EVOLUTION OF ESA K BAND CAPABILITIES ON POLAR REGIONS FOR THE SUPPORT OF EARTH OBSERVATION MISSIONS

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Abstract

The Copernicus programme established by the EU in the recent years, with an important participation of ESA, is continuously collecting and delivering large amount of data in near-real-time for the monitoring of the Earth environment. At the heart of the Programme is the Sentinels constellation, currently composed by seven satellites devoted to the monitoring of climate change, atmosphere, land and marine phenomena as well as enabling security and emergency services. In the next decade, the implementation of Sentinel Expansion and Extension missions will enlarge the constellation by almost 20 more satellites, increasing enormously the data volume reception requirements of the Copernicus programme.

ESA Ground infrastructure for Earth Observation missions will have to evolve accordingly in order to support the new functionalities that will be introduced, mainly driven by the need of higher data rates. In this context, the ESA polar station located in Kiruna, Sweden, will be upgraded by the deployment of a new terminal in the range of 9-11 meters diameter, featuring S, X and K frequency bands[1]. The back-end of the station will also be enhanced to cope with the new data reception capabilities of K Band and the accompanying challenges in terms of link availability and bandwidth use optimisation; including the adoption of adaptive modulation and coding schemes, as well as novel data delivery protocols. In parallel, the experimental terminal SNOWBEAR (6.4 m) deployed in Svalbard with S and K Band reception capacity will be upgraded to become a fully operational terminal integrated within the ESA network.

The new terminals will provide support to the commissioning of new missions serving also to the validation and troubleshooting of novel technologies on-board the next generation of EO satellites. Special importance is given to the development of new RF communication techniques that will be required by the new missions:

- Implementation of K band downlink: Up to four channels of 600 MHz bandwidth each are planned to be adopted by some missions currently under definition.
- Implementation of distributed CFDP (CCSDS File Delivery Protocol) able to handle multiple parallel RF links and traffic of several Gbps.
- Implementation of the new VCM (Variable coding and modulation) technologies that will allow the transmission up to 10 Gbps using K Band.
- Preparation for the implementation of ACM (Adaptive Coding and Modulation) techniques that will allow to optimise the use of the allowable bandwidth with an increased reliability and simplified operations.
- Implementation of a future DTN (Delay Tolerant Network) node that will provide a greater flexibility to the networks
- Preparation for the implementation of the new X Band uplink band for Earth Observation missions.

[1] Bands for Earth Observation. S Band: 2025-2110 MHz uplink, 2200-2290 MHz downlink. X Band: 7190-7250 MHz uplink (future), 8025-8400 MHz downlink. K Band 25.5-27 GHz downlink.

The introduction of all these new functionalities will also require the complete revision of Kiruna Station architecture, targeting high flexibility; capable of adapting to the evolving requirements of the missions that will be put in place in the coming years.

The paper will describe the evolution roadmap envisaged for Kiruna and SNOWBEAR ground stations with special emphasis in the new functionalities to be deployed in order to meet the challenging needs of the future Earth Observations missions in the upcoming decade.

Figure 1 Kiruna Station (left) and SNOWBEAR terminal (right)