.For earth-moving cell, the location-based cell measurement rules of quasi-fixed cell is reused, i.e., for cell reselection in earth-moving cell, UE initiates measurements when its location to serving cell reference location is larger than the configured distance threshold. |

During discussion offline in [At121][104] below proposals are summarized in [1] based on companies views:

**P1: For earth-moving cell with fixed beam, the trajectory of serving cell reference location can be derived by UE based on satellite’s ephemeris and ephochTime.  (19/28)**

**P2. If confirmed UE can derive the trajectory of serving cell reference location based on satellite’s ephemeris and epochTime, no additional assisting information is needed.**

**P3: For earth-moving cell, new IE is introduced to indicate the reference location of serving cell. (19/26)**

**P5: For cell (re)selection in earth-moving system, a distance threshold is introduced for location-based measurement initiation, which reuses distanceThresh in SIB19. (16/26)**

Above proposals intends to address two ffs as highlighted in the agreements:

* FFS on whether additional information needs to be broadcast to inform the UE how the reference location moves over time or if this can be derived from other information (e.g. Epoch time and ephemeris).
* FFS on whether the R17 IEs are reused or not.

As for the first ffs, according to the summary report of [At121][104], 19 out of 28 companies support to P1, while below concerns were observed from objecting camp:

* The trajectory of satellite represented by ephemeris is an ellipse which is not parallel to the earth. There is still relative motion between reference location and satellite due to their different trajectories.
* Concerns on accuracy and would like to check with RAN1/4
* If ephemeris is provided by PVT parameters, we are not sure the UE can derive the trajectory of satellite or the ground track of sub-satellite point.

Regarding companies’ concerns on PVT format might not be sufficient to derive satellites’ orbit information, Rapporteur notice that in RAN1’s contribution in [2], two references [3][4] have provided to give example algorithm used to transfer the two formats into each other. However, rapporteur does consider discussing the format is out of RAN2 scope, therefore consult to RAN1 might be needed.

In addition, there are also questions on whether UE estimated RP location can fulfil the accuracy requirement defined by RAN4, and would like to consult RAN4.

To address companies’ concern while still respect the majorities’ views, original P1 is modified as below to indicate that is only RAN2 understanding. Question on LS to other working groups is also provided to collect companies views in later section.

**Modified Proposal: RAN2 understands for earth-moving cell, the trajectory of serving cell reference location can be derived by UE based on satellite’s ephemeris and epochTime.**

**Question 1.1) Do companies indicate whether agree on above modified proposal, and provide comments if any.**

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| **Company** | **Yes/No** | **Comments** |
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**Rapp summary:**

* Yes:
* No:

If company’s reply to Q1.1. is yes, please continue comments in Q1.2-1.3. If company’s reply to Q1.1. is not, please provide comments in Q1.4.

Since below proposals in offline [At121][104] is relevant to P1, If reply to Q1.1 is yes, then companies are invited to indicate which of above proposals are agreeable, and indicate comments if any.

**P2. If confirmed UE can derive the trajectory of serving cell reference location based on satellite’s ephemeris and epochTime, no additional assisting information is needed.**

**P3: For earth-moving cell, new IE is introduced to indicate the reference location of serving cell. (19/26)**

**P5: For cell (re)selection in earth-moving system, a distance threshold is introduced for location-based measurement initiation, which reuses distanceThresh in SIB19. (16/26)**

**Question 1.2) Companies are invited to indicate which of above proposals are agreeable, and provide comments if any.**

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| **Company** | **Agreeable proposals (P2/3/5)** | **Comments** |
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**Rapp summary:**

If company’s reply to Q1.1. is yes, companies are invited to provide comments on the below question on whether consultant to other working groups (e.g., RAN1/4) is needed or not. And indicate the detailed questions/action needed.

**Question 1.3) Companies are invited to indicate whether LS is needed or not to other working groups, and indicate in the comments column the respect questions needed to be asked for corresponding WGs.**

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| **Company** | **RAN1**  **(Yes/No)** | **RAN4**  **(Yes/No)** | **Comments** |
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**Rapp summary:**

* RAN1:
* RAN4:

If reply to Q1.1. is not, please indicate in below question the methods and required information needed to inform the UE how the reference location moves over time.

**Question 1.4) If reply to Q1.1 is not, please provide in below comments column the method and required information to inform the UE how the reference location moves over time.**

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| **Company** | **Comments** |
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**Rapp summary:**

### Time-based trigger

Time-based measurement trigger for neighboring cell measurements was discussed in offline [At121][104], and there are 19 out 24 companies responds that time based trigger to address the feeder link switch case, therefore below proposal was made to address majorities views:

**P6: For cell (re)selection in earth-moving system, time-based measurement initiation is used to address feeder-link switch case. (19/24)**

Among which there are comments that this approach only needed for soft feederlink switch since for hard switch there will be service interruption, no need to trigger UE to perform measurement during the interruption time. Rapporteur tends to agree that the comment is valid.

Based on above information, companies are invited to provide comments to below question:

**Question 1.5) Companies are kindly asked to indicate whether to agree on P6. If do, please indicate whether soft/hard feeder link switch or both will be considered. Comments are welcome.**

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| **Company** | **Agree /Disagree** | **Soft / hard feeder link switch or both** | **Comments** |
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**Rapp summary:**

**Key comments:**

## Cell reselection criteria

Based on companies’ inputs in offline [At121][104], below proposals are made in summary report[1]:

**P7: RAN2 further discuss whether to support location-based cell reselection criteria. (support: 12, not support: 11)**

**P8: Time-based cell reselection criteria is not pursued in R18. (support: 8, not support:15 )**

**Question 2.1) Companies are kindly asked to indicate which above proposals are agreeable, and provide comments if any**

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| **Company** | **P7**  **(Agree/Disagree)** | **P8**  **(Agree/Disagree)** | **Comments** |
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**Rapp summary:**

**P7:**

* Agree:
* Disagree:

**P8**

* Agree:
* Disagree:

If agreed on P7, please provide on further comments on below question relevant to location based cell reselection criteria. As summarized in [1], below are identified candidate options for location based cell reselections:

* **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.**

**Question 2.2) Do you agreed that RAN2 further discuss location based criteria based on above three options. If do, please also indicate your preference on the option, and provide your comments if any.**

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| **Company** | **Agree/Disagree** | **Option 1/2/3/other** | **Comments** |
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**Rapp summary:**

* Option 1:
* Option 2:
* Option 3:

**Key comments:**

**Proposed proposal:**

## Others

**Question 3.1) Please provide your comments if there are any relevant issues that you consider is necessary to be discussed but is not mentioned in the questions.**

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| **Company** | **Comments** |
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**Rapp summary:**

# Conclusions

# References

1. R2-2301953 [AT121][104][NR NTN enh] NTN-NTN cell reselection (ZTE) ZTE Corporation, Sanechips discussion
2. R1-2100927 On UL time and frequency synchronization enhancements for NTN Ericsson
3. Eng, M., and René Schwarz, "Keplerian Orbit Elements → Cartesian State Vectors," available at https://downloads.rene-schwarz.com/download/M001-Keplerian\_Orbit\_Elements\_to\_Cartesian\_State\_Vectors.pdf.
4. Eng, M., and René Schwarz, "Cartesian State Vectors → Keplerian Orbit Elements," available at https://downloads.rene-schwarz.com/download/M002-Cartesian\_State\_Vectors\_to\_Keplerian\_Orbit\_Elements.pdf.