WARP Mechanics ZFS Array
Lustre User Group 2013

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- Goal: Bring HPC technologies into non-HPC markets
- Current focus: ZFS and Lustre
- Historical customers: Hollywood studios
- Produce ZFS RAID arrays and turn-key HPC systems
Primary Value: ZFS Array

- OEM-quality hardware with ZFS controllers
- RAID and NAS modes
- Available as self-contained storage shelf or full system
- 1/10/40 GbE, 8/16 GbFC, QDR/FDR IB
Example ZFS RAID Implementation

• 4u allows 240TB HDD, or 120TB SSD, or a hybrid balance of HDD+SSD+NVRAM
• Footprint includes 2x PCIe g3 Sandy Bridge controllers
Example Implementation (cont.)

- **WARPraid 39800**
  - 60x 6Gbps SAS slots
  - Each slot may contain 4TB HDD, 2TB SSD, or 100k IOPS NVRAM
  - Each chassis has 2x controllers

- **Up to 240TB in 4u**

- **Controller 1**
  - QDR IB

- **Controller 2**
  - NVRAM
  - SSD
  - HDD

- **SAS**

- **ZIL**

- **L2ARC**

- **Primary Data Store**

- **[ ... ]**

- **TB HDD**

- **NVRAM**

- **Controllers**

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Do more with less ≠ OEM storage

• WARP 39810 Storage Matrix
  – MSRP starting from $60,000 → ~$0.25/GB
  – Maximum density - **240TB** raw per 4u shelf
  – Up to **2.4PB** raw per standard cabinet

• WARP 39820 Hybrid Matrix
  – MSRP starting from $120,000 → ~$0.50/GB
  – 10TB SSD cache + NVRAM write accelerators
  – Balance cost vs. performance - 200TB raw

• WARP 39830 Memory Matrix
  – MSRP starting from $600,000 → ~$0.60/IOPS
  – SSD performance & high capacity - **120TB** raw of pure SSD
  – Up to **1.2PB** raw per standard cabinet
  – Sustains >10 gigabytes/s, or >1M IOPS
Questions?
Expandable / flexible system

• The 39800 series supports numerous cost/performance configurations, interface types, advanced software features, and storage protocols
  – Starting at ~$0.25 per GB for archival HDD
    • About a quarter million USD per PB
  – Starting at ~$0.50 per GB for hybrid HDD+SSD+NVRAM
    • About a half million USD per fast PB
• Same 4u “building block” is the basis for numerous large scale WARP storage systems
Robust Logistics, Service; Support

- Delivered via major partners
  - Sanmina -- $6 Billion+
  - Hyve Solutions -- $10 Billion+

- Supported by WARP Mechanics plus escalation
  - Intel / WhamCloud Lustre
  - Nexenta ZFS
WARP Mechanics Approach

- How a ZFS RAID array connects to OSSs and cluster fabric
- Example shows two OSS / RAID HA pairs