Unique DDN and Lustre benefits

- **Performance**
  - More Performance Per Pipe and Per OSS
  - S2A directRaid does real time hardware Raid

- **Scalability**
  - Linear scalability with drive expansion
  - S2A enables Storage Network Scaling

- **QOS**
  - Unique True Active/Active Dual Controllers
  - Real Time Parity Check
  - The S2A can raid the JBODs too
  - S2A building blocks use up to 10 times less Disk Daisy Chaining
Unique DDN and Lustre benefits

- **Virtualization**
  - The S2A can export all Luns to All Ports and enable parallel access
  - True Lustre OST fail over
  - True Lustre Load Balancing via ALL ports

- **Lustre Network RAID1**
  - Log Based Lustre Network Raid1 can take advantage if S2A virtualization

- **OST Addition and Deletion**
  - S2A makes online OST addition and deletion agnostic from the storage side
Unique DDN and Lustre benefits

- Performance Enabling
  S2A directRaid can saturate the Host Pipes (FC or IB) & the disks

- Enabler of Failover and Load Balancing

- Best Internal and External bandwidth
  Less controllers and Servers to manage with higher bandwidth per server

- Best Cost ($/MB/s)

- Ease of management and Integration
Cheetah 1 FC
- Dual ported at 100MB/s
- 1GB capacity
- Sustained reads at 5MB/s
- 6.5mS full stroke seek
- Block reassign in ~1.5s

Cheetah 7 FC
- Dual ported at 200MB/s
- 300GB capacity
- Sustained reads at 50+MB/s
- 6.5mS full stroke seek
- Block reassign in ~2.5s

The challenge is to achieve dramatic performance increases with no change in disk random performance
High Performance Silicon Based Storage Controller

- Parallel access for hosts
- Parallel access to a large number of disk drives
- True performance aggregation
- Reliability from a parallel pool
- Quality of Service
- Scalability
- Drive error recovery in real time
- True State Machine Control
The S²A: Architecturally Unique

DDN S²A9500 Content Access: Host Parallelism and PowerLUNs

Like straws in a glass of water
• No Switching Latencies
• Greatly reduced Port contention
• No Striping Overhead
• Tested up to 53% improvements just due to host parallelism and PowerLUNs with only 8 hosts

Generic RAID SAN Architecture

• Congested, Complicated Fabrics
• Lots of Switching Latencies
• Lots of Port Contention
• Host Striping robs CPU Performance
• Small I/O size per Storage Device
• Many more components (higher complexity)
S2A9500 Basic Configuration

- PowerLUNs can span arbitrary number of Tiers
- directRAID
  - Equivalent READ & WRITE performance
  - No performance degradation in crippled mode
  - Tremendous back-end performance for very low-impact rebuild, disk scrubbing, etc.

- RAIDed Cache
- Parity Computed on Writes AND Reads
- Multi-Tier Storage Support, Fibre Channel, SATA and SAS Disks
- Up to 1250 disks total
- 1000 formattable disks
Modular Host Port Modules
- 4Gb/s FC, 10Gb/s IB
- PCI AS, Others

Modular Disk Port Modules
- Fibre-Channel
- SATA/SAS

RAID “3/5” 8+1
Byte Stripe
(Optional 8+2 in Development)
S2A9500 Large Capacity Scaling

Full JBOD Redundancy
SAFX248 SATA Chassis
- 48 Slots, 4U
- 480 Disks per Rack
- 240TB per Rack
Five and 20 Chassis Configuration

S2A9500 with

- Five 48-Slot JBODs
- Two Dual Loop per JBOD 240 Disks
- 120TB SATA using 500GB Drives

or

- Twenty 48-Slot JBODs
- Two Dual Loop per JBOD 960 Disks
- 480TB SATA using 500GB Drives
DDN vs. Generic Raid Scalability

**S2A**
- 20 48-Slot JBODs
- Single Daisy-Chain JBOD
- 960 Disks
- 480TB SATA

**4x Capacity**
**4x Simpler**
**2-Rack Footprint**

**Standard RAID**
- 16 14-Slot JBODs
- 224 Disks
- 112TB SATA

**Note:**
- 500GB SATA Disks
Technology Roadmap
• S2A9500 FC-4
  – 3 GB/sec aggregate bandwidth
  – Production Q4/05

• S2A9500 IB 4x (SRP)
  – 3 GB/sec aggregate bandwidth
  – Production Q4/05

• You can mix and match FC-4 and IB 4x host side pipes on an S2A9500
• Stage One: SAS/SATA Enabled Enclosure
  – Production in 12/05

• Stage Two: SAS/SATA Back End S2A
  – Production in Q2/06

• Stage Three: Integrated Virtual Drives
  – Production in Q2/07
• Stage One: SAS/SATA Enabled Enclosure
  – Production in 12/05

• Stage Two: SAS/SATA Back End S2A
  – Production in Q2/06

• Stage Three: Integrated Virtual Drives
  – Production in Q2/07
• 12GB/s sustained from each Couplet

• Virtual drives with distributed cache created from each 48 drive enclosure

• Virtual drives can be daisy chained for huge system capacity

• Internal bandwidth > 20GB/s/Singlet