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EchoStar/Hughes

Priorities for Rel-19 NTN-IoT Evolution

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Motivation for Rel-19 NTN Evolution

Release 17 - **introduced basic NTN functionality**, focusing on the transparent satellite payload scenario and necessary adaptations to LTE to work in a non-terrestrial environment.

Release 18 - **refined the initial NTN release** by improving service continuity between terrestrial and non-terrestrial and finalizing the remaining aspects of Rel-17 IoT NTN.

Release 19 - will increase diversity of supported device types, QoS requirements, and improve network architectures *to facilitate deployment and integration of NTN into existing networks.*

NTN-IoT Rel-19 Priorities

Features	RAN WG
1. Uplink Capacity Enhancement 2. 5GC support NTN-IoT 3. Store and Forward	RAN 1,2,3 -led
4. High Power UE (HPUE) for NTN-IoT *5. In-Band IoT for IoT-NTN*	*RAN 4-led*

Uplink Capacity Enhancement for NTN-IoT | RAN 1,2,3

Rationale: Current NB-IoT NTN UL system capacity is limited by the corresponding system DL capacity, due to the larger signaling overhead in the downlink (up to ~53%), and the tight coupling between UL and DL signaling. This impacts predominantly UL-driven traffic, such as Mobile Originated (MO) transmissions, which are the primary target of massive IoT, and initial emergency messaging use cases supported by IoT NTN. Every time a UE needs to transmit UL data, it requires an approximately equal number of DL control messages from the network. This limits the UL capacity, which, by itself, is expected to be at least double due to more efficient resource multiplexing and lower UL signaling overhead. To unlock the additional UL capacity potential, there is a need to *identify methods to* de-couple the UL from the DL as much as possible.

Proposal:

- Specify enhancements to enable multiplexing of multiple UEs (e.g., up to 4) in a single 3.75kHz or 15 kHz subcarrier by orthogonal cover codes for NPUSCH
- Specify enhancements to existing Early Data Transmission (EDT) procedure to minimize the amount of necessary downlink/uplink signaling to complete an EDT transaction

5GC Support of NTN-IoT | RAN 1,2,3

Rationale: NTN-IoT in Rel-17/18 is supported by EPC only. With potential implementation of integrated NTN-NR and NTN-IoT in one network, there is a need to enable 5GC support for NTN-IoT as this will reduce the CAPEX and OPEX of operators significantly. There is already 5GC support for terrestrial NB-IoT/eMTC in Rel-16, although not deployed mainly due to the existence/availability of legacy EPC. In the case of NTN, it will be a new deployment and there is no existing EPC.

It will likely require limited study, i.e., only to confirm that existing features in TN can be adapted to NTN/Sat Arch. This feature could be a game changer in offering improved support, e.g., joint NR- NTN and IoT- NTN deployment, as well as accelerating the evolution path of NB-IoT NTN in 5GS. This is essential for satellite operators and therefore vital that 5GC support be completed by including IoT NTN.

Proposal:

- Adapt existing features of 5GC support of IoT in terrestrials onto NTN-IoT/Sat Arch
- Enable 5GC support of IoT-NTN

Store and Forward | RAN 1,2,3

Rationale: Along with support for discontinuous coverage, support for S&F operation is key to facilitate cost-effective deployment of IoT NTN services and enable an immediate operational service with:

i. sparse LEO constellations and
ii. reduced ground segment infrastructure

Support of S&F puts the 3GPP IoT NTN solution on par with non-3GPP solutions intended for massive satellite IoT, which already support S&F services

Note: S&F operation assumes regenerative payload

Proposal:

- Specify the support of eNB on board in TS 36.300 and define, if needed, any necessary enhancements to address the feeder link switch over issue
- Define necessary enhancements in RAN to support store and forward (S&F) operation for delay-tolerant services; specific aspects to be considered if applicable:
  - Signaling procedures for S&F operation
  - Data transmission under S&F operation

HPUE for NTN-IoT | RAN4

Rationale: Satellite communication involves transmitting signals over long distances, which results in larger path loss. As such NTN operations generally benefit from high power UE to ensure that communication is available even in adverse conditions such as severe weather events or natural disasters. Although repetitions are allowed in NB-IoT, they come at the expense of significant system capacity. Higher TX powers, on the other hand, can help satellite operators deliver services without compromising system capacity.

Current NTN UE is assumed to have -5.5 dB antenna gain, therefore the need for higher TX powers to compensate for these losses especially for many IoT NTN use cases, including automotive, maritime, logistics, outdoor industrial monitoring and other scenarios not reliant on battery power, such that the higher power requirements are not a battery issue.

Proposal:

- eMTC IoT NTN UEs (Cat M1) and for NB-IoT NTN UEs (Cat NB1, NB2) to be considered
- NTN FR1 bands (i.e. n256, n255, n254 and upcoming bands)
  - Support UE with PC2 (+26 dBm)
  - Support UE with PC1.5 (+29 dBm) and PC1 (+31 dBm)

    (Note that PC1 and PC1.5 are not targeted for smartphones)

In-Band IoT | RAN4

Rationale: NTN NB-IoT has been defined in Rel-17 and there has been successful demonstration of NTN capable devices. To support growth of NTN NB-IoT it is necessary to further improve and encourage the network deployment with NTN-NR operation. NB-IoT in-band operation co-existence with NR allows the configuration of the DL/UL resource reservation on non-anchor carriers for unicast transmission to avoid resource overlapping with NR channels/signals. In leveraging the co-existence work in TN, three system scenarios have been studied and captured in TR 37.824:

- For NB-IoT operation in NR in-band
- For NB-IoT operation in NR guard band
- For NB-IoT standalone operation, based on coexistence study, it is concluded that there is no issue for NB-IoT standalone coexistence with NR

Proposal:

- Investigate if the work done for TN can be leveraged for NTN NB-IoT for in-band, guard band and standalone operation co-existence with NTN NR
- Adapt/specify for NTN NB-IoT in-band, guard band and standalone operation co-existence with NTN NR

Proposal for NTN-IoT Rel-19 Priorities

TSG RAN to consider for RAN 1,2,3-led, at least the following:

- Uplink Capacity Enhancement
- 5GC support NTN-IoT
- Store and Forward

TSG RAN to consider for RAN 4-led, at least the following:

- High Power UE (HPUE) for NTN-IoT
- In-Band IoT

Thank You !