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
    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 $8 \cdot 22 \cdot 25 \text{ mm}^3$ (thickness \cdot length \cdot width).
- Mass without pigtails: 5 g

Electrical properties:
- Power dissipation < 500mW
- Excellent electrical performance
- BER < $1.3 \cdot 10^{-14}$ @ 2.5 Gbps

Eye diagram of the 3.125 Gbps PRBS at the receiver output
SpaceFibre
CODEC
Block
Diagram

Martin Suess

SpaceWire WG Meeting #8
17 to 19.01.2007, ESTEC
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

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**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