LSI – Preparing for Petascale Computing

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2005 LSI Revenue Profile

- LSI Storage: $1.3B
- Storage Systems: 35%
- Storage Semiconductors: 32%
- Consumer: 18%
- Legacy Communications: 15%
- LSI Consumer: $350M

Total LSI Revenue = $1.92B
LSI Storage Growth

Revenue ($M)

2002 2003 2004 2005

LSI Logic Confidential 2006
25 Years of Storage Innovation

Co-wrote SCSI industry specifications
Developed first SCSI protocol chip
First SCSI macro cell
First RISC-based SCSI chip
First PCI-Ultra2 SCSI chip
First dual channel PCI-Ultra2 SCSI chip
Achieved SNIA certification for SMI-S provider
Industry's first complete line of enterprise-class SANmark 2003 certification
Industry's first serial ATA enterprise storage
Debuted Hotscale™ technology
Native InfiniBand demonstration
Industry's first complete line of enterprise-class
First to validate Ultra320 interoperability
SANmark 2003 certification
Industry's first serial ATA enterprise storage
First SPC-1 results
Achieved SNIA certification for SMI-S provider
Shipped first production SAS silicon to leading OEMs
Industry's first 4 Gb/s Fibre Channel storage system
Shipped first SAS solution to the channel
Achieved industry’s first SAS Windows qualification
Sampled industry’s first PCI Express SAS controller

More than 180 Storage related patents issued and another 160 pending
Shipped over 300,000 storage systems
Over 40PB of Storage Systems installed in HEC Environments today

Same technology, same partners, different names…
LSI Storage Footprint

- **Systems**
- **Board Level**
- **Standard Silicon**
- **Custom Silicon**
Technology Roadmap – Industry View

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk Drive Interface</td>
<td>2 Gb FC</td>
<td>4 Gb FC</td>
<td>8 Gb FC</td>
<td>10Gb iSCSI</td>
</tr>
<tr>
<td>Disk Drive Interface</td>
<td>1.5 Gb SATA</td>
<td>3Gb SATA</td>
<td>6Gb SAS</td>
<td>6Gb SATA</td>
</tr>
<tr>
<td>Expansion Interface</td>
<td>2 Gb FC</td>
<td>4 Gb FC</td>
<td>8 Gb FC</td>
<td>10Gb iSCSI</td>
</tr>
<tr>
<td>Expansion Interface</td>
<td>3Gb SAS</td>
<td>6Gb SAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Host Interface</td>
<td>10Gb IB</td>
<td>20Gb DDR IB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Host Interface</td>
<td>1 Gb iSCSI</td>
<td>10Gb iSCSI</td>
<td>6Gb SAS</td>
<td></td>
</tr>
<tr>
<td>External Drive Form Factor</td>
<td>3.5” Low Profile (7.2K – 15K RPM)</td>
<td></td>
<td></td>
<td>2.5” High RPM</td>
</tr>
</tbody>
</table>
Technology Watch List “Planning Dashboard”

Visibility

Recognizing Value
- Guaranteed QoS
- Active-active host ports
- Storage processor based platforms
- Programmable Dual core storage
- Unified wire iSER & iWarp

Peak of Inflated Expectations
- Clustered & Grid Disk
- Specialized RAID Blades
- MetaLUNs
- Unified NAS/SAN
- 2 ½” Disk
- Thin Provisioning
- Server RAID for blades
- Embedded SMIS Provider

Doldrums of Early Deployment
- MAID
- Non-disruptive Data Movers
- ROC based Platforms

Gaining Traction
- Host IB
- Browser based
- Dense disk enclosures

Destined to be Mainstream
- Tiered Storage (Mixed disk)
- 2nd wave Replication futures
- Host IB

Source: IDC
Technology Trends

• The Fundamentals
  ▪ Power/Cooling
  ▪ Disk Density
  ▪ I/O Interfaces

• Innovation at the Fundamentals
  ▪ RDMA
  ▪ Multi-Core Processors
  ▪ Object Based Storage

• Data Management
  ▪ Continuous Data Protection (CDP)
  ▪ Predictive Failure Analysis (PFA)

• Standards
  ▪ Storage Bridge Bay
  ▪ IBTA+OFA
  ▪ T10, TCG, IEEE, DMTF, SNIA, OASIS, IETF, T11, T13
  ▪ Storage Performance Council (SPC)
Complete Data Protection Solutions

- Robustness
- Interoperability
- Common Management Software
- Scalability
- Investment Protection

PB 5-6
PB 4
PB 1-3
HBAs
SW RAID

SANtricity
MegaRAID

Manage
Protect
Move
Connect

LSI Logic Confidential 2006
SS3600 (PB 1-3) Enclosure

- 2U, 12 Drive SAS/SATA Enclosure
  - JBOD or drive expansion module SAS-SAS/SATA ESM
- Integrated controller module
  - 4Gb FC-to-SAS/SATA
  - 3Gb SAS-to-SAS/SATA
  - 1Gb iSCSI-to-SAS/SATA
- RoHS and WEEE compliant
## Modular Hardware Components (PB 4-6)

<table>
<thead>
<tr>
<th>Controller Module</th>
<th>Embedded Controller</th>
<th>Drive Module</th>
</tr>
</thead>
</table>
| • Dual-active controllers  
  • 8 host/SAN connections  
  • 8 drive loops  
  • Ethernet connections  
  • Hot-swappable FRUs | • Dual-active controllers  
  • 4 or 8 host/SAN connections  
  • 16 FC and/or SATA Drives  
  • Redundant pathing  
  • Hot-swappable FRUs | • 16 FC and/or SATA Drives  
  • Loop or switched architecture  
  • Redundant pathing  
  • Hot-swappable FRUs |

- **699x**
- **399x**
- **FC4600**
FC4600 – (PB 4-6) Enclosure

- 3U, 16 Drive, 3 ½” Drive Enclosure
- Integrated controller module or SBOD expansion
  - 4Gb FC
  - Infiniband
  - 16-Port Managed Switch
- Supports 2Gb and 4Gb Fibre Channel and/or 3Gb SATA drives.
- Drive CRU is common between PB13 and PB46
- RoHS and WEEE compliant
6998 FC4 Controller Module

- Four Host Connections
- Four Drive Connections
- ~2U Height
- RS232 Connection
- Dual Ethernet Connections
- Power switch and connection
6498 Infiniband Controller Module

- Using host daughter card technology
- Does not increase controller’s host-side bandwidth
- Limited release (HPC)
- Only for Linux (not all variants)
699x-ES Overview

• 6998 controller with embedded switch
  ▪ 16 external ports, 4 internal ports
  ▪ All ports capable of auto-negotiation

• Full fabric services and interoperability
  ▪ Supports WWN Zoning
  ▪ Compatible with other major switch vendors
  ▪ Will certify with an extensive compatibility matrix

• An easy-to-use interactive GUI for management
  ▪ Uses Ethernet port for management and configuration

• Does not increase controller’s host-side bandwidth
Finally

- New technology demonstrations at SC06
- Follow-on discussions?
Questions