SPACEWIRE LINK ANALYSER MK2: A NEW ANALYSIS DEVICE FOR SPACEWIRE SYSTEMS

Session: SpaceWire Test and Verification

Short Paper

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ABSTRACT

The process of testing, validation and verification of a SpaceWire network [1] benefits from the ability to analyse the traffic passing over a SpaceWire link and to monitor its status. This paper gives an overview of the capabilities of two STAR-Dundee products which perform this important task: the SpaceWire Monitor and SpaceWire Link Analyser. Both of these devices' functionality is combined into a new product; the Link Analyser Mk2, which features interfaces to both a Logic Analyser and a Personal Computer (PC), external triggering capabilities and a large memory for capturing decoded data. Software running on the PC is capable of interpreting data captured by the Link Analyser Mk2 into a user-defined protocol.

1 INTRODUCTION

A typical SpaceWire system may consist of many SpaceWire components from different sources connected together through a network of routers and links which are often duplicated for redundancy. The testing, validation and verification of simple point to point connections or complex networks call for a tool to analyse the data flowing at any given time across a SpaceWire link.

2 EXISTING SPACEWIRE LINK ANALYSIS TOOLS

2.1 SPACEWIRE MONITOR

The SpaceWire Monitor [2] used together with a logic analyser provides a means of analysing the traffic flowing through a SpaceWire link. Figure 1 illustrates how two SpaceWire cables are used to connect the SpaceWire Monitor across a link to be monitored. The Monitor decodes the characters and symbols passing bi-directionally across a link and provides direct indication of link status and traffic flow on a series of LEDs.

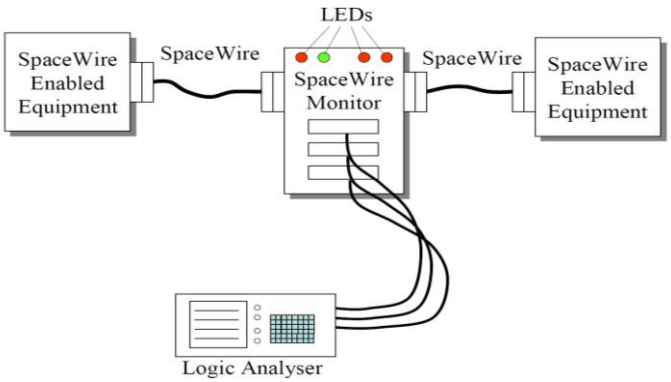

Figure 1: Using a SpaceWire Monitor and logic analyser to analyse a SpaceWire link.

For a deeper insight into the link under test, a logic analyser may be interfaced to the monitor to record the decoded values of characters and symbols as shown in Figure 2.

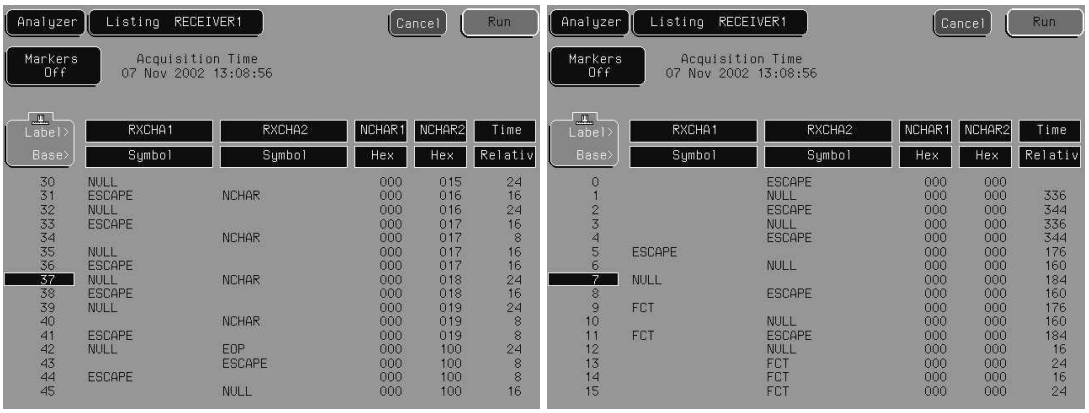

Figure 2: A SpaceWire ink during data transfer (left) and link start-up sequence (right).

The SpaceWire Monitor lacks external trigger signals to interface to the logic analyser. Triggers can only be programmed into the interfaced logic analyser and errors latched onto the relevant indicator LEDs.

2.2 SpaceWire Link Analyser

The STAR-Dundee SpaceWire Link Analyser [3] provides link monitoring and analysis capabilities with inbuilt logic analysis functionality. It is connected across a SpaceWire link in a similar fashion to the SpaceWire Monitor. A host PC is interfaced to the Link Analyser via a high speed USB 2.0 interface shown in Figure 3.

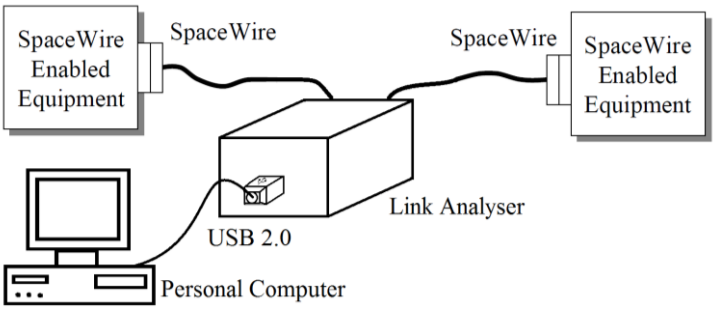

Figure 3: Using a SpaceWire Link Analyser and PC to analyse a SpaceWire link.

Data passing across a link under test are decoded into characters and symbols which are recorded into the Link Analyser memory. Software running on the PC is used to configure a sequence of triggers in the Link Analyser to activate on a change in state of the link status and/or a series of characters flowing over the link. Statistical information on the level of traffic through the link is continuously gathered and displayed on the host PC as shown in Figure 4.

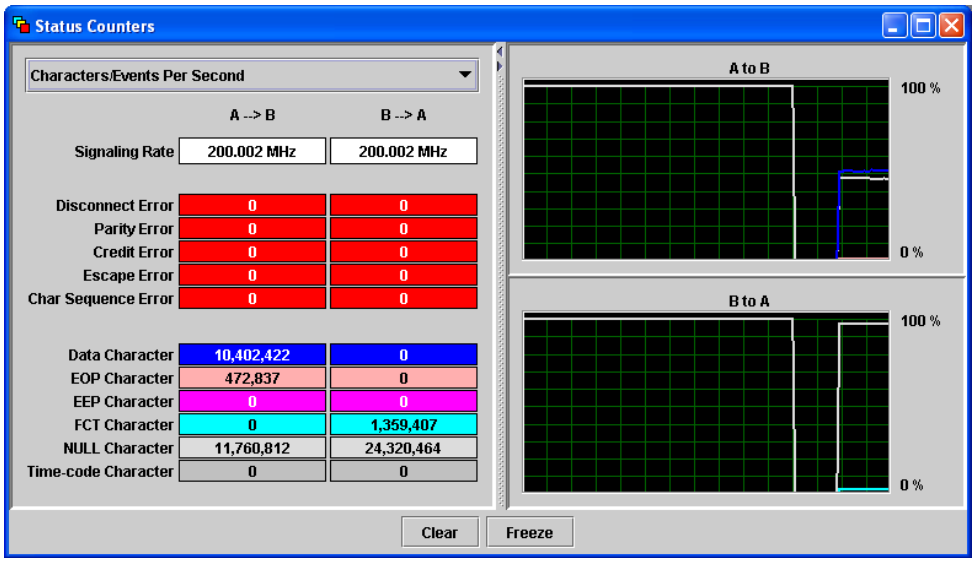

Figure 4: Display of link level activity and statistics of analysed link activity.

The Link Analyser is capable of monitoring, tracing and recording traffic at the link level to confirm link start-up, flow-control, data transfer and error recovery. Data can be monitored, traced and recorded at the packet level to confirm the response of a system to packet errors and the control of SpaceWire systems using control packets. The link and packet level data is shown in Figure 5.

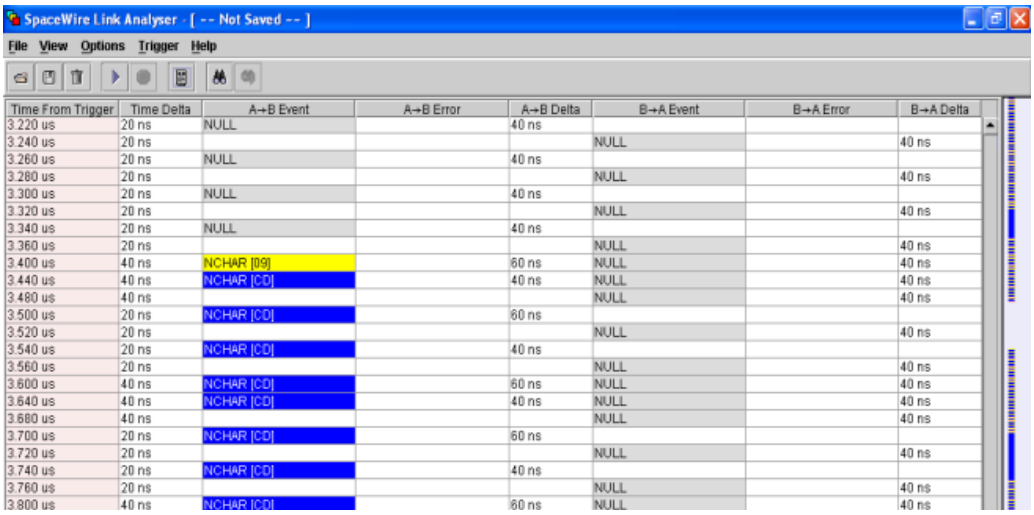

Figure 5: Display of packet level trace of analysed link activity.

The Link Analyser has enough memory to bi-directionally record 8,000 events. This can prove a limitation if a great deal of data needs to be analysed either side of a trigger event. Data filtering capabilities are provided in the Link Analyser to make maximum use of the available memory.

3 INTRODUCING THE SPACEWIRE LINK ANALYSER MK2

The SpaceWire Link Analyser Mk2, shown in Figure 6, combines the functionality of the SpaceWire Link Analyser and SpaceWire Monitor by providing both a USB 2.0 interface to a PC and ports suitable for interfacing to major logic analyser brands. It features two external trigger ports which can be independently configured as trigger in or out. Onboard memory provides enough capacity to store 16 million events.

Figure 6: The STAR-Dundee SpaceWire Link Analyser Mk2. The front panel (top) features, from left to right, 2 triggers and 2 SpaceWire ports. The rear panel (bottom) features, from left to right, 2 logic analyser ports, USB 2.0 connector and +5V power supply jack.

Drivers and software provide compatibility with Windows and Linux. The new software for the Link Analyser Mk2 builds on its predecessor by including the ability for the user to specify their own high-level protocols. Figure 7 shows a sequence of packets interpreted into the Remote Memory Access Protocol (RMAP).

Time Fro…	Time …	End A	End A D…	End B	End B Delta
0 ns		**(PID=1) Header:** RMAP Command			
		Path Address: 04			
		Target Address: FE			
		Instruction: Read Command			
		Increment Target			
		Key: 20			
		Reply Path: 00 00 01 03			
		Initiator Address: FA			
		Transaction ID: 1592			
		Extended Address: 00			
		Address: 00000001			
		Data Length: 000004			
4.080 µs	4.080 µs	**EOP** (4.080 µs @ 5.147 Mbytes/s)	4.080 µs		
5.620 µs	1.540 µs			**(PID=1) Header:** RMAP Reply	
				Path Address: 03	
				Target Address: FA	
				Instruction: Read Reply	
				Increment Target	
				Status: Success	
				Initiator Address: FE	
				Transaction ID: 1592	
				Data Length: 000004	
				Data:	
				00 00 00 0D	
8.520 µs	2.900 µs			**EOP** (2.900 µs @ 6.207 Mbytes/s)	2.900 µs
1.0046 ms	996.08…	**(PID=2) Header:** RMAP Command	1.00052 …		
		Path Address: 04			

Figure 7: Interpreting a recorded sequence of packets into RMAP.

4 CONCLUSION

This short paper has given a brief insight into the importance of link analysis and an overview of the SpaceWire Monitor and SpaceWire Link Analyser. The SpaceWire Link Analyser Mk2 unites the respective PC and logic analyser interfaces of these devices. It builds on these features by including 2,000 times the memory of the Link Analyser, a pair of external triggers and an enhanced version of software based on that of its predecessor. The SpaceWire Link Analyser Mk2 is a powerful, flexible tool for testing, validating and verifying a SpaceWire system.

5 REFERENCES

1. ECSS, Standard ECSS-E-ST-50-12C, "SpaceWire – Link, Nodes, Routers and Networks", European Cooperation for Space Standardization, July 2008.

2. S. Parkes, C. McClements, S. Mills and I. Martin, "SpaceWire: IP, Components, Development Support and Test Equipment", Proceedings of DASIA 2003, Prague, Czech Republic, 2-6 June 2003.

3. STAR-Dundee, "SpaceWire Link Analyser, http://www.star-dundee.com