



telecommunications & internet

A Highly Reliable, Streamlined Method for High- and Low-Rate Avionics Communication

...using the SpaceWire link-and-switch implementation



Benefits

- **Expanded:** Extends the existing SpaceWire standard capabilities with additional features that improve spacecraft system performance and reliability while reducing complexity
- **Simple:** Enables high- and low-rate communication between avionics systems using a simple first in/first out (FIFO) interface
- **Reliable:** Provides a well-verified and -maintained design using both simulation and testing, including compatibility testing
- **Flexible:** Can be configured according to number of serial ports, local ports, FIFO sizes, etc.
- **Mature:** Incorporates well-verified features from many different NASA system engineering project teams

NASA Goddard Space Flight Center has developed a unique SpaceWire link-and-switch implementation. This new design provides for a standard that enables high- and low-rate communication between avionics over a network architecture. This significant advancement helps reduce the complexity of communication over satellite architecture applications and other space-flight systems while improving speed and reliability.

Applications

The SpaceWire link-and-switch implementation may be applicable to any aerospace or military hardware microelectronics:

- Spacecraft systems
- Military hardware systems
- Bus systems
- Other microelectronics for space-flight applications

Technology Details

How it works

The SpaceWire specification is a set of serial links that describe a network fabric used to move information defined in packets. Specific to Goddard's SpaceWire design, the link and switch is a unique implementation that enables avionics computers to seamlessly communicate at varying data rates (2 Mbps to more than 200 Mbps), minimizing interconnects. The communication allows resources to be distributed and provides for redundancy across space flight applications.

Goddard's implementation provides several features that add to the reliability and usability of the SpaceWire standard for space-flight applications. Redundant physical interfaces (cables) simplify operation because the user does not need to interact with the design. Additional time-code enhancements allow multiple time-code masters to operate on the network simultaneously, sending low-latency broadcast pulses over a SpaceWire network to signal an event, interrupt an event, or distribute time information. A new zero-jitter time code reduces uncertainty as to when the time-code signal arrives at all destinations. Finally, the link and switch offers design verification using direct and random testing. This means that all parameters of the design are randomized and tested in a continual loop (indefinitely, if needed) to find errors or difficult-to-anticipate situations.

Why it is better

The SpaceWire standard itself offers advantages over other communication protocols for space-flight applications. The IEEE 1355 specification, a leading alternative, offers functionality similar to SpaceWire but suffers from ambiguities that may make two different implementations of the specification not compatible. In contrast, Goddard's link and switch leaves no ambiguities in its interpretation and is compatible with other SpaceWire implementations. In addition, the use of up to four time-code masters enables more out-of-band signaling between nodes in the network, enhancing flexibility in the system design. Goddard's redundant physical interfaces also reduce complexity by eliminating the need for the user to be involved in finding the most reliable data connection. Finally, Goddard's combination of random and direct testing also helps improve data-transmission accuracy and reliability, making the design the most robust SpaceWire implementation available to date.

For More Information

If you are interested in more information about this technology (GSC-14734-1), please contact:

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More information about working with NASA Goddard's Office of Technology Transfer is available online:

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