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HP LTO-5 8Gb Native Storage Networking Architecture

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INTRODUCTION – STORAGE NETWORKING DRIVE HISTORY

An important component of Quantum's iLayer™ feature set is the storage networking functionality, which provides advanced SAN connectivity functions. Historically, Quantum has provided this storage networking functionality in the Scalar® i2000 and Scalar i500 libraries via a Fibre Channel I/O Blade; a Quantum-designed fiber switch that can be integrated into the back of the Scalar libraries.

This I/O Blade has been bundled with Fibre Channel tape drives (one blade for every four drives) and sold as a "Storage Networking Drive" or "SNW Drive" for short. Starting with LTO-2 tape drive technology, these I/O Blades have provided substantial value to Quantum customers by providing fiber switch port aggregation, data throughput performance optimization by acting as a data buffer or cache, as well as additional features providing redundancy and failover when connecting to a SAN.

As the performance of LTO tape drives continues to improve with each generation, the value of the I/O Blade for data throughput optimization has eroded. Likewise, the value of port aggregation has also eroded over time as the cost of fiber switches continues to come down. However, the redundancy and failover features of the I/O Blade continue to provide substantial value to customers connecting their tape libraries into SANs, as do other blade features that assist in SAN configuration.

8Gb STORAGE NETWORKING DRIVE STRATEGY

LTO-3 and LTO-4 fiber drives were 4Gb fiber devices that worked with Quantum's 4Gb I/O Blade. With the introduction of 8Gb fiber speeds on LTO-5 drives, Quantum was exploring strategies to continue to provide the storage networking features in 8Gb SANs, bearing in mind the diminished value of port aggregation and throughput optimization.

Rather than develop an all new 8Gb Fibre Channel I/O Blade, through Quantum's joint development of the LTO-5 drive with HP we had the opportunity to integrate the most relevant storage networking features more directly into the LTO-5 tape drives and the iLayer software in the Scalar i6000 and Scalar i500 drive sleds.

This is the strategy that has resulted in Quantum's 8Gb native storage networking drives that are being sold today. This 8Gb native storage networking feature set is only available with HP LTO-5 drives in the Scalar i6000 and Scalar i500 libraries, and is explained in detail in this document.

HP LTO-5 DRIVE OFFERINGS

Based on this strategy, Quantum offers three different drive variants for the HP LTO-5 fiber drive sold in the Scalar i6000 and Scalar i500 libraries:

- HP LTO-5 8Gb Native Fiber Drive – This is the "standard" native fiber drive.
 - ↳ This drive sled has two fiber ports and an external Ethernet port for management, but only the primary fiber port can be used in this drive.
- HP LTO-5 4Gb Storage Networking Drive = "standard" native fiber drive + 4Gb Fibre Channel I/O Blade
 - ↳ The 4Gb Fibre Channel I/O Blade is still sold based on a ratio of one blade for every four drives, and still provides all of the same feature set that it has provided historically.
- HP LTO-5 8Gb Native Storage Networking Drive = "standard" native fiber drive + 8Gb SNW license key
 - ↳ This license key is sold on a per-drive basis, and when this license key is installed on a library it enables three features: (1) Control Path Failover, (2) Data Path Failover, and (3) LUN Mapping (also known as host access control). These features are explained in detail below.

Note that all three drive offerings use the same standard native fiber drive and sled. That means that the standard HP LTO-5 fiber drives can be upgraded to a 4Gb SNW drive by adding an I/O Blade, or can be upgraded to an 8Gb Native SNW drive by adding the 8Gb SNW license key.

Important: Not all of these native storage networking features are available today. Please review the availability of these features listed at the end of this document.

Next we compare the architectures of the 4Gb SNW and 8Gb Native SNW drive types.

I/O BLADE VS 8Gb NATIVE STORAGE NETWORKING ARCHITECTURE

Figures 1 and 2 below show a side by side comparison between the I/O Blade ‘storage networking’ architecture and the new ‘native storage networking’ architecture only available with the HP LTO-5 drive in the Scalar i6000 and Scalar i500.

Figure 1 - I/O Blade SNW Architecture

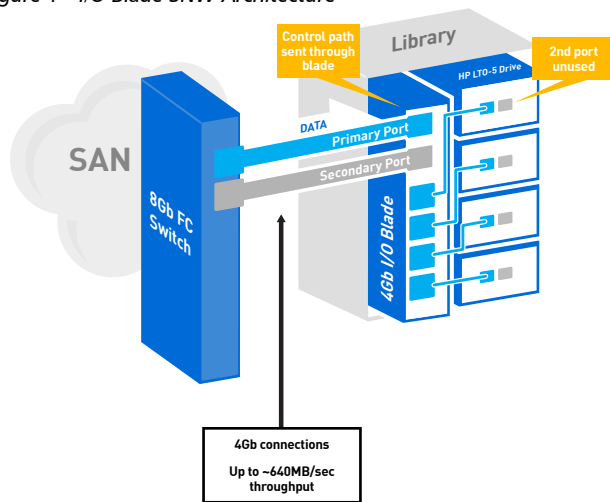
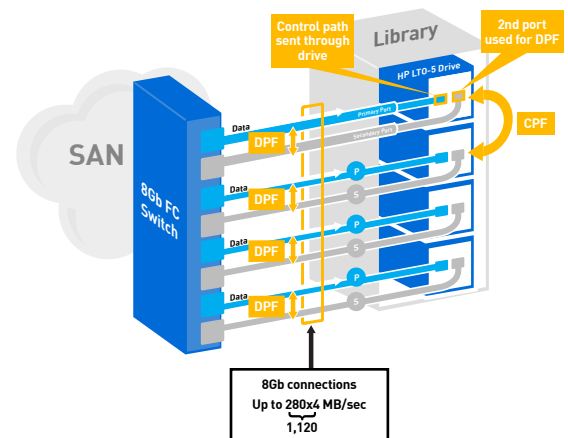


Figure 2 - Native SNW Architecture (HP LTO-5 only)



8Gb NATIVE STORAGE NETWORKING FEATURES – TECHNICAL DETAILS

When an HP LTO-5 tape drive is licensed to enable the 8Gb native storage networking functionality, that license key enables three features:

- **Control Path Failover (“CPF”)** – Provides the ability to work around control path drive failures
- **Data Path Failover (“DPF”)** – Provides the ability to work around fiber connectivity issues on the SAN
- **LUN Mapping, aka Host Access Control** – Provides the ability to easily control which hosts have access to which drives on the SAN

This section explains all three features in detail.

Control Path Failover (“CPF”)

The “control path” refers to the communication path between the backup server and the robot in the library, otherwise known as the ‘medium changer.’ In some libraries, this control path is provided via a dedicated fiber port on the main library controller, or as shown above an alternative historically has been to send the control path commands through the Fibre Channel I/O Blade.

The Scalar i6000 library (with HP LTO-5 drives only), and the Scalar i500 library (with any drive type) support configuring the control path to be sent through a tape drive of the customer's choosing. The customer configures one control path drive for every partition in the library, and then the backup application will send robotic commands to the control path drive, and then the commands are sent through the control path drive to the robot.

Sending the control path commands through a tape drive is becoming the most common way in the industry to send control path commands, but this approach does create the problem of how to send commands to the robot if the control path drive is unavailable.

Control path failover provides the ability to work around control path drive failures by allowing customers to configure a 'primary' control path drive and a 'secondary' control path drive. Quantum's iLayer software can then automatically failover to the secondary drive in the event of a primary drive failure. The result is less chance of disruption to the customer's backup.

Important: In order for CPF to work, both of these drives must be in the same partition, and both drives must be connected to the same fiber switch and must be in the same zone on the SAN. Also, the fiber switch must support NPIV technology (described below), though most fiber switches support this technology today.

Control Path Failover Technical Details

Once the primary and secondary control path drives are configured, the iLayer software leverages a switch technology called Node Port ID Virtualization, or NPIV, to enable seamless control path failover from the primary drive to the secondary drive in the event that the primary drive is unavailable. (Note: The control path can also failover from the primary port to a secondary port on the same drive – this does not require the use of NPIV, and is discussed further below.)

NPIV enables fiber switches to have two physical ports look like a single 'virtual' port with a single device on that port. More specifically, the switch only sees one active port (i.e., one World Wide Port Name, or "WWPN") at a time. To illustrate this, let's outline how control path failover will work from the perspective of the backup application.

As an example, assuming switch Port 1 is connected to the primary control path drive, and switch Port 2 is connected to the secondary control path drive. The switch sees one WWPN and sees that WWPN on Port 1. Control path commands are sent from the host to the switch, and then from the switch down to the primary tape drive on Port 1.

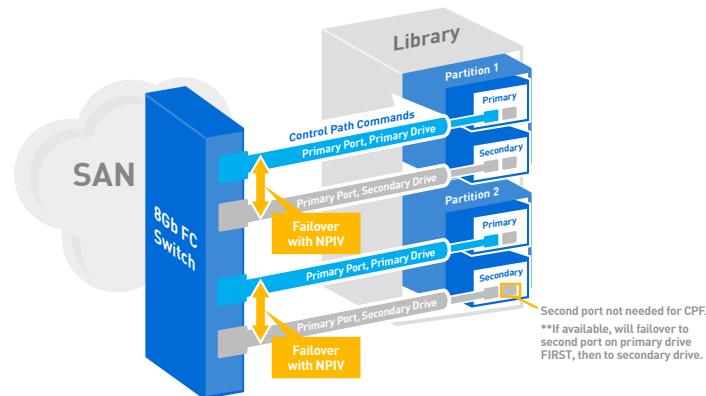
If the primary control path drive becomes unavailable:

- The switch will detect that the link on Port 1 is down.
- The library reconfigures the secondary control path drive to become the new primary control path drive.
- After a short period of time (generally less than one minute), the WWPN that the switch 'lost' comes back online, but that same WWPN is now appearing on Port 2 of the switch, not Port 1.
- Depending on how long the reconfiguration took, the switch will retry the command on Port 2, which will then send the original robotics command through the tape drive connected to Port 2.
- If the timing to reconfigure the drive exceeded the switch timeout, it is possible that the switch could not recover in time, in which case the host will time out and the application will retry the command, which it will perform automatically without any manual administrative involvement.
- Either way, the original robotics command will be sent to the library, this time through the secondary (now primary) control path drive.

In summary – from the point of view of the backup application, control path failover will be totally transparent to the application in most cases, and in the other cases it will only result in a command retry.

Control path failover is illustrated in Figure 3 below.

Figure 3 - Control Path Failover Illustrated



Data Path Failover (“DPF”)

Data path failover is the feature that takes advantage of the dual ports on the HP LTO-5 drive sleds, and is **designed to work around fiber connectivity issues on the SAN by providing a primary and redundant or secondary port on the same drive sled.**

The “data path” refers to the communication path between the backup / media server and the tape drive. Since the HP LTO-5 drive sleds used in the Scalar i6000 and Scalar i500 contain two ports, this allows users to have both a primary and a secondary fiber port on the same drive sled.

Once a particular drive sled is enabled for the 8Gb SNW license key, then that drive sled can use DPF to detect fiber signal quality on the primary fiber port on a given drive sled, and if the fiber signal quality drops below a certain level, the iLayer software (working with the HP LTO-5 drive) can failover the data path communications to the secondary fiber port on the same sled.

Important: In order for DPF to work, both the primary and secondary ports on the drive sled must be connected to the same Fibre Channel switch and must be in the same zone on the SAN.

Data Path Failover Technical Details

Data path failover does not use NPIV technology, but it employs a very similar concept that is managed by the tape drive. NPIV is not needed since the drive has control of both ports, and the drive makes sure both ports are presented to the switch with the same WWPN. Only one port is active at all times, and this is also managed by the tape drive.

When configured to use data path port failover, if the tape drive detects that the primary port configured as the active primary port has failed (e.g., disconnected cable, failed transceiver, etc.), then the tape drive automatically attempts to use the standby primary port.

Like control path failover, a data path port failover event may cause the switch to retry sending its data over the ‘secondary’ port, but since that port is presented with the same WWPN the switch will retry and succeed, and this operation is transparent to the host application.

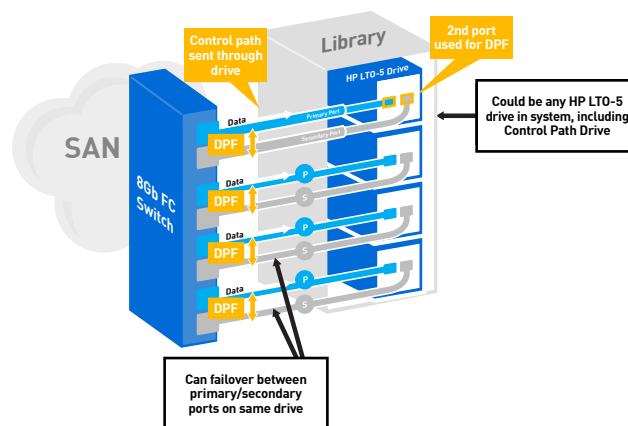
Combining Data Path and Control Path Failover

If you have a tape drive that is configured for both data path failover and control path failover, and in the event that the primary port link goes down, the library will first attempt to failover both data and control path commands from the primary port on the tape drive to the secondary port on the same tape drive (i.e., **first** we try to work around a possible fiber connectivity issue). If after this first 'failover' there is still an issue with the secondary link, the library will then failover control path commands to the secondary control path drive (i.e., **second** we try to work around a possible control path drive issue).

In this case the robotics commands will failover to the secondary drive successfully, but the backup data that was originally supposed to be sent to the failed drive will have to be sent to a different drive.

Data path failover is illustrated in Figure 4 below.

Figure 4 - Data Path Failover Illustrated



LUN Mapping (Also Called "Host Access Control")

LUN mapping refers to the ability to map LUNs (i.e., devices like tape drives) on a SAN to hosts. In the case of Quantum's tape libraries, **LUN mapping provides the ability to control which hosts or servers have access to which tape drives on the SAN.** This is valuable to customers because it makes it easier to configure complex SANs (saving administrators time), and it provides another layer of security on the SAN, in other words it provides another way to control access of storage resources among different users or departments in addition to partitioning.

Host access control is a feature that has been in place historically with Quantum's I/O Blades, and from the user's point of view the way this feature works is almost identical whether the system has I/O Blades or the native storage networking drive types. The additional details provided below are excerpted from the Scalar i500 User's Guide.

To configure host access, you must first register the host(s) for host access, and enable host access on the desired tape drive(s). Then you will map the host to the tape drives or partitions you want the host to access. Details about host access include:

- A registered host has full access to all tape drives in the library that have not been enabled for host access, and full access to all tape drives that are enabled for host access and have been mapped to that host. A registered host has no access to drives that have been enabled for host access but are not mapped to that host.
- An unregistered host has full access to all tape drives in the library that have not been enabled for host access, but no access to tape drives that have been enabled for host access.
- Tape drives that are enabled for host access can only be accessed by registered hosts that are mapped to them. Tape drives that are not enabled for host access can be accessed by all hosts.

- If the control path and any failover tape drives for a partition are enabled for host access, then only the hosts mapped to that partition will be able to send medium changer commands to that partition. Unregistered hosts and registered hosts not mapped to that partition will not be able to send medium changer commands to that partition. However, unregistered hosts and registered hosts that are not mapped to that partition do still have access and can send commands to any non-host-access-enabled tape drives in the partition, as well as any host-access-enabled tape drives in the partition to which they are mapped.
- A maximum of 64 host entries can be mapped for access control to each tape drive, regardless of whether the hosts are mapped to the tape drive, to the partition for which the drive provides the library control path, or both. If the same host is mapped to both the tape drive and the partition, the same host consumes two host entries.

AVAILABILITY OF THE 8Gb STORAGE NETWORKING FEATURES

The features described in this tech brief—CPF, DPF, and LUN mapping—are only available with HP LTO-5 drives in the Scalar i6000 and Scalar i500 libraries. Some of these features were available at launch of the HP LTO-5 drive in these products, and some of these features are coming later this year. The availability of these features is summarized in the table below:

8Gb Native Storage Networking License Key Feature Set			
Automation Product	Control Path Failover	Data Path Failover	LUN Mapping
Scalar i6000	Available NOW	Available CQ1'11	Available NOW
Scalar i500	Available NOW	Available CQ1'11	Available NOW

Important: If a customer purchases an 8Gb Native SNW drive today, they will be licensed for whatever features are available today. For example, today that customer would be enabled for control path failover and LUN mapping, but not data path failover. Once data path failover is available, that customer would just need to upgrade their library firmware to then enable data path failover. No additional license activation is needed at that time.

CONCLUSION

Quantum's iLayer software has historically provided an advanced SAN connectivity feature set via a Fibre Channel I/O Blade, sold and positioned as storage networking drives. Although Quantum will continue to offer the 4Gb I/O Blade for sale with LTO-5 drives, we can now deliver improved control path and data path failover features and similar LUN mapping capabilities directly integrated into the drive sleds with HP LTO-5 drives. These features continue to deliver substantial value to customers by providing ways to work around control path tape drive issues, work around fiber connectivity issues on the SAN, and make it easier to configure complex SANs through the 8Gb native SNW functionality.

This functionality is only available with HP LTO-5 drives in Quantum's Scalar i6000 and Scalar i500 libraries, and represents a great opportunity to differentiate Quantum's solutions by solving customer problems with advanced technology.

About Quantum

Quantum Corp. (NYSE:QTM) is the leading global specialist in backup, recovery, and archive. From small businesses to multinational enterprises, more than 50,000 customers trust Quantum to solve their data protection, retention and management challenges. Quantum's best-of-breed, open systems solutions provide significant storage efficiencies and cost savings while minimizing risk and protecting prior investments. They include three market-leading, highly scalable platforms: DXi®-Series disk-based deduplication and replication systems for fast backup and restore, Scalar® tape automation products for disaster recovery and long-term data retention, and StorNext® data management software for high-performance file sharing and archiving.

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