Abstract for presentation at ASMS 2025

15.01.2025

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Title:

5G Non-Terrestrial Networks: NB-IoT for Space - from Study to Deployment

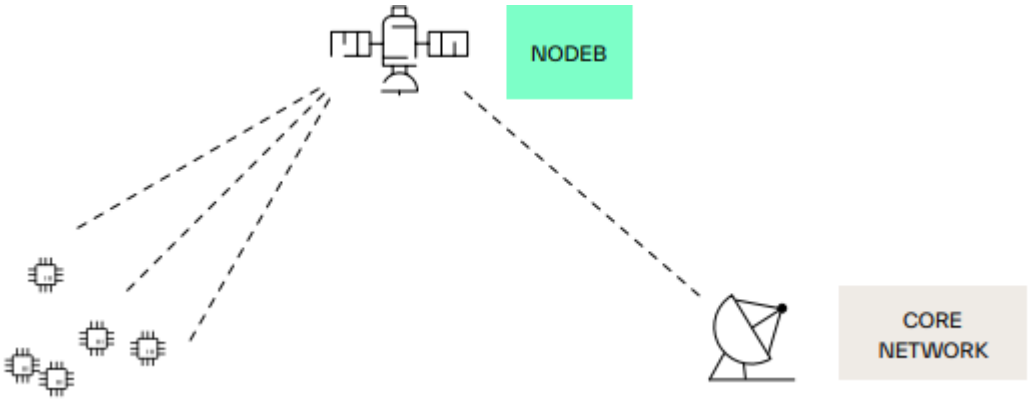
Abstract:

The presentation will, after a brief introduction to our 5G timelapse, move into the development and especially lab verification of our "Space NB-IoT" solution. Special focus will be on the importance of getting control (and how) on the time and frequency offsets in a NGSO and GEO NTN system and sharing our practical experiences in orbit. The presentation should reach both the beginners as more skilled 5G NTN listeners.

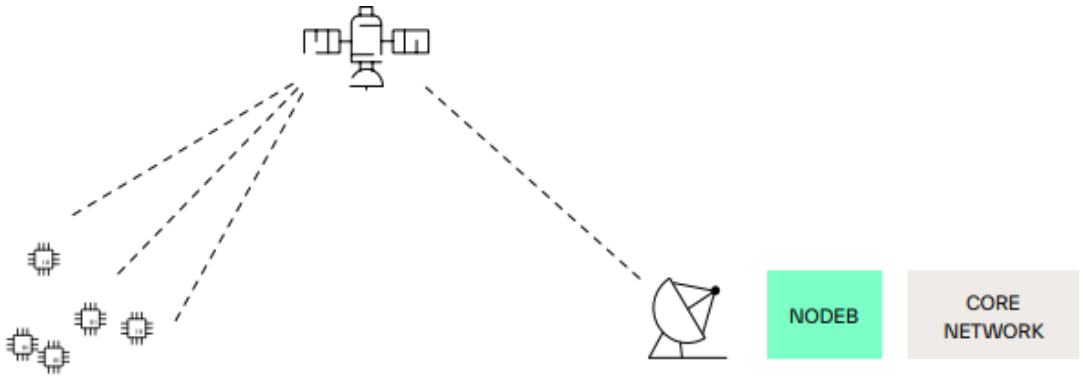
We will include results from the latest validations

1) Applying pre-qualified commercial devices applicable in both TN and NTN networks in the validation setup – i.e. validate connectivity between ground located 5G NB-IoT devices transmitting data via satellite.

2) Deploying the network components in both NGSO and GEO orbit satellite systems as well as in both regenerative mode as illustrated below,

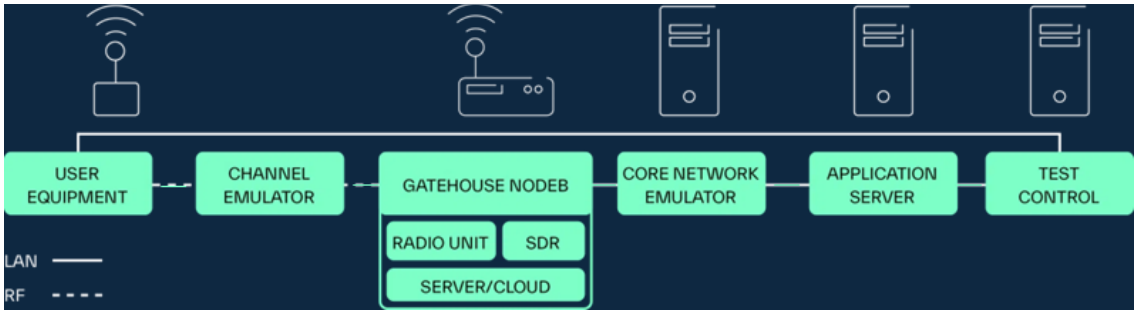


and transparent mode as illustrated below.



During the presentation we will cover the following topics:

- Use of Test benches during development for verification, interoperability testing, integration and the provisioning of 5G NTN Networks. During development our test bench has proven to be an invaluable tool to test different values and implementations of the critical algorithms related to timing and doppler.



- A test bench is also valuable when fine tuning configurations before deployment. Finally, it is used for validation and proof of new features and capabilities.

- 3GPP specifies methods with system information to provide the frame for doing compensation, and this has been validated during the test activities. We have tried how different values in the system information and different implementations of the algorithms affect the overall performance.

- NTN link compensation is done by using the locations of the device, satellite and ground station within a propagation model suggested by 3GPP that is supposed to have the necessary accuracy. Especially when deployed in NGSO time and frequency is rapidly changing making it difficult to secure a good quality connection.

- The link timing and frequency offset compensation is successful if the UE interpretation of the satellite position/track fits with the actual satellite path and is in time sync. This requires optimal system information settings and optimal UE compensation. UE and ground stations are at relatively fixed locations and satellites follow a well-known trajectory, so both timing and doppler compensation is based on calculations.

- The link compensation can be configured, verified and tuned in both lab and orbit environments. It has been validated both in lab and in orbit. We will present results from validation from both GEO and NGSO satellite systems.

- When the basics work then the system/network configuration (capacity) begins. Optimal scheduling of radio resources by using CE-level configuration and channel quality measurement.