
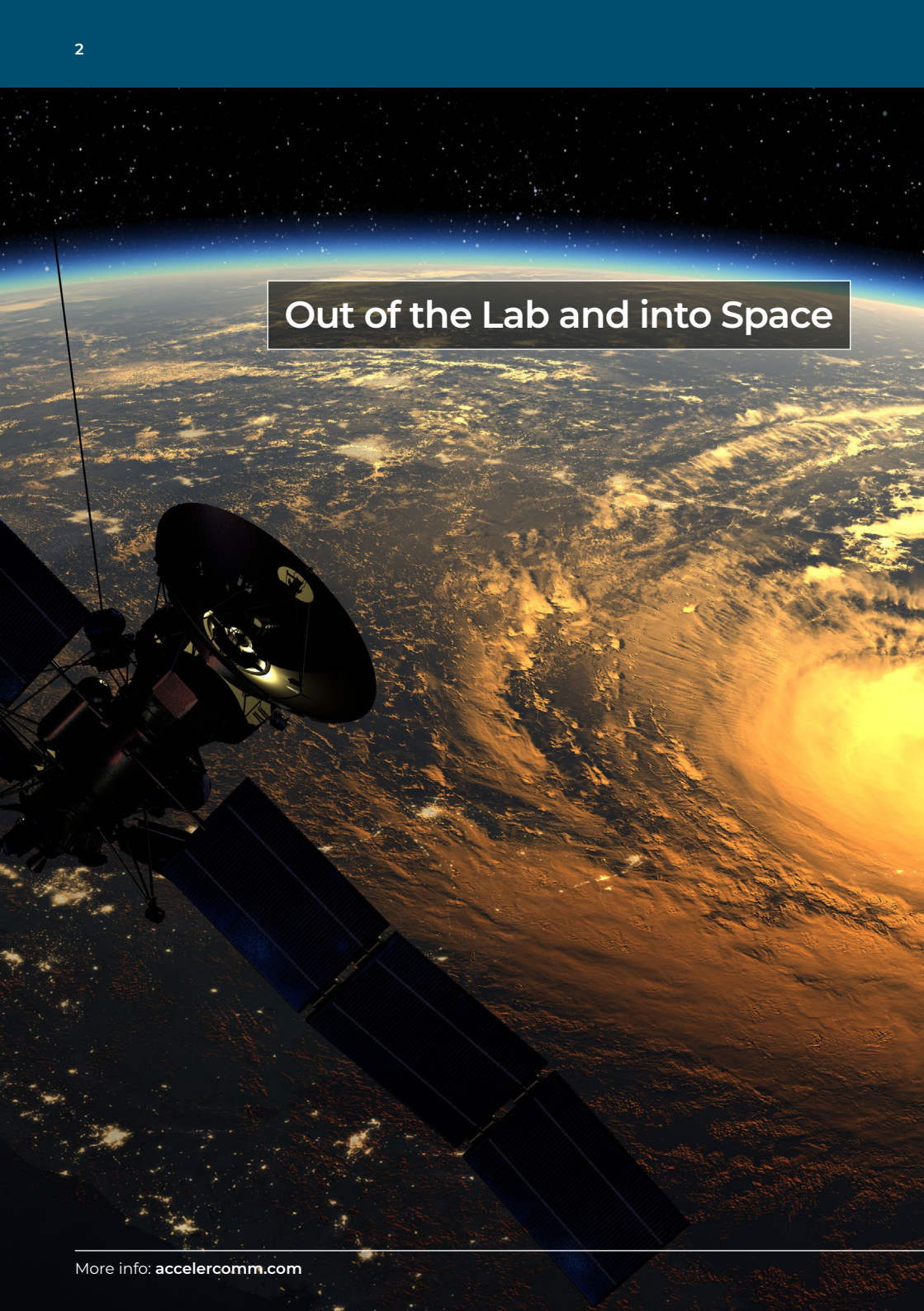


Physical layer solutions for 5G Non-Terrestrial Networks

A satellite with solar panels is shown in the upper left quadrant of the image, floating in space against a starry background.

Modular, high performance
5G NR Layer 1 (PHY) solutions for
Non-Terrestrial Network applications

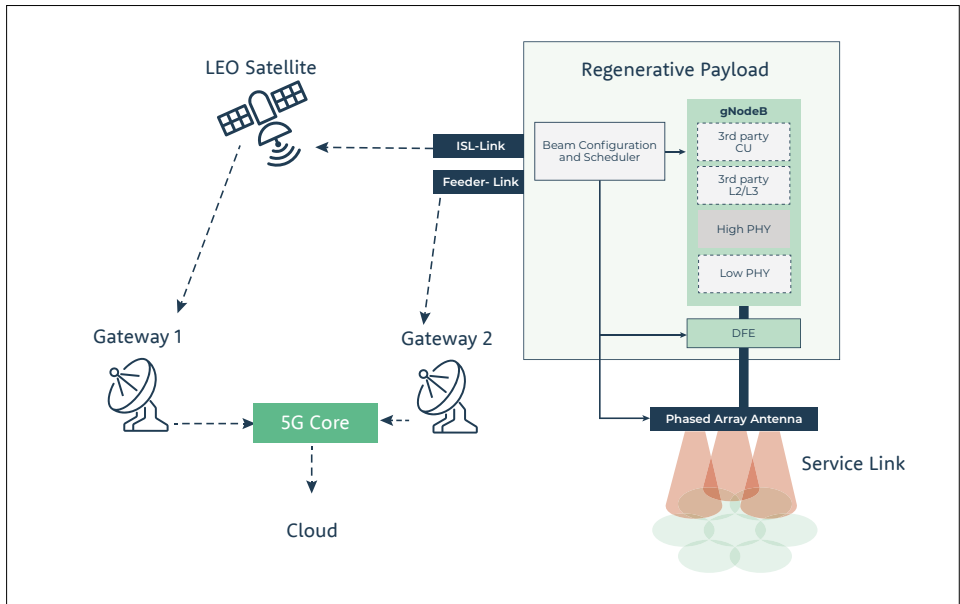


Out of the Lab and into Space

AccelerComm physical layer solutions for 5G non-terrestrial networks.

Introduction

As the 3GPP standards for 5G NR Non-Terrestrial Networks (NTNs) evolve it is clear that the market for Direct to Device (D2D) services will be best served by regenerative architectures. As well as performance and spectral efficiency gains, regenerative architectures allow the use of Inter Satellite Links (ISLs), which simplify the deployment of ground stations and feeder links, while allowing for secure routing of traffic within the constellation.



The regenerative architecture requires that a large amount of real time signal processing is carried out on the satellite, which effectively becomes a base station in space. The on-board environment of a satellite brings with it requirements that are very different from those in which terrestrial base stations operate. In particular, Size, Weight, and Power (SWAP) are all tightly constrained.

As well as the demanding environmental requirements, the nature of the signal processing required also looks very different to that of a

terrestrial base station. 5G NTN signals with very high path loss, latency and Doppler shift present different challenges to signals in dense urban terrestrial applications.

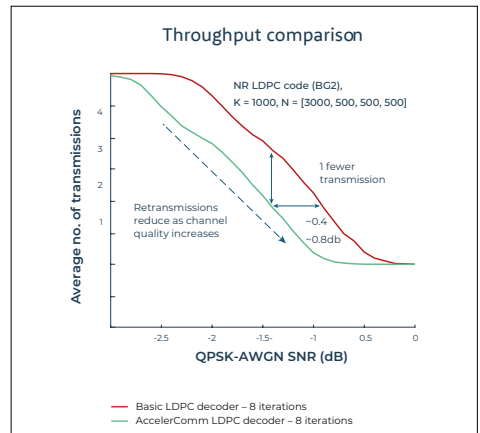
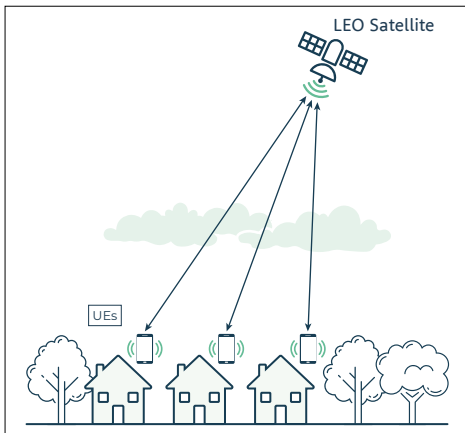
AccelerComm has developed a range of flexible physical layer (PHY) solutions for 5G regenerative NTN constellations that directly address these unique challenges, drawing on our many years of experience with advanced algorithms and innovative implementation. The solutions can be provided as a complete PHY or as modules.

Link performance

The NTN service link between the satellite and the User Equipment (UE) is primarily a line of sight channel with a distance of approximately between 600 km and 1200km in Low Earth Orbit (LEO) applications. The characteristics of such a link are markedly different to those found in terrestrial networks, which are relatively short, non line of sight multipath links. In order to achieve maximum link performance careful choice of signal processing algorithms is required. For example, the AccelerComm Forward Error Correction (FEC) decoder has configurations specifically for NTN use cases that deliver up to 0.8 dB performance improvement over industry standard decoders.

Our channel estimator and equaliser also have specific configurations optimised to correct for the Ricean fading that is typical of line of sight channels, which bring further improvements over standard algorithms.

5G NR complements FEC with Hybrid Automatic Repeat Request (HARQ) which allows for a partial resend of data not received correctly. Resending information is more costly in terms of latency and spectral efficiency in an NTN system and AccelerComm's solutions include specific features to almost completely remove unnecessary resends due to error floors that are common in systems targeted for terrestrial use only.



Power consumption

As noted above, power consumption is a key constraint of satellite payloads and innovative techniques are required to deliver the tens of Gbps of throughput required for a commercial satellite within the available power budget.

AccelerComm IP can be configured to make use of the available processing resource in the most power efficient manner. Compute intensive tasks such as channel estimation and equalisation can be carried out by the latest generation of vector processors (referred to as AI Engines or NPUs by some silicon vendors) delivering up to 20x the power efficiency of standard terrestrial datacentre CPUs.



Platform flexibility

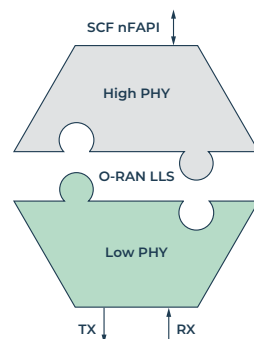
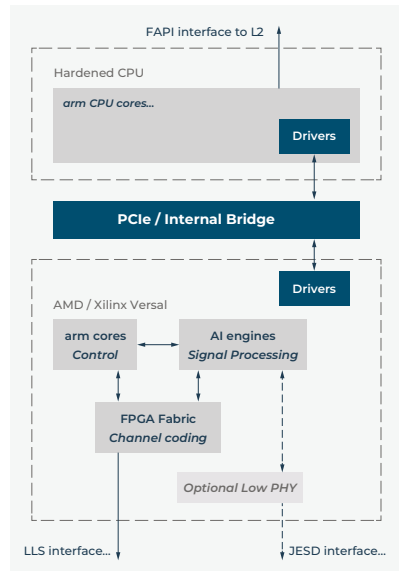
Operation in space requires silicon that has been “space hardened” which includes additional protection against in-service radiation as well as protection from the harsh conditions of launch.

There is a relatively narrow choice of devices which meet these space hardening requirements and provide the necessary signal processing power. AccelerComm IP is available pre-configured for a number of industry standard platforms from a single chip integrated solution using an AMD RFSoC device, to a two-device scalable solution using an AMD Versal device and NXP arm CPU, devices which are found in a number of commercially available On Board Processors (OBPs).

To meet the needs of diverse payloads, the solution also can be configured for a wide range of current and future devices, with the flexibility to allocate processing to different resources, ensuring most efficient use of the platform is made. On-chip hard macros such as FFT can be integrated where available.

For larger constellations, some operators will look towards custom IC (ASIC) solutions to reduce cost and deliver maximum performance. AccelerComm's solutions are proven for integration into space hardened ASIC platforms,

The use of standardised interfaces further adds to platform flexibility. The AccelerComm complete PHY solution provides an SCF FAPI interface, which has already been successfully integrated with a number of L2/L3 solutions. A simplified O-RAN LLS interface is provided between the High and Low PHY sections allowing the pre integrated AccelerComm Low PHY to be replaced by a 3rd party Low PHY if required.





Reducing project risk

Launching a satellite constellation is a large multi-year project. AccelerComm's solutions have been developed to offer a range of opportunities to accelerate the early phases of the project and reduce project risks.

In the early stages of system simulation and constellation design, AccelerComm's bit-accurate C models can be included in end-to-end simulations to accurately model the system behaviour.

Implementation of industry standard interfaces such as SCF FAPI and O-RAN LLS ensure that system integration tasks are reduced to allow early integration of the complete 5G system.

Availability of development platforms using off the shelf hardware allow laboratory integration and test to be carried out in parallel to the development of flight hardware, reducing the complexity of later integration phases.

To find out more go to www.accelercomm.com/contact or contact us at info@accelercomm.com





AccelerComm delivers high-performance, error-resilient physical layer solutions for specialized 5G networks, including satellite and private. Experts in Radio Access Networks (RAN) applications, the company develops solutions with cutting-edge performance and efficiency. Our comprehensive portfolio ranges from customisable signal processing components through to complete physical layer solutions which are implemented over a wide range of platforms. AccelerComm's solutions can be configured for a wide range of applications, optimizing aspects such as power consumption, latency, reliability, and resilience. Through continuous innovation, we ensure our customers have access to the latest advancements in physical layer technology.

Find out more about us at [accelercomm.com](https://www.accelercomm.com)