Shareable Storage with Switched SAS

Terry Gibbons, LSI Corporation
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Abstract

Shareable Storage with Switched SAS

- This session outlines SAS as a shared storage alternative, a subject of interest to IT Professionals and System Integrators. This tutorial explores sharing storage amongst servers by using switching technology at the SAS level. This tutorial provides a technology review of Switched SAS, applications driving storage “closer” to the server, and how to reduce infrastructure while improving performance and operating expense.
Agenda

- Overview & Discussion Points
- What is Switched SAS?
  - Building Blocks
  - Technology Comparisons
- Applications and Environments
  - High Density Servers
  - Virtualization
  - Tiered Storage
  - Messaging Environment
- Infrastructure Improvements
- Summary
Overview

- Typical view of DAS

- SAS view of (external) DAS
  - May not be a standard feature

- New view – “Networked Connectivity”

**Ethernet**

**Or Fibre Channel**

**Why not SAS?**
Common Storage Solution Req’s

- Importance of data security (logical and physical)
- Performance (throughput, latency, and IOPS)
  - Predictable latency – high IOPS
- Availability, reliability, and uptime
  - Low latency replication of data
- Capacity to support growing data needs
- Flexibility to adapt to different environments
  - Blades, racks, external storage systems
- Cost effective, energy efficient, easy to install & use
- Storage moving closer to servers even with networked and cloud scenarios

Source: Making the Switch to Shared 6G/s SAS Storage
Greg Schulz, Server and StorageI/O Group
What is Switched SAS?

- It’s not a standard, it’s a way of conveying unique SAS attributes

- Combines usage of various SAS standards
  - SAS Expander (Connection Manager and Router)
  - Zoning
  - Wide Port Configuration

- Commonly delivered as a single unit with up to 16 ports
  - Each port is a x4 connection carrying 24Gb/s
  - Connects to controllers (servers) or expanders (JBOD/RBOD) only
Expander Overview

- Any-to-Any Connection
- Cables connect w/ 4-Phys
- Disks connect w/ 1-Phy
SAS Switch Overview

- Illustrates two initiators to many expander-based storage units
- Each initiator could be in separate host

SAS Switch

Expander Abstraction

SAS Expander

SAS Expander
## IO SAN Technologies

<table>
<thead>
<tr>
<th>Attribute</th>
<th>1GbE iSCSI</th>
<th>6Gb/s SAS</th>
<th>8Gb/s FC</th>
<th>10GbE iSCSI / FCoE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point-to-Point</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Switched</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>Low</td>
<td>Higher</td>
<td>Higher</td>
</tr>
<tr>
<td>Performance</td>
<td>Good</td>
<td>Very Good</td>
<td>Very Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Distance</td>
<td>DC or WAN</td>
<td>Up to 25m</td>
<td>DC or Campus</td>
<td>DC or Campus</td>
</tr>
<tr>
<td>Strength</td>
<td>Cost</td>
<td>Cost</td>
<td>Performance</td>
<td>Performance</td>
</tr>
<tr>
<td>Simplicity</td>
<td>Distance</td>
<td>Performance</td>
<td>Scalability</td>
<td>Scalability</td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
<td>Distance</td>
<td></td>
</tr>
<tr>
<td>Weakness</td>
<td>Performance</td>
<td>Distance</td>
<td>Cost</td>
<td>Cost FCoE Emerging</td>
</tr>
<tr>
<td>Servers</td>
<td>10’s to 100’s</td>
<td>10’s</td>
<td>100’s to 1000’s</td>
<td>100’s to 1000’s</td>
</tr>
</tbody>
</table>

Source: Making the Switch to Shared 6G/s SAS Storage
Greg Schulz, Server and StorageI/O Group
### Host Interface Options

<table>
<thead>
<tr>
<th>Description</th>
<th>iSCSI</th>
<th>SAS</th>
<th>FC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Interconnect technology build on SCSI and TCP/IP</td>
<td>Serial protocol for data transfer incorporating SCSI command</td>
<td>A set of related physical layer networking standards to transport SCSI command sets</td>
</tr>
<tr>
<td>Architecture</td>
<td>IP-based standard – SCSI commands sent in TCP/IP packets over Ethernet</td>
<td>Serial, point-to-point with discrete signal paths</td>
<td>Switched – multiple concurrent transactions</td>
</tr>
<tr>
<td>Distance</td>
<td>Unlimited – latencies increase over distance</td>
<td>10m Passive Copper [25m Active Copper]</td>
<td>30 meters (copper) 50,000 meters (optical)</td>
</tr>
<tr>
<td>Scalability</td>
<td>[Virtually] no limit for number of devices**</td>
<td>Varies – [1024 SAS Addresses is typical]</td>
<td>[Practical limit of 5K-20K devices in switched fabric++]</td>
</tr>
<tr>
<td>Raw Performance</td>
<td>1Gb/s on closed network</td>
<td>6Gb/s w/ x4 wide port or 24Gb/s per cable</td>
<td>Up to 8Gb/s</td>
</tr>
<tr>
<td>Investment</td>
<td>Low to Medium – may use existing IP network</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>IT Expertise</td>
<td>Medium – requires some storage and IP X-training</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

**Address uses 223 byte URL-style field, UTF-8 encoded
++Addressable to over 15M devices
Applications and Environments

Shared and switched 6Gb/s SAS support:

- Storage for high density servers and blade systems
- Server and desktop virtualization
- Database, data warehouse and business analytics
- Email, messaging and collaboration
- Application and server clustering
- Disk-to-disk backup/restore; Data protection appliances
- Video and multi-media streaming, security or gaming surveillance, seismic analysis
- Scale out NAS, object and cloud storage solutions

Source: Making the Switch to Shared 6G/s SAS Storage
Greg Schulz, Server and StorageIO Group
High Density Servers

- High Availability
- High Bandwidth
  - Latency ~100ns per step
- Scales to 100’s of drives
- Ease of setup – reduce cable confusion
- Central Management thru Switch
- SAS Zoning to isolate storage to servers
- Rack or Room, Blades, External Storage System

All Connections are SAS x4
Test Setup:

- Six servers w/ single 2.26GHz processor
  - Two 6Gb/s SAS HBA per server
- One 16-port 6Gb/s SAS Switch
- Eight 6Gb/s SAS JBOD
  - (96) 146GB 6Gb/s SAS Hard Disk Drives
  - HDD limit of 1000 LBA thus avoiding Seek operations
- Iometer 2006 in client/server configuration
  - IO Queue Depth of 8

Results

- 6 Servers (2 HBA each) to 4 JBOD pairs w/ 24 HDD per pair
- 7,820 MB/s Read ~ 8,069MB/s Write

Source: Switched SAS – Shareable, Scalable SAS Infrastructure
Terry Gibbons, LSI Corporation
Virtualization

- Multiple Servers
- Multiple VM’s each

- Bandwidth issue?
- Mobility manager moves VM instance to new server

- VM Images on Disk
- Accessible to all servers
- Metadata on Disk for identification
Managing Storage Options

- Is the data hot, warm, or cool?
- Database, data mining, HPC
  - Use SSD to maximize IOPS
  - Especially 2KB-16KB blocks
- Performance is important but not critical
  - Use SAS HDD at the next immediate level
- Data warehouse
  - High capacity SATA HDD
Sample Model

- Create primary database
- Replicate over Private Network
- Use SAS to enhance efficiency of updating change logs (high IOPS/low latency)
- Use SAS for additional backup paths (note the intent is orange to orange and blue to blue)
- Currently – different Racks w/ 25m Active Copper
- Future – different Rooms w/ 100m Optical Cable
Infrastructure Improvements

- Replacement for traditional DAS
  - Save Power
    - No need to purchase servers to acquire storage
    - Activate only the storage required for the task at hand
    - SAS Switch – economical 3.1W/port

- Improve throughput, reduce protocol controllers and cables
  - No protocol translation for SAS or SATA within storage unit
  - 4 cables, max raw throughput
    - SAS = 9,600MB/s; FC = 3,200MB/s; 1GbE iSCSI = 400MB/s

- Lower cost**: SAS $-per-MB/s 10% of iSCSI; 20% of FC

- Management from Switch
  - Add/Subtract or re-Zone storage with no reliance on servers
  - Let the Switch manage the cabled connections

**Source: Channel Host Interface Positioning Guide
LSI Corporation
Summary

- Applications and storage media are changing thus requiring new solutions
- Low latency of SAS Expanders, high IO processing capability of SAS IO Controllers, and 4-wide cables for throughput make SAS a strong choice for intense workloads
- Protocol changes delivered with 6Gb/s SAS have made Switch products achievable as opposed to custom built and limited
- Switched SAS allows a system integrator to match server traffic to storage needs especially in Racks and Blades
- SAS Switches simplify the topology, setup, and management thus reducing capital and operating expenses
Q&A / Feedback

Please send any questions or comments on this presentation to SNIA: trackstoragemgmt@snia.org

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