

COBHAM

The most important thing we build is trust



SpaceFibre Port IP Core

TEC-ED & TEC-SW Final Presentation Days

6 – 7. December 2016

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Commercial in Confidence

Cobham Gaisler AB



Official name since 10 December 2014

- Founded in 2001
- Located in Gothenburg, Sweden
- Fully owned subsidiary of Cobham plc
- Management team with 60 years combined experience in the space sector:
 - Sandi Habinc: General Manager
 - Per Danielsson: Senior Advisor
 - Jan Andersson: Director of Engineering
- 24 employees with expertise within microelectronics and software design
- Complete design facilities in-house for ASIC and FPGA development
- 63.8 MSEK or 8.8 M\$ turnover 2015



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- The activity was planned as a 14 months activity with the following milestones:
 - Task 1: Preliminary SpaceFibre delivery (+2 months)
 - Task 2: Final SpaceFibre delivery (+12 months)
 - Due to preliminary internal work, Cobham Gaisler was able to already provide a fully verified prototype implementation as a result of Task 1, which at that time was implemented according to draft version H1 of the specification.
 - During Task 2, the implementation and verification environment was continuously updated to reflect the updates of the specification, with the final delivery being in sync with the latest draft version H7 v3.

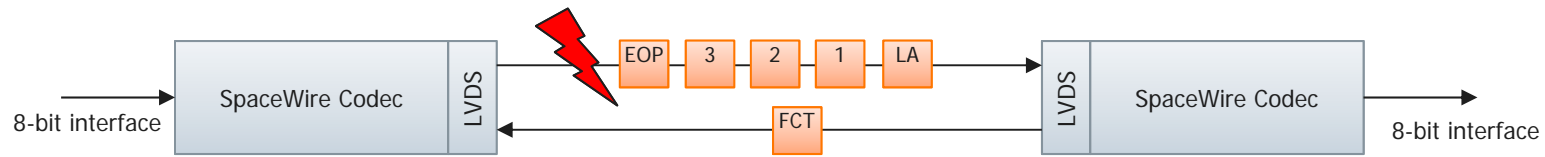
-
- Datasheet and User's Manual (D1 and D2)
 - Verification and Validation Report (D3)
 - Final Report (FR)

 - VHDL Sources & Testbench (MOD1) including:
 - Source files
 - Testbench
 - Macro files for ModelSim/QuartaSim and Riviera-PRO
 - Simulation Log File
 - Code Coverage Reports
 - Synthesis and Place & Route Estimates

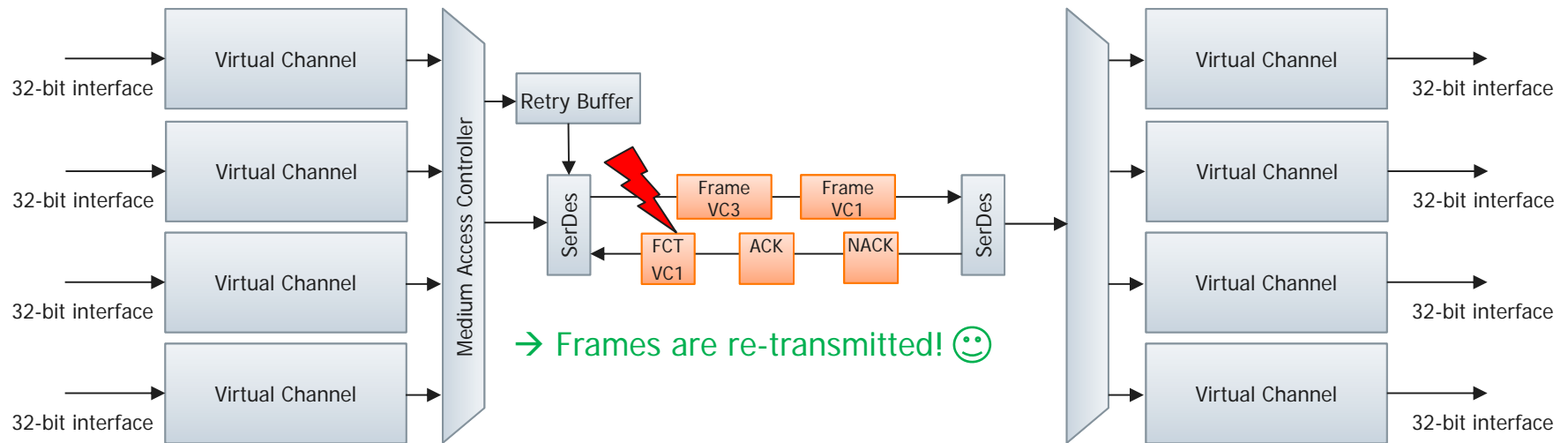
SpaceFibre Port



Introduction: SpaceFibre – A powerful enhancement of SpaceWire



→ Data is interrupted (EEP added)

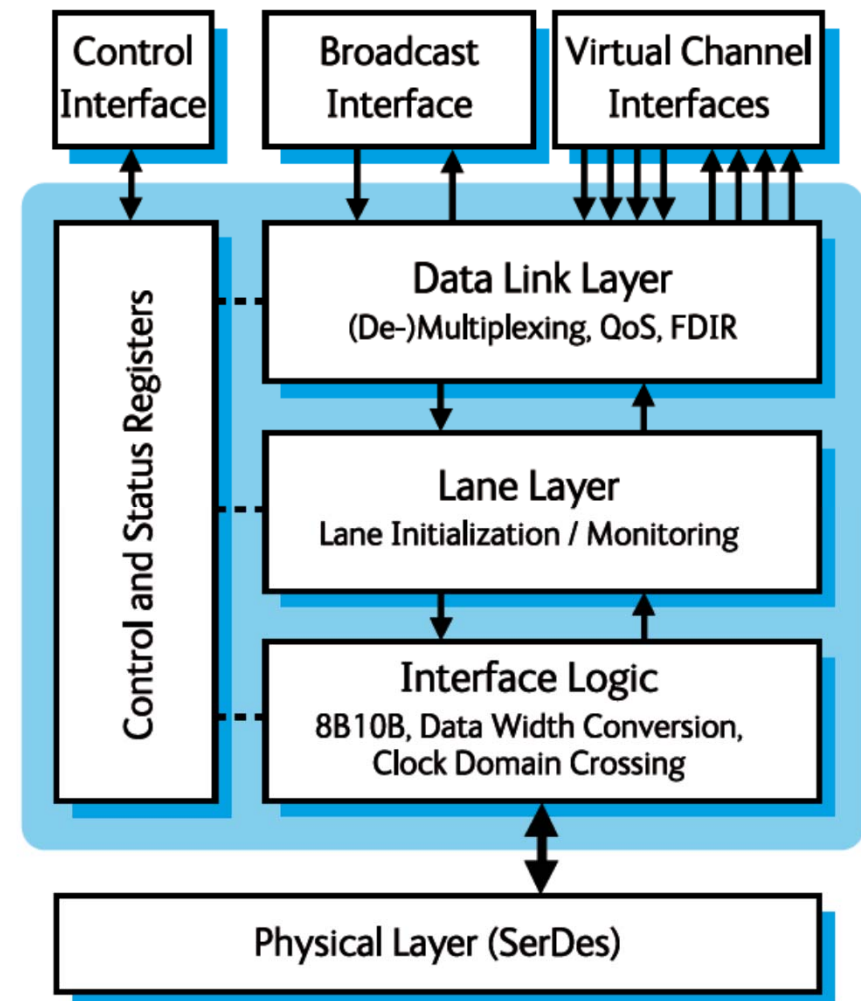


→ Frames are re-transmitted! 😊

SpaceFibre Port

Introduction

- Implemented, verified and validated according to latest specification H7 v3.
- Single-lane implementation optimized for speed.
- Highly configurable, yet easy to use IP core.
- Integration into existing SpaceWire designs, e.g. routing switches, is straight-forward.



Virtual Channels

- The number of virtual channels
- The depth of the receive buffers.
- The depth of the transmit buffers.
- Width of the data bandwidth credit counter.
- Bandwidth idle time limit in clock cycles.

Broadcast Channel

- Width of the broadcast bandwidth credit counter.
- Minimum bandwidth credit threshold limit.

Error Recovery

- Depth of the data error recovery buffer.
- Depth of the FCT error recovery buffer.
- Depth of the broadcast error recovery buffer.

SerDes Interface

- With internal 8B/10B coding: 20-bit or 40-bit interface, without internal 8B/10B coding: 18-bit or 36-bit interface.
- Enable/disable internal 8B/10B coding.
- Use a separate transmission clock: This feature is mandatory if the 18-/20-bit SerDes interface is used and optional in case of the 36-/40-bit interface.

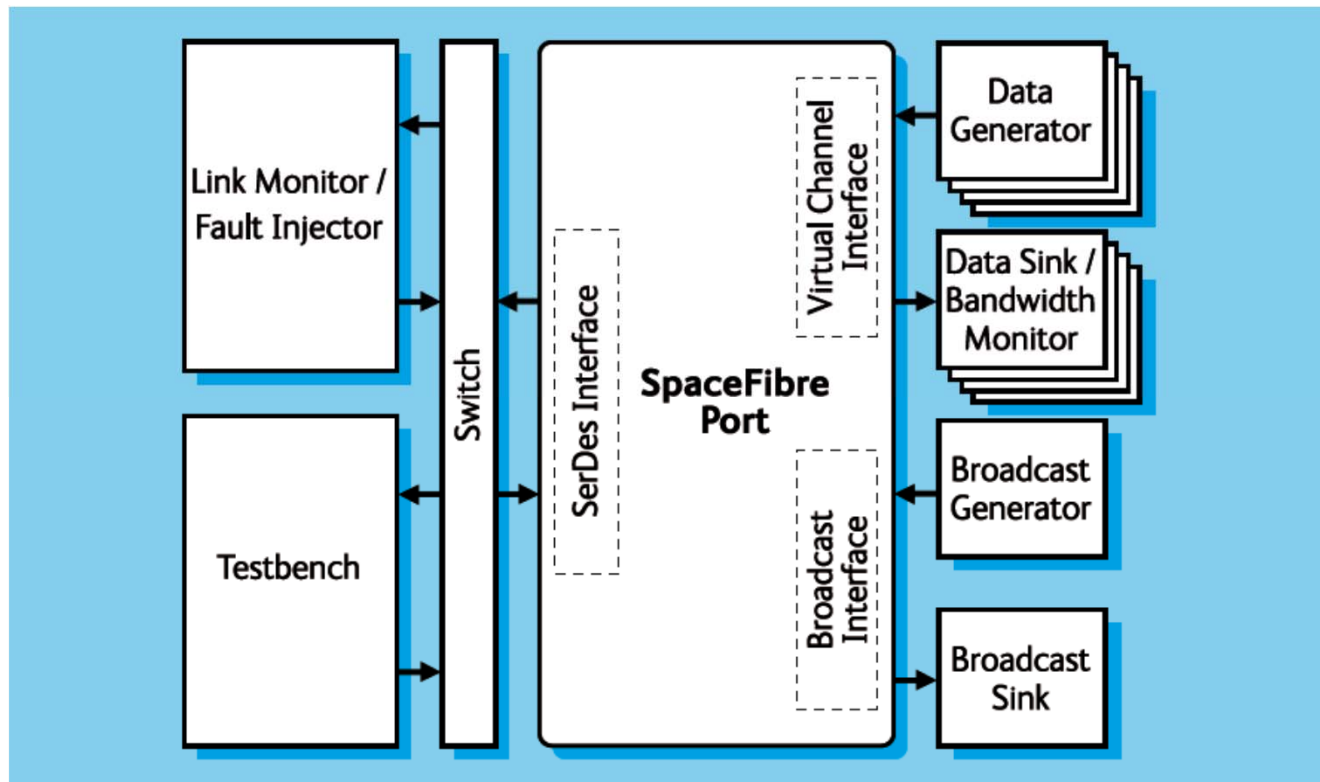
Technology

- Use asynchronous or synchronous reset.
- Generic memory description, which infers correct memories on RTG4 and Virtex-5. Can easily be replaced by technology-dependent memories.

SpaceFibre Port

Verification (1/4)

- Testbench setup comprises a SpaceFibre port with four virtual channels.
- Verified according to guidelines of the European Space Agency (ESA).



- The testbench executes 45 tests, including tests covering all aspects of:
 - the lane layer
 - the virtual channel data communication and flow control
 - the virtual channel QoS mechanisms (bandwidth allocation, priorities, timeslots, babbling idiot protection)
 - the reception and transmission of broadcasts
 - the correct behaviour of the error-recovery mechanisms and
 - the data scrambler and de-scrambler.
- Comes with a convenient macro file to compile and run tests:

```
-----  
| SpaceFibre port IP core testbench                                     (c) Cobham Gaisler  
-----  
| Possible commands:  
|  
| (c) Compile all files          (cc) Code coverage test runs  
| (lt) List all test cases      (cp) Configure SpaceFibre port  
| (ra) Run all tests           (ri) Run individual test  
| (cd) Clean directory         (q) Quit  
-----
```

SpaceFibre Port

Verification (3/4)



- The link analyser output is written to a log file during loopback test runs:

```
3205408000 ps          0000 C5_72_31_DA
3205424000 ps          0000 0E_93_D7_A0
3205440000 ps          ACK   0001 SEQ: 10 | CRC: 21
3205456000 ps          0000 55_A4_AF_DC
3205472000 ps          0000 16_72_F0_E7
3205488000 ps          0000 84_38_D5_68
3205504000 ps          SDF   0001 VC: 01
3205520000 ps          0000 00_00_00_01
3205536000 ps          0000 00_00_00_02
3205552000 ps          0000 00_00_00_03
3205568000 ps          0000 00_00_00_04
3205584000 ps          0000 00_00_00_05
3205600000 ps          0000 00_00_00_06
3205616000 ps          0000 00_00_00_07
3205632000 ps          0000 00_00_00_08
3205648000 ps          0000 00_00_00_09
3205664000 ps          0000 00_00_00_0A
3205680000 ps          0000 00_00_00_0B
3205696000 ps          0000 00_00_00_0C
3205712000 ps          FCT   0001 SEQ: 11 | CRC: 3E | CH: 00
3205728000 ps          0000 00_00_00_0D
3205744000 ps          FCT   0001 SEQ: 12 | CRC: 21 | CH: 01
3205760000 ps          0000 00_00_00_0E
3205776000 ps          FCT   0001 SEQ: 13 | CRC: 07 | CH: 02
3205792000 ps          0000 00_00_00_0F
3205808000 ps          FCT   0001 SEQ: 14 | CRC: 1F | CH: 03
3205824000 ps          0000 00_00_00_10
3205840000 ps          FCT   0001 SEQ: 15 | CRC: 39 | CH: 00
3205856000 ps          0000 00_00_00_11
```

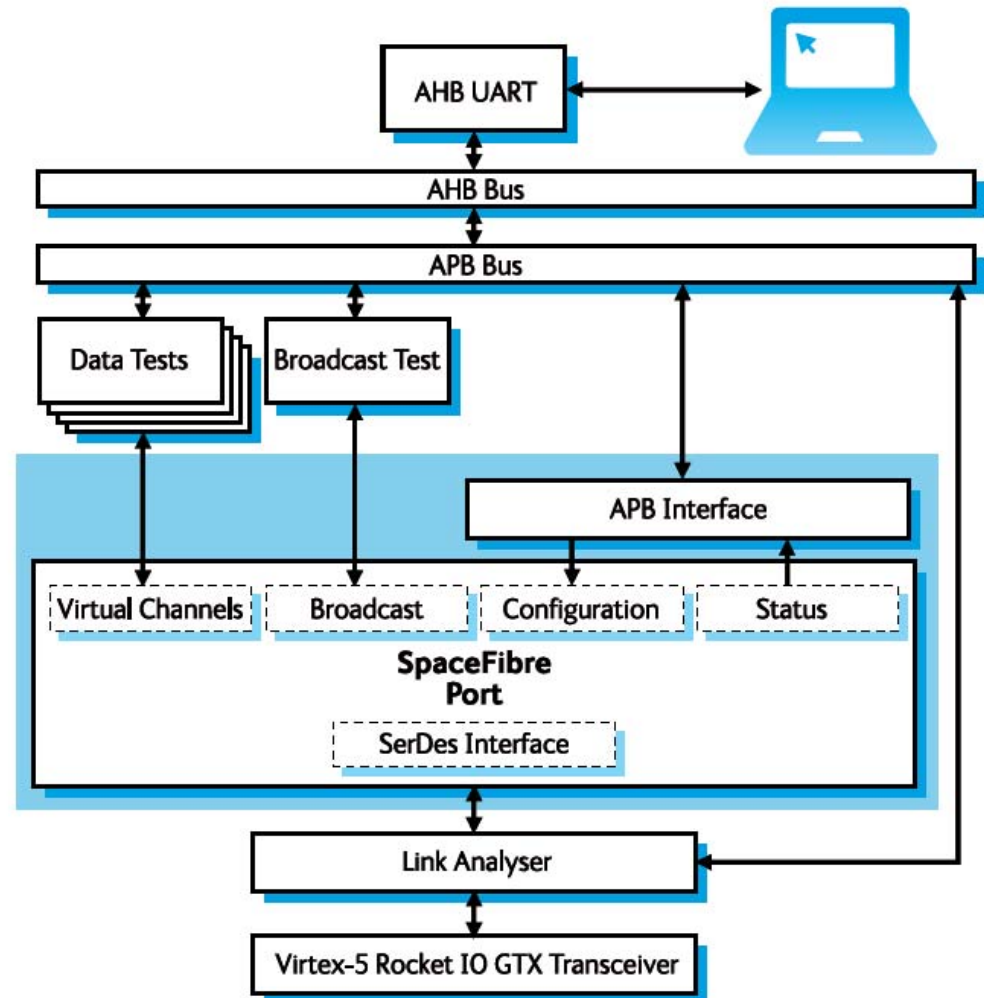
- Full code coverage can be achieved by regression testing using different hard configuration options:

File	Statements	Branches	Condition Terms
async_fifo.vhd	40/40	12/12	2/2
bc_layer.vhd	30/30	20/20	-
fwft_fifo.vhd	25/25	17/17	4/4
fwft_fifo_ack.vhd	27/27	20/20	2/2
if_layer.vhd	166/166	80/80	26/26
lane_layer.vhd	224/224	85/85	40/40
lreset_sm.vhd	24/24	13/13	4/4
retry_buf.vhd	132/132	62/62	8/8
retry_layer.vhd	494/494	308/308	104/104
spfi_pkg.vhd	217/217	4/4	-
spfi_top.vhd	54/54	-	-
sync_dpram.vhd	6/6	9/9	-
vc_layer.vhd	222/222	79/79	28/28

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Validation: Overview

- Validation performed on Xilinx Virtex-5 FX130T and Microsemi RTG4.
- Configuration: 4 Virtual Channels.
- Additional components:
 - 4 Data Generators / Sinks.
 - 1 Broadcast Generator / Sink.
 - Link Analyser.
 - Comfortable control of validation test bench through GRMON / Graphical User Interface.



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Validation: Test Software (1/3)

- Overview of all IP core status flags.
- Control flags:
 - Start / Autostart / Internal Loopback.
 - Scrambler enabled.
- Expected bandwidth of broadcast channel (1% to 95%).
- Expected bandwidth of virtual channels (1% to 95%).
- Priority level of virtual channels (0 to 15).
- Time-Slot vectors of virtual channels (64 bits).
- Triggering of system reset / link reset.
- Connection to GRMON via TCP connection.

The screenshot displays the 'SpaceFibre IP Core Demonstrator' software interface. The interface is organized into several functional areas:

- Port Configuration:** Includes sub-tabs for 'Data and BC Tests' and 'Link Analyser'. It features three toggle buttons: 'Toggle Start', 'Toggle Autostart', and 'Toggle Internal Loopback'.
- Lane Layer:** A status table with columns for 'Yes', 'Lane Autostart', and 'No'. It lists various operational flags such as 'Lane Start', 'Loopback', 'INIT3 Start', 'Loss of Signal', 'RX Polarity', 'Lane Active', 'RX Error Counter', and 'Lane State' (Active).
- Retry Layer:** Includes a 'Toggle Scrambler Enabled' button and a status table for 'Scrambler Enabled', 'CRC16 Error', and 'Retry Count'.
- Broadcast Channel:** Features a dropdown for 'Expected Bandwidth' (set to 10%) and an 'Update Parameters' button.
- Virtual Channels (0-3):** Each channel panel contains a dropdown for 'Expected Bandwidth' (set to 5%), a dropdown for 'Priority' (set to 15), and a text field for 'Timeslot Vector (Hex)'. Below these are 'Update Parameters' buttons and a status table with columns for 'No', 'Destination has credit', and 'Yes', listing metrics like 'RX Buffer Overflow', 'Bandwidth Overuse', and 'Bandwidth Underuse'.
- Bottom Section:** Includes an 'IP Address' field (127.0.0.1), a 'TCP Port' field (1234), 'Connect' and 'Disconnect' buttons, and three buttons for 'Read Status', 'Trigger Warm Reset', and 'Trigger SpFi Reset'.

- Data Tests (4x):

- Up to 4 SpaceWire addresses.
- Packet Length.
- Number of packets.
- Auto-repeat function.
- Indication of:
 - Number of RX/TX packets.
 - Sequence, EOP and EEP errors.
 - Average throughput rate.

- Broadcast Test:

- Number of broadcasts.
- Transmission delay between broadcasts.
- Broadcast channel.
- Auto-repeat function.
- Indication of:
 - Number of RX/TX packets.
 - Number of BCs with Late flag set.
 - Sequence and Payload errors.
 - Average throughput rate.

COBHAM SpaceFibre IP Core Demonstrator

Port Configuration | Data and BC Tests | Link Analyser

Data Test 0

Addr (Hex): 00000000 | Status: Seq. Error: No, EOP Error: No, EEP Error: No, RX Counter: 426, TX Counter: 426, Throughput: 1852.85 Mbit/s (92.6427%)

Addr Mask (Hex): 0 | Repeat, Enable, TX Start, RX Start

Packet Length: 1000

Packets TX: 1000

Packets RX: 1000

Read | Update | Reset Core

Data Test 1

Addr (Hex): 00000000 | Status: Seq. Error: No, EOP Error: No, EEP Error: No, RX Counter: 0, TX Counter: 0, Throughput: 0.00 Mbit/s (0%)

Addr Mask (Hex): 0 | Repeat, Enable, TX Start, RX Start

Packet Length: 0

Packets TX: 0

Packets RX: 0

Read | Update | Reset Core

Data Test 2

Addr (Hex): 00000000 | Status: Seq. Error: No, EOP Error: No, EEP Error: No, RX Counter: 0, TX Counter: 0, Throughput: 0.00 Mbit/s (0%)

Addr Mask (Hex): 0 | Repeat, Enable, TX Start, RX Start

Packet Length: 0

Packets TX: 0

Packets RX: 0

Read | Update | Reset Core

Data Test 3

Addr (Hex): 00000000 | Status: Seq. Error: No, EOP Error: No, EEP Error: No, RX Counter: 0, TX Counter: 0, Throughput: 0.00 Mbit/s (0%)

Addr Mask (Hex): 0 | Repeat, Enable, TX Start, RX Start

Packet Length: 0

Packets TX: 0

Packets RX: 0

Read | Update | Reset Core

Broadcast Test

No. of Broadcasts TX: 0 | Broadcast Channel: 0 | Status: Seq. Err.: No, Payload Err.: No, Throughput: 0%

No. of Broadcasts RX: 0 | Transmission Delay: 0 | Repeat, Enable, TX Start, RX Start

RX Counter: 0, TX Counter: 0, RX Late Counter: 0

Read | Update | Reset Core

SpaceFibre Port



Validation: Test Software (3/3)

- Comfortable analysis of link traffic.
 - Sample position can freely be chosen.
 - Raw data is decoded, e.g. virtual channel numbers and sequence numbers.
 - Simple export of results to text file.
- Triggering on the following events:
 - Data/Broadcast Payload
 - RXERR, SKIP, IDLE, STANDBY, LOS words
 - INIT1, INIT2, INIT3 words
 - ACK, NACK words
 - FULL, RETRY words
 - SDF / EDF words
 - SBF / EBF words
 - FCT words, SIF words

COBHAM SpaceFibre IP Core Demonstrator

Port Configuration | Data and BC Tests | Link Analyser

Trigger Control
 Side: TX | Word: SDF | Trigger on: Nothing | Value (Hex): | Sample Position: 100
 Start | Core Status: IDLE

Sample #	TX Data	TX K-Flags	TX Info	RX Data	RX K-Flags	RX Error	RX Info
98	0000206	0		00002F6	0	[E] 00	
99	c3c7443c	1	<< EDF >> Sequence No.: 68	00002F7	0	[E] 00	
100	00002FC	2	<< SDF >> Virtual Channel No.: 0	00002F8	0	[E] 00	
101	0000207	0		00002F9	0	[E] 00	
102	0000208	0		00002FA	0	[E] 00	
103	0000209	0		00002FB	0	[E] 00	
104	000020a	0		00002FC	0	[E] 00	
105	000020b	0		00002FD	0	[E] 00	
106	000020c	0		00002FE	0	[E] 00	
107	000020d	0		00002FF	0	[E] 00	
108	000020e	0		0000300	0	[E] 00	
109	000020f	0		0000201	0	[E] 00	
110	0000210	0		0000202	0	[E] 00	
111	0000211	0		0000203	0	[E] 00	
112	0000212	0		0000204	0	[E] 00	
113	0000213	0		0000205	0	[E] 00	
114	0000214	0		0000206	0	[E] 00	
115	0000215	0		c3c7443c	2	[E] 00	<< EDF >> Sequence No.: 68 << SDF >> Virtual Channel No.: 0
116	0000216	0		00002FC	2	[E] 00	
117	0000217	0		0000207	0	[E] 00	
118	0000218	0		0000208	0	[E] 00	
119	5545887c	1	<< FCT >> Channel No.: 0, Sequence No.: 69	0000209	0	[E] 00	

Write selected rows to text file

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Validation: Test Hardware



Interoperability test between Gaisler's SpaceFibre IP (on Virtex-5) and STAR-Dundee's STAR-Fire unit



Loopback tests on Microsemi's new RTG4 device

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Validation: Test Results - Loopback

- SpaceFibre core is operated in external loopback mode (near-end PMA loopback of SerDes activated).

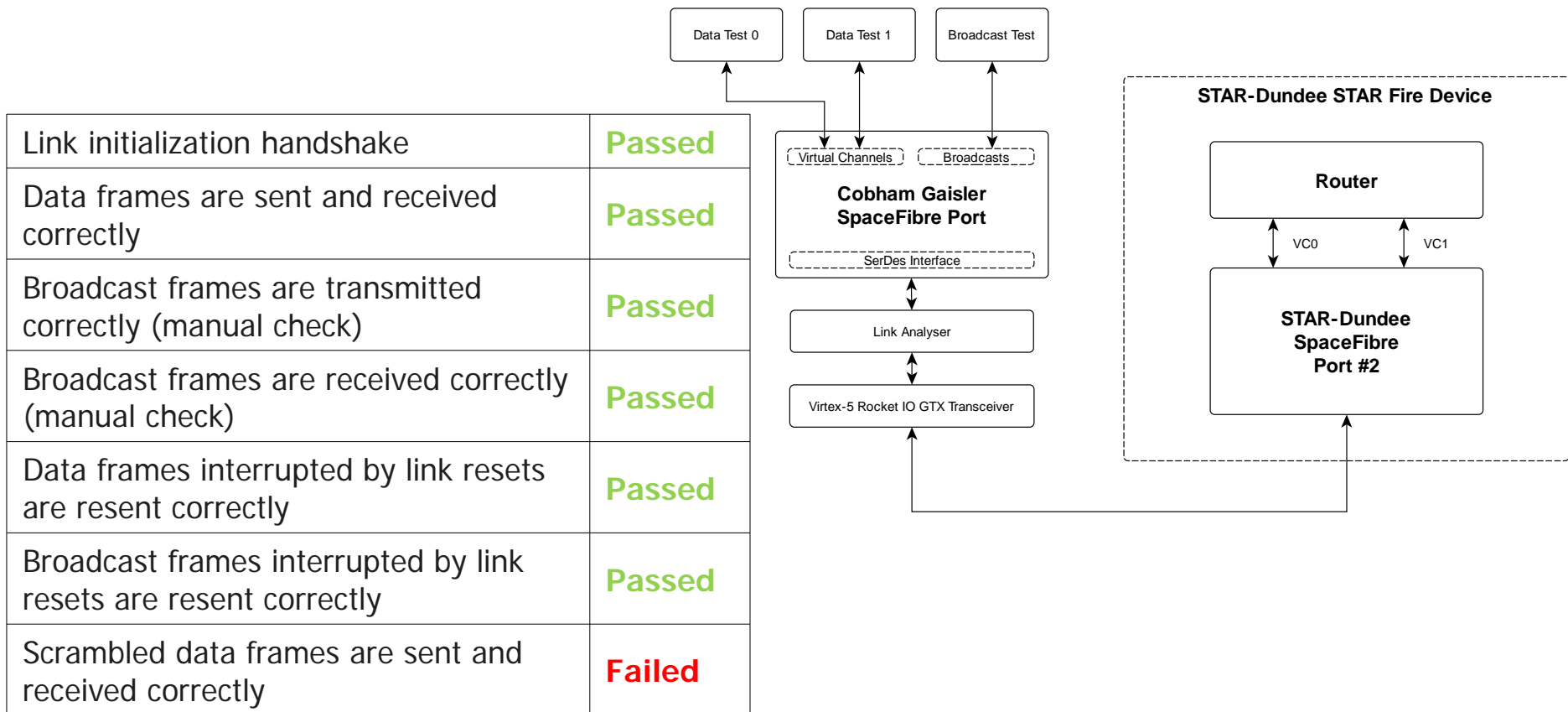
1	Link initialization handshake test (link start and auto start mode)	Passed
2	Transmission and reception of data frames	Passed
3	Data frames interrupted by link resets are resent correctly	Passed
4	Transmission and reception of broadcast frames	Passed
5	Broadcast frames interrupted by link resets are resent correctly	Passed
6	Scrambled data frames transmitted/received correctly	Passed
7	Broadcast transmission do not exceed maximum allowed bandwidth value	Passed
8	Priority mechanism for virtual channels works as expected	Passed
9	Timeslot mechanism for virtual channels works as expected	Passed
10	Bandwidth limitation of virtual channels works as expected	Passed
11	Internal loopback mode works as expected	Passed

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Validation: Test Results - Device Interoperability

- SpaceFibre core is connected to STAR Fire unit via Serial ATA cables. Data is sent/transmitted on virtual channels 0 and 1 and looped back through routing switch in STAR Fire unit.



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Synthesis Estimates



Technology	Configuration	Area	Expected data rate
C65SPACE	Full config with 8 VCs	25,971 NAND gate equivalents	> 6.25 Gbps
Virtex-4QV SX55	No 8b10b with 4 VCs	3% FFs, 9% LUTs, 3% RAMs	> 3.125 Gbps
Virtex-5Q FX130T	No 8b10b with 4 VCs	2% FFs, 4% LUTs, 3% RAMs	6.25 Gbps
RTG4	Full config with 4 VCs	2% FFs, 4% LUTs, 4% RAMs	2.5 – 3.125 Gbps
RTAX2000s	Full config with 2 VCs	27% C-Cells, 19% S-Cells, 37% RAMs	2.0 – 2.5 Gbps

Thank you for
your attention

SpaceFibre Port



Video Demonstration: Virtual Channel – Bandwidth Allocation

The screenshot displays the 'SpaceFibre IP Core Demonstrator' software interface, version Draft H7 v3 (October 2016). The interface is divided into several sections for configuring and monitoring the system.

Port Configuration: Includes tabs for 'Data and BC Tests' and 'Link Analyser'. The 'Lane Layer' section has 'Toggle Start', 'Toggle Autostart', and 'Toggle Internal Loopback' buttons. Status indicators show Lane Start (No), Lane Autostart (No), Loopback (No), Far-end link reset (No), RX Error Counter (161), Counter Overflow (Yes), Far-end LOS (No), Far-end Standby (No), RX Polarity (No), Lane Timeout (No), and Lane State (Disabled).

Virtual Channel Configuration: Four virtual channels (0-3) are shown, each with a dropdown for 'Expected Bandwidth' (set to 5%), a dropdown for 'Priority' (set to 15), and a text field for 'Timeslot Vector (Hex)' (set to ffffffff). Each channel has an 'Update Parameters' button. Status indicators for each channel show RX Buffer Overflow (No), Destination has credit (No), Bandwidth Overuse (No), and Bandwidth Underuse (Yes).

Retry Layer: Includes a 'Toggle Scrambler Enabled' button. Status indicators show Scrambler Enabled (No), Retry Buffer Empty (Yes), CRC16 Error (No), CRC8 Error (No), Sequence Error (No), Frame Error (No), and Retry Count (0).

Broadcast Channel: Includes a dropdown for 'Expected Bandwidth' (set to 10%) and an 'Update Parameters' button.

Control Panel: At the bottom, there are fields for 'IP Address' (127.0.0.1) and 'TCP Port' (1234), along with 'Connect' and 'Disconnect' buttons. Below these are four buttons: 'Read Status', 'Trigger Lane Reset', 'Trigger Link Reset', and 'Trigger System Reset'.

SpaceFibre Port



Video Demonstration: Virtual Channel – Different Priorities

SpaceFibre IP Core Demonstrator
Draft H7 v3 (October 2016)

Port Configuration | Data and BC Tests | Link Analyser

Lane Layer

Toggle Start | Toggle Autostart | Toggle Internal Loopback

Status

Lane Start:	No	Lane Autostart:	No
Loopback:	No	Far-end link reset:	No
RX Error Counter:	0	Counter Overflow:	No
Far-end LOS:	No	Far-end Standby:	No
RX Polarity:	No	Lane Timeout:	No
Lane State:	Disabled		

Virtual Channel 0

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Virtual Channel 1

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Virtual Channel 2

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Virtual Channel 3

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Retry Layer

Toggle Scrambler Enabled

Status

Scrambler Enabled:	No	Retry Buffer Empty:	Yes
CRC16 Error:	No	CRC8 Error:	No
Sequence Error:	No	Frame Error:	No
Retry Count:	0		

Broadcast Channel

Expected Bandwidth: 10%
Update Parameters

IP Address: 127.0.0.1 | TCP Port: 1234 | Connect | Disconnect

Read Status | Trigger Lane Reset | Trigger Link Reset | Trigger System Reset

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Video Demonstration: Virtual Channel – Timeslots

The image displays the 'SpaceFibre IP Core Demonstrator' software interface, version Draft H7 v3 (October 2016). The interface is overlaid on a video background that shows a satellite launch and a close-up of a hardware board with fiber optic connections.

SpaceFibre IP Core Demonstrator
Draft H7 v3 (October 2016)

Port Configuration | Data and BC Tests | Link Analyser

Lane Layer

Toggle Start | Toggle Autostart | Toggle Internal Loopback

Status

Lane Start:	No	Lane Autostart:	No
Loopback:	No	Far-end link reset:	No
RX Error Counter:	0	Counter Overflow:	No
Far-end LOS:	No	Far-end Standby:	No
RX Polarity:	No	Lane Timeout:	No
Lane State:	Disabled		

Retry Layer

Toggle Scrambler Enabled

Status

Scrambler Enabled:	No	Retry Buffer Empty:	Yes
CRC16 Error:	No	CRC8 Error:	No
Sequence Error:	No	Frame Error:	No
Retry Count:	0		

Broadcast Channel

Expected Bandwidth: 10%

Update Parameters

Virtual Channel 0

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Virtual Channel 1

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Virtual Channel 2

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

Virtual Channel 3

Expected Bandwidth: 5%
Priority: 15
Timeslot Vector (Hex): ffffffff
Update Parameters

Status

RX Buffer Overflow:	No	Destination has credit:	No
Bandwidth Overuse:	No	Bandwidth Underuse:	Yes

IP Address: 127.0.0.1 | TCP Port: 1234 | Connect | Disconnect

Read Status | Trigger Lane Reset | Trigger Link Reset | Trigger System Reset

SpaceFibre Port



Video Demonstration: Virtual Channel – Broadcasts

The screenshot displays the 'SpaceFibre IP Core Demonstrator' software interface, version Draft H7 v3 (October 2016). The interface is divided into several sections:

- Port Configuration:** Includes tabs for 'Data and BC Tests' and 'Link Analyser'. It features 'Toggle Start', 'Toggle Autostart', and 'Toggle Internal Loopback' buttons. The status section shows: Lane Start: No, Lane Autostart: No, Loopback: No, Far-end link reset: No, RX Error Counter: 0, Counter Overflow: No, Far-end LOS: No, Far-end Standby: No, RX Polarity: No, Lane Timeout: No, Lane State: Disabled.
- Retry Layer:** Includes a 'Toggle Scrambler Enabled' button. The status section shows: Scrambler Enabled: No, Retry Buffer Empty: Yes, CRC16 Error: No, CRC8 Error: No, Sequence Error: No, Frame Error: No, Retry Count: 0.
- Broadcast Channel:** Includes an 'Expected Bandwidth' dropdown set to 10% and an 'Update Parameters' button.
- Virtual Channel 0, 1, 2, and 3:** Each channel has an 'Expected Bandwidth' dropdown (5%), a 'Priority' dropdown (15), and a 'Timeslot Vector (Hex)' field (ffffffff). Each channel includes an 'Update Parameters' button and a status section: RX Buffer Overflow: No, Destination has credit: No, Bandwidth Overuse: No, Bandwidth Underuse: Yes.
- Bottom Controls:** Includes an 'IP Address' field (127.0.0.1), a 'TCP Port' field (1234), and buttons for 'Connect', 'Disconnect', 'Read Status', 'Trigger Lane Reset', 'Trigger Link Reset', and 'Trigger System Reset'.

The background of the interface shows a video of a satellite launch, with a 'vokoscreen webcam' label in the top right corner. The COBHAM logo is visible in the top left of the software window.

SpaceFibre Port



Video Demonstration: Virtual Channel – Link errors

The screenshot displays the 'SpaceFibre IP Core Demonstrator' software interface, version Draft H7 v3 (October 2016). The interface is divided into several sections for configuration and monitoring:

- Port Configuration:** Includes tabs for 'Data and BC Tests' and 'Link Analyser'. It features 'Toggle Start', 'Toggle Autostart', and 'Toggle Internal Loopback' buttons.
- Virtual Channel 0-3:** Each channel has a configuration panel with 'Expected Bandwidth' (set to 5%), 'Priority' (set to 15), and 'Timeslot Vector (Hex)' (set to ffffffff). Each panel includes an 'Update Parameters' button and a 'Status' section with indicators for 'RX Buffer Overflow', 'Destination has credit', and 'Bandwidth Underuse'.
- Retry Layer:** Features a 'Toggle Scrambler Enabled' button and a status section with indicators for 'Scrambler Enabled', 'Retry Buffer Empty', 'CRC16 Error', 'CRC8 Error', 'Sequence Error', and 'Frame Error'.
- Broadcast Channel:** Includes an 'Expected Bandwidth' dropdown (set to 10%) and an 'Update Parameters' button.
- Control Panel:** At the bottom, it shows 'IP Address: 127.0.0.1' and 'TCP Port: 1234', along with 'Connect' and 'Disconnect' buttons. Below these are buttons for 'Read Status', 'Trigger Lane Reset', 'Trigger Link Reset', and 'Trigger System Reset'.

The background of the software window shows a 3D rendering of a space station in orbit. A small 'vokoscreen webcam' window in the top right corner shows a physical circuit board with several cables connected to it.