SDSS: Peta-scale Storage for Very High End Computing

Collaborative Research

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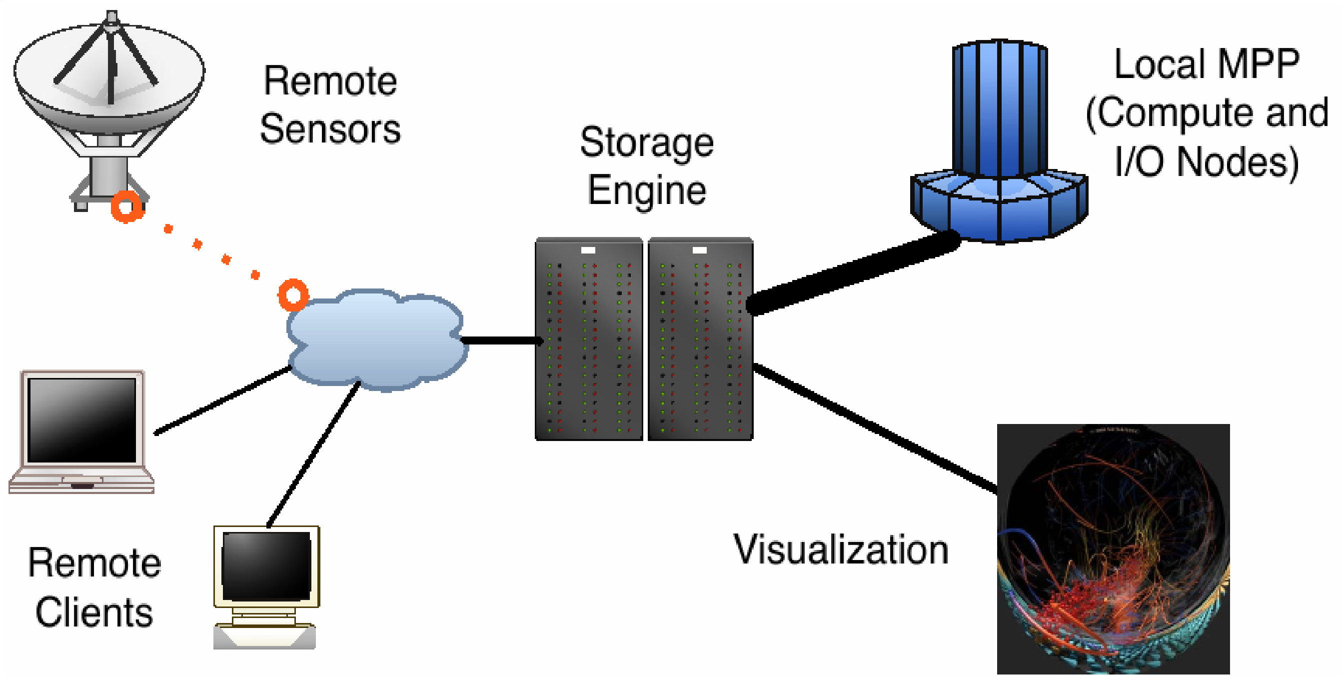


Research Challenges:

- \# clients vs. limited # nodes in I/O partition
- balance b/w utilization across system for scalability

=> address mismatch between current point-to-point, file-based I/O and the actual needs of data-intensive HPC applications

Solution Approach: LWFS and I/O Graphs

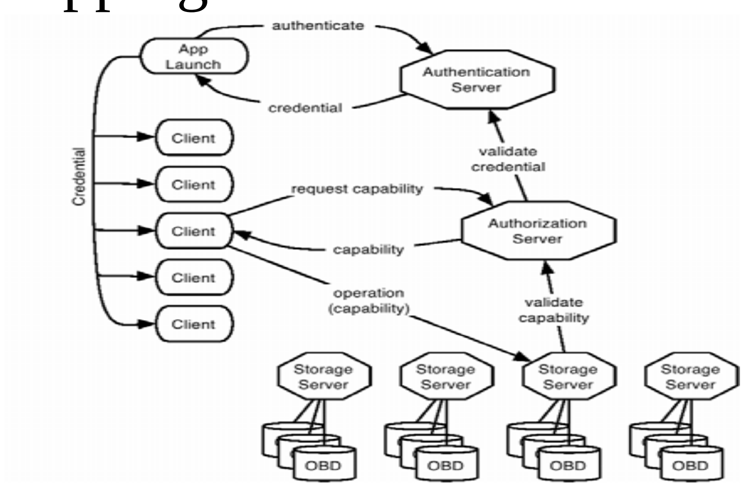
Rich application(-specific), customizable I/O structure:

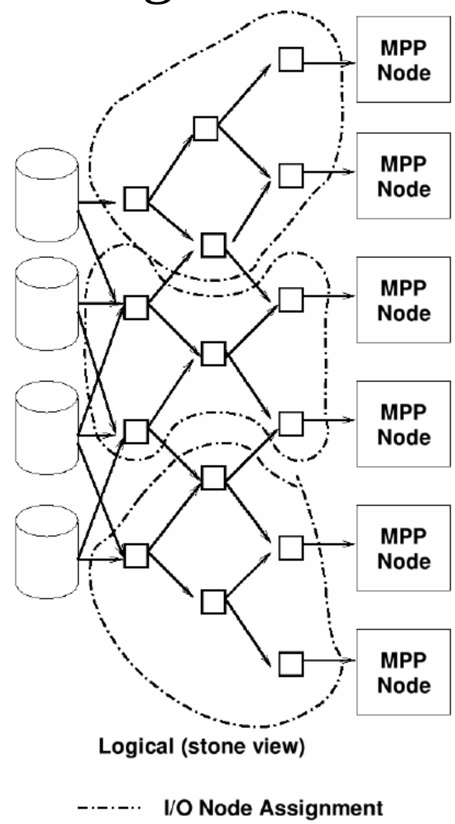
LWFS: Light Weight File System:

- asynchronous or off-line processing of file/storage actions

I/O Graphs:

- explicitly represent I/O tasks and their mapping to MPP and I/O nodes





Key Elements of Solution Approach

Addressing scalability challenges:

- prohibit system-imposed functions requiring O(n) functions (n = #client nodes)
- prohibit data structures of size O(n) (e.g., no connection-based mechs.)

New tools to `upgrade’ from lightweight nature of I/O system:

- deal with differing storage organizations
- enhance metadata associated with I/O data and actions
- ensure performance and QoS requirements of I/O

Proposed SDSS System

- I/O described as ‘structured events’ manipulated by dynamic flow graphs (i.e., I/O Graphs)

- I/O Graphs ‘connect’ simulation components with I/O subsystem; created, configured, removed dynamically; mapped automatically

- I/O Graph nodes implement application-specific I/O services (e.g., data staging); managed automatically

- I/O Graphs are integrated with LWFS, in fact, they perform some of the actions required by LWFS (e.g., consistency management done by transaction managers)

- I/O Graphs can operate asynchronously and concurrently (e.g., use of MetaBots)

Implementation

- SDSS extends, not replaces, existing back-end storage/file systems (e.g., LWFS) and HPC transport protocols (e.g., portals)
- SDSS uses efficient binary representation of metadata (e.g., PBIO)
- SDSS interoperates with other systems (e.g., Lustre)
- SDSS will run on realistic machines (e.g., ORNL/Sandia machines) with realistic applications (e.g., fusion modeling, ORNL)

SDSS Team Capabilities

- UNM: Maccabe, Bridges, Widener
- Sandia: Oldfield (LWFS)

- Georgia Tech: Schwan, Eisenhauer, Wolf
- (ORNL: Klasky (Fusion Modeling))