

SpaceFibre - Introduction

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TEC-EDP
ESTEC

Overview

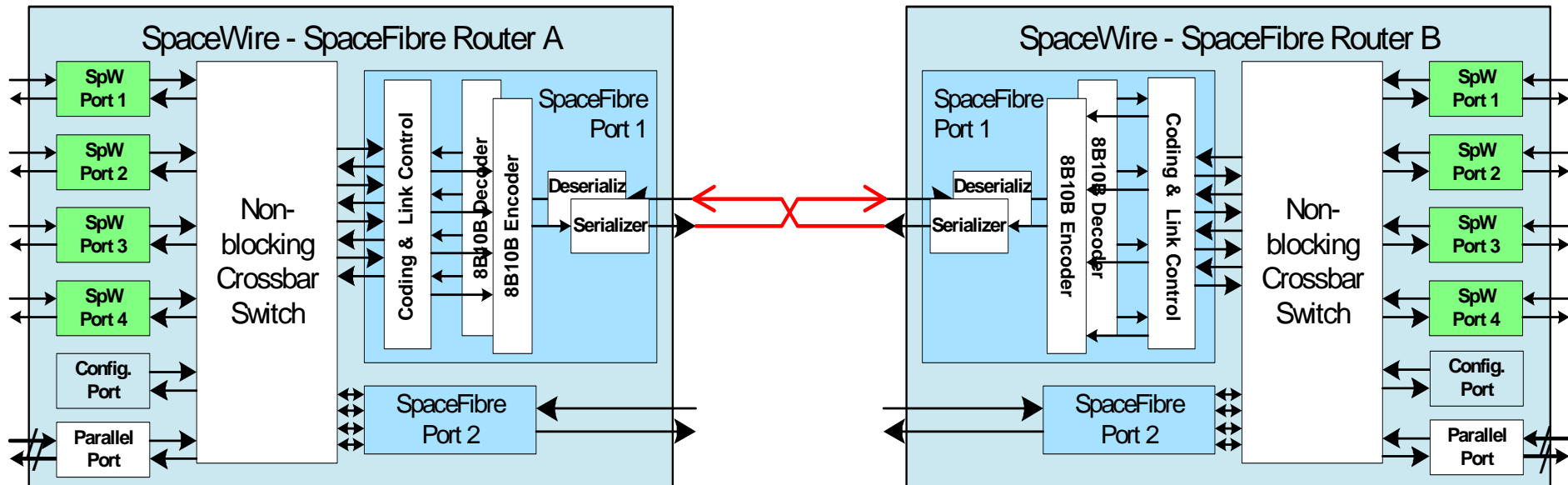
- SpaceFibre requirements
- Demonstrator developments
- ESA roadmap for SpaceFibre developments
- Next Steps to be done in SpaceWire WG

SpaceFibre Requirements

- Provide symmetrical, bi-directional, point to point link connection
- Handle data rates 1-10Gb/s and support variable signalling rates
- Bridge distances up to 100m at maximum data rate
- Be based on fibre optic link technology which provides galvanic isolation
- Copper version with AC coupling for shorter distances
- Allow for mixed SpaceWire – SpaceFibre networks via special SpaceWire-SpaceFibre Routers
- Transmit a scalable number of virtual SpaceWire links over one SpaceFibre
- Compliant to the protocols and routing mechanisms defined in the SpaceWire standard
- Similar bit error rates as specified for SpaceWire
- Fast start up and fine grained power management
- Intrinsic support to quality of service

Mixed SpaceWire – SpaceFibre Router & Networks

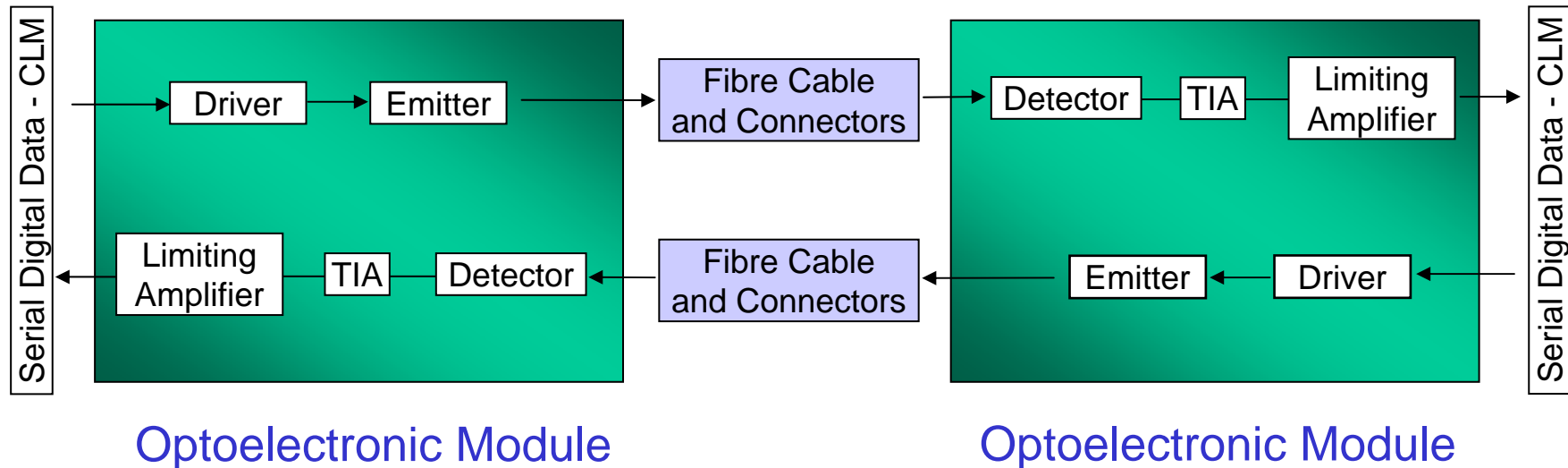
- Transfer speed in network is determined by slowest link on the path
- SpaceFibre must not be slowed down by SpaceWire Link in network
- Concept: Several virtual SpaceWire Links over one SpaceFibre
 - Multiplexing of data streams is required
 - This can be performed on character or frame level
 - Frame level multiplexing is preferred for a higher level of flexibility



SpaceFibre Prototyping Activities

- Prototyping has been performed by two teams
- Covering complementary areas:
 - SpaceFibre physical layer optical
 - SpaceFibre Codec
- Two parallel development contracts
 - “Optical Links for the Space Wire Intra Satellite Network Standard”
Objective: The development of a high speed point to point fibre optic link for space applications.
Contractors: **Patria (Prime), VTT, INO, Fibre Pulse, W.L. Gore**
 - “Space Fibre” The TOPNET Call Off No. 2
Objective: Codec development and SpaceFibre integration into the Space Wire network through the development of a high speed router.
Contractor: **University of Dundee**

SpaceFibre Optical Link Overview



- Development, bread boarding of electro-optical technology as physical layer for SpaceFibre
- Includes first environmental testing
- NEXT STEP: Development of Engineering Model (EM) of a high speed fibre-optic transceiver to be used for pre-qualification

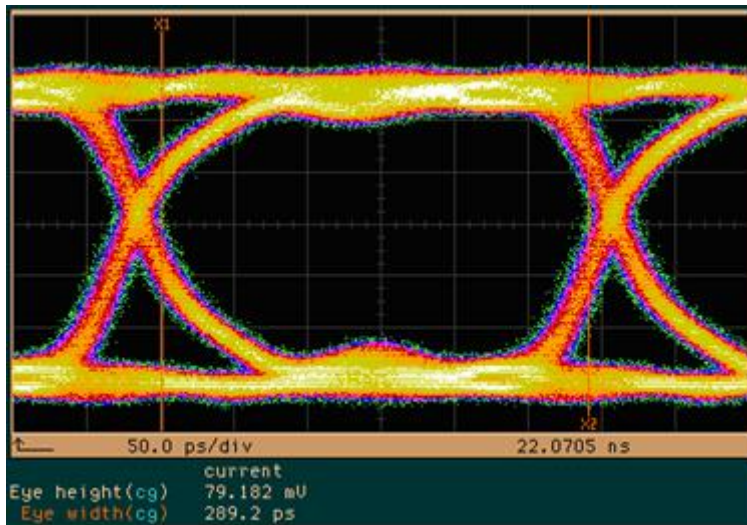
SpaceFibre Optical Transceiver Module

Mechanical properties:

- Dimensions of 8 · 22 · 25 mm³ (thickness · length · width).
- Mass without pigtailed: 5 g

Electrical properties:

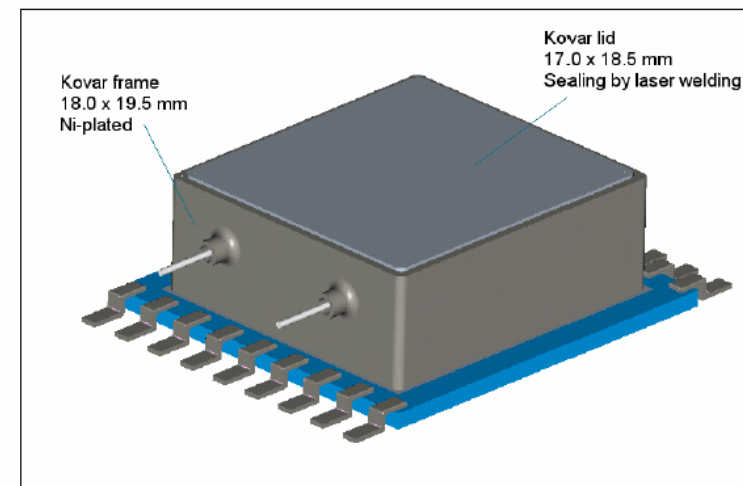
- Power dissipation < 500mW
- Excellent electrical performance
- BER < 1.3 · 10⁻¹⁴ @ 2.5 Gbps



Eye diagram of the 3.125 Gbps PRBS at the receiver output

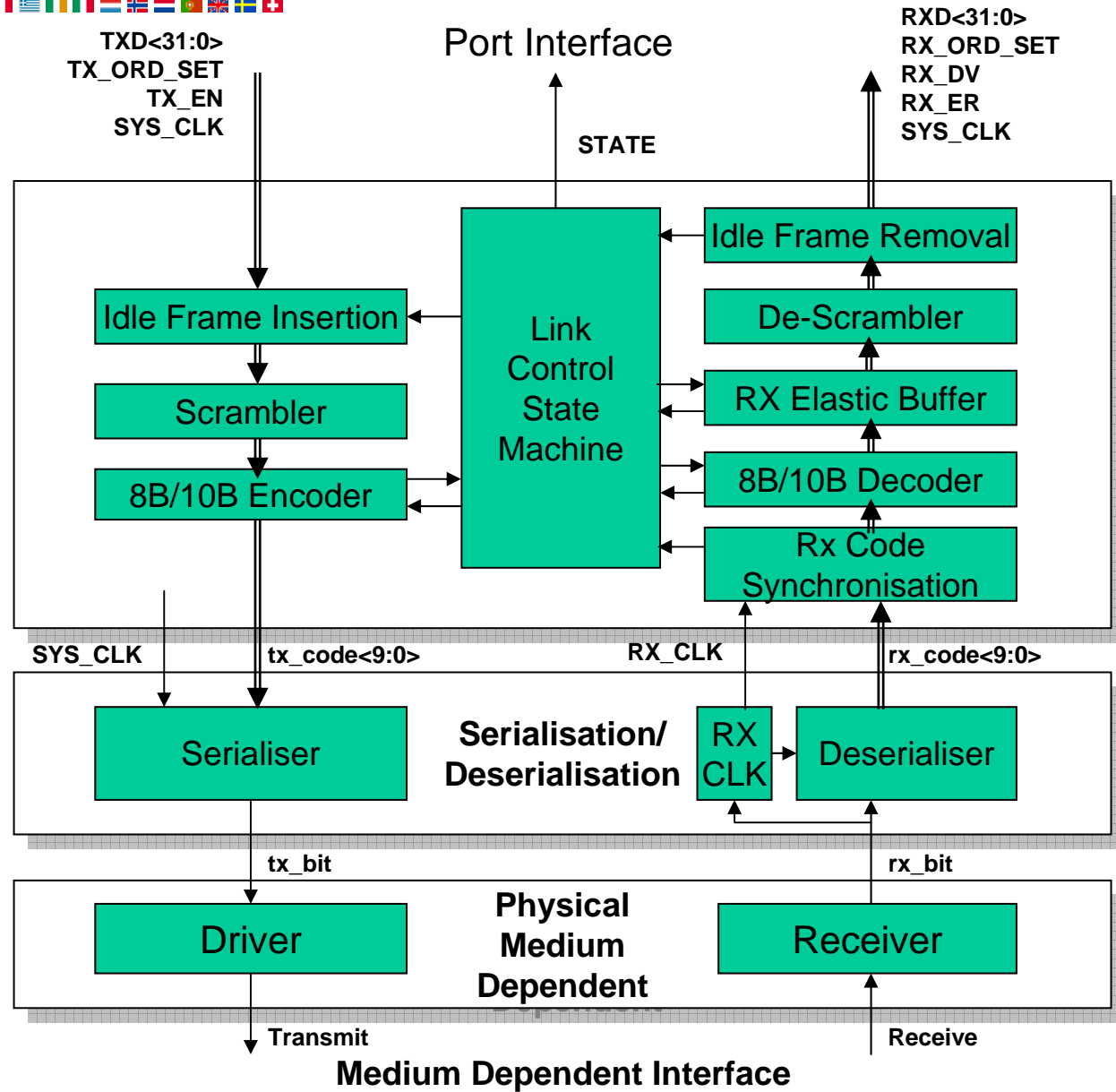


SpaceFibre transceiver module with Diamond AVIM connectors



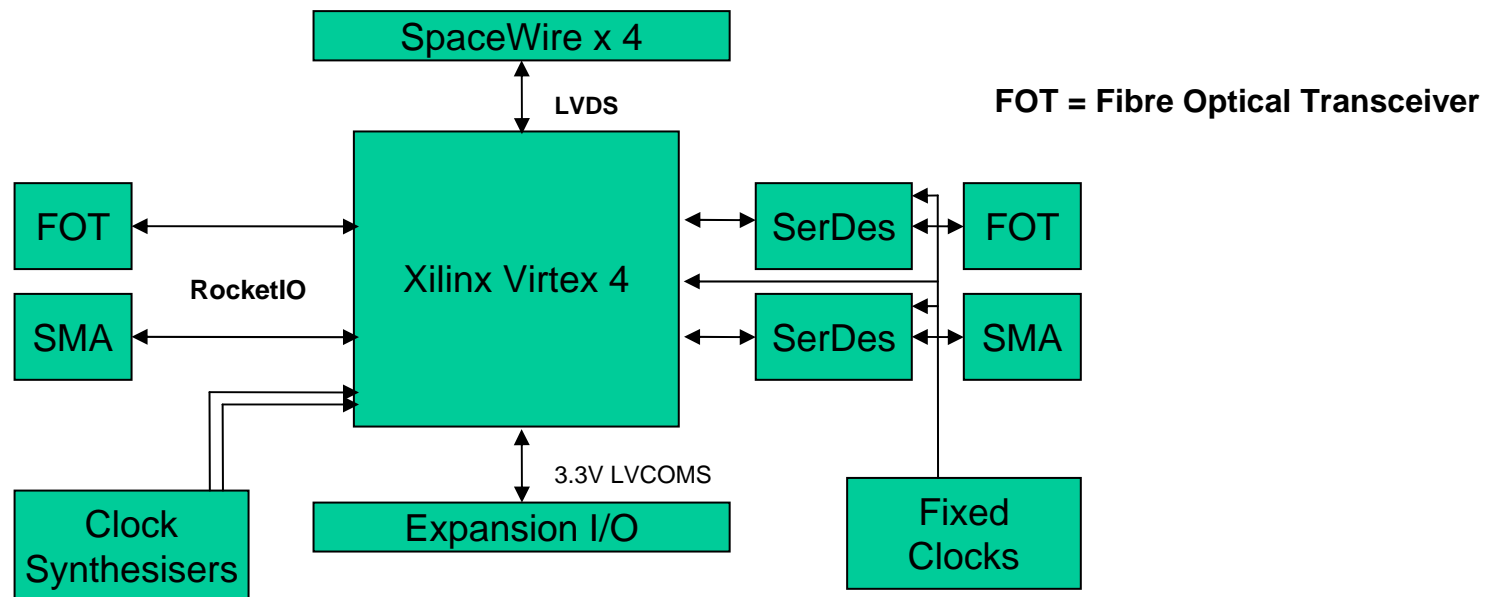


SpaceFibre CODEC Block Diagram



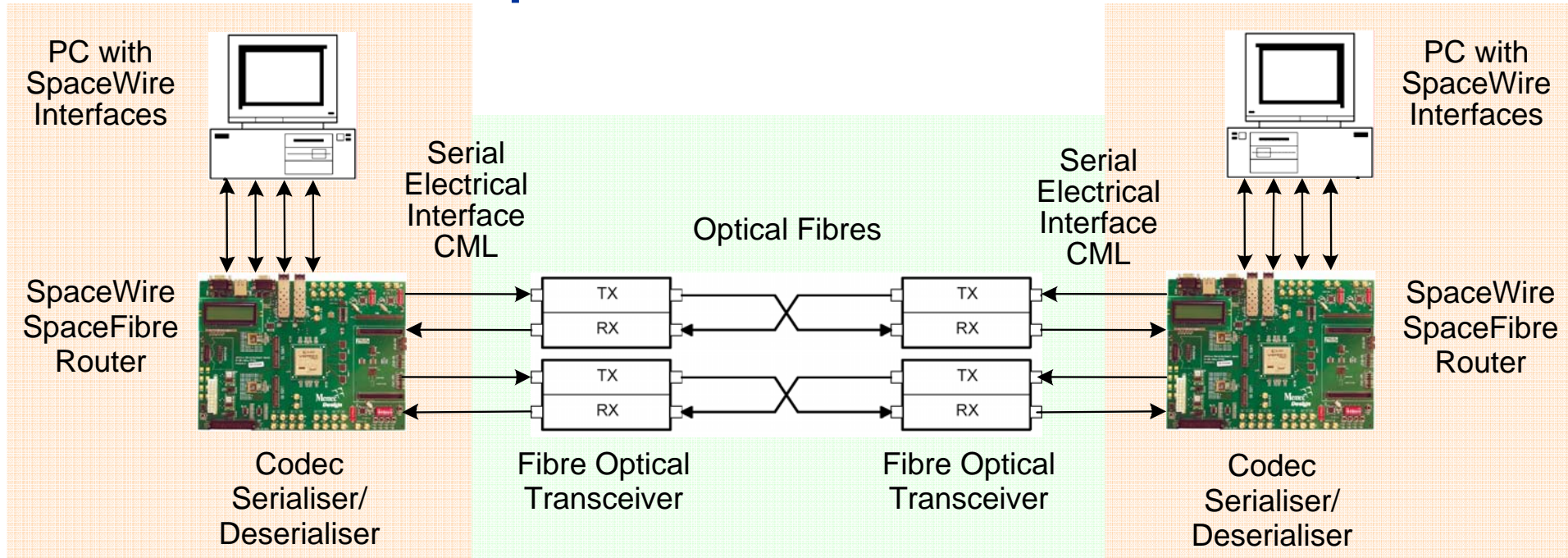
SpaceWire-SpaceFibre Router Implementation

- Specific board based on Xilinx Virtex 4 has been designed
- Makes use of Rocket-IO interface and dedicated SerDes chips
- Supports SpaceFibre Optical Link interface and SpaceFibre copper version via SMA connector
- Copper version will only bridge a limited distance due to cable losses



Block Diagram of SpaceWire-SpaceFibre Router with optical and electrical interfaces

SpaceFibre Demonstrator



- Integration of both developments into one demonstrator
- University of Dundee:
 - SpaceWire-SpaceFibre Routers
 - CODEC
 - Serialiser / Deserialiser
 - Copper Version
- Patria et.al.:
 - Fibre Optical Transceiver
 - Optical Fibres
 - Optical Cable Assembly
 - Fibre Connectors
 - Environmental test program

ESA Roadmap for SpaceFibre Development

| Task Name | 2007 | | | | 2008 | | | | 2009 | | | | 2010 | | | | Q1 |
|---|--|----|----|----|-------|----|----|----|-------|----|----|----|-------|----|----|----|----|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | |
| SpaceFibre | [Timeline bar from Q1 2007 to Q1 2010] | | | | | | | | | | | | | | | | |
| SpaceFibre Fibre-optic Data Link | [Bar] | | | | | | | | | | | | | | | | |
| SpaceFibre Very High Speed Link Technology Demonstrator | [Bar] | | | | | | | | | | | | | | | | |
| European SerDes IP-core and Component | | | | | [Bar] | | | | | | | | | | | | |
| SpaceFibre Codec IP-core and Network Terminal Bhip | | | | | [Bar] | | | | | | | | | | | | |
| SpaceWire - SpaceFibre Network Bridge | | | | | | | | | [Bar] | | | | | | | | |
| SpaceFibre Router | | | | | | | | | | | | | [Bar] | | | | |

– SpaceFibre Roadmap

As proposed and harmonised with the OPDP Dossier

- **SpaceFibre Fibre-optic Data Link**
 - *Engineering Model of Electro-optical converter*
- **SpaceFibre Very High Speed Link Technology Demonstrator**
 - *Early feasibility demonstration of possible flight implementation based on existing qualified components*
- **European SerDes IP-core and Component**
 - *Key component with improved performance compared existing devices*
- **SpaceFibre Codec IP-core and Network Terminal Chip**
- **SpaceWire - SpaceFibre Network Bridge**
- **SpaceFibre Router**
 - *Basic component required to implement SpaceWire – SpaceFibre network*

Next Steps for SpaceWire WG

- Review within SpW WG proposals for:
 - CODEC design
 - Physical layer – optical
- Establish baseline for physical layer – electrical
- Perform breadboarding activities for proposal consolidation
- Drafting of standard documents

- Coordination meeting and discussion this Friday PM in room Bc047