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HIGH DATA-RATE INTER-SATELLITE LINK (ISL) FOR SPACE-BASED INTERFEROMETRY

Abstract

Inter-satellite link (ISL) in swarm and constellation missions is a key enabler in the autonomy of the mission. OLFAR (Orbiting Low Frequency Array) is one such mission where 10+ nano-satellites are required in lunar orbit and perform radio astronomy from the far-side of the moon. Each of the nano-satellite in the swarm would carry a receiver that performs observations between 0.3 – 30 MHz, which are the least explored frequency bands in radio astronomy, thus attracting a large scientific interest. Observations in this frequency bands from Earth are highly challenging as the ionosphere is opaque to these frequency bands. Furthermore, RFI (Radio Frequency Interferences) generated on Earth makes it highly challenging to perform astronomical observations below 30MHz band. The challenges posed by Earth-based or near-Earth-based radio astronomy for these frequency bands is the motivation to perform measurements from the far-side of the moon.

The purpose of using a swarm of nano-satellites to perform low frequency observations is because the effective aperture of observation increases with the number of satellites. For the swarm of nano-satellites to operate as a single aperture, it is very important to cross-correlate the information collected by each satellite and this is where ISL become very crucial. Apart from exchanging data collected by the payload, other information such as attitude and timing information needs to be exchanged.

This work elaborates on the science cases that OLFAR mission will focus on and derive mission level requirements which would be used to define a suitable communication architecture. The approach chosen for communication system for such a swarm mission will comprise of two types of ISL: High data-rate directional link that will be used to exchange payload date and Low data-rate omni-directional link that will be used to exchange attitude, timing information and be used for localization, positioning and ranging of the nano-satellites in the swarm. This work will present link budgets to show the feasibility of the proposed communication architecture and derive the specs to further design the transceivers.