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SYSTEM DESIGN OF AN S-BAND NETWORK OF DISTRIBUTED NANOSATELLITES

Abstract

Traditional communication missions are based on rather big single satellites and are expensive to develop, launch and operate. Hence, due to the advances in small satellite technology over the last decades, missions involving multiple small satellites as a constellation have become attractive for both the commercial space market and the research community. Especially at a time when, space born systems have become an essential infrastructure to face global challenges such as climate change, emergency population warning or monitoring of maritime systems, rapid response and low cost systems are demanded more than ever. The Iridium constellation (66 satellites á 681 kg launch mass) for voice service or Orbcomm (currently 29 satellites á 42kg) for text service are some examples for a network with distributed satellites. Also the A-train constellation should be mentioned which currently consists of five active sun-synchronous Earth observation satellites each with different spectral bandwidth. These distributed satellites, however not small satellites in this case, increase response and revisit time for disaster monitoring purpose. Despite of resource limitations in electrical power, propulsion or communication bandwidth, a constellation of small communication satellites enables more frequent and flexible Earth coverage compared to single spacecraft systems. A key technology to increase the operation efficiency of distributed satellite systems via formations or even autonomous swarms is the miniaturizing of inter satellite communication technology. However the cross-links in the past missions were all limited to point-to-point links and a narrow bandwidth (UHF) with low data rate of some 10 kpbs. So far, no multipoint cross-link mission could be demonstrated based on nanosatellites. To push further the technological boundary of cross-communication of nanosatellites, TU Berlin developed an S band (2.0-2.3 GHz) transceiver (SLink) with 100 kbps crosslink and 1 Mbps downlink capability suitable for accommodation in nanosatellites. Currently TU Berlin is developing a mission of four nanosatellites to verify the SLink payload and demonstrate the intersatellite communication on a sophisticated level. The description of mission and system design of this S Net mission is the main intention of this paper.