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SPACEFIBRE: MULTI-GBITS/S NETWORK FOR SPACEFLIGHT APPLICATIONS

Abstract

SpaceFibre is a very high-speed serial data-link being developed by the University of Dundee for ESA which is intended for use in data-handling networks for high data-rate payloads. SpaceFibre is able to operate over fibre-optic and copper cable and support data rates of 2 Gbit/s in the near future and up to 5 Gbit/s long-term. It aims to complement the capabilities of the widely used SpaceWire on-board networking standard: improving the data rate by a factor of 10, reducing the cable mass by a factor of four and providing galvanic isolation. Multi-laning improves the data-rate further to well over 20 Gbits/s.

SpaceFibre provides a coherent quality of service mechanism able to support best effort, bandwidth reserved, scheduled and priority based qualities of service. It improves considerably the fault detection, isolation and recovery (FDIR) capability compared to SpaceWire. The SpaceFibre interface is designed to be implemented efficiently and uses a packet level protocol which is the same as SpaceWire, enabling simple connection between existing SpaceWire equipment and high-speed SpaceFibre links and networks.

SpaceFibre is specifically designed for handling data on-board spacecraft. It can be used to provide point-to-point connections between equipment or, using SpaceFibre routers, to provide a complete interconnection network. SpaceFibre aims to support high data-rate payloads, for example synthetic aperture radar and hyper-spectral optical instruments. It provides robust, long distance communications for launcher applications and supports avionics applications that have deterministic delivery constraints through the use of virtual channels. SpaceFibre enables a common on-board network to be used across many different mission applications resulting in cost reduction and design reusability.

At present the SpaceFibre standard is in advanced draft form, chip designs have been implemented and tested in FPGAs, and extensive simulation has been carried out to validate the protocols. Interoperability testing between Japanese and European implementation has been successful and test equipment, including interface boards and link analyzers, are now available from STAR-Dundee. A radiation tolerant interface chip is currently being designed and several beta projects are currently designing SpaceFibre interfaces into various applications, including on-board processors and memory units.

The full paper will describe SpaceFibre in more detail, explain its protocol stack and consider example application architectures. It will also provide test results of SpaceFibre implementations and outline the current state of the SpaceFibre standard specification.