

Unique Benefits of the 4Links EtherSpaceLink family of SpaceWire test equipment



Overview of unique benefits for users and projects

Bug detection and resolution

- 4Links equipment has detected bugs, in many SpaceWire designs, that have remained undetected in months of simulation and test.
- 4Links equipment has often quickly enabled users to solve longstanding problems that other test and/or simulation techniques have failed to solve.

Uniqueness of claim

Unique to 4Links

Unique to 4Links

Quality

- No bug has been found in 4Links' implementation of SpaceWire since 2003. No other SpaceWire implementation has comparable maturity.
- 4Links equipment works out of the box. Customers do not have to debug it.
- Internal voltages and temperatures are monitored continuously and may be logged to detect drift and hence suggest preventive maintenance ahead of failure.
- 4Links ensure that the test equipment can not damage flight equipment, e. g. with separate LVDS buffers for each port and current and voltage limits for each buffer.

Unique to 4Links

Should not be unique.
May be it is.

Unique to 4Links

Unique to 4Links

Usability and cost effectiveness

- 4Links equipment has a clear and bright front-panel display that gives information about the state of the equipment, the interface to Ethernet and of each port, including speed and traffic in each direction. Many users have commented how comprehensive and useful this information can be.
- The same hardware can be customized, via a memory card plugged in to the front panel to perform a wide variety of functions that are useful at different stages of a project. Such jobs include simulation, test, debug, monitoring, control, validation and performance characterization of devices, boards, subsystems and systems.
- Interfacing to Ethernet and IP, 4Links equipment can be used with almost any computer running any operating system. It has been used successfully with different versions of Windows, different builds of Linux including real-time, and Solaris. Untried operating systems have been up and running within hours of the equipment arriving.

Unique to 4Links

Unique to 4Links

No comparable Ethernet/IP interfaced SpW test equipment

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Overview of unique benefits for users and projects (Continued)

- ❖ Because 4Links interface via the Internet, users can be physically remote from the equipment under test (EUT). Testing can from an office in the same building as the EUT, from another building, another company, or another country or continent.
- ❖ 4Links provide software that can easily be parameterized to perform different tests. These are provided as Java files which will run on almost any computer, or as executables and C source. An API is also provided in C source for users to write their own test programs, often based on the example test program that is supplied.

As above

None as portable or as usable as 4Links

Performance

- ❖ The SpaceWire transmit speed can be set in small increments up to 498Mbits/s, and the receive speed is good on most of our products to well above 450Mbits/s.
- ❖ With the SpaceWire Packet Generator (SPG) versions of the products, test bandwidth and latency are no longer limited by the PC and its operating system. Test bandwidth from a single unit total several Gbits/s for a single unit and tens of Gbits/s with multiple units. Latency for responses and acknowledgements can be well under 1 microsecond.

One faster design is known, not available as test equipment

Unique to 4Links

Functionality

- ❖ A simple bridge (ESL-RG201) is available from the computer/Ethernet to a single port, to up to eight SpaceWire ports on a single box up to any number of SpaceWire ports on multiple boxes.
- ❖ All the bridges are able to record traffic and to replay all or a selected part of the recorded traffic.
- ❖ The simple bridges can be augmented by optional SpaceWire functionality such as Time Codes, and/or by a wide range of instrumentation and diagnostics.
- ❖ A highly flexible SpaceWire routing switch can emulate multiple switches with one unit or a single switch with more than eight ports, and can gather traffic statistics for each port.

No other supplier can drive so many ports so easily

As above

The instrumentation and diagnostics are unique to 4Links


No SpaceWire routing switch is more flexible


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Overview of unique benefits for users and projects (Continued)


Diagnostics


-  Waveforms can be captured of the wire signals on the occurrence of a wide variety of events, particularly violations of the SpaceWire standard. These are displayed as waveforms with full decode of bits, SpaceWire tokens, and characters, for a period before and after the event. A displayed time tag reports the time at which the event occurred. Waveform files can be saved for subsequent, off-line, analysis.

One imitator, but offers fewer events, provides no time tag, less information, and is less easy to read
-  Error Injection makes it possible to test for the correct response to error conditions. 4Links error injection is precise.

Uniquely complete and precise
-  4Links equipment in its normal running creates conditions which are fully permitted in the SpaceWire standard and that will inevitably occur at some point in a space mission, even if they occur rarely. Other designers may not realize that these conditions can occur or may treat them as corner cases that will be sufficiently rare that they can be ignored. 4Links maintain interoperability with such designs, but can zero in on such corner cases remarkably quickly.

4Links continue to detect bugs in designs that are claimed to have been rigorously proven.
-  SpaceWire routing switches include arbiters between their asynchronous input ports. Functionally testing of such arbiters requires packets to arrive at multiple ports at the same time. That is only possible with Output Synchronization from the 4Links Diagnostic SpaceWire Interface or SpaceWire Packet Generator.

Unique to 4Links
-  A simple diagnostic aid is to record traffic to and from one or more ports. 4Links provides selective replay of such records, for reproducing error conditions, for regression testing, or for later analysis when a problem comes to light that may have been missed earlier, but for which the records make information available.

Believed to be unique
-  Pre-tested subsystems sometimes do not work together, and the problem may not be found until late in integration. The Multi-link SpaceWire Analyzer monitors traffic over four links at exceptionally low cost per link. The traffic statistics and time-tagged error waveforms have proved to be excellent at resolving the demarcation issues when two or more such devices are brought together.


Other monitors exist. None resolves longstanding problems as quickly as 4Links

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Overview of unique benefits for users and projects (Continued)


Instrumentation of Time

 Time tags are important to the space industry. 4Links has long offered time tagging in our test equipment and has progressively improved the resolution from 100ns down to 1.4ns, with typically sub-nanosecond skew between ports on one unit, and very low skew between units.


Unique to 4Links

 Many SpaceWire test setups are small, and a single test unit with up to eight ports is adequate. But missions are envisaged with many tens or even hundreds of SpaceWire ports. Multiple 8-port units that can be used together as if they were a single unit with many ports is clearly good modular practice. 4Links not only supplies such capability but enables time tags of any number of units to be synchronized, to a tolerance of ± 3 ns, over a distance of 50 metres.

Unique to 4Links


 4Links enable measurement of the SpaceWire disconnection timeout. This has detected failure to meet even the wide tolerance permitted by the ECSS standard.


Unique to 4Links


 Test equipment needs to report not only IF something works but also how well it works. A key parameter of any SpaceWire design is how fast it can receive data, but test equipment from other suppliers has large gaps between the available transmit speeds and so offers little more than a go/no-go test of the SpaceWire receiver. 4Links enable the user to adjust the test speed in increments of 1Mbit/s, so that the actual operational margins can be measured.

Believed to be unique to 4Links


Customer and User Experience


 'The most mature, most appropriate solution'

 'You have established 4Links as THE supplier of quality SpaceWire test equipment'


 'The beautiful 4Links box'

 'The choice was obvious'

 'We've had all sort of problems with our new equipment, but none at all with the 4Links test equipment'

 'We've had all sorts of problems with the free-issue test equipment we were given, no problem at all with the 4Links. We want to buy more'

 'This is just what SpaceWire needs, and no one else is anywhere close'

 'We love these guys'

All comments were volunteered;

All suggest delight in using 4Links products.

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