3GPP TSG-RAN WG2 Meeting #119-e R2-2208146

e-Meeting: August 17th – 29th, 2022

**Title: Discussion on Mobility Enhancements**

**Source: Turkcell**

**T****ype: Discussion**

**Document for: Decision**

**Agenda Item: 8.6.3 Mobility Enhancements**

**Release: 18**

1 Introduction

In the latest RAN Plenary meeting, #96, the objective of WID on IoT NTN enhancements has been revised at below [1]. This contribution provides recommendations for discontinuous coverage.

**Objectives:**

The work item aims to specify further enhancements for E-UTRA (LTE-RAN) based NTN (non-terrestrial networks) according to the following assumptions:

- GEO and NGSO (LEO and MEO).

- Earth fixed Tracking area. Earth fixed & Earth moving cells for NGSO

- FDD mode

- UEs with GNSS capabilities

The detailed objectives are to specify enhanced NB-IoT NTN and eMTC NTN radio interfaces and E-UTRAN/NG-RAN as follows:

4.1.1 IoT-NTN Performance Enhancements in Rel-18 to address remaining issues from Rel-17

This work considers Rel-17 IoT-NTN as baseline as well as Rel-17 NR-NTN outcome and the further IoT-NTN performance enhancements objectives are listed below:

- Disabling of HARQ feedback to mitigate impact of HARQ stalling on UE data rates [RAN1,RAN2]

- Study and specify, if needed, improved GNSS operations for a new position fix for UE pre-compensation during long connection times and for reduced power consumption. Simultaneous GNSS and NTN NB-IoT/eMTC operation is not assumed. [RAN1]

• NOTE: The need for RAN4 Core requirements for this objective will be identified after the conclusion on the need for improvements.

4.1.2 Mobility enhancements

The following mobility enhancements objectives are listed.

- Support of neighbour cell measurements and corresponding measurement triggering before RLF, using Rel 17 (TN) NB-IoT, eMTC as a baseline. [RAN2]

- Re-use the solutions introduced in Rel-17 NR NTN for mobility enhancements for eMTC, with minimum necessary changes to adapt them to eMTC [RAN2]

- Define UE RRM core requirements for the above mobility enhancement features [RAN4].

4.1.3 Further enhancement to discontinuous coverage

- Study and specify, if needed, mobility management enhancements and power saving enhancements for discontinuous coverage, taking into account the conclusions from the SA2 study FS\_5GSAT\_Ph2. [RAN2, RAN3].

In this contribution, we discuss the idle and connected mode mobility for IoT NTN.

2 Discussion

2.1 System Information

The serving cell is fixed for the static sensors/devices. For these kinds of devices, the neighbour cell measurement is not necessary for Terrestrial Network (TN). But in Non-Terrestrial Networks (NTNs), these sensors need to measure their neighbours due to Non-Geostationary Satellite Orbit (NGSO). NB-IoT doesn’t support connected mode mobility. It experiences a Radio Link Failure (RLF) if the NB-IoT devices lose the serving cell coverage. Then the device starts RRC Re-establishment.

**Observation 1**: NGSO satellites trigger frequent handover for static and mobile users. Depending on the altitude and cell size of the LEO satellite, an IoT NTN device can stay connected for 6.61 seconds (50 km cell size) and 132.38 seconds (1000 km cell size) [2].

IoT devices can calculate the coverage validity duration before the serving cell becomes out of coverage. Different power consumption analyses are shared in TR 36.763 [3] Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) [4]. The below one assumes UE acquires GNSS once per each UL report, 50 bytes UL and 50 bytes DL packet sizes. Early Data Transmission (EDT) and regular RRC resumes are covered in the following table. If we postpone the RRC connection for a longer UL reporting interval than 2 hours, we can reach more than %10 battery lifetime enhancement or power reductions. The enhancement depends on the Maximum Coupling Loss (MCL). NTN UE battery life can have a better value than 2.5 years, 11.2 years and 18.1 years for 164, 154 and 144 MCL, respectively.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NB-IoT, 50 bytes UL, 50 bytes DL** | **Battery life TN (year)** | **Battery life NTN (year)** | **Change (%)** | **Battery life TN (year)** | **Battery life NTN (year)** | **Change (%)** | **Battery life TN (year)** | **Battery life NTN (year)** | **Change (%)** |
| MCL (dB) | 164 | 154 | 144 |
| 2 hr | EDT | 3.4 | 3.3 | 2.94 | 13.4 | 12.0 | 10.45 | 22.2 | 18.5 | 16.67 |
| 2 hr | RRC Resume | 2.6 | 2.5 | 3.85 | 12.4 | 11.2 | 9.67 | 21.6 | 18.1 | 16.20 |
| 24 hr | EDT | 20.5 | 19.1 | 6.83 | 33.2 | 29.6 | 10.84 | 36.2 | 31.9 | 11.88 |
| 24 hr | RRC Resume | 17.8 | 16.7 | 6.18 | 32.7 | 29.1 | 11.01 | 36.0 | 31.8 | 11.67 |

**Proposal 1**: NB-IoT devices can postpone the RRC connection if the calculated serving time is less than its data transmission time to decrease power consumption and prevent unnecessary RLFs.

**Observation 2**:  The static device like sensors for agriculture or meters don’t need to monitor the serving cell in TN. NTN network triggers neighbour cell measurement in NGSO satellites even for these static users.

The serving cell measurement can consume power for the limited battery-capable IoT sensors in the quasi-earth fixed scenario.

**Proposal 2**: IoT static devices can make less tense measurements of the serving cell for power efficiency. They can measure neighbour cells when the serving cell coverage is lost for the quasi-earth fixed scenario.

NTNs and TNs can be available in the same geographical region. The cell selection/reselection of NB-IoT and eMTC technologies can be prioritized between TNs and NTNs. NTN is a different Radio Access Technology (RAT) than TN. GSO (GEO) and NGSO (LEO, MEO) can be defined as different RAT.

**Observation 3**:  If IoT devices are aware of the cell type, one of the networks can be prioritized. A cell type can be TN, LEO NTN, MEO NTN or GEO NTN

**Proposal 3**: A ranking mechanism between TN and different NTN architectures can be used to steer IoT devices to a prioritized network for better throughput or power efficiency.

3 Conclusion

This contribution provides our views on mobility enhancements in IoT NTN. We support the minimum changes in UE behaviour and 3GPP technical specifications. Our observations and proposals are shared below:

**Observation 1**: NGSO satellites trigger frequent handover for static and mobile users. Depending on the altitude and cell size of the LEO satellite, an IoT NTN device can stay connected for 6.61 seconds (50 km cell size) and 132.38 seconds (1000 km cell size) [2].

**Observation 2**:  The static device like sensors for agriculture or meters don’t need to monitor the serving cell in TN. NTN network triggers neighbour cell measurement in NGSO satellites even for these static users.

**Observation 3**:  If IoT devices are aware of the cell type, one of the networks can be prioritized. A cell type can be TN, LEO NTN, MEO NTN or GEO NTN

We have the following proposal:

**Proposal 1**: NB-IoT devices can postpone the RRC connection if the calculated serving time is less than its data transmission time to decrease power consumption and prevent unnecessary RLFs.

**Proposal 2**: IoT static devices can make less tense measurements of the serving cell for power efficiency. They can measure neighbour cells when the serving cell coverage is lost for the quasi-earth fixed scenario.

**Proposal 3**: A ranking mechanism between TN and different NTN architectures can be used to steer IoT devices to a prioritized network for better throughput or power efficiency.

4 References

1. RP-221806 Revised WID on IoT NTN enhancements
2. TR 38.821 Solutions for NR to support Non-Terrestrial Networks (NTN)
3. TR 36.763 Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN)
4. R1-2103061 On time and frequency synchronization enhancements for IoT NTN

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