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NEXT-GENERATION COMMUNICATION PROTOCOL CONCEPTS FOR FUTURE NANOSATELLITE CONSTELLATIONS

Abstract

Nanosatellite constellations at low Earth orbits represent a cost-efficient way for the accomplishment of Earth and space observation tasks. With the growing complexity of the exploration tasks, increasing science data amounts are expected to occur. For data download purposes, efficient communication strategies must be adopted. The performance of a single nanosatellite spacecraft is limited due to high power consumption of communications equipment. A constellation of nanosatellites allows to share resources efficiently, assigning major tasks to different spacecrafts. Within the constellation, a dedicated spacecraft which acts as data relay, monitoring and controlling inter-satellite communications, shall be implemented. This allows all other satellites to reassign the energy gained from the use of low-energy consuming hardware and reduced communications activities for their specific tasks. With this approach, taking advantage of scheduled communication contacts, the overall system performance can be maximized.

For the envisaged data relay scenario, the adoption of advanced communication protocol concepts is a major constraint. This paper presents innovative solutions for the fulfillment of the described communications challenges. After an investigation of the system requirements, strategies for the interconnection of the spacecrafts for the creation of a small constellation network are provided. Suitable transport protocol implementations are investigated and efficient store-and-forward concepts are proposed. A communication architecture for the usage of a data relay satellite within the constellation, describing the role of the different nodes in the network, is presented.