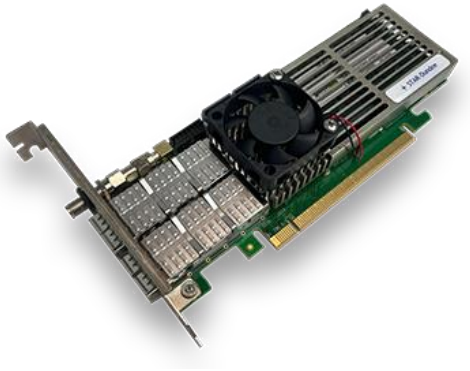
STAR-Dundee

SpaceWire and SpaceFibre Expertise

STAR-Ultra PCIe Single-Lane Router

The STAR-Ultra PCIe Single-Lane Router is a SpaceFibre Single-Lane Routing Switch with eight single-lane SpaceFibre ports, an 8-lane Gen 3 PCIe port providing two internal routing switch ports, and an internal configuration port. It can be used both as a stand-alone routing switch with eight SpaceFibre interfaces, and as a network interface card with an embedded routing switch, supporting packet transfer between a host PC and the routing switch at data rates well in excess of 10 Gbit/s in both directions simultaneously.



STAR-Ultra PCIe Single-Lane Router Architecture

A block diagram showing the STAR-Ultra PCIe Single-Lane Router architecture is shown below.

At the heart of the STAR-Ultra PCIe Single-Lane Router is a SpaceFibre routing switch with a total of twelve ports.

Port 0 is the configuration port which is accessed using Virtual Channel 0 (VC0) only. Any port on the routing switch can access the configuration port through VC0. This is used for configuration, control and monitoring of the SpaceFibre routing switch.

Ports 1 to 8 are the eight SpaceFibre ports, each with eight virtual channels. The SpaceFibre ports are single-lane ports which can support lane speeds (and link speeds) of up to 6.25 Gbit/s. The SpaceFibre ports are connected to a pair of QSFP+ connectors, ports 1 to 4 to the upper QSFP+ connector (QSFP1) and ports 5 to 8 to the lower QSFP+ connector (QSFP2). Each SpaceFibre link in a QSFP+ connector can be separated out using a QSFP+ to four SFP+ cable assembly. STAR-Dundee provides a range of adaptors for SFP+, including SFP+ to four SMP connectors and SFP+ to SpFi-TypeC (eSATA). QSFP+ fibre optic transceivers together with MPO to four LC fibre optic cable assemblies can also be used to break out individual SpaceFibre fibre optic links.

Ports 9 and 10 are internal ports, each with eight virtual channels which are connected to a multi-channel host interface. This multiplexes the many individual streams of data over a PCIe Gen3 x8 lane interface which provides the interface to the host PC. Data rates well in excess of 10 Gbit/s to and from the host PC can be achieved on a typical PC.

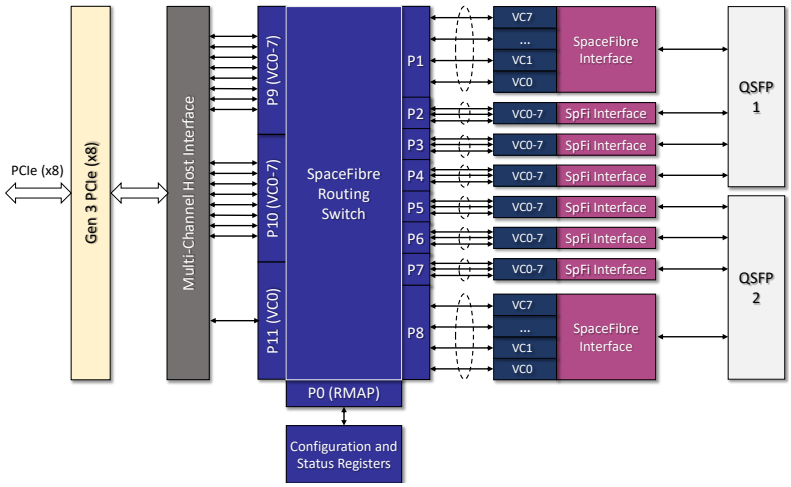
Port 11 is a control channel interface which allows the host PC to configure, control and monitor the SpaceFibre routing switch over the PCIe bus.

The routing switch is a non-blocking routing switch which supports up to 64 virtual networks. Each of the virtual channels on each port can be individually mapped to a virtual network. These mappings form a set of virtual routing switches, which in turn form independent virtual networks. Virtual networks are dynamically configurable using virtual network mapping tables accessed via the routing switch configuration port. The routing switch is fully non-blocking, so data on one virtual network cannot interfere with data travelling on another virtual network. For data travelling on the same virtual network, round-robin arbitration and configurable watchdog timeouts are used.

Key Features

Twelve-port SpaceFibre routing switch: Fully compatible with the SpaceFibre network layer defined in ECSS-E-ST-50-11C. The routing switch has the following features:

- Fully non-blocking switch matrix with deterministic switching latency.
- Up to 64 virtual networks. A virtual network does not share any switching resources with any other virtual network.
- Each virtual channel of each port can be configured to belong to any virtual network.
- RMAP configuration port supporting both host and remote configuration.



Eight SpaceFibre single-lane interfaces: Fully compatible with the SpaceFibre standard (ECSS-E-ST-50-11C). Lane data signalling rates configurable up to 6.25 Gbit/s are supported.

Eight virtual channels per SpaceFibre interface: Each with configurable quality of service (QoS): priority, bandwidth allocation and scheduling.

High-speed interface to host PC: An eight-lane Gen 3 PCIe interface connects the STAR-Ultra PCIe Single-Lane Router to a host PC, allowing SpaceFibre packets to be transmitted and received from software at high-speed.

Multi-channel host interface: The multi-channel host interface provides a local configuration interface and several virtual channel interfaces. The local configuration interface is used to configure, control and monitor the SpaceFibre routing switch and other functions on the board. The virtual channel interfaces effectively provide virtual channels between the host software and the SpaceFibre routing switch. VC0 can be used to access the routing switch configuration port via the routing switch. VC1 to VC7 provide independent virtual channels that can be mapped to virtual networks in the routing switch.

QSFP connectors: Support for both passive copper and active fibreoptic (with fibre optic transceiver) QSFP compatible cables.

Field upgradability: The STAR-Ultra PCIe Single-Lane Router supports field upgradeability of the unit functionality. Any upgrades or requested customisations can be downloaded from the STAR-Dundee website and installed quickly and efficiently.

User-friendly software: Multiple graphical applications for STAR-Ultra PCIe Single-Lane Router control and display purposes are included. Help menus and buttons provide descriptions of application components and SpaceFibre properties to aid software use.

First-class support: As with all STAR-Dundee's products, a year's support and maintenance are included with the STAR-Ultra PCIe Single-Lane Router. This support is provided directly by the team that developed each product so that we can respond quickly with detailed answers to questions, give assistance with application development, and resolve any problems quickly.

Software Applications

In addition to the applications included with STAR-System, three GUI software applications are provided to support the SpaceFibre capabilities of the STAR-Ultra PCIe Single-Lane Router.

STAR-Ultra Controller: View and modify SpaceFibre routing switch settings including routing table entries and virtual network configuration. Access SpaceFibre interface properties including link status and settings, virtual channel QoS, and lane settings and status. The settings of other STAR-Ultra PCIe Single-Lane Router and STAR-Ultra PCIe Interface devices on the same SpaceFibre network can be accessed remotely.

STAR-Ultra Statistics: Displays live virtual channel statistics including transmit and receive data rates. To help visualise the effects of virtual channel QoS and data rate changes, transmit and receive percentage link utilisation are graphed over time.

STAR-System

The STAR-Ultra PCIe Single-Lane Router is supported by our software stack, STAR-System, which provides a consistent programming interface for accessing all STAR-Dundee's most recent, and future, router and interface devices. This includes:

- **Software drivers:** High-performance drivers for the STAR-Ultra PCIe Single-Lane Router are supplied for Windows and Linux. STAR-System is regularly updated to support the latest versions of both operating systems.
- **SpaceFibre Configuration API:** Access and configure the STAR-Ultra PCIe Single-Lane Router settings from custom software. This C API can be used to integrate the STAR-Ultra PCIe Single-Lane Router functionality into bespoke software systems and to write automated tests.
- **C, C++ and Python APIs:** Transmit and receive SpaceFibre packets and broadcasts from custom software. The API is common across many STAR-Dundee products enabling software reuse across different devices. Example code and comprehensive documentation are provided.
- **Software applications:** Example command line applications are provided with source code to demonstrate common tasks, and to test a device's throughput and latency. GUI applications are also provided to support the transmission and reception of SpaceFibre packets.
- **RMAP support:** Build RMAP packets to be transmitted, and interpret RMAP packets received, using the RMAP Packet Library API. Additionally, transmit RMAP commands and receive RMAP replies using the RMAP Initiator GUI application.

Specifications

Part Number	165
Size	• Half-length, low profile, PCIe board with x16 connector. Both low-profile and full-height brackets are provided. • 174 x 68.9 x 32.5 mm
Power	Supplied via PCIe connector
Software	• Application software included • C APIs with examples
Platforms	• Windows (11 and 10) • Linux (6.x, 5.x, 4.x and 3.x kernels)
SpaceFibre Ports	• Compliant with ECSS-E-ST-50-11C • Number of SpaceFibre Ports: 8 • Number of Virtual Channels per port: 8 • Lanes per port: Single-lane ports • Configurable lane data signalling rate: 1, 1.25, 1.5, 1.875, 2, 2.5, 3, 3.125, 3.75, 4, 5, 6 or 6.25 Gbit/s • Connectors: Two QSFP+
PCIe Interface	• Host Interface: PCI Express Gen 3 x8 • Board Format: x16 connector
EMC	The STAR-Ultra PCIe Single-Lane Router card is sold as a component for inclusion in a computer unit. EMC certification is the responsibility of the user.

STAR-Dundee

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