

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Communication Technologies, Part 1 (4)

Author: Dr. Huasong Zeng
Beihang University, China, zenghuasong@buaa.edu.cn

Prof. Chunxi Zhang
Beihang University (BUAA), China, zhangchunxi@buaa.edu.cn

Prof. Xiaosu Yi
Beihang University (BUAA), China, yixiaosu@buaa.edu.cn

DEMONSTRATION OF A SPACEFIBRE OVER PASSIVE OPTICAL NETWORK

Abstract

SpaceFibre is a very high-speed serial link and network technology, designed specifically for use on board spacecraft, which connects network nodes and deliveries SpaceWire packets among them via routing switches. In a centralized spacecraft system or sub-system, since most of the data are terminated at one single master node, the advantage of non-blocking packet switching among all ports brought by the routing switch is not obviously. Whereas, in fiber-based SpaceFibre networks, the power consumption of optical transceivers on the routing switches is significant. Therefore, this paper proposes a SpaceFibre over passive optical network (Spfi-PON), which connects network nodes through fiber couplers instead of routing switches. In the Spfi-PON system, since multiple network nodes share one single optical medium, a SpaceFibre point-to-multipoint (Spfi-P2MP) protocol is designed in this paper, in order to support the time division multiple access (TDMA) transmission among network nodes, which is under the control of the master node. Hence, this protocol enables a collision-free packet transfer between one master node and multiple slave nodes on a shared wavelength in the Spfi-PON network without routing switches. A Spfi-PON demonstration system with 1.25Gbps line rate has been built to evaluate the performance. The packet transfer test shows that the Spfi-PON can delivery SpaceWire packets between master and slave nodes as well as between slave and slave nodes (via redirection by the master node). The throughput test shows that the Spfi-PON achieves 0.77 and 0.94 bandwidth efficiency (955Mbps and 1184Mbps throughput, not considering the 8b10b coding overhead) using conventional continuous optical transceivers and EPON burst optical transceivers, respectively. The Spfi-PON is energy-efficient since it reduces half of the optical transceivers in the SpaceFibre network by using passive couplers instead of active routing switches. In addition, the reduction of active devices (routing switches) in Spfi-PONs has a beneficial effect on the network reliability. Therefore the proposed Spfi-PON applies to centralized spacecraft systems or sub-systems which are energy and reliability sensitive.