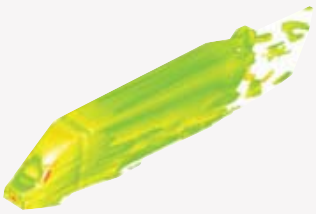
SOLUTIONS

FLUENT

ACTIVESTOR PARALLEL STORAGE FOR FLUENT

FLUENT with ActiveStor Storage Delivers 6x to 37x Performance Advantages Over NFS.



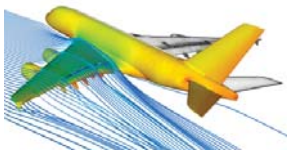
The combination of scalable ANSYS application software and HPC clusters with Panasas parallel storage has demonstrated new and significant productivity advantages for workflows in CAE applications. The benefits range from dramatic HPC cost-performance improvements to "non-practical" high-fidelity CAE simulation solutions on commodity clusters.

The Panasas and ANSYS alliance with joint engineering collaboration ensures that ANSYS technology and its user community achieve their ongoing CAE simulation, engineering and business objectives. Companies that deploy ANSYS applications and HPC clusters for high-fidelity CFD simulations, design optimization, fluid-structure coupling, and other complex requirements can be more productive, more profitable and attain greater market leadership when they deploy an ANSYS and Panasas solution.

I/O Bottlenecks in the CAE Workflow

As the CAE industry continues an aggressive platform migration from proprietary Unix servers to commodity HPC clusters, CAE models also become more realistic, requiring clusters to handle ever-increasing volumes of I/O and the movement of large files. As organizations rapidly expand their cluster deployments, many encounter I/O bottlenecks when using legacy network attached storage (NAS) architectures.

Initially these NAS systems offered advantages such as shared storage and simplified IT administration which reduced costs, but today few provide the scalability required for effective I/O performance in parallel CAE simulations. Recently a new class of shared parallel storage technology was developed to remove serial bottlenecks and scale I/O, therefore extending the overall scalability of CAE simulations on clusters.



Panasas parallel storage is the leading solution of parallel NAS and enables the most advanced and I/O demanding CAE challenges to become practical applications. Examples include high-fidelity transient CFD, large eddy simulation (LES), aero-coustics, large DOF structural dynamic response, parameterized non-deterministic CAE simulations for design optimization, and the coupling of CAE disciplines such as fluid-structure interaction (FSI).

CAE workflows are overburdened with lost productivity when engineers and scientists must wait for serial I/O operations and large file transfers to complete. Further, as simulation and workflow performance degrades, so does CAE analyst efficiency and effective workgroup collaboration. Panasas parallel storage eliminates the I/O bottlenecks with a cost-saving solution that restores productivity and drives analyst creativity.

FEATURES AND BENEFITS

PanFS Shared Parallel File System:

- **Enhanced CAE Workflow**
  Enables ease in collaboration tasks such as pre- and post-processing. Drives productivity for FLUENT throughput requirements of multi-job instances and coupling with FEA like ANSYS.

Panasas DirectFLOW Parallel Access Protocol and Support for NFS and CIFS:

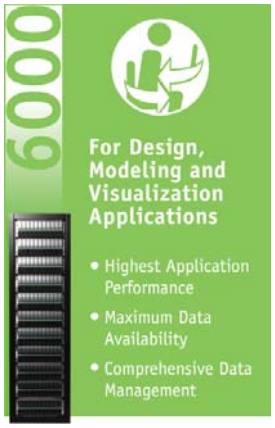
- **Maximum Performance**
  Shared storage for all data and platforms, with maximized performance for each protocol that is used for I/O transfer.

Single Global Namespace:

- **Reduces IT Overhead**
  Simplifies storage management, and provides seamless scalability as FLUENT model size and number of jobs grow.

ActiveStor Parallel Storage

ActiveStor parallel storage architecture combines key advantages of legacy NAS, yet eliminates the drawbacks that have made them unsuitable for large distributed clusters. ActiveStor storage offers the high-performance of direct access to disk, and the benefits of shared files and metadata. Just as clusters are designed to distribute computational work evenly across compute nodes, ActivStor parallel storage distributes data evenly across storage devices for shared parallel data access between cluster nodes and the parallel file system.

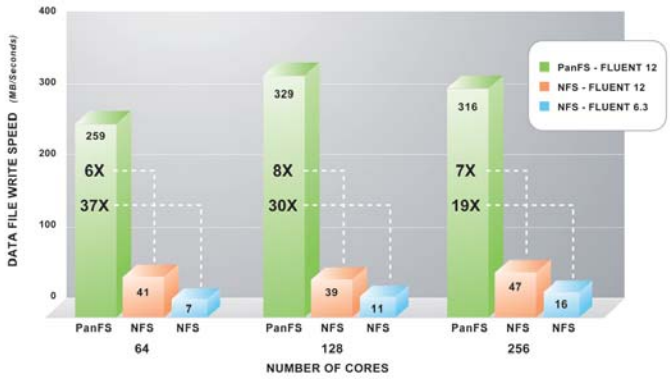


As CAE analysts continue to increase the number of compute cores per simulation, I/O operations must be performed in parallel to realize the essential benefits of overall simulation scalability. With Panasas ActiveStor storage, each node on a cluster has direct access to the shared storage and file system for concurrent data reads and writes during a computation. Once the simulation is complete, end-users have direct access to results on the same file system for post-processing and visualization, without the need for file to file transfer.

FLUENT Transient CFD and Parallel I/O

The benefits of ActiveStor parallel storage are demonstrated in an example of a transient CFD model using FLUENT, the market leading commercial CFD software from ANSYS Inc. (www.ansys.com). A parallel I/O scheme has been developed for FLUENT 12, based on MPI-IO under the MPI-2 standard. This enables overall FLUENT scalability for even the heaviest I/O applications, including large steady state models with frequent checkpoints, and more challenging transient CFD that can require 100 solution writes per single simulation.

A production FLUENT case of a 111-million cell, external-aerodynamics model of a truck vehicle was used as the baseline for the parallel I/O investigation that compares FLUENT 6.3 with serial I/O and FLUENT 12 with both serial and parallel I/O. The flow conditions were unsteady with a detached eddy simulation (DES) model for turbulence, and the pressure-based segregated solver is applied. The case was run for 5 time steps and 100 iterations (non-converged) on a Linux cluster using 64, 128, and 256 cores with an infiniband interconnect between cluster nodes, and using



ACTIVESTOR STORAGE WITH THE PANFS PARALLEL FILE SYSTEM CONSISTENTLY OUTPERFORMS NFS BY 6X – 37X WHEN RUNNING FLUENT SOFTWARE

Specifications

- **Application: Fluent v.6.3, v.12**
- **CPU: 8 GB memory per node; 4.6 TB total memory**
- **Interconnect: InfiniPath QLE7140 SDR HCAs: Silverstorm 9080 and 9240 switches**
- **Cluster: 2340 cores; 585 nodes Intel Woodcrest**
- **Storage File System: Panasas ActiveStor 5000/PanFS, 4 shelves, 20 TB capacity**

a conventional NAS with NFS. Although the conditions are unsteady, the solution file (.dat) is in the range of 15 GB to 19 GB (depending on which version of FLUENT), and is written only once at the conclusion of the 100 iterations.

The benefits of FLUENT 12 and parallel vs. serial I/O were demonstrated with concurrent writing of the local domain solutions into the global solution file on the PanFS parallel file system. FLUENT 12 for the case at 128 cores improved the .dat file write time about 8-fold over FLUENT 12 with serial I/O, and more importantly, about 30-fold over FLUENT 6.3. These gains mean maxmum utilization of the FLUENT application and the ability to grow model size and complexity without limitations on I/O scalability.

Engineers, migrating from FLUENT 6.3 to FLUENT 12 and using Panasas parallel storage, will observe as high as a 37-fold solution write speed-up for the truck model, making such large-scale unsteady CFD models practical applications.

For more information, contact us today at www.panasas.com or 1-888-PANASAS.

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