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HIERARCHICAL COMMUNICATION ARCHITECTURE AND NETWORK PROTOCOL FOR
CISLUNAR CONSTELLATION

Abstract

This decade has seen increasing interest in lunar explorations and the vision of cislunar economy. Serving for the follow-up lunar and cislunar explorations and utilizations, ideas of cislunar constellation has been proposed to provide foundational supports for cislunar activities, including communication, navigation and other information services. Considering the large-scale ranges and orbital features, we proposed a hierarchical communication architecture and network protocol for cislunar constellation, with a trade-off analysis among service coverages, reliability, user burdens, scalability and feasibility. Nodes in multiple types of orbit, such as ellipse lunar frozen orbit (ELFO), distant retrograde orbit (DRO), Earth-Moon Lagrange (EML) Halo orbit and Near Rectilinear Halo Orbit (NRHO), are analyzed to set up a comprehensive multi-rank relay access, and eventually form a Cloud-Edge-End hierarchical network. Compliant with ITU radio regulation and CCSDS standards, layered network protocol is proposed to define the frequency allocations and signal schemes of different transmission links which construct the whole network, and also define the protocol of information flow within this heterogeneousintegratednetwork. Then, using lunar south-polar exploring missions as a user scenario of cislunar constellation services, a system design case is demonstrated in order to show the preformation advances, implementation constraint and technical requirements of the proposed communication architecture and network protocol. This paper provides a top-level option for guiding the future cislunar constellation design.