

Gatehouse  
Satcom

# 5G NTN NB-IoT NodeB Software



# 5G NTN

## NB-IoT NodeB Software



The Gatehouse Satcom NB-IoT NodeB software is designed for use in a Non-Terrestrial Network and can provide direct-to-device connectivity for NB-IoT capable devices on the ground.

The Gatehouse Satcom developed 5G NTN NodeB software manages the radio channels used for communication between user equipment and mobile network. When connectivity from or to a device (user equipment, UE) is needed, the NodeB assigns a dedicated radio channel. Data can now be exchanged between the device and the NodeB. Data is received from the Core and transmitted to the device and vice versa. When there is no more data to be handled the radio channel is released.

### 5G NTN NB-IoT System Description

The NodeB is the Radio Base Station or Radio Access Network component of a 4G/5G network. It provides radio coverage and

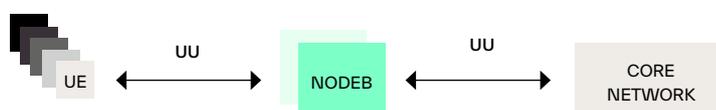
transfers data between user equipment and the core network. This is illustrated in Fig. 1 with a large number of devices connected via the air-interface (Uu) to a NodeB which is one of a group of NodeB's constituting the Radio Access Network. The NodeB's are connected with the Core Network (CN) via the S1 interface for transferring control and user data.

The NodeB software is based on 3GPP NTN 5G NB-IoT cellular radio access technology specified to address the fast-expanding market for low power wide area connectivity used in IoT applications. The NodeB can be used as "standalone" technology for deployments in dedicated spectrum.

Traditionally communication satellites operate as a mirror for signals transmitted from the ground station and then retransmitted from the satellite. This is defined as transparent mode in the 3GPP standards while regenerative mode is defined as having NodeB as a payload on the satellite and thereby moving parts of the 5G network functionality to the satellite. These modes are explained in more details in the following sections.

Being a 3GPP standardized solution means that satellite operators will be able to tap into the fast growing 3GPP community with devices in large volumes from different manufacturers that support multimode operation with both terrestrial and satellite based connectivity.

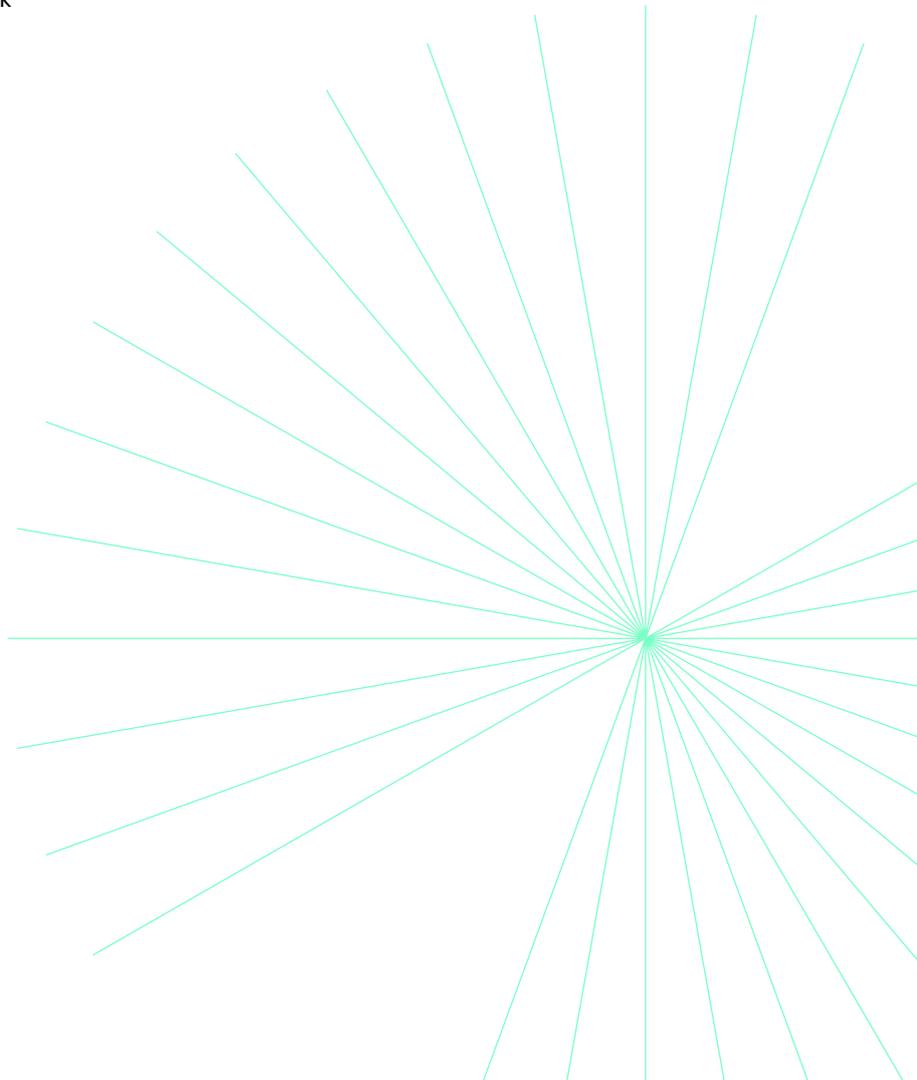
Fig. 1





# Benefits

- The Gatehouse Satcom NodeB software was built natively to support NTN
- We offer support and maintenance, which will guarantee you continuously updated software as Gatehouse Satcom is actively contributing to the 3GPP standards
- Can be deployed within a short time period
- Highly portable and proved on COTS SDR hardware
- Interoperability tested with major device chipsets
- Ideal for narrowband connectivity services in underserved areas for delay tolerant applications like IoT, messaging and Push-To-Talk



# Use Cases

## Transparent mode

NodeB functionality is located at the ground station connecting with UE's via a mirrored satellite connection, see Fig. 2. NodeB software is delivered together with hardware fitting into ground station infrastructure and being connected to the antenna for actual transmission and reception of data to and from the satellite.

long distances imposes new requirements to manage the radio channels which have been taken into account in 3GPP release 17.

GEO satellites are app. 36,000 km above the earth surface, and they are seen as stationary from the ground which means they are easy to locate but have a substantial latency and path loss on transmitted data.

LEO satellites are located 500 to 1,200 km above the earth surface having a substantial higher speed which means that they are visible from a ground position for app. 9 minutes, so to maintain connectivity user equipment needs to switch between satellites. Latency and path loss is significantly smaller while the relative speed of the satellite results in doppler effect and delay variations.

## Regenerative mode

NodeB functionality is installed in a payload hardware on the satellite, see Fig. 3. The service link will be managed by NodeB directly from the satellite while the feeder link carries the S1 interface between NodeB and Core.

Finally MEO satellites are located in between 5,000 to 20,000 km distance which means that their relative speed is much less and they are visible from the ground for app. 1 hour before a satellite switch is needed.

## Connectivity in different orbits

Communication satellites operate from different orbits, geostationary earth orbit (GEO), medium earth orbit (MEO) or low earth orbit (LEO). Data Communication over such

Fig. 2 - Transparent mode

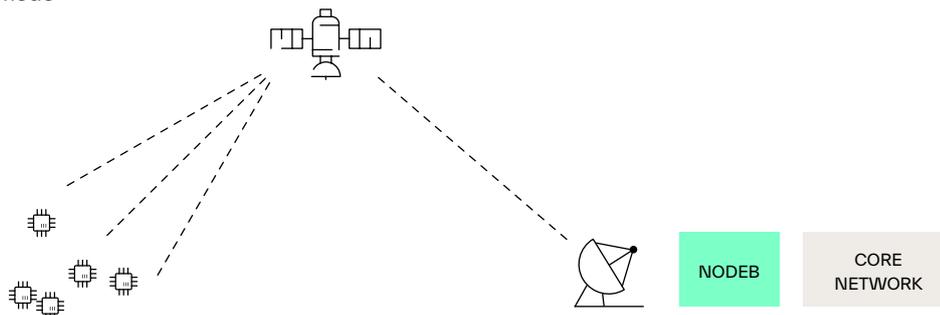
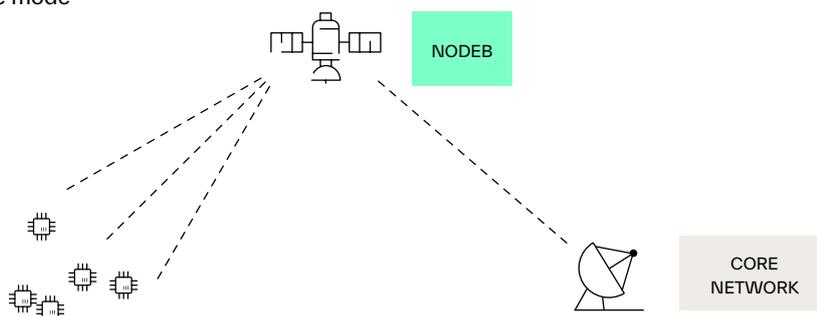


Fig. 3 - Regenerative mode





# Technical Description

Our NodeB software is a implementation of the 3GPP standards for NB-IoT and as such a standardized and non-differentiating component when building a 5G NTN system.

The NodeB software includes the layers PHY, MAC, RLC and RRC. It has been designed and developed for portability and executed on different Commercial of The Shelf (COTS) hardware platforms. The NodeB software is prepared for being embedded into any capable hardware platform being developed in standard C++ programming language to fit the application needs.

NodeB software is a COTS product which will follow the 5G NTN standards as specified by 3GPP. Gatehouse Satcom will continuously update the product according to modifications of the standards.

The major functions supported by NodeB are:

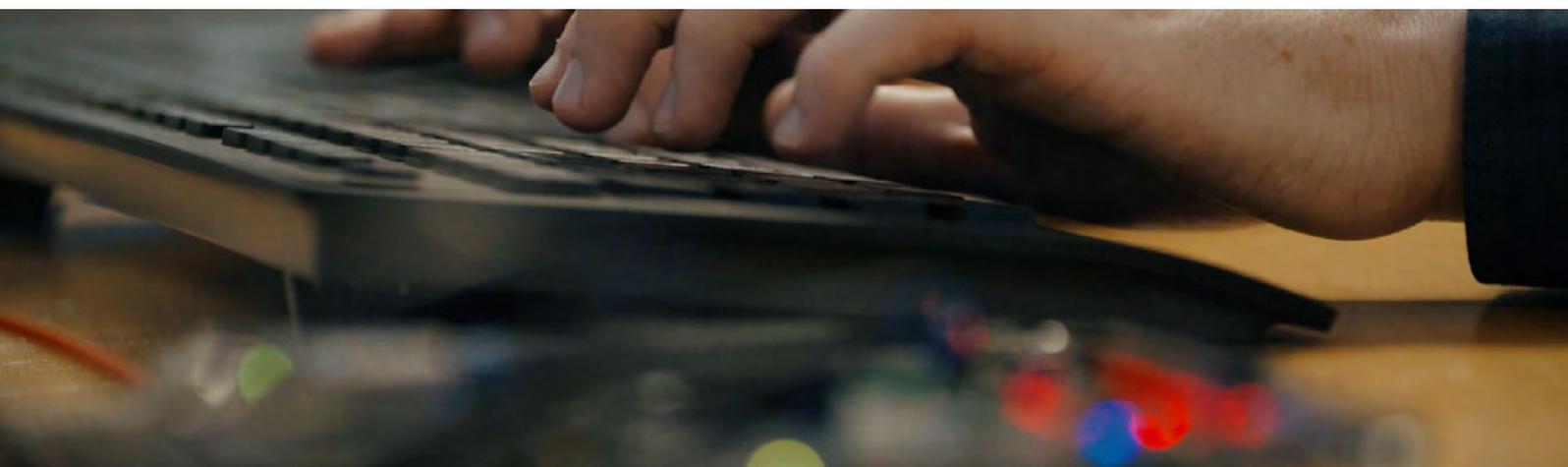
- Radio Bearer Control
- Scheduling (dynamic allocation of resources)
- Encryption of user data stream
- Selection of a Mobility Management Entity in Core Network and transfer of UE attachment
- Routing of Control Plane User data towards Service Gateway in Core Network
- Scheduling and transmission of paging messages originated from the Core Network
- Scheduling and transmission of broadcast information (SIB)
- Measurement and reporting configuration for scheduling
- Uu interface to UE's
- S1 interface to Mobility Management Entity in Core Network for control data (C-plane)

# Technical Specifications

- 3GPP 5G NTN compliant (Rel-17)
- Transparent mode operation
- Regenerative mode operation
  - Medium footprint with a ROM range of 16-20MB, RAM memory minimal 2GB
  - Bitstream size (depending on target, ~45Mb ZU3 / ~61Mb ZU5 / ~212Mb ZU9)
  - Supported COTS hardware configurations (Xilinx Ultrascale ZU3EG and Analog Devices AD936x RF)
- Requires position and velocity inputs for satellite, e.g. PPS or GNSS data from onboard GNSS or ground-based measurements, for timing and frequency synchronization (3GPP compliance)
- Standard C++17 programming language
- Running on Embedded Linux RT
- Debugging interface
- Higher level interface for ephemeris
- Standardised FAPI interface to physical layer
- Provides datalinks comparable to terrestrial networks (127 kbps peak, physical layer)
- Operations and Maintenance Interface
- Capacity of 100 data messages of 100 Bytes per second per carrier (scenario dependant)

## SUPPORTED 3GPP FEATURES

Standalone Configuration	NB-IoT carrier occupies a liberated 200kHz spectrum enabling narrow channel standalone deployment
TAU and Periodic TAU	NTN Tracking Area List, TN Tracking Areas and Tracking Area Update
Control Plane Clot Optimization	Transport User Data (IP-Non-IP) Over NAS
Single Tone (NPSUCH)	15 kHz and 3.75 kHz SCS (NPSUCH)
Interface to the CN	S1-Ap
IoT NTN extensions	Timing Advance, Timer extensions and scheduling delays
	Time-frequency compensation for NTN, SIB31-NB
	Segmented UL transmissions
	Discontinuous coverage, SIB32-NB
	Miscellaneous NTN: SIB1-NB, TAL



## Get in touch

Get in touch with us to learn how you can realize 5G NTN NB-IoT, eMTC or New Radio on your current or future satellite fleet to compete in the evolving market. You can contact us at [satcom@gatehouse.com](mailto:satcom@gatehouse.com) and set up a meeting to discuss your 5G NTN strategy.



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# Let's unlock the power of satellite communications software