Demartek

Quarch Technology Torridon Disk Storage Test Equipment Evaluation

Performance evaluation sponsored by Demartek, LLC

Introduction

Demartek evaluated the Torridon disk storage test equipment from Quarch Technology, Ltd. Quarch supplied its Torridon equipment and various tests were run in the Demartek lab in Arvada, Colorado, USA.

Evaluation Summary

We found that the Quarch Torridon testing solution was a useful and flexible tool for conducting manual and automated testing of the interface between disk controllers and disk drives. It is suitable for complete system test automation as well as fault injection and debugging down to the individual signal level.

The Quarch Torridon system can improve and streamline testing of disk storage systems by use of its automation features, and is valuable for a variety of scenarios. It can provide testing for a single disk drive interface or for many interfaces simultaneously.

We believe that if we had this Quarch system in our labs during some of our own previous testing of disk storage subsystems, this automated system would have saved a great deal of time and manual effort.

Introduction

Quarch Technology, Ltd, designs and manufactures the Torridon test equipment that provides automated testing functions for storage arrays by managing and manipulating the individual control lines between disk controllers and individual disk drives. The Torridon system allows for full automation of insertion and removal of disk drives from a storage enclosure without physically having to remove or insert the drives.

The Quarch Technology Torridon system provides complete control over every power and control signal between the disk controller and the disk drive. This allows not only automated insertion and removal of disk drives, but virtually any error condition to be programmatically created and repeated, with precise timings for all the signals on the interface.

The Torridon system also provides similar test modules for SBB canisters, PSUs and data cables.

Demartek deployed the Torridon equipment from Quarch Technology in the Demartek lab and performed a few tests using the Torridon equipment. These tests were limited to programmatic drive insert and removal, and did not include manipulating individual signals (3 volt, 5 volt, 12 volt, etc.) except for altering the timing of some of these signals.

Evaluation Environment

The evaluation was conducted at the Demartek lab in Arvada, Colorado using Demartek server, networking and storage infrastructure. Quarch supplied the Torridon test equipment.

The testing consisted of using a management computer to control the disk drive interfaces of a separate disk drive server computer, using the Quarch equipment.

Management computer:

- Windows 7 Ultimate 32-bit laptop computer
- Serial port connected to Torridon unit with serial cable provided by Quarch
- USB port connected to Torridon unit with USB cable provided by Quarch

Disk drive server:

- Windows Server 2003 R2 Enterprise 64-bit
- Dual Intel Xeon E5320, quad-core, 1.86 GHz (8 total cores, 8 logical processors)
- 4GB ECC RAM
- Intel RAID controller SRCSASRB
- One four-drive hot-swap disk drive cage
- One six-drive hot-swap disk drive cage

The disk drive server cages were loaded with various SAS and SATA 3.5-inch disk drives controlled by the Intel RAID controller.

Quarch Equipment:

- Torridon single drive interface module
- Torridon array controller (handles up to 28 drives)
- Torridon control modules with attached ribbon cables

Two different configurations were tested:

- Management computer connected to the Torridon single-drive module
- Management computer connected to the Torridon 28-drive array controller

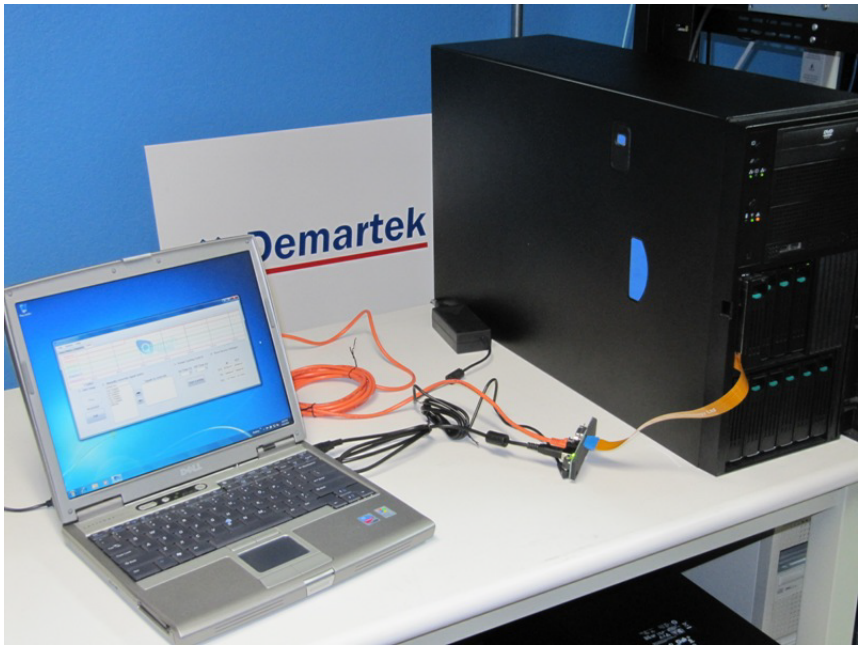

Figure 1 - Torridon single-drive module

Figure 2 - Torridon 28-drive array controller

Test Process

In order to test the Quarch Torridon system, a control module is attached to the disk drive, and the drive is placed into the enclosure or drive cage in the normal manner. The drive protrudes a small distance out of the cage or enclosure. The ribbon cable attached to the control module is then connected to the Torridon single-drive module or the Torridon array controller.

Quarch provides control modules for 3.5-inch SAS or SATA disk drives, 2.5 inch SAS or SATA disk drives and SBB modules. They also provide customized and vendor-specific modules on request.

Figure 3 - Disk drive and control module

Figure 4 - Disk drive with control module attached

Figure 5 – Drive with attached control module in drive cage

Test Results

The Quarch Torridon system may be driven with the TestMonkey graphical user interface or with a script communicating with the serial port of the Torridon unit. Quarch provides a number of sample scripts with the Torridon system. The examples shown below use the TestMonkey graphical user interface.

The TestMonkey software was installed onto the management computer and was used to logically insert and remove the drive from the disk driver server computer. The RAID controller software on the disk driver server computer was used to monitor the activity of the disk drive.

After connecting the Torridon equipment to the computers, TestMonkey was used to insert and remove one disk drive one time. TestMonkey was then used to programmatically insert and remove the disk drive multiple times at 20 second intervals. All the signals (3 volt, 5 volt, 12 volt, etc.) were all enabled or disabled together to simulate the insertion and removal of the disk drive.

The Torridon module we tested provides for individual control of the following signals:

- 3V3_POWER
- 3V3_CHARGE
- 5V_POWER
- 5V_CHARGE
- 12V_POWER
- 12V_CHARGE
- SPECIAL1 (vendor-specific mated signal)

Each signal can be given an initial delay and a number of bounce settings. The device voltages are displayed in real-time while the tests are running. Each of the individual signals can be enabled or disabled and set to always on, always off or to be changed at the cycle times.

For these tests, all the signals were enabled and set to change at the same time, with a 50 ms delay for the first signal and a 100 ms delay for the second signal.

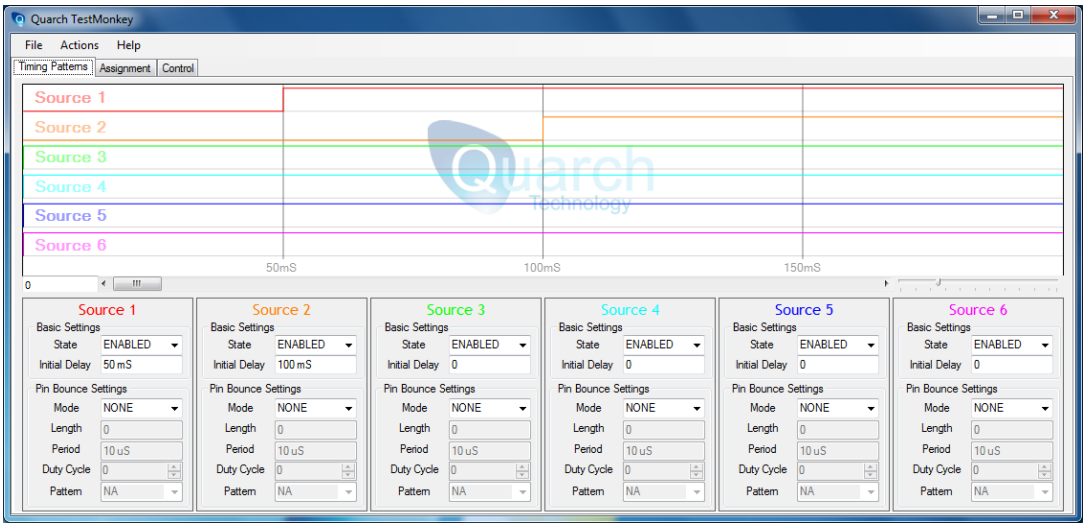

Figure 6 - Initial Timing Patterns

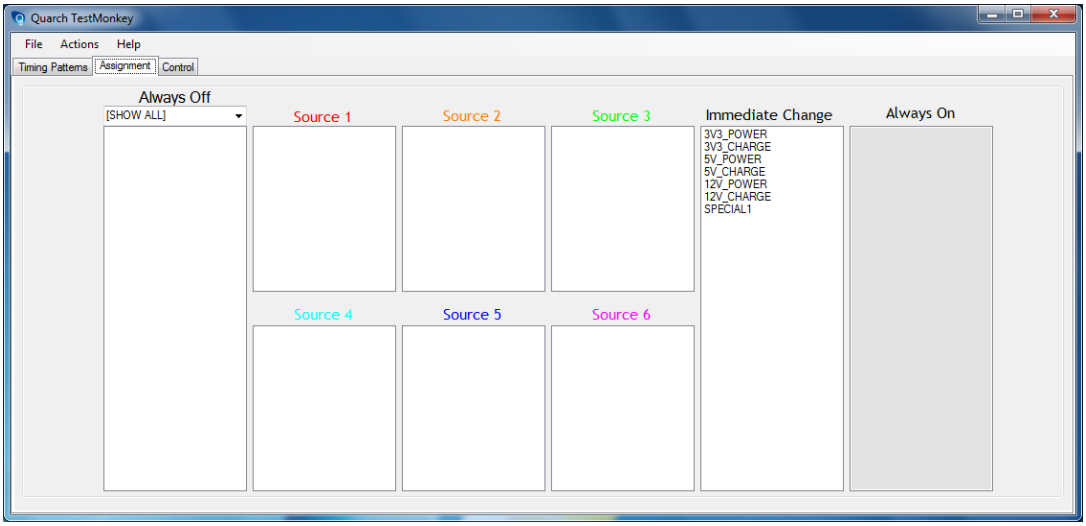

Figure 7 - Signal Assignment

At this point, the disk drive is considered "pulled" (not connected) and is not visible to the disk drive server, as shown by RAID controller management software in the disk drive server.

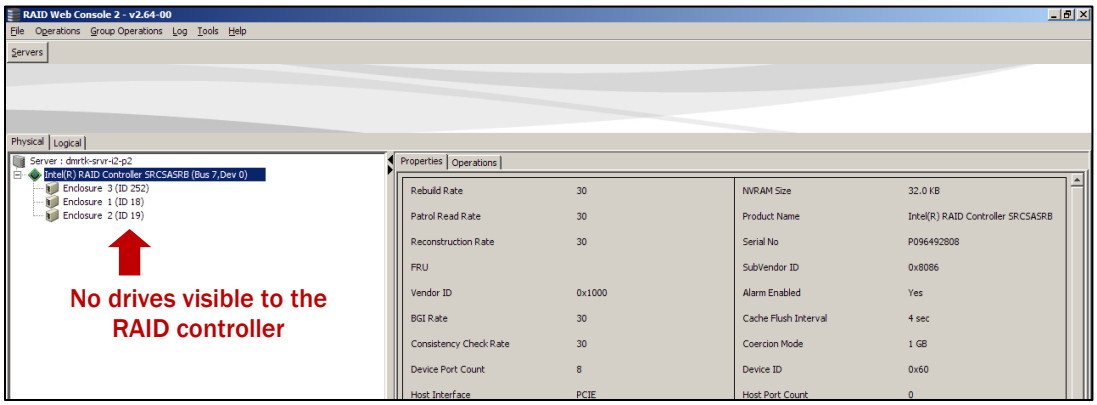

Figure 8 - RAID controller software: no drives visible

When the "plug" command (logically insert the drive) is issued from TestMonkey, the RAID controller responds by detecting the presence of the disk drive.

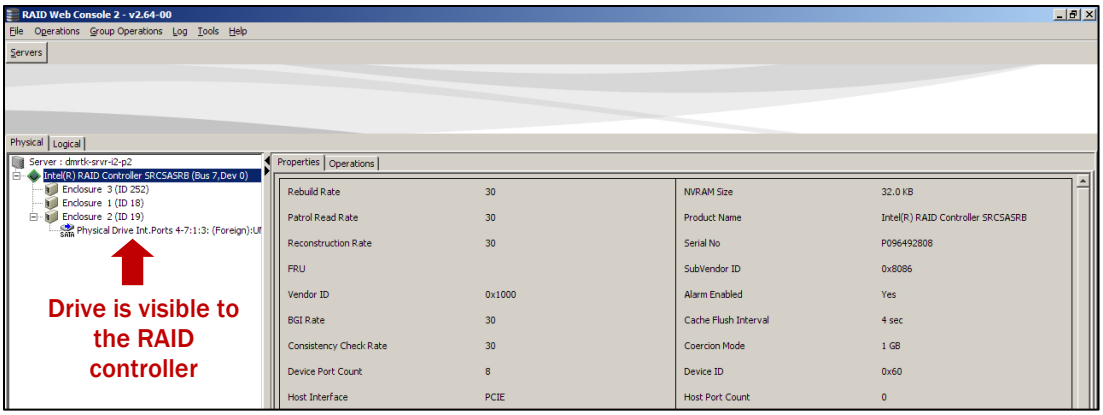

Figure 9 - RAID controller software: drive is visible

A series of plug and pull commands were programmatically issued at 20 second intervals. When each pull (remove) command was issued, the RAID controller immediately noticed the absence of the disk drive. When each plug command was issued, the RAID controller required approximately eight seconds to detect and properly identify the disk drive. The RAID controller log indicated the repeated presence and absence of the disk drive.

ID	Error Level	Date / Time	Description
3059	[Information, 0]	2010-03-11, 16:21:10	Controller ID: 0 State change: PD = Int.Ports 4-7:1:3 Previous = Unconfigured Bad Current = Unconfigured Good
3058	[Information, 0]	2010-03-11, 16:21:10	Controller ID: 0 Device inserted Device Type: Disk Device Id: Int.Ports 4-7:1:3
3057	[Information, 0]	2010-03-11, 16:21:10	Controller ID: 0 PD inserted: Int.Ports 4-7:1:3
3056	[Warning, 1]	2010-03-11, 16:21:10	Controller ID: 0 Sensor bad on enclosure: : :1 Sensor 3
3055	[Warning, 1]	2010-03-11, 16:21:10	Controller ID: 0 Sensor bad on enclosure: : :1 Sensor 3
3054	[Information, 0]	2010-03-11, 16:20:42	Controller ID: 0 State change: PD = Int.Ports 4-7:1:3 Previous = Failed Current = Unconfigured Bad
3053	[Information, 0]	2010-03-11, 16:20:42	Controller ID: 0 State change: PD = Int.Ports 4-7:1:3 Previous = Unconfigured Good Current = Failed
3052	[Information, 0]	2010-03-11, 16:20:42	Controller ID: 0 Device removed Device Type: Disk Device Id: Int.Ports 4-7:1:3
3051	[Warning, 1]	2010-03-11, 16:20:42	Controller ID: 0 PD removed: Int.Ports 4-7:1:3
3050	[Information, 0]	2010-03-11, 16:20:30	Controller ID: 0 State change: PD = Int.Ports 4-7:1:3 Previous = Unconfigured Bad Current = Unconfigured Good
3049	[Information, 0]	2010-03-11, 16:20:30	Controller ID: 0 Device inserted Device Type: Disk Device Id: Int.Ports 4-7:1:3
3048	[Information, 0]	2010-03-11, 16:20:30	Controller ID: 0 PD inserted: Int.Ports 4-7:1:3
3047	[Warning, 1]	2010-03-11, 16:20:30	Controller ID: 0 Sensor bad on enclosure: : :1 Sensor 3
3046	[Warning, 1]	2010-03-11, 16:20:30	Controller ID: 0 Sensor bad on enclosure: : :1 Sensor 3
3045	[Information, 0]	2010-03-11, 16:20:02	Controller ID: 0 State change: PD = Int.Ports 4-7:1:3 Previous = Failed Current = Unconfigured Bad
3044	[Information, 0]	2010-03-11, 16:20:02	Controller ID: 0 State change: PD = Int.Ports 4-7:1:3 Previous = Unconfigured Good Current = Failed
3043	[Information, 0]	2010-03-11, 16:20:02	Controller ID: 0 Device removed Device Type: Disk Device Id: Int.Ports 4-7:1:3

Displaying log from server

Figure 10 - RAID controller activity log

This same type of automated drive insertion and removal testing can be conducted on multiple disk drives at the same time using the scripting functions of the Torridon system.

These tests simply showed the programmatic insertion and removal of the drives. Additional error conditions could be injected into the system by altering the individual signals and timings, which can aid in controller debugging.

Quarch provides several different modules that support different interfaces and features, and these are listed in Appendix A. We did not test all of the modules but expect that they would work in the same manner as the modules that we did test.

Conclusion

The Quarch Torridon system is a useful, flexible and automated disk drive interface testing system. This test automation system is easy to understand and simple to integrate into an existing test environment. It can be used for a variety of purposes such as:

- Automated system testing
- Inserting and removing disk drives to conduct RAID group drive rebuild tests
- Automating the insertion and removal of drives in an existing test sequence
- Interface testing
- Injecting errors for debugging purposes
- Qualifying new drives within an enclosure
- Finding the failure limits of a hot-swap system

The Torridon system can be used to test the interface to a single disk drive or many disks simultaneously, and the tests can be run manually or in an automated fashion. The automated test capabilities can streamline any number of testing scenarios. We believe that this level of detailed testing would be extremely difficult to perform without the Torridon system.

We believe that if we had this Quarch system in our labs during some of our own previous testing of disk storage subsystems, this automated system would have saved a great deal of time and manual effort. We estimate that 90% of the manual effort required in some of the previous test projects that we conducted would have been eliminated by this automated test system.

Given the cost of engineering time, we believe that the Quarch Torridon system would be able to achieve a rapid return on investment.

Appendix A

This appendix describes the Torridon modules and some of the kinds of testing that can be performed with these modules.

3.5" and 2.5" SAS/SATA Drive Control Modules

- Control 3.3v, 5v and 12v power to a drive
- Short circuit any or all of the power rails

Automate drive removal and insertion; create drive power failures and short circuits

2.5" SAS/SATA HS Drive Control Modules

- Control 3.3v, 5v and 12v power to a drive
- Control individual SAS signals

Automate drive removal and insertion; create drive power failures, port failure, data errors

2.5" SAS/SATA Lite Drive Control Modules

- Control 3.3v, 5v and 12v power to a drive

Automate drive removal and insertion, create drive power failures

SBB Control Module

- Control power to an SBB Canister
- Control all non-SAS signals

Automate Canister removal and insertion; create Canister failures including TWI, SGPIO, Drive presence, PSU presence, Vendor Specific

MiniSAS Control Module

- Control all signals in a 4 lane miniSAS cable

Automate cable pull and push, simulate any cable failure including intermittent and data errors.

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