



# Integrating Array Management into Lustre

#### **System Fabric Works**

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#### **Topics**

- Lustre Adoption Barriers
- Wider Lustre Adoption
- Integration of Lustre with Other Components and Functions
  - Integrating NetApp's E-Series Disk Arrays / Santricity with Intel®
    Enterprise Edition for Lustre (Intel EE Lustre)
  - Screen Shots
- Summary



#### Lustre Adoption Barriers

- Until recently, Lustre has been solely focused at supercomputers and large-scale tech-savvy enterprise customers
  - Lustre performance was wasted on smaller configurations
  - Lustre deployment/operation cost was high
  - Lustre feature set was missing key capabilities for general usage
    - Native clients for "other than Linux" operating systems
    - Effective support for tiered storage (HSM, SSDs, tape)
  - Lustre was not simple to deploy and operate
    - Command line biased interface
    - Experts required
  - Lustre wasn't a fully integrated storage solution
    - Lustre uses storage hardware, Linux servers for OSS and MDS functions, and switches
    - Separate tools needed to monitor each component

Lustre has historically been a very-high performance niche file system



#### Wider Lustre Adoption

- Recent developments have added to Lustre's functionality
  - New features (notably HSM) create good reasons to deploy Lustre even when performance requirements are modest
- New technologies and tools are making Lustre easier/less expensive to deploy and operate
  - Virtualization makes it practical to build smaller Lustre configurations
  - New Lustre releases (notably Intel's Enterprise Edition) are focused on improving ease of Lustre deployment and usage
    - Possible to use a GUI for most actions
  - Vendors are integrating monitoring of other components and functions into Lustre tools
- More systems and applications require high performance file systems

The obvious barriers to Lustre adoption are being addressed



# Integration of Lustre with Other Components and Functions

- "Single pane of glass" is beneficial for system monitoring
  - Key requirement is to alert and inform system operator
  - Errors are easier to notice using a single tool
- "Good" Lustre operational monitoring doesn't need to replicate every low level capability for components
  - Experts on individual components (storage, server, network) can use their own tools to address problems
  - Goal is not to replace all tools for all uses goal is to provide sufficient visibility to:
    - Alert user
    - Assist in determining when additional steps are needed
    - Assist in showing where to start/who to call

"Single pane of glass" provides a better operations perspective

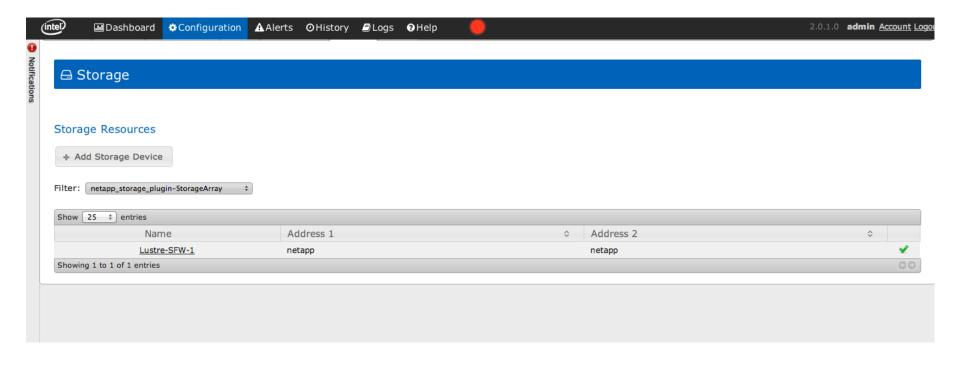


#### Integrating Santricity with Intel EE Lustre

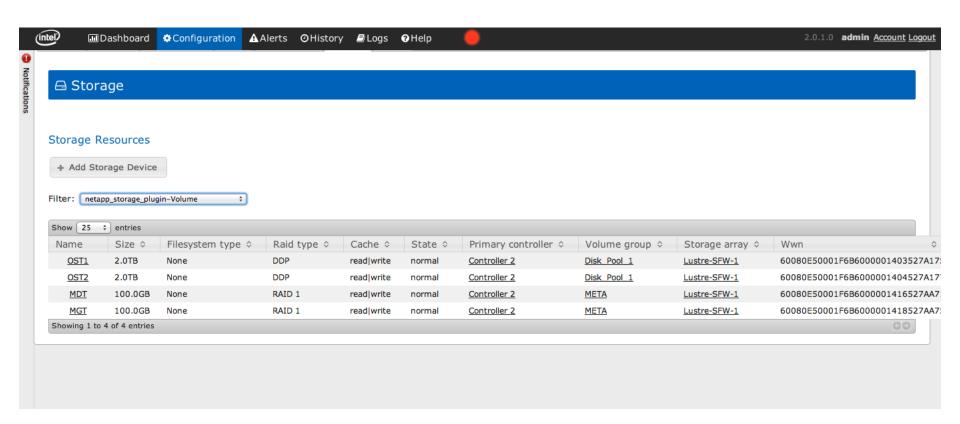
- NetApp E-Series storage has a long history with large Lustre deployments (e.g. LLNL)
  - Management/monitoring of NetApp arrays traditionally performed using NetApp's Santricity software
- NetApp now provides an Intel EE Lustre plug-in for monitoring the health and performance of NetApp E-Series storage
  - NetApp originally built the plug-in for Whamcloud Chroma
  - NetApp funded SFW to update the plug-in for Intel EE Lustre
  - SFW work just completed, plug-in available
  - NetApp plug-in monitors the health/performance of storage arrays and volumes (screen shots follow)

NetApp E-Series supports an Intel EE Lustre management plug-in

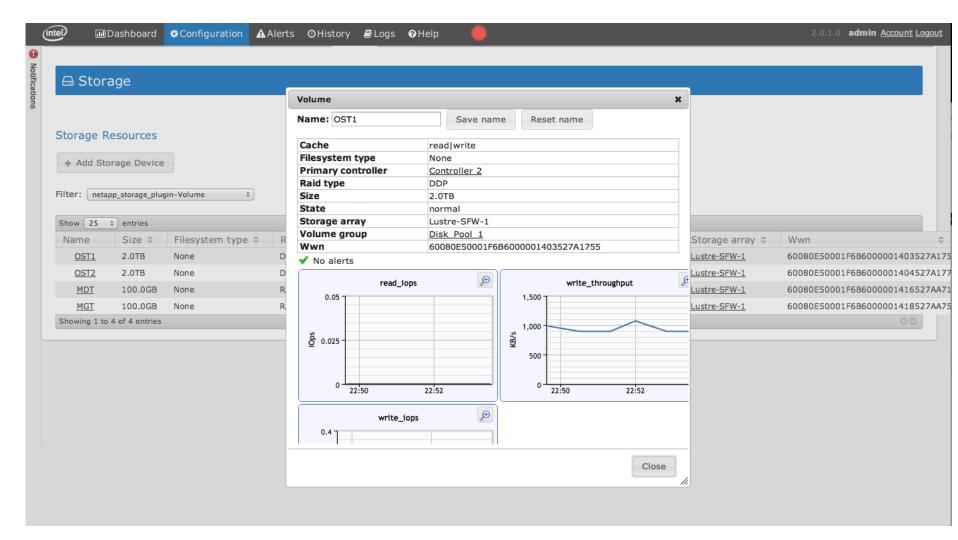




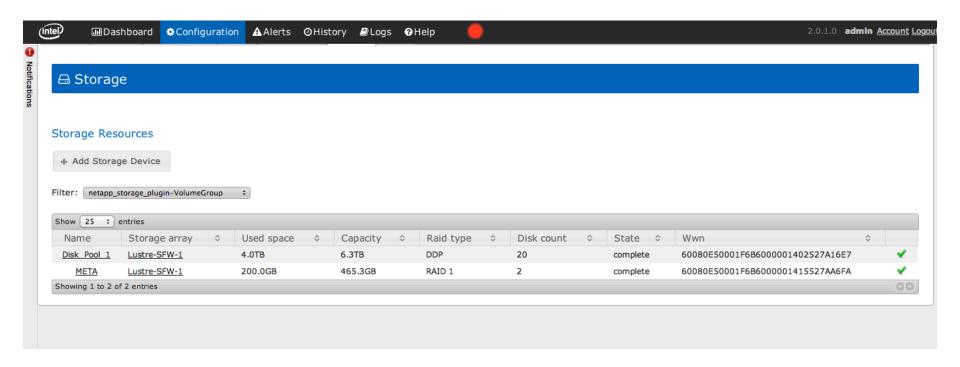




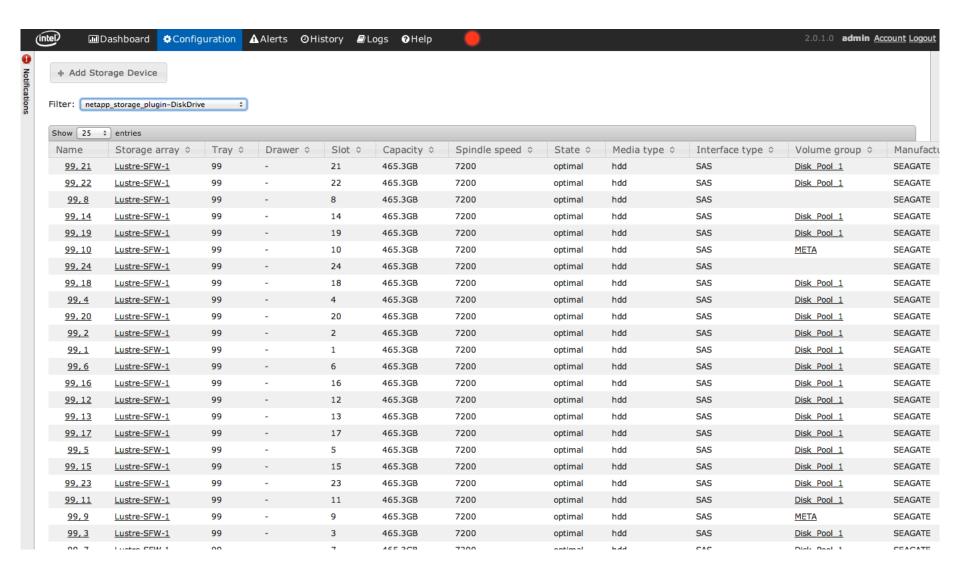




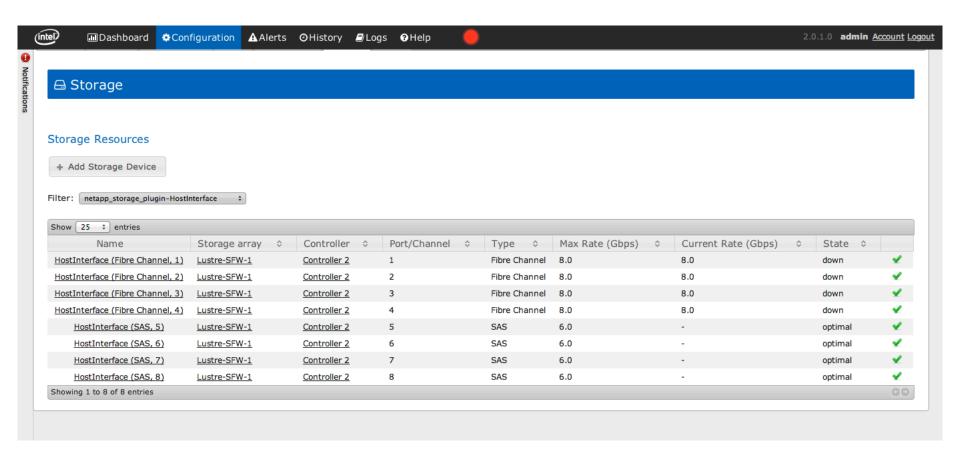




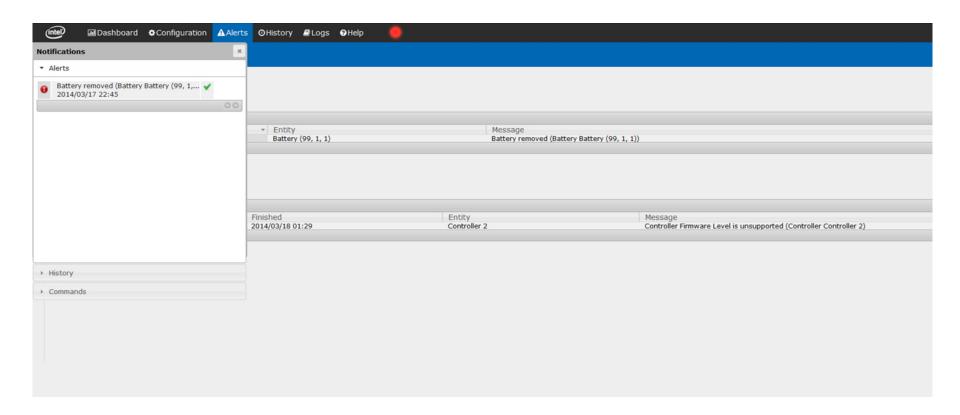




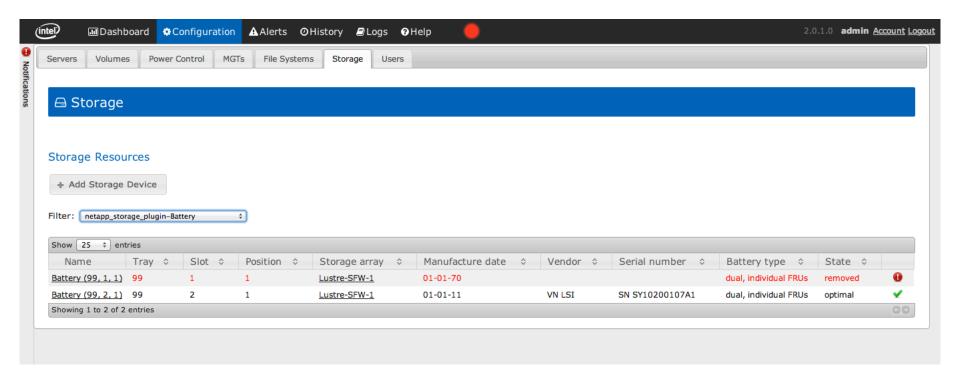














#### Summary

- Lustre historically has been limited to the niche role of a very high-performance file system
- Lustre will expand into other roles as barriers to adoption are addressed and functionality is added
- Intel EE for Lustre Plug-ins address a significant adoption barrier by improving ease of use
  - SFW has implemented a NetApp plug-in for Intel EE Lustre
  - Additional plug-ins for storage, networks, and servers are encouraged

Lustre plug-ins connect deep component-level reporting with the Intel EE Lustre dashboard for consolidated, smart monitoring