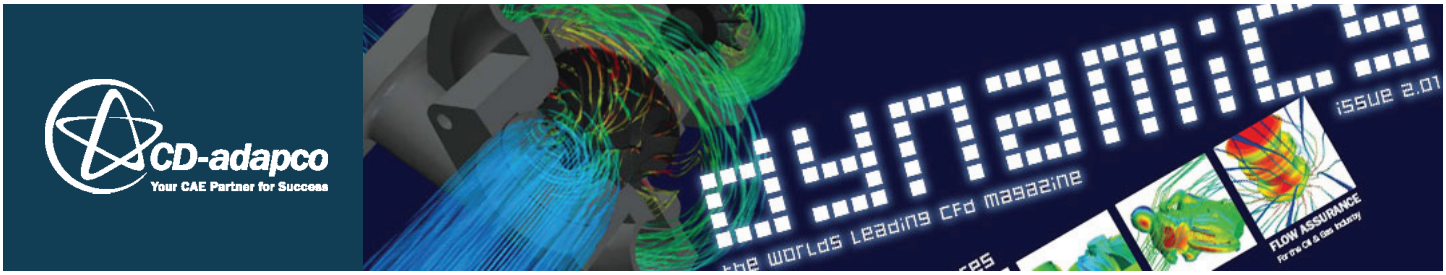

Gaining CAE Productivity with CD-adapco & Panasas

Panasas Parallel Storage Solutions Demonstrate Substantial Performance and Workflow Gains for STAR-CD Simulations

Stan Posey, Director of Vertical Marketing and Business Development, Panasas, Inc.

The combination of scalable STAR application software and Panasas parallel storage for Linux® clusters has demonstrated new and significant productivity advantages for CD-adapco customers. Recent tests demonstrate STAR-CD workflow benefits that include performance gains in 1) geometry partitioning; 2) simulation scalability; and 3) file-merging of results. The tests also show dramatic improvements in cost-performance.

Introduction: I/O Bottlenecks in CAE

The HPC market is undergoing an aggressive platform migration from proprietary supercomputers and Unix servers to Linux-based clusters. This is partly driven by organizations' desire to cost-effectively increase compute resources for technical applications. During this migration, many of the same organizations have also implemented network attached storage (NAS) architectures to simplify administration and further reduce costs.

While a NAS approach offers many advantages, it is often limited in the scalability required to effectively manage the I/O demands of parallel CAE applications. As such, a similar storage migration is now underway to replace legacy, serial NAS with parallel storage architectures and parallel file systems.

CD-adapco and Panasas offer a capability that scales I/O and overcomes serial NAS I/O bottlenecks – enabling high-fidelity CAE solutions that were previously impractical to run on clusters with conventional NFS/NAS implementations. With the scalability barrier removed, CD-adapco customers can proceed with a CAE applications roadmap of the most complex current and future HPC requirements.

Panasas developed this new class of parallel file system and storage technology that scales I/O in order to extend overall scalability of Linux clusters. Founded in 1999, Panasas identified the need for a parallel storage system capable of balancing capacity and performance growth while ensuring high availability and ease of management.

Panasas, Inc. founder and CTO Garth Gibson, a pioneer in RAID design, led the effort to develop an entirely new storage architecture that combines the key advantages of contemporary storage systems, yet eliminates the complexities and drawbacks that have made them unsuitable for large Linux cluster deployments. Today Panasas is a mid-sized global HPC technology company providing storage solutions to a variety of industries.

panasas®

Whether mapping the human genome, imaging the earth's substructure to find new energy reserves, or designing efficient automobiles and aircraft, data intensive HPC applications are placing immense pressure on computing and data storage environments. Linux clusters have evolved as the preferred computational solution in these environments. To generate true business value from these cluster computing advances, organizations require a scalable, easy-to-manage and cost-effective way to administer the large data sets at the core of these HPC applications.

Productivity Gains for STAR-CD

To address the large and growing I/O and data challenges for CAE applications, CD-adapco and Panasas developed a business and technology alliance with investments in scalable I/O. This joint focus ensures that STAR-CD simulations scale to their full potential for the range of CAE objectives and model fidelity, and that workflow collaboration is enhanced by reducing the time required for geometry partitioning, and for merging final results files for post-processing.

CD-adapco employs a parallel I/O scheme in STAR-CD v3.2 that leverages the Panasas® PanFS™ parallel file system for extended STAR-CD scalability and multi-job throughput. As CFD model sizes grow and cluster core counts are increased, I/O operations must be performed in parallel to realize the full benefits of scalable CFD.

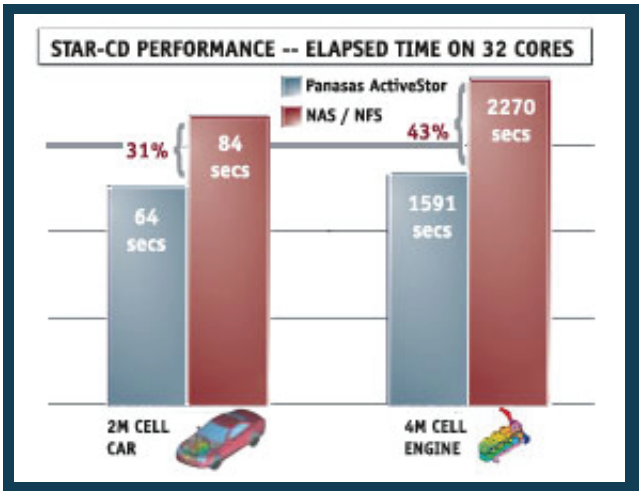

Figure 1: Panasas ActiveStor storage reduces solution time by 43% over traditional disk file systems

Panasas conducted STAR-CD tests for 2 million and 4 million cell cases. STAR-CD with parallel I/O combined with Panasas ActiveStor parallel storage, produced up to a 43% performance advantage at 32-core over a conventional NFS serial I/O scheme. Such gains mean 43% additional utilization of existing STAR-CD software licenses already purchased. Greater performance boosts are expected for model sizes beyond 4 million cells—a small size by today's industry practice. Detailed results of the 2M and 4M cell cases appear in Figure 1.

Panasas storage was successfully implemented to support Linux clusters at CD-adapco headquarters in Melville, NY, and at the Plymouth, MI site. Further investigation is underway of potential benefits from Panasas parallel storage to STAR-CD v4 and STAR-CCM+ v3.

ActiveStor Parallel I/O and Unified Storage

Today as expectations grow for Linux clusters to meet the demands of increasing fidelity in CAE modeling and simulation, the rapid growth of I/O requirements and data management in the CAE workflow are an increasing bottleneck. In particular, the use of legacy file systems such as NFS on serial NAS storage can actually increase overall job time as more compute cores are added, rather than provide the desired effect of scalability and faster job turn-around.

Panasas unified storage provides the benefits of a single namespace of shared storage. This system provides the foundation for a storage infrastructure that can be

ActiveStor Feature	STAR-CD Benefit
DirectFLOW® Protocol	**Maximizes Performance:** Parallel I/O enables faster CFD solutions from STAR-CD. **Maximizes Productivity:** Drives STAR-CD efficiency for single job scalability and multiple job throughput, and simplifies the coupling of STAR-CD with FEA software.
Unified Storage Infrastructure	**Empowers Collaboration:** Engineers can speed up collaboration tasks of pre- and postprocessing because of shared data and storage for all platforms.
Single Global Namespace	**Reduces IT Overhead:** Simplifies storage and data management to provide seamless scalability as STAR-CD model sizes and number of jobs grow.
NFS and CIFS Support	**Easy to Integrate:** Supports heterogenous CAE environments with Unix or Windows.

leveraged for parallel I/O and a unified CAE workflow, including all tasks of CAE computation and collaborative pre and post-processing.

The key advantage of Panasas storage over other solutions is in the file system architecture. Panasas is the market leader of object-based storage —the core principle of which is that data is managed in large virtual objects and not as small blocks or files. In this way, access of data control (metadata management) can be separated from the data path, allowing for parallel I/O access directly between cluster compute nodes and the Panasas parallel storage system.

The lost productivity and wait-time of serial I/O in the CAE workflow may not only degrade simulation performance, but may also inhibit workgroup collaboration. Further, if solutions are not implemented to scale I/O as CAE continues to advance, those simulations that produce the most I/O and data such as transient CFD, large eddy simulation (LES), fluid-structure interaction (FSI) through weak coupling, etc., will be limited in their impact on industrial-level applications.

Conclusion: HPC Innovation for CAE

Automotive, aerospace, and other manufacturing industries are striving to reduce design cycle times and costs; satisfy global regulations on safety and environmental concerns; develop military advancements; and respond to customers who demand high-quality, well-designed products. As such, the need for production deployment of STAR-CD and Linux clusters for high-fidelity CFD is one example of what drives Panasas' investments in parallel file system and storage technologies, and in ISV alliances with CAE software developers such as CD-adapco.

Effective and lasting market leadership is achieved for companies and organizations that leverage CAE technology innovation throughout their engineering and product development processes. Panasas' leadership in HPC storage systems, combined with a strategic business and technology alliance with CD-adapco ensure that STAR technology and its user community continue to achieve their ongoing CAE simulation objectives. Panasas invites you to learn more about how parallel storage can benefit your CAE workflow at www.panasas.com.

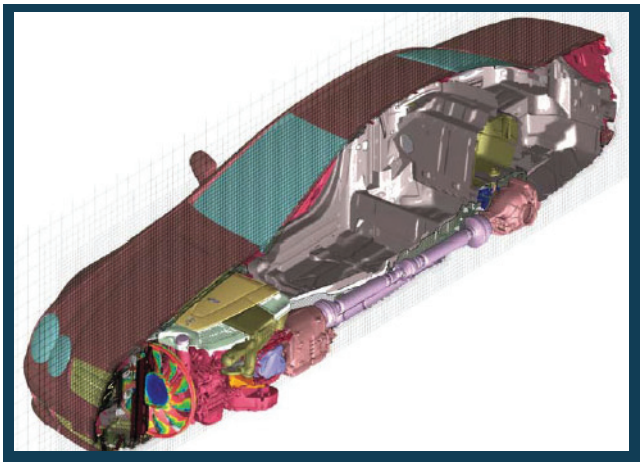

Figure 2: Underhood and underbody aerodynamic cooling study.

Accelerating Time to Results™

Corporate Office

6520 Kaiser Drive

Fremont, California 94555

Tel: 1.888.PANASAS

Fax: 510.608.4798

www.panasas.com

International Phone Numbers

US & Canada: 1.888.PANASAS

UK & France: 00 800.PANASAS2

Italy: 00 800.787.702

All Other Countries: +001 510.608.7790