MAX Launch Abort System (MLAS) SpaceFibre Demonstration

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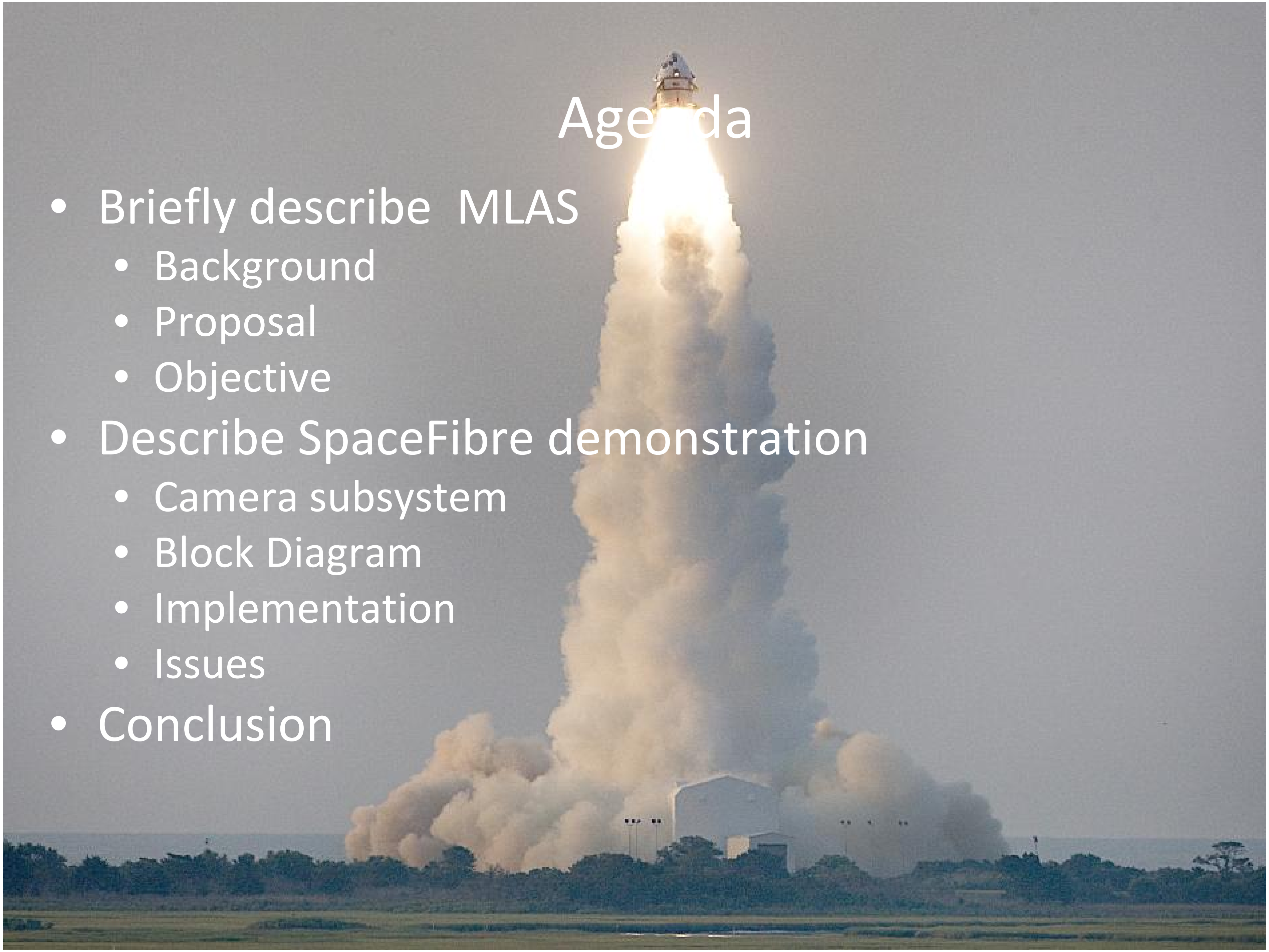


Agenda

- Briefly describe MLAS
  - Background
  - Proposal
  - Objective
- Describe SpaceFibre demonstration
  - Camera subsystem
  - Block Diagram
  - Implementation
  - Issues
- Conclusion

MLAS Background

What

- An alternative Launch Abort System (LAS) for the Orion vehicle
  - Orion will be the new NASA crewed vehicle for transportation to ISS and the moon

Why

- Demonstrate an alternate escape system to explore different technological approaches to accomplish the same task

Named after

- Maxime (Max) Faget, a Mercury-era pioneer, who was the designer of the Project Mercury Capsule and holder of the patent for the "Aerial Capsule Emergency Separation Device," which is commonly known as the escape tower.

SpaceFibre MLAS Proposal

Purpose

- To make available SpaceFibre documentation so that the wider SpaceWire community can participate in the discussion

Result

- Release of SpaceFibre Outline Specification by ESA

Findings

- Specification is good starting point
- Codec definition is a good draft but requires more thought and definition
- Network level needs definition
  - Cliff Kimmery (Honeywell) has contributed significantly in understanding issues and potential solutions

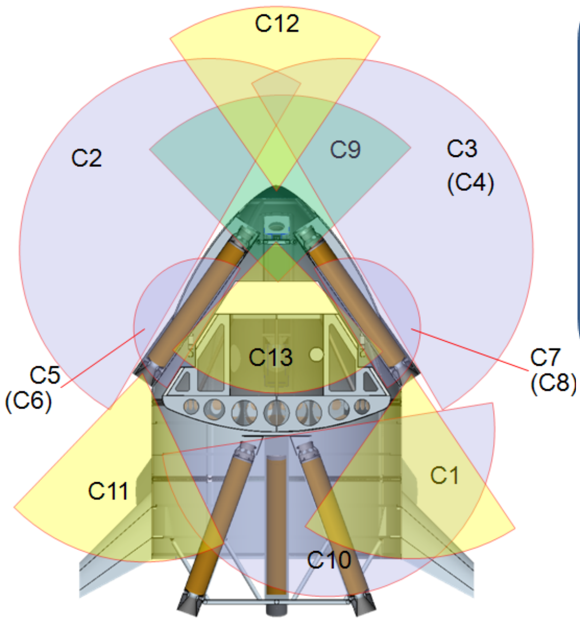
SpaceFibre Demonstration Objective

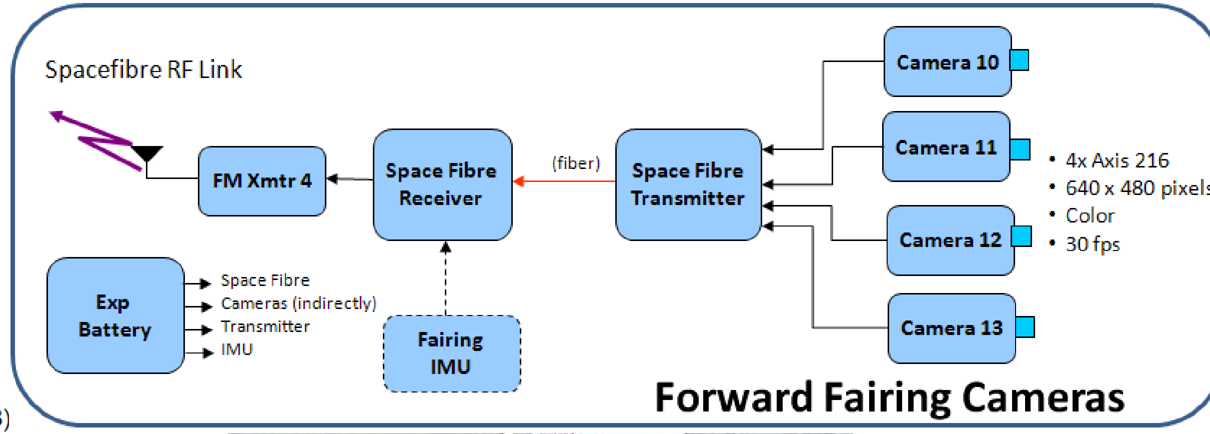
The objectives of the SpaceFibre Technology Demonstration Assessment were to:

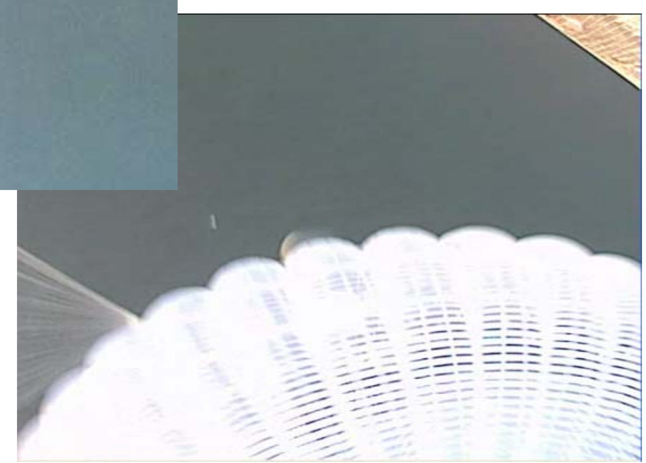
- Demonstrate beta version of SpaceFibre to provide a standardized simple solution for avionics that requires one or more of the following:
  - Galvanic Isolation
  - Gigabit Data Rates (~2.5 Gigabit)
  - High Quality of Service (QoS)
  - Lower mass
  - Bridges to Space Wire
  - Long cable distances (100m)
- Identify advantages, risks and potential mitigation of non-wire harness design
- Demonstrate de-centralized instrumentation approach for launch vehicles
- Low cost non-critical video solution for launch and space system design

SpaceFibre Camera Subsystem

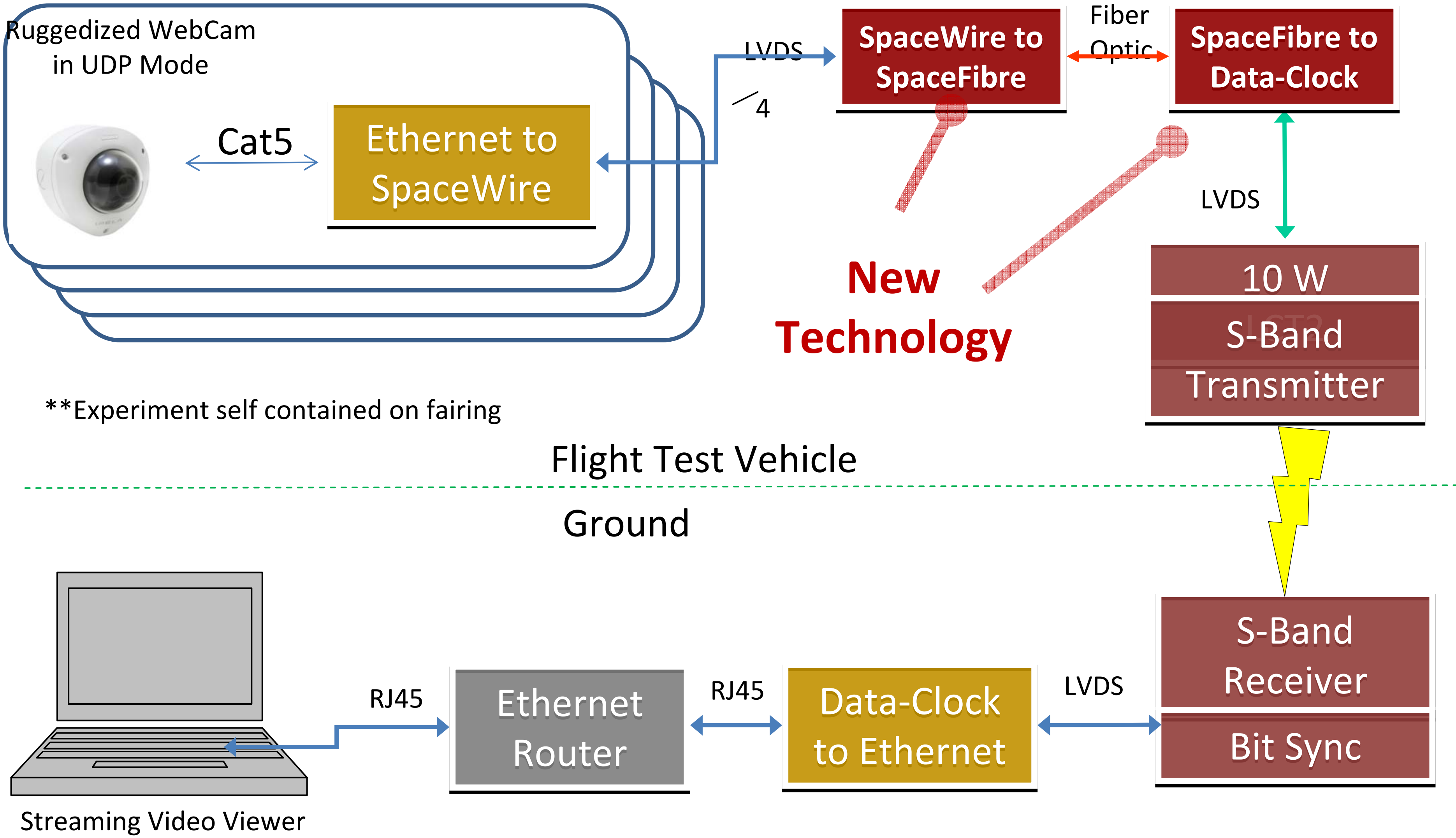
- Yellow cones are SpaceFibre camera views (C1, C11, C12, C13)







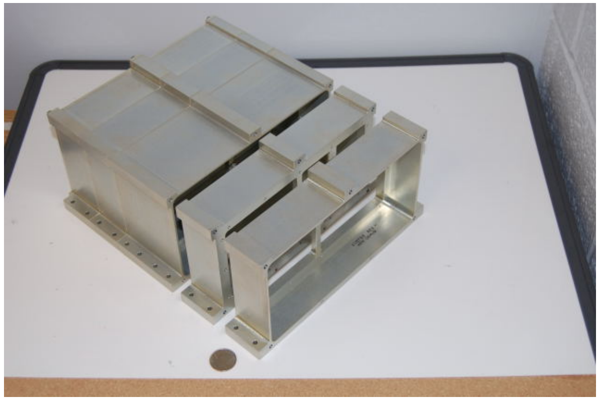
SpaceFibre Demonstration Block Diagram



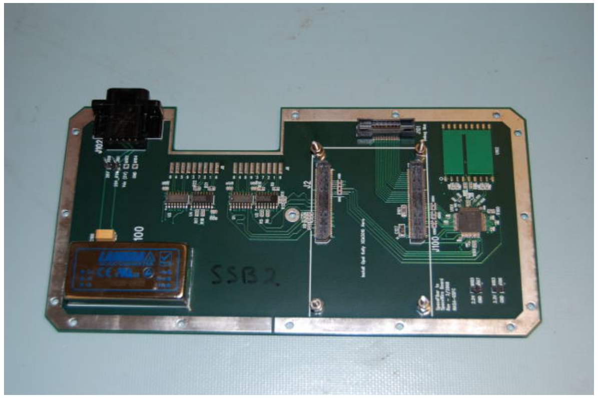
MLAS SpaceFibre Implementation

- Implemented basic elements of SpaceFibre Outline Specification (OS)
  - User interface
  - EMC mitigation (scrambling)
  - Framing
  - Link initialization & ~~power management~~
  - Data rate adjustment (elastic buffer)
  - 8b/10b encoding decoding
    - only 1 implemented – not 4 in parallel per SpF OS
  - Parallel loopback
  - Symbol & ordered set synchronization
- Commercial FPGA board used – Opal Kelly board XEM3010 with Spartan FPGA mated to custom PWB (2 types)
- Commercial SERDES part used - Texas Instrument TLK1211
- Used 100 Ohm cable instead of fiber optic transceiver (ESA MOU agreement not executed in time)

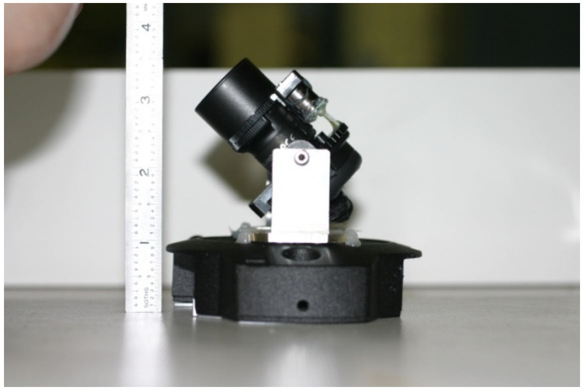
SpaceFibre Hardware



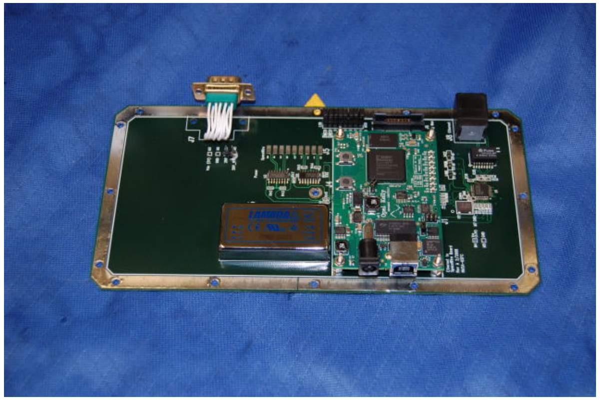
Hub Enclosure
(6 board slices)



SpaceWire SpaceFibre Board
(without FPGA board installed)



Camera



Ethernet SpaceWire Board
(with FPGA board installed)

Draft Specification Issues

Specification Issues

- Network layer not specified (See Cliff Kimmey's presentation titled "SpaceWire Virtual Channels and Flow Control" , 2nd International SpaceWire Conference 2008 for details)

Examples of some Codec Issues (not exhaustive)

- Need to further define State Machine to handle power saving mode
- Speed changes needs definition
- Power management ordered sets not coded
- CRC not defined
- Flow control needs more definition
- QoS in header – how is this used?
- Priority of ordered sets
- Complete 8b/10b coding not included
- 4 8b/10b encoders in pararellel – how is parity dispersion handled between 4?
- Loopback control details
- More details on SpaceFibre Yahoo group site

Conclusion

- SpaceFibre Outline Specification release has been important for receiving critique that can make the specification better
- Cliff Kimmery's presentation @ 2nd SpW Conference (Japan) should be the basis focusing the SpaceFibre effort
- MLAS effort demonstrated
  - the ability to quickly and cheaply develop the basic SpaceFibre Codec technology
  - that the SpaceFibre Codec implementation is a reasonable size for radiation tolerant FPGAs
- Availability of radiation tolerant physical layer components still a concern
  - SERDES and fiber optic transceivers