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ARCHITECTURE OF INTER-SATELLITE LINK IN W-BAND BASED ON STEERABLE METASURFACE ANTENNAS

Abstract

The rise of the commercial space industry has led to the development of mega-constellations that aim to provide a global coverage. Overloaded frequency bands motivate the development of inter-satellite links (ISL) in higher bands - Q/V/W, the miniaturization trend in space technology has resulted in the development of lightweight, flat-profile equipment such as the metasurface antenna (MSA). MSA is a promising technology that can become an alternative to the currently used optical and radio-frequency approaches for building ISLs. For a precise beam acquisition several techniques of mechanical and electrical steering can be used.

This paper focuses on the W-band ISL architecture for a low-Earth orbit (LEO) communication constellation. In such mega-constellations with thousands of satellites, ISLs provide real-time communications of a signal latency of a few tens of milliseconds. What is more, the higher carrier frequency and bandwidth significantly increase the bit rate required to support 5G and beyond-5G networks.

The key improvements targeted by this work are production cost and time reduction, miniaturization of components, and increased throughput and reliability of the communication system. This paper provides a comprehensive overview of architectural and technological components that enable MSA-based ISLs to be built and deployed in a real commercial LEO constellation. Several techniques to maximize the achievable data rates are described. The study presents the results of modeling and experimental measurements of a produced steerable MSA, as well as the improvements proposed in the frame of the project.