Experience from using SpaceWire in a spacecraft telemetry system

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TM system overview





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Connections in reality



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Connecting the TM system to a SpaceWire network



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TM system with SpaceWire





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Link congestion problem



- SpaceWire link also used for control purposes
- The blue packet in the Rx FIFO could be a control packet!



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Possible solutions

- A Let the TM system regularly broadcast its FIFO status to the SpaceWire network
- B Let the TM system regularly transmit its FIFO status to selected nodes
- C Have the transmitting nodes interrogate the FIFO status
- D Let the transmitting nodes keep track of the allocated bandwidth
- E At a link stall, abort and resend the current packet on the link

- Requires a SpaceWire broadcast mechanism for data
- Requires implementation of a nonstandard protocol in hardware
- Requires implementation of a nonstandard protocol in hardware
- Requires complete concept change on system level
- Cannot guarantee that already received packets are not lost

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Details on link reset



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Method selected

- Mixture of SpaceWire link and dedicated links
- Dedicated links maintained for non-intelligent sources (mass memory, essential TM)



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Transmission of large data structures

- Mixing several sources on the same link
 - Need for guaranteed bandwidth and latency for a specific application
 - Create Virtual Channels over a SpaceWire link

• Splitting large structures

- How to select optimum SpaceWire packet size?
- Do we need to ensure sequential delivery?
- Need for hardware support to split?

• Signaling end of structure

- How to signal the end of the large data structure?
- Simple method needed for non-intelligent devices



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Selected structure splitting method



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Selected structure splitting method





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Control commands over a SpaceWire link

• Simple method selected:

- View the device as a read/write memory

Write command:



Read command:



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Problems experienced

- Lack of high-level handshaking method
 - How to ensure that a packet to be sent will be received
 - Needed in order not to block a link
- Lack of standardised method to transmit large data structures
 - Mixing several data sources on the same link
 - Splitting larger structures into smaller SpaceWire packets
 - Signaling end of data structure
- Other mechanism than link reset to resolve congestion problems
- Lack of standardised redundancy concept
 - Link cross-strapping
 - Switching between redundant links



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Problems with lack of standardised cross-strapping method



- In Rosetta both methods B and C were required!
- Internal unit cross-strapping drastically reduces unit modularity!

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Prototype TM/TC board



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