3GPP TSG RAN WG1 Meeting #104e R1-2102258

January 25th–February 5th, 2021

Agenda Item: 8.15

Source: MediaTek Inc.

Title: Text proposal for TR 36.763 chapter related to RAN1

Document for: Decision

# Introduction

This document contains Text Proposals for TR 36.763 based on agreements and Feature Lead recommendations in AI 8.15.1 at RAN1#103e. During RAN Plenary session #89e it was decided to start email discussions for RAN1 Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) activities in November 2020 to proceed with the Study Item. The skeleton of TR 36.673 was submitted to RP#90 in [1]

TPs based on agreement as captured in Chairman RAN1#103-ereport on AI 8.15.1

* IoT NTN scenarios
* IoT NTN paramters

TP based on Feature Lead recommendations in summary for AI 8.15.1 in R1-2008868

* IoT NTN Overview

# TP for Chapter 4 “IoT Non-Terrestrial Networks overview and scenarios” of TR 36.763

The Text Proposal on IoT NTN scenarios for TR 36.763 Chapter 4 shown below is as agreed and captured in Chairman report for RAN1#103e:

--- Start of text proposal ---

**4.2 IoT Non-Terrestrial Networks reference scenarios**

IoT NTN scenarios A, B, and C are included in the study as shown in Table 4.2-1 below:

Table 4.2-1: IoT-NTN reference scenarios

|  |  |
| --- | --- |
| **NTN Configurations** | **Transparent satellite** |
| GEO based non-terrestrial access network | Scenario A |
| LEO based non-terrestrial access network generating steerable beams (altitude 1200 km and 600km) | Scenario B |
| LEO based non-terrestrial access network generating fixed beams whose footprints move with the satellite (altitude 1200 km and 600km) | Scenario C |

--- End of text proposal ---

# TP for Chapter 5 “Radio Layer 1 issues and related solutions” of TR 36.763

The Text Proposal on IoT NTN reference parameters for TR 36.763 shown below is as agreed and captured in Chairman report for RAN1#103e:

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**6.1 IoT NTN Reference Parameters**

The IoT NTN reference scenario parameters are listed in Table 6.1-1 below:

Table 6.1-1: IoT NTN reference scenario parameters

|  |  |  |
| --- | --- | --- |
| Scenarios | GEO based non-terrestrial access network - scenario A | LEO based non-terrestrial access network -Scenario B & C |
| Orbit type | station keeping a nominally fixed position in terms of elevation/azimuth with respect to a given earth point | circular orbiting at low altitude around the earth |
| Altitude | 35,786 km | 600 km  1,200 km |
| Frequency Range  (service link) | < 6 GHz (e.g. 2 GHz in S band) | |
| Device channel Bandwidth  (service link) (NOTE 7) | * NB-IoT 180 kHz (DL), Up to 180 kHz with all permissible smaller resource allocations 12\*15 kHz, 6\*15 kHz, 3\*15 kHz, 1\*15 kHz, 1\*3.75 kHz (UL) * eMTC: 1080 kHz (DL), Up to 1080 kHz with all permissible smaller resource allocations , including 2\*180 kHz, 180 kHz, 2\*15 kHz or 3\*15 kHz or 6\*15 kHz  (UL) | |
| Payload | Transparent type | Transparent Type |
| Earth-fixed beams | Yes | Scenario B:  Yes (steerable beams), see NOTE 1  Scenario C: No  (the beams move with the satellite) |
| Max beam foot print size (edge to edge) regardless of the elevation angle | 3500 km (NOTE 3) | 1000 km  (NOTE 2) |
| Min Elevation angle for both sat-gateway and C-IoT device | 10° for service link and 10° for feeder link | 10° for service link and 10° for feeder link |
| Max distance between satellite and C-IoT device at min elevation angle | 40,581 km | 1,932 km (600 km altitude)   3,131 km (1,200 km altitude) |
| Max Round Trip Delay (propagation delay only) | 541.46ms (service and feeder links) | 25.77 ms (600km) (service and feeder links)  41.77 ms (1200km) (service and feeder links) |
| Max differential delay within a cell | 10.3 ms | 3.12 ms and 3.18 ms for respectively 600km and 1200km |
| Max Doppler shift (earth fixed user equipment) (NOTE 6) | 0.93 ppm | 24 ppm (600km)   21ppm(1200km) |
| Max Doppler shift variation (earth fixed user equipment)  (NOTE 6) | 0.000 045 ppm/s | 0.27 ppm/s  (600km)    0.13 ppm/s  (1200km) |
| C-IoT device motion on the earth | Min 0 km/s (stationary device), max 120 km/h | Min 0 km/s (stationary device), max 120 km/h |
| C-IoT device antenna types | Omnidirectional antenna with 0 dBi TX antenna gain and 0 dBi RX antenna gain  (NOTE 4) | |
| C-IoT device max Tx power | UE power class 3 with up to 200 mW (23dBm), UE power class 5 with up to 100 mW (20 dBm) | |
| C-IoT device Noise Figure | Omnidirectional antenna: 7 dB or 9 dB  (NOTE 5) | |
| Service link | 3GPP defined Narrow Band IoT and eMTC | |
| NOTE 1:    Each satellite has the capability to steer beams **towards fixed points on earth** using beamforming techniques. This is applicable for a period of time corresponding to the visibility time of the satellite.  NOTE 2:   This beam size refers to the Nadir pointing of the satellite.  NOTE 3: The Maximum beam foot print size for GEO is based on current state of the art GEO High Throughput systems, assuming either spot beams at the edge of coverage (low elevation) or a single wide-beam.  NOTE 4: The use of a Circular polarized antenna is optional.  NOTE 5: Same Noise Figure of 7 dB as in Release 16 TR 38.821 or 9 dB as in Release 12 TR 36.888 for device can be assumed for link budget. The noise figure is device vendor implementation specific.  NOTE 6: Max Doppler shift and Max Doppler shift variation in the absence of any device pre-compensation of satellite Doppler shift on the service link.  NOTE 7: System bandwidth is FFS | | |

--- End of text proposal ---

# TP for Chapter 4 “IoT Non-Terrestrial Networks overview and scenarios” of TR 36.763.

The Text Proposal on IoT NTN scenarios for TR 36.763 Chapter 4 shown below is as agreed and captured in Chairman report for RAN1#103e:

--- Start of text proposal ---

**4.1 IoT Non-Terrestrial Networks overview**

A non-terrestrial network refers to a network, or segment of networks using RF resources on board a satellite.

The typical scenario of a non-terrestrial network providing access to user equipment is depicted below:



Figure 4.1-1: Non-terrestrial network typical scenario based on transparent payload

Non-Terrestrial Network typically features the following elements:

- One or several sat-gateways that connect the Non-Terrestrial Network to a public data network

- a GEO satellite is fed by one or several sat-gateways which are to enable satellite coverage over the targeted area (e.g. regional or even continental coverage). It is assumed that UE in a cell are served by only one sat-gateway

- A Non-GEO satellite served successively by one or several sat-gateways at a time. The system ensures service and feeder link continuity between the successive serving sat-gateways with sufficient time duration to proceed with mobility anchoring and hand-over. Service discontinuity can also be deployed.

- A Feeder link or radio link between a sat-gateway and the satellite

- A service link or radio link between the user equipment and the satellite.

- A satellite which implements a transparent payload. The satellite typically generate several beams over a given service area bounded by its field of view. The beam could be either earth fixed beam or earth moving beam for LEO. The footprints of the beams are typically of elliptic shape. The field of view of a satellite depends on the on board antenna design and minimum elevation angle.

- A transparent payload: Radio Frequency filtering, Frequency conversion and amplification. Hence, the waveform signal repeated by the payload is un-changed;

- User Equipment are served by the satellite within the targeted service area.

There may be different types of satellites listed here under:

Table 4.1-1: Types of NTN platforms

|  |  |  |  |
| --- | --- | --- | --- |
| Platforms | Altitude range | Orbit | Typical beam footprint size |
| Low-Earth Orbit (LEO) satellite | 300 – 1500 km | Circular around the earth | 100 – 1000 km |
| Geostationary Earth Orbit (GEO) satellite | 35 786 km | notional station keeping position fixed in terms of elevation/azimuth with respect to a given earth point | 200 – 3500 km |

Typically

● GEO satellite are used to provide continental, regional or local service.

● a constellation of LEO is used to provide services in both Northern and Southern hemispheres. In some case, the constellation can even provide global coverage including polar regions. For the later, this requires appropriate orbit inclination and sufficient beams generated.

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# Conclusion

In this contribution, we provided Text Proposals for inclusion in TR 36.763 Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) (Release 17) as follows:

TPs based on agreement as captured in Chairman RAN1#103-ereport on AI 8.15.1

* IoT NTN scenarios
* IoT NTN paramters

TP based on Feature Lead recommendations in summary for AI 8.15.1 in R1-2008868

* IoT NTN Overview

# References

1. RP-200XXX, MediaTek, Eutelsat, TR 36.763 Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) (Release 17), RP#90, December 2020
2. R1-3GPP TR 38.811, Eutelsat, Summary #4 of 8.15.1 IoT NTN Scenarios, RAN1#103e, November 2020.