

Cluster Computing with Windows CCS

Microsoft

New clustering technology from Microsoft speeds up engineering simulation.



By Barbara Hutchings, ANSYS, Inc.

The disciplines of computer-aided engineering (CAE) and high-performance computing (HPC) have been closely aligned and interdependent since the 1970s, when ANSYS, Inc. was founded. As software and hardware technologies have evolved, engineers who conduct simulation analysis have been among the beneficiaries. Recent advances in HPC have been particularly valuable, bringing down the cost of entry for small workgroups in need of large-scale computing capacity. In particular, cluster-based computers — based on x86/64-bit processors from Intel® and AMD — now represent over 50 percent of HPC solutions and provide enormous computing capacity for a fraction of the cost of previous-generation solutions. Working with Microsoft® and other partners, ANSYS, Inc. now is making clusters a more viable solution for Windows®-based customers through support of the Microsoft Windows Compute Cluster Server 2003 (Windows CCS) operating system.

The Argument for Clusters

Engineers who perform simulations in support of product development are well versed in the business drivers that make clusters attractive. Simply put, more computing capacity increases productivity along with the value that simulation brings to the product development process. By

reducing turnaround time, increased parallel computing capacity helps ensure that simulation results are available in a time frame that can impact engineering decisions. By enabling larger and more detailed simulations, computing systems with more memory (RAM) yield more accurate and more reliable results. Finally, by increasing throughput, a larger computing capacity enables the engineering team to simulate multiple design options while meeting schedule requirements. Clusters provide all three benefits — parallel speedup, large memory availability and capacity for high throughput — in a form that can be expanded over time as simulation needs expand.

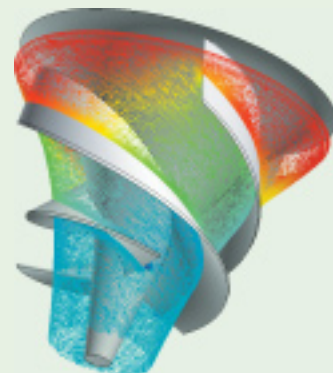
Given these benefits, it is not surprising that clusters are now the dominant platform for computational fluid dynamics (CFD) simulations using ANSYS CFX or FLUENT software, since these packages have, for many years, been designed for parallel speedup on clusters. More recently, with the release of version 11.0 technology from ANSYS, clusters have become a much stronger solution for finite element analysis (FEA) simulations as well. The new distributed memory solver in version 11.0 provides improved parallel scale-up. In addition, clusters are being used to increase throughput for parametric FEA analysis.

Early Adopters

Alden Research Laboratory, Inc., based in Massachusetts, U.S.A., is an acclaimed fluids flow engineering and environmental laboratory providing analytical, computational and physical flow modeling services. When the CFD team at Alden wanted to expand their analysis capacity, they turned to a cluster running FLUENT 6.3 software on Windows CCS. “We needed to increase our computing power in order to increase the number of FLUENT simulations we perform as well as to consider larger, more detailed models,” said Dan Gessler, Alden’s director of numeric modeling.

Using FLUENT software, Alden engineers simulate flow in advanced hydroturbine designs. For example, the Alden/Concepts NREC turbine team used flow modeling to maximize generating efficiency of the fish-friendly turbine. The unique turbine design has the lowest fish mortality for turbines in its class.

According to Charles Ulrich, Alden’s IT manager, “The ability to deploy a cluster using Windows CCS was very attractive for us, as it leverages our expertise and fits into our current computing environment. The deployment was quite smooth: We had our cluster up and running FLUENT software within two weeks. The integration of FLUENT with the Microsoft Job Scheduler is especially valuable, giving us the ability to manage and monitor multiple simulations on the cluster.”



Flow around a vertical axis runner, simulated using FLUENT software and Windows CCS
Image courtesy Alden Research Laboratory, Inc.

Windows Compute Cluster Server 2003

Windows CCS was released by Microsoft in 2006 to enable cluster computing within a Windows environment. Windows CCS is based on the Windows Server 2003 64-bit Standard Edition and leverages familiar Windows technologies, such as Active Directory, to provide authorization and authentication services on the cluster. In addition, Windows CCS provides cluster management utilities for deploying and administering the cluster as well as a built-in job scheduler to control and manage multiple tasks on the cluster. The combination of support for clustering and 64-bit memory addressing has made Windows CCS a very viable option for engineers using products from ANSYS who want to leverage their existing Windows infrastructure and expertise.

A typical cluster configuration involves one or more client systems (for example, desktop workstations) running the ANSYS Workbench platform. These clients submit compute tasks (solver jobs) to the cluster via the ANSYS Remote Solve Manager (RSM) and the Windows CCS Job Scheduler running on the cluster head node. For software not yet integrated within the ANSYS Workbench environment — such as the FLUENT 6.3 application — the process is very similar, with the FLUENT GUI running on the client systems and solve requests submitted to the Microsoft Job Scheduler on Windows CCS. Both version 11.0 from ANSYS and FLUENT 6.3 packages are fully integrated with the Windows CCS Job Scheduler, providing off-the-shelf management of jobs on the cluster.

Performance

The performance of ANSYS 11.0 and FLUENT 6.3 products on Windows CCS has been documented by Hewlett-Packard, and the results are very good. For FLUENT, parallel scaling is nearly linear with the number of processors on a correctly sized cluster and similar to

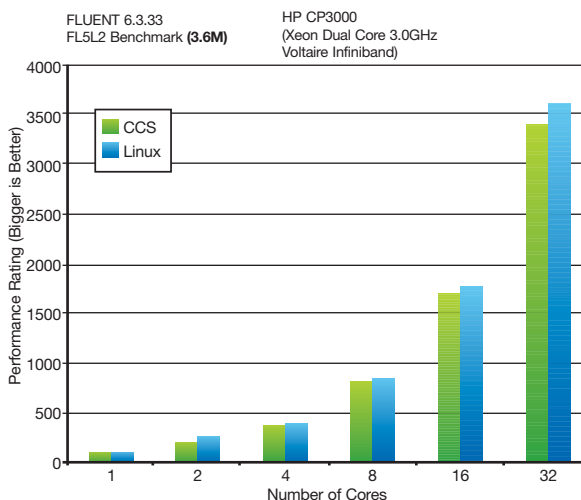


Figure 1. Performance of FLUENT 6.3 software using the HP-MPI (message passing interface) on a standard benchmark simulation of flow around a simple automotive sedan shape. The performance rating is comparable for Windows CCS and Linux. Results courtesy Hewlett-Packard.

performance on equivalent clusters running Linux®. Figure 1 shows performance of a typical FLUENT simulation involving 3.6M finite volume cells as the cluster size increases up to 16 processors (32 cores). As CPUs are added to the cluster, the simulation speed scales well — with a speedup of roughly 75 percent of ideal scaling on 32 cores. ANSYS 11.0 scaling on Windows CCS is shown in Figure 2, in which the benchmark suite yields a range of speedups depending on the solver and physics involved.

ANSYS and Microsoft

Microsoft and ANSYS have worked closely to ensure that Windows-based clusters are a strong solution for engineers using solutions from ANSYS, Inc. This engagement began and continues in the technical arena, with support from Microsoft for porting and tuning applications from ANSYS on Windows CCS. Feedback from ANSYS helps to define requirements and improve the combined offering. The resulting performance makes Windows CCS an excellent choice for expanding simulation capacity.

The two companies also are working together at customer sites, building a combined understanding of the details required to successfully deploy software from ANSYS on Windows CCS. Working with Microsoft, ANSYS has developed detailed guidance for customers on sizing the cluster, setting up the cluster and deploying engineering simulation software on the cluster with connection to desktop clients. Despite its very attractive price/performance ratio, cluster technology has a reputation for being a challenge to implement. By teaming up, ANSYS and Microsoft have improved their ability to respond promptly to questions and problems that customers encounter. Both organizations also are working with original equipment manufacturers (OEMs) — including Hewlett-Packard, IBM®, Dell®, SGI® and Sun®, as well as system integrators and resellers — to help streamline the delivery of complete Windows CCS solutions to engineering simulation customers. ■

For more information, email windowscs@ansys.com.

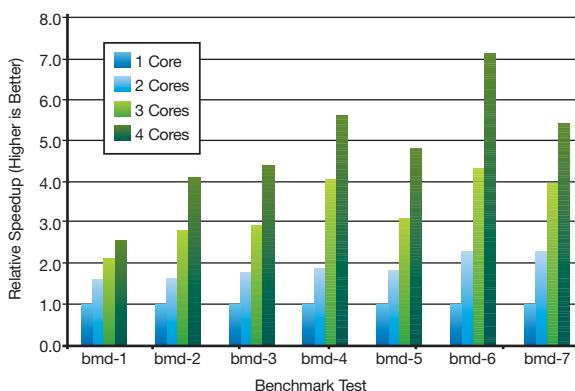


Figure 2. Performance of ANSYS 11.0 benchmarks as the processors count increases up to eight cores. The new Distributed ANSYS solver scales well on clusters. Results courtesy Hewlett-Packard.