

SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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AN ARCHITECTURE DESIGN FOR HIGH-AVAILABILITY SPACE NETWORK BASED ON
PARALLEL REDUNDANCY STRUCTURE

Abstract

Abstract: With the development of space technology, the data requirement has been increased, especially for space station, space operation vehicle and observing satellite, not only the network is longing for higher speed catering for masses of information transmission demand, such as high-resolution video signals and payload traffic, but also high reliability, scalability and failure disposal are needed. The data communication problem in the spacecraft is urging a high-availability space network. First of all, since the basic network technology, the full duplex switched Ethernet is adopted. Aiming at a multi-module spacecraft, a mixed topology based on parallel redundancy structure is proposed. Gigabit-Ethernet is used in backbone with redundant ring, and 100Mbps Ethernet is applied to access layer forming trees structure. Then the structure of protocol stack supported parallel redundancy structure is issued. Secondly, adaptability of Parallel Redundancy Protocol (PRP) one of a key protocol in the stack, is discussed. An advanced PRP redundancy algorithm is presented. Simulation results showed that the advanced algorithm is of high robustness and fault tolerance, hence adapt to the complex space environment. Finally, the high-availability space network model is established using OPNET Modeler, and the network performance with 700Mbps network traffic is analyzed. Single network collapse, link invalidation and device anomaly are simulated; Simulation results demonstrated the designed network architecture provided rapid even seamless recovery in case of link failure or single network breakdown, and Quality of Service (QoS) guarantee based on priority. The availability of network is proved at system level.

Key Words: Space Network; high-availability; Network Architecture; Parallel Redundancy Structure; OPNET