



***Recommended SpaceWire Standard***  
***Quality of Service Improvement***  
***(while maintaining backward compatibility)***

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# Presentation Outline



- A SpaceWire major concern – poor Quality of Service (QoS)
- Comment on SpaceWire QoS
- Current SpaceWire working group solutions for QoS - SpaceWire-D and SpaceFiber
- Recommendation to fix SpaceWire QoS for heritage SpaceWire designs
- Summary

# One Major SpaceWire Concern



- SpaceWire's lack of QoS due to no packet length limitation and an inherent wormhole packet switching scheme that has caused difficulty in the design and analysis of SpaceWire networks
  - Implementations with small receive buffers make it difficult to meet network performance requirements and being able to perform reliable network analysis because packets are often “strung” across multiple switches (circuit switching)
  - Implementations with no transmit side data buffers increase difficulty in meeting network performance
- Results in loss packets, and/or network lock-up
- Implementations often have unique recovery mechanisms in the form of time-outs, credit and packet length checks, etc., that are used to recover from network problems. However these do not fully prevent problems

# Comment on SpaceWire QoS



- Switch blockage is the reason that SpaceWire network determinism cannot be achieved within an upper and lower bound
- When no switch blockage occurs in SpaceWire networks, an upper and lower bound for receive packet “jitter” can be calculated
- Question: How to best fix SpaceWire switch blockage in the most cost effective manner without:
  - affecting heritage SpaceWire implementations and
  - complicating how SpaceWire networks are constructed

# Current SpaceWire Working Group Solutions for QoS (1 of 2)



- SpaceWire-D and SpaceFiber are two new standards that the SpaceWire working group is developing to solve the QoS problems of SpaceWire
- However, both of these standards are substantially different from SpaceWire and have no backward compatibility with heritage SpaceWire designs
- A fix that is backwards compatible with heritage SpaceWire designs is needed to prevent costly changes to existing SpaceWire infrastructure investments

# Current SpaceWire Working Group Solutions for QoS (2 of 2)



- Additionally, SpaceWire-D requires costly back-end software tool chains to develop SpaceWire network schedules and it has a single point failure in the master timecode necessary to schedule the network
- SpaceFiber is a more complex design (requiring higher FPGA utilization) that has little to no re-use from existing SpaceWire designs
- SpaceFiber also uses an 8b/10b encoding scheme running for twice the number of signals than required for an 8b/10b code (i.e., uses clock and data, instead of the clock already embedded with the 8b/10b code)

# Recommendation to fix SpaceWire QoS for heritage SpaceWire designs



- Implement the “virtual network” solution to network blockage proposed by 4-Links’ Paul Walker
- Solution uses SpaceWire time-code mechanism to interleave data bytes (n-char) of packets over the SpaceWire link
- Requires no changes to existing SpaceWire node designs
- Simple design modification to SpaceWire switch designs (usually implemented in FPGA)
- Proven solution but needs to be standardized

# Summary



- One major concern with SpaceWire is the QoS
- The proposed fix for this problem needs to be implemented in a way that SpaceWire heritage implementations can still be used in order to maintain the investment in SpaceWire infrastructures
- The “virtual networks” solution for QoS is the proposed solution for preserving heritage SpaceWire implementations