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RESEARCH ON WIRELESS AD-HOC NETWORK FOR INTELLIGENT SATELLITE CLUSTER IN SPACE EXPLORATION

Abstract

Space presents great potential for a wide range of science exploration activities including earth science, comet and asteroid detection, deep space planetary exploration. Space technology is envisioned that, coupled with the innovative small satellite concept will revolutionize the space exploration activities. Intelligent satellite cluster is an novel concept proposed in recent years, which is composed of tens or hundreds cluster flying micro-, nano- or pico-satellites working in an autonomous and coordinated way. Because of its great technical advantages in the fields such as comprehensive exploration, distributed measurement, multi-mission reconfiguration etc., intelligent satellite cluster concept hasgained more and more attention in space exploration. To enable the usage of intelligent satellite cluster, some key technologies have to be developed. One of the main technical challenges in a intelligent satellite cluster system is wireless ad-hoc networking for information exchanging. This paper focuses on the design issues for wireless ad-hoc network of intelligent satellite cluster. With reference of the Open Systems Interconnection (OSI) model, the problems that should be concerned during the design process at each layer of the cluster network are researched and some innovative schemes are proposed. At physical layer, the antenna mechanism that considers omnidirectional coverage and low power consumption requirements are discussed. At data link layer, the modified IEEE 802.11 (WiFi) protocol based space link scheme is proposed to support medium access of the shared physical medium in the cluster domain which has a much longer communication range compared with the conventional indoor communication. At network layer, a specific network packet format for application layer data transfer is devised and a transfer time delay constrained optimal transmission power consumption routing algorithm is designed. At application layer, a novel application layer protocol based on network status aware and state transition is designed, which can support intelligent self-organization and autonomous cooperation of a cluster of satellites.