Next Generation HPC Storage Initiative

Torben Kling Petersen, PhD
Lead Field Architect - HPC
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Unique and Deep Understanding of Storage Market

Networked Storage Solutions

Disk Drive Capital Equipment Technology

High Performance Storage Systems

Storage Infrastructure
Leading OEM Provider of Digital Storage Technology

- **SI: Largest independent supplier of Disk Drive Capital Equipment**
  - ~50% of w/w disk drives are produced utilizing Xyratex Technology
  - ~75% of w/w 3.5” LFF disk drives

- **NSS: Largest OEM Disk Storage System Supplier**
  - 33% WW OEM Market Share in 2009, 5 Tier-1 OEM’s
  - 16% of worldwide external storage capacity shipped in 2009 (IDC)
  - >3.0 Exabyte’s of storage shipped in 2010
  - ~139,000 storage enclosures shipped in 2010

2010 Revenue ($1,603M)

- $343
- $1,260

SI  NSS
Xyratex: Global Presence

Over 2150 Employees Worldwide
Global Customer Relationships

Strategic relationships established with both market & technology leaders
Xyratex in HPC

- Via our OEM base, Xyratex has had a successful history in supplying storage building blocks for HPC storage solutions

- In 2010, Xyratex shipped over 3.0 Exabytes of external storage capacity worldwide, ~750 Petabytes (25%) was deployed into HPC environments

- Benefits for our HPC OEMs:
  - 30+ years of storage technology development & innovation
  - Proven track record of overcoming storage integration challenges
  - Enables OEM Partners to focus on their core competencies
    - HPC Compute Expertise
    - Creates sustainable leadership & competitive advantages for their storage systems
    - Improved business flexibility via a global logistics capability

- Xyratex is making strategic investments to strengthen our HPC market position
  - Capabilities, Technology (Hardware & Software), Product Breadth & Scale
The ClusterStor Acquisition

- **ClusterStor**
  - Clustered File System start-up, led by the founder of Lustre – Dr. Peter Braam
  - World-class development team, deep Lustre expertise
    - Have 3 of top-5 Lustre developers in the world
  - Skilled technical staff with over a 100 years of combined Lustre experience

- **Xyratex Acquisition**
  - Dr. Braam and the ClusterStor team have joined Xyratex, where they will form a new File System development and support team
    - Attracting other key Lustre talent
      - Peter Bojanic, former head of Lustre at Sun/Oracle
      - Makia Manich, Isaac Huang, Nathan Rutman and others
  - Dr. Braam will lead this team as SVP of Storage Software
    - ~150 people worldwide
Strong Lustre Adoption Continues in Top500…

- Lustre’s share of Top 100 HPC sites is actually growing…
  - Now 8 of Top 10 Systems in Nov 2010
  - Now 65 of Top 100, up from 47 in previous year
Lustre Community – Xyratex’s Position

- Oracles position on Lustre has changed
  - Shut down all Lustre development efforts

- Xyratex is 100% committed to supporting Open Lustre in the Linux community and future roadmap
  - Key part of Xyratex long term strategy, supported by significant and ongoing investment
  - Industry leading Lustre architecture and development team led by Dr. Peter Braam and Peter Bojanic
  - Focused of Lustre 2.x, significant investment in stability/testing/quality
  - Development focused both on core Lustre file system features and application integration
  - Opportunity for Xyratex partners to influence Xyratex Lustre release/features/roadmap

- Lustre community is responding with a number of key initiatives both in the US and Europe

- US
  - HPCFS - (US, Europe and ASIA)- Founding member, Intel led
  - OpenSFS (US)- in process held up by IP ownership issues, DOE funding

- Europe
  - European Open File System SCE (OFS)- Founding Member
  - PRACE- partnering with CEA and Cines on Lustre based Exascale demonstration system
Xyratex – Truly Differentiated in the Lustre Market

**Designs, Develops and Tests the World’s Best Purpose Built Storage Platforms**

**OEM Business Model – Economies of Scale – Number 1 OEM Storage Supplier in the world (IDC)**

**Linux based Storage Appliance Middleware Development**

**World-Class Clustered File System Development & Support Expertise**

**Storage Cluster Management Framework**

*Unique Ability to Deliver and Support a “True” Lustre Appliance*
LNET Channel Bonding
LNET – Closer to the metal

Vendor Network Device Libraries
- Lustre Network Drivers (LNDs)
- Sun LNET Library
- Network I/O (NIO) API
- Lustre Request Processing

- Support for multiple network types including routing API
- Similar to Sandia Portals with some new features
- Move small and large buffers
- Use RDMA
- Generate events

Legend:
- API
- Not supplied by with Lustre software
- Not portable
- Portable Lustre component

Zero-copy marshalling libraries
Service framework and request dispatch
Connection and address naming
Generic recovery infrastructure
Channel bonding

- **Channel Bonding – Why ??**
  - LNet is network module designed to exchange messages between Lustre nodes.
  - Channel bounding is needed to extend network bandwidth between nodes, and to allow to send many messages parallel, each in own network channel.
  - Channel Bonding will also allow for redundancy in addition to improved bandwidth.

- **Some channel bounding modes already exists in Linux**
  - System bounding – some networks channels merged in single logical channel on system side and lustre see that as one channel with single address space.
  - LND based bounding – currently supported on sockInd (tcp network module). In that case nodes use extended HELO protocol to send all addresses from node to remote peer and peer a look to these addresses to send request in round robin order.

- None of these modes support a channels bonding between different network types such as IB and Ethernet networks.

- To avoid that problem we are developing an implementation of channel bonding inside the LNet module.
Other Xyratex enhancements to Lustre Open Source

- samba-xattr-fixes.patch - Improvements for xattr handling for Samba.
- quota-type-fix.patch - Allows Lustre 2.0 to be started on top of an 1.8 FS with quota enabled.
- obd-device-list.patch - Allows more than 8192 obd devices per host.
- mdt statistics - two patches related to speeding up mdt performance
- patches related to backup / restore 2.x FS.
- patches related to build process – Specifically for ldiskfs / lustre / kernel requirements and build fixes.

Several other projects (such as Channel Bonding) is currently underway and the roadmap will be presented at LUG2011 in Orlando (April 12-14th).