DS3500 – Product Hardware Overview

- Single or Dual-active, intelligent 6Gb/s x4 SAS controller architecture
- Two 6Gb/s x4 SAS host connectors per controller (standard)
- Optional host interface card adds additional connectivity
  - SAS HIC: Two 6 Gb/s x4 SAS connectors per controller
  - FC HIC: Four 8 Gb/s FC ports per controller
  - 1Gb/s iSCSI HIC: Four 1Gb/s iSCSI ports per controller
  - 10Gb/s iSCSI HIC: Two 10Gb/s iSCSI ports per controller
- Two 6 Gb/s x4 SAS drive-side connectors for capacity expansion
- Support for up to 192 drives per system
  - Intermix EXP3524 (2U/24) and EXP3512 (2U/12) expansion units
- 1GB (standard) or 2GB (optional) cache per controller
DS3500 Express Storage System

Two starting points to best meet storage infrastructure requirements

**DS3524**
Best suited for highest performance (SSD) and performance value (10K)

- (24) 2.5" SAS drives
- SSD, 15K, 10K, NL, SED

**DS3512**
Intermix high performance (15K) and highest capacity (3TB) drives

- (12) 3.5" SAS drives
- 15K, NL, SED
DS3500 Dual Controller Back View

Native SAS host ports only

1 Controllers
2 Power / cooling
DS3500 Controller – Back Panel w/ no Host Card

- (2) 6Gb/s x4 SAS host interface connector
- 6Gb/s SAS x4 drive expansion connector
- Serial
- Dual Ethernet connections
- Optional host interface card
Optional Host Interface Card

SAS Host card
• (2) 6Gb/s x4 SAS connectors

FC Host card
• (4) 8Gb/s FC ports

iSCSI Host Card
• (4) 1Gb/s iSCSI ports (shown)
• (2) 10Gb/s iSCSI ports
DS3500 Controller

Optional host card provides additional connectivity

Processor with imbedded XOR/P+Q RAID parity engine

DDR2 SDRAM cache memory is mirrored, battery backed and de-staged to flash upon power loss

CACHE Battery
DS3500 Expansion

**Systems can be built using same enclosure**

**Or intermix any combination to best meet requirements**

* Up to max enclosures (16) or drives (192)
Back-end Designed For High Availability

- When attaching enclosures, drive loops are configured as redundant pairs utilizing one port from each controller. This helps ensure data access in the event of a path/loop or controller failure.

- Top-down, bottom-up cabling ensures drives stay online.
SAS Drive Technology Options

- **Solid State Drives (SSD) – 2.5-inch**
  - Deliver highest performance and lowest latency
  - Ideally suited for highest-performance environments

- **15,000 RPM – 3.5-inch and 2.5-inch**
  - Deliver highest performance in traditional form factor (rotational)
  - Great fit for transactional environments not able to afford SSDs

- **10,000 RPM – 2.5-inch**
  - Exceptional price/performance, larger capacities, lower power/cooling
  - Great fit for cost-sensitive sites looking for performance value

- **7,200 RPM near-line (NL) – 3.5-inch and 2.5-inch**
  - Deliver highest capacities and best price-per-gigabyte
  - Best choice for data-intensive or cost-sensitive environments
## Drive Capacities (GB)

<table>
<thead>
<tr>
<th></th>
<th>DS3524 / EXP3524</th>
<th>DS3512 / EXP3512</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Type</td>
<td>Drive Capacity</td>
<td>Drive Capacity</td>
</tr>
<tr>
<td>SSD</td>
<td>200/400 GB</td>
<td>---</td>
</tr>
<tr>
<td>15K SAS</td>
<td>146 GB</td>
<td>300/450/600 GB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600 GB SED</td>
</tr>
<tr>
<td>10K SAS</td>
<td>300/600/900 GB</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>300 GB SED</td>
<td></td>
</tr>
<tr>
<td>NL-SAS</td>
<td>500/1000 GB</td>
<td>1000/2000/3000 GB</td>
</tr>
</tbody>
</table>

(24) 2.5” drives in 2U
(12) 3.5” drives in 2U

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Drive Capacities (GB)

- SSD: 200/400 GB, ---
- 15K SAS: 146 GB, 300/450/600 GB, 600 GB SED
- 10K SAS: 300/600/900 GB, ---
- NL-SAS: 500/1000 GB, 1000/2000/3000 GB

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## DS3500 Performance Comparing Base And Turbo

<table>
<thead>
<tr>
<th>Dual controller results</th>
<th>DS3500 Base Performance</th>
<th>DS3500 Turbo Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burst I/O rate cache reads</td>
<td>140,000 IOPS</td>
<td>200,000 IOPS*</td>
</tr>
<tr>
<td>Sustained I/O rate disk reads</td>
<td>30,000 IOPS</td>
<td>65,000 IOPS</td>
</tr>
<tr>
<td>Sustained I/O rate disk writes</td>
<td>7,500 IOPS</td>
<td>15,000 IOPS</td>
</tr>
<tr>
<td>Drives</td>
<td>96</td>
<td>192</td>
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<tr>
<td>Burst throughput cache read</td>
<td>2,500 MB/s</td>
<td>5,000 MB/s</td>
</tr>
<tr>
<td>Sustained throughput disk read</td>
<td>2,000 MB/s</td>
<td>4,000 MB/s</td>
</tr>
<tr>
<td>Sustained throughput disk write</td>
<td>1,100 MB/s</td>
<td>2,200 MB/s</td>
</tr>
<tr>
<td>Host ports</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

*Max cache IOPS requires SAS host card
## DS3500 Performance by Host Interface (Turbo Performance)

<table>
<thead>
<tr>
<th>Dual controller results</th>
<th>6 Gb/s SAS host card* Turbo performance</th>
<th>1 Gb/s iSCSI host card Turbo performance</th>
<th>10 Gb/s iSCSI host card Turbo performance</th>
<th>8Gb FC host card Turbo performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burst I/O rate cache reads</td>
<td>200,000 IOPS</td>
<td>74,000 IOPS</td>
<td>74,000 IOPS</td>
<td>170,000 IOPS</td>
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<td>Sustained I/O rate disk reads</td>
<td>65,000 IOPS</td>
<td>38,000 IOPS</td>
<td>38,000 IOPS</td>
<td>65,000 IOPS</td>
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<tr>
<td>Sustained I/O rate disk writes</td>
<td>15,000 IOPS</td>
<td>13,000 IOPS</td>
<td>13,000 IOPS</td>
<td>15,000 IOPS</td>
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<tr>
<td>Drives (192 15K SAS)</td>
<td>192</td>
<td>192</td>
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<tr>
<td>Sustained throughput disk read</td>
<td>4,000 MB/s</td>
<td>900 MB/s</td>
<td>4,000 MB/s</td>
<td>4,000 MB/s</td>
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<tr>
<td>Sustained throughput disk write</td>
<td>2,200 MB/s</td>
<td>900 MB/s</td>
<td>2,200 MB/s</td>
<td>2,200 MB/s</td>
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<tr>
<td>Host ports</td>
<td>4</td>
<td>8</td>
<td>4</td>
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</tr>
</tbody>
</table>

* SAS host card only. Native SAS host ports were not utilized in this test.
## Feature/Platform Map

<table>
<thead>
<tr>
<th>Feature</th>
<th>DS5020 / DS3950</th>
<th>DS3500 / DCS3700</th>
<th>DS5100 / DS5300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Disk Pooling</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Thin Provisioning</td>
<td></td>
<td></td>
<td>✓</td>
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<tr>
<td>ALUA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>VAAI (VMware integration)</td>
<td>Future</td>
<td>✓</td>
<td>Future</td>
</tr>
<tr>
<td>Try-&amp;-Buy Licensing</td>
<td></td>
<td></td>
<td>✓</td>
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<tr>
<td><strong>PREMIUM FEATURES</strong></td>
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<tr>
<td>Enhanced FlashCopy:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Increased scalability</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• Consistency Groups</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• Rollback (Legacy and Enhanced FC)</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>• Try &amp; Buy available on Enhanced FC</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
24-drive pool example

- Logical Drive made up of one or more D-Chunks (different colors)
- Each D-Chunk is 4GB in a 8+2 RAID 6 (512MB pieces)
- Each D-Chunk corresponds to a single logical drive
Dynamic Disk Pools (DDP) Benefits Summary

**Traditional RAID Drive Rebuilds Eliminated**
- Data is automatically rebalanced across drive pool
- Addresses ever-growing drive capacities

**Improved Performance**
- Automated load balancing
- Maintains performance under drive failure

**Simple Configuration Low Maintenance**
- Automatic expansion
- No hot spares
- No RAID groups
- No dedicated parity drives

**DDP delivers a lower Total Cost of Ownership**
Traditional RAID Logical Drives

- Disk drives organized into Arrays (RAID groups)
- Logical Drives reside across the drives in an Array
  - Performance is dictated by number of spindles
- Hot spares sit idle until a drive fails
- Spare capacity is “stranded”

24-drive system with (2) 10-drive Arrays (8+2) and (4) hot spares
Traditional RAID – Drive Failure

- Data is recreated on hot spare
  - Single drive responsible for all writes (bottleneck)
  - Recreation happens linearly (one stripe at a time)

- All Logical Drives in that Array are significantly impacted

24-drive system with (2) 10-drive Array (8+2) and (4) hot spares
DDP Logical Drives

- Each logical drive’s data, protection information and spare capacity is distributed across all drives in disk pool
- All drives are active; none are idle
- Spare capacity is available to all Logical Drives

24-drive system with single 24-drive pool
DDP – Drive Failure

- Data is reconstructed throughout the disk pool
  - All drives share responsibility for writes
  - Operations run in parallel
  - Up to 1000X faster return to optimal condition
Additional Resources for End-users and Business Partners

- **End-users**
  - [www.ibmdsstorage.com](http://www.ibmdsstorage.com)

- **IBM Business Partners**
  - [www.ibmdsseries.com](http://www.ibmdsseries.com)