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HIGH SPEED RF INTER-SATELLITE COMMUNICATIONS

Abstract

Low frequency radio astronomy, observing at frequencies below 30 MHz, is one of the last unexplored frequency ranges, and is one of the topics receiving increased interest in astronomy. Since Earth-based observations at those frequencies are not possible, observations have to be done in space. In the ESA/ESTEC funded DARIS (Distributed Aperture Array for Radio Astronomy in Space) mission we investigate a space-based radio telescope concept. DARIS consist of 5 to 50 antennas (satellites) having a maximum separation of 100 km. The main limiting factor is the inter-satellite link, which is the topic of this paper.

As the satellite cloud needs to operate as an interferometer, a lot of data has to be transmitted inside the cloud between the satellites. The amount of data transmitted inside the cloud may vary between 20 Mbit/s and 1.6 Gbit/s depending on the number of bits used for sampling the astronomical signal. To meet these constraints an efficient modulation scheme must be used. For terrestrial use Orthogonal Frequency Division Multiplexing (OFDM) has been proved to be a bandwidth efficient modulation technique. It is wide spread because it offers high data rates and a high spectral efficiency.

The inter-satellite link (ISL) is a two way communication link, existing of a downlink of the astronomical data and housekeeping towards the central correlator in the mothership and an uplink for command, control, timing and synchronization. The data rate of the uplink is rather small. The data rate of the downlink includes the data generated by a three antenna system, each sampling twice the required bandwidth of 1 MHz. With a bandwidth of 1 MHz, this leads to a data rate of 6 Mega samples per second. With 8 bits sampling the inter-satellite link will be 48 Mbps for each satellite. Link budget calculations show that such a satellite link for the requested data rate within the cloud is possible. In these calculations, an OFDM scheme is used for multiplexing the signals.

Conclusions: A new, unique RF inter satellite link for the DARIS mission is presented. In the paper a more detailed description of the ISL is given.