Inmarsat-Viasat operator priorities for NTN Evolution in Release 19

RP-232596 (was RP-232468), RAN4-led items

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Introduction and General Views

- NTN is a reality **now, with networks being deployed as we speak.**
- Initial focus of deployments and products has been NB-IoT NTN in FR1, but systems will evolve in time
- NB-IoT NTN devices are being released to the market, even before the Release 17 and 18 work has been fully finalized
  - NB-IoT NTN was arguably rushed to market with a shorter Work Item phase in R17, this meant some aspects were missed.

- We **must** focus on:
  - **Features that ensure better system efficiency based on learnings from field**
  - **Features that facilitate deployment and ROI**
- Release 19 is likely the last chance to improve what's missing before too many products are already on the market.

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Overall Key Priorities (RAN123 and 4)

- **IoT NTN (specifically NB-IoT NTN)**
  - Network Capacity Enhancements – NB-IoT NTN Deployments are capacity limited, severely limited by the DL signalling overhead. Improving system capacity via reduced DL signalling and techniques such as CBS PUR and OCC is critical to meet the capacity demands and ensure economic viability.
  - UE Location Reporting for NB-IoT - The lack of support of UE location reporting for NB-IoT NTN is a significant limitation of Rel-17 & 18 for IoT NTN that was missed in Rel-17 due to wrong assumptions. All satellite operators deploying NB-IoT NTN would need this **critical** feature for mobility and resource management.
  - HPUE - For all FR1 IoT NTN bands including especially for NB-IoT NTN, with support for PC2 (+26 dBm), PC1.5 (+29 dBm) and PC1 (31 dBm).
- **NR NTN**
  - NR less than 5 MHz – At least enabling support for 3 MHz channel BW and 12 PRB transmission, as already specified by NR_FR1_lessthan_5MHz_BW also for NTN bands. This is critical to enable NR NTN deployments within the context of existing non-3GPP services, as well as to support EIRP limited satellites and maximize frequency reuse efficiency.
  - UL Capacity/Throughput enhancements – NR NTN deployments will be severely UL limited, Rel-18 focused on UL Coverage enhancements using repetitions. Use of PRB sharing and OCC can lead to huge capacity increase whilst maintaining coverage gains. This is crucial to make NR NTN economically viable.
  - HPUE – For all FR1 NTN bands, with support for PC2 (+26 dBm), PC1.5 (+29 dBm) and PC1 (31 dBm), reusing existing TN assumptions for FDD HPUE

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RAN4 Priorities

IoT NTN

1. HPUE - For all FR1 IoT NTN bands including especially for NB-IoT NTN, with support for PC2 (+26 dBm), PC1.5 (+29 dBm) and PC1 (31 dBm).
   - Duty-cycle and SAR related aspects may need to be considered. FFS whether some effort is required in RAN1.
2. In-Band NB-IoT

NR NTN:

1. NR less than 5 MHz – At least enabling support for 3 MHz channel BW and 12 PRB transmission, as already specified by NR_FR1_lessthan_5MHz_BW also for NTN bands. This is critical to enable NR NTN deployments within the context of existing non-3GPP services, as well as to support EIRP limited satellites and maximize frequency reuse efficiency.
2. HPUE – For all FR1 NTN bands, with support for PC2 (+26 dBm), PC1.5 (+29 dBm) and PC1 (31 dBm), reusing existing TN assumptions for FDD HPUE

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NR NTN less than 5 MHz

- **Initial NR NTN deployments will have to coexist with existing non-3GPP satellite services**
- Furthermore, satellites will still have limited power and will be largely EIRP-limited
- Reduction of the minimum BW required can facilitate with:
  - Early NR NTN deployment around existing services
  - Support of EIRP-limited satellite assets
  - Easier frequency resource management and reuse
- **As a minimum, reuse existing TN assumption of support down to 12 PRB with no impact to PSS/SSS and PBCH puncturing.**
- **If further puncturing of PSS/SSS could be considered to achieve further minimum BW reduction, this may be very beneficial to flexibility of initial deployments**
- If assumptions are reused from TN (no PSS/SSS puncturing, no PBCH re-design), from our perspective, this could be handled as a normal Spectrum Related WI, as Basket WI (new channel bandwidths for existing NTN bands), entirely within RAN4.

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HPUE support

- Current NTN systems in are both coverage and capacity challenged in UL due to the tight link budget, especially when taking realistic antenna gain assumptions (e.g. -5.5 dBi gain)
- Current solutions to improve coverage are mostly based on repetitions, which severely affect system capacity.
- This issue was raised during RAN#97 and later RAN#99 and was postponed to Rel-19.
- Satellite UE transmission regulation allow transmission powers up to 15 dBW for hand-held type terminals (e.g. satellite phones). 3GPP should better align with what is allowed within the current satellite regulatory framework.
- <u>The lack of this capability is currently severely limiting ongoing NTN deployments and use cases, which are starting with NB-IoT.</u>

Objectives:

The objectives to support higher Tx power IoT NTN and NR NTN are as follows:

- Taking exemplary bands 256/n256, 255/n255, the L/S band (254/n254) and upcoming Extended L-band (253/n253) into consideration:
  - For eMTC IoT NTN UEs (Cat M1): Specify support of UE Power class 2 (+26 dBm) for smartphone form factor; Power class 1.5 (+29 dBm) UE Power class 1 (+31 dBm) at least for non-smartphone form factor;
  - For NB-IoT NTN UEs (Cat NB1, NB2): Specify support for a new UE Power Class with MOP of +26 dBm; Power Class with MOP of +29 dBm) and Power Class with MOP of +31 dBm;
  - For NR NTN UEs: Specify support for PC2 (+26 dBm) for smartphone form factor; PC1.5 (+29 dBm) and PC1 (+31 dBm) at least for non-smartphone form factor.
  - Consider aspects related to duty cycle to control Specific Absorption Rate (SAR) for smartphone applications.
  - UE TX PA architecture may need to be analysed for NB-IoT

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Thank You!