SpaceFibre-to-SpaceWire Bridge IP Core

SpaceWire (SpW) is a data-handling network for use on-board spacecraft. SpW is an ECSS standard (ECSS-E-ST-50-12C) with some specific characteristics that helps it support data handling applications in space: simplicity, high-speed (2 Mbits/s to 200 Mbits/s), low-power, low implementation cost, and architectural flexibility making it ideal for many space missions. Data-handling networks can be built to suit particular applications using point-to-point data-links and routing switches.

SpaceFibre (SpFi) is a multi-Gbit/s serial link designed specifically for use onboard spacecraft, with built-in innovative Quality of Service (QoS) and Fault Detection, Isolation and Recovery (FDIR) mechanisms. The SpFi standard (ECSS-E-ST-50-11C) was published by ECSS on May 2019.

SpFi is compatible with the packet level of the SpW standard. SpFi carries SpW packets over virtual channels and operates at more than 15 times the data-rate of SpW and can run over fibre optic (long distances) or copper media (less than 10 m). This means that applications developed for SpW can be readily transferred to SpFi.

Bridging between SpaceWire and SpaceFibre

The STAR-Dundee SpaceFibre-to-SpaceWire Bridge IP Core allows to connect a number of SpW devices to a SpFi network, enabling legacy equipment to take full advantage of the QoS and FDIR capabilities of SpFi. Some of the benefits are:

- Allows data from multiple SpW devices to be concentrated over a single SpFi link. This substantially reduces cable harness mass and simplifies redundancy strategies.
- The QoS mechanism in SpFi simplifies spacecraft system engineering which reduces system engineering costs and streamlines integration and test. The use of virtual channels (VC) provides multiple independent communication channels over a single physical link. VCs provide “babbling node” protection and scheduled, deterministic communication without wasting any network bandwidth.
- SpFi enhances on-board network robustness through its inherent FDIR and graceful degradation techniques incorporated in the network hardware. This simplifies system level error-handling software, reducing development and system validation time and cost. FDIR detects, isolates and recovers from faults in the link where they occur, which prevents faults from propagating and causing further errors. The FDIR capability of SpFi provides galvanic isolation, transparent recovery from transient errors, and error containment in VCs and frames.

IP Core Features

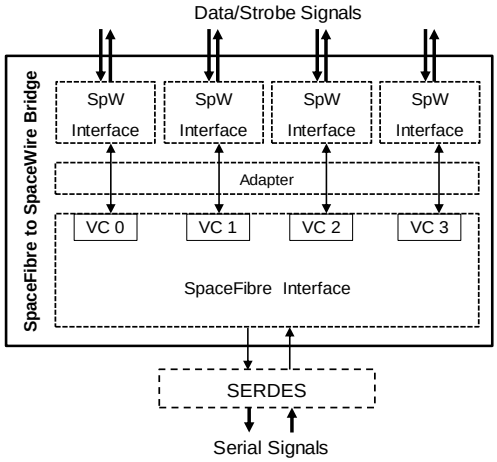
The following parameters of the Bridge IP Core can be configured:

- Number of SpW interfaces.
- Size for the SpW packet buffers.

Two SerDes interface options are offered with the IP:

- 8B10B encoding (20-bit or 10-bit interface), clock correction and symbol alignment done inside the IP Core.
- 8B10B encoding (32-bit interface), clock correction and symbol alignment done in the SerDes device.

STAR-Dundee provides stand-alone IP Cores ready for ASIC implementation or for specifically interfacing to several FPGA families such as the RTG4, RTAX, Virtex, Kintex, Zynq, etc. A block diagram of the interconnection of the IP Core is shown below.



Resources Required

The RTG4/Virtex-5QV resources required by the Bridge IP are detailed below for different number of SpW interfaces.

	RTG4 [1]			Virtex-5QV		
	LUT	DFF	µ/LSRAM Blocks	LUT	DFF	RAM Block
1 SpW	4430 2.9%	2701 1.8%	2 / 4 1.0% / 1.9%	3250 3.7%	2765 3.1%	6 2.0%
2 SpW	5981 3.9%	3475 2.3%	4 / 6 1.9% /2.9%	4138 4.7%	3396 3.9%	10 3.4%
4 SpW	9083 6.0%	5023 3.3%	8 / 10 3.8% / 4.8%	5914 6.7%	4658 5.3%	18 6.0%

[1] 8B/10B encoding performed inside the IP Core

IP Core Delivery Files

The STAR-Dundee SpFi-to-SpW Bridge IP Core comes with a reference design for RTG4 (Libero) and Virtex-5QV (ISE) that can directly be implemented in the FPGA for easy adoption. There is also a comprehensive end-user test bench for Modelsim/Questa simulators.

Licensing

STAR-Dundee SpFi-to-SpW Bridge IP Core is available under license. For more information on the IP core, license, or if you have specific or custom requirements, please contact us.

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