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On the Issue of a Space Relay System Concept for Controlling a Multi-Satellite Orbital Constellation

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Abstract. The paper studies the issues of a space relay system concept for controlling a multi-satellite orbital constellation as a multi-agent spacecraft system generating many applications for the implementation of individual technological spacecraft control cycles. The relay system is considered as a queuing system, for the successful operation of which the implementation of multi-station access technologies is necessary. The characteristics of the system are investigated and options for upgrading the existing domestic space relay system are proposed.
In the modernization model proposed by the authors, it is assumed that an active electronically scanned array (AESA or multi-horn system) with partial overlap of radio coverage areas in the direction of spacecraft is used as an antenna for relay satellites, in the range of altitudes of circular orbits from 400 km to 2000 km. For the return channel, it is proposed to use BPSK/QPSK modulation with orthogonal code manipulation and spread spectrum.
The authors have estimated the theoretically achievable spacecraft service rate with multiple access of 128-256 kbit/s and the overall system performance. Practical implementation of the proposals considered in the paper involves a step-by-step modernization of ground-based facilities for generating signals with the required signal-code structures, modernization of relay satellites with the installation of a multi-beam antenna system and the implementation of signal processing onboard the relay satellites.
Keywords: space relay system, multi-satellite orbital constellation, queuing system, multi-station access
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