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ANALYSIS OF KEY TECHNOLOGIES USED FOR DEVELOPMENT MULTI-SATELLITE ORBITAL GROUPINGS BASED ON SMALL SATELLITES

Abstract

One of the key trends in the modern world cosmonautics is the development of cluster space systems for various purposes consisting of a large number of functioning spacecrafts. This was made possible by the gradual reduction in the mass of spacecraft, the creation and use of new materials in space, the rapid development of electronics and MEMS systems, the development of a group launch method (up to several dozen satellites for one launch), the development of multi-agent technologies and inter-satellite communication systems. Currently, there are projects of space systems of foreign countries consisting of a large number of space objects: the "OneWeb" project of "OneWeb LLC"- up to 700 telecommunications satellites are planned (to this date 40 satellites have been launched); the "Dove" project of "Planet Labs" Inc. - 175 nanosatellites for monitoring the earth's surface are already functioning in orbit; the "Starlink" project of "SpaceX" involves the creation and deployment of up to 12,000(!) satellites in orbit small satellites for the purpose of creating a high-performance satellite Internet communication channel (to this date more than 1000 satellites have been launched). The main classes of devices that are used to create such multi-satellite systems are small satellites, including micro (up to 100 kg) and nano (up to 10-15 kg), which have significant advantages over heavy spacecrafts especially in terms of speed and cost of production. However, the process of developing even a small spacecraft traditionally takes years. The development period of one of the modern Russian remote sensing spacecraft "AIST-2D" (joint project of Space-rocket center "Progress" and Samara University) was a record 32 months for the industry from the beginning of design to launch. However, it is obvious that the deployment of multi-satellite groups, including hundreds or even thousands of satellites, requires fundamentally new approaches to the creation of spacecrafts and the system as a whole at all stages of the life cycle. The report examines the key technologies used for development multi-satellite orbital groupings based on small satellites on different stages of life cycle - from the early stages of design to the stage of operation and disposal (removal from orbit).