Taming the HPC Queue

Parker Aerospace recruited workstations into a virtual server to deliver timely, robust designs.

By Kenneth Wong, CAD Industry Journalist, *Desktop Engineering*

At Parker Aerospace, the Enterprise Systems team faced a computational dilemma: Their high-performance computing (HPC) resources could barely keep up with the ever-increasing demand to process simulation applications. The aircraft system component developer uses ANSYS virtual engineering software to gain insight into air and fluid flow inside valves and pumps along with the effects of stress on them. "We're looking at hundreds to thousands of individual components, analyzed together as a unit," said Bob Deragisch, manager of Enterprise Systems at Parker Aerospace. "These are aircraft hydraulic and fuel systems that have to fly for 30 to 50 years and meet certification requirements. We test them for all foreseeable situations, all operating conditions."

The vast amount of calculation required for such work ruled out the use of individual workstations, leaving only the HPC server. A long job queue was the catalyst for supplementing the server's shortcomings with horsepower from engineers' workstations.

The group determined to turn a number of its workstations into a virtual cluster, powerful enough to share the burden with the dedicated HPC server. "I remembered SETI@home one day, and the answer to our problem came to me," said Deragisch. SETI@home is an ongoing scientific experiment that uses web-connected home-based computers to search for extraterrestrial intelligence. Researchers at the University of California at Berkeley bundle donated computing resources — unused CPU capacity — into a single virtual server, powerful enough to analyze huge amounts of data.

The success of the Parker Aerospace virtual cluster experiment positions the organization to deliver much more

"We realized that today's workstations are tremendously underutilized. We made a conscious decision to identify and execute a new strategy to achieve greater value from our hardware and software investments. We have significantly increased our throughput, and we are using all the available technologies at Parker Aerospace to expedite design decisions using ANSYS."

— Bob Deragisch, Manager of Enterprise Systems, Parker Aerospace robust designs within the same time frame, and it is now part of the company's IT strategy. The exercise was made possible by, among other things, the highly parallel nature of ANSYS software, Windows® HPC Server 2008 DCC (Distributed Computing Cluster) software, and assistance from Intel®, HP® and Microsoft®.

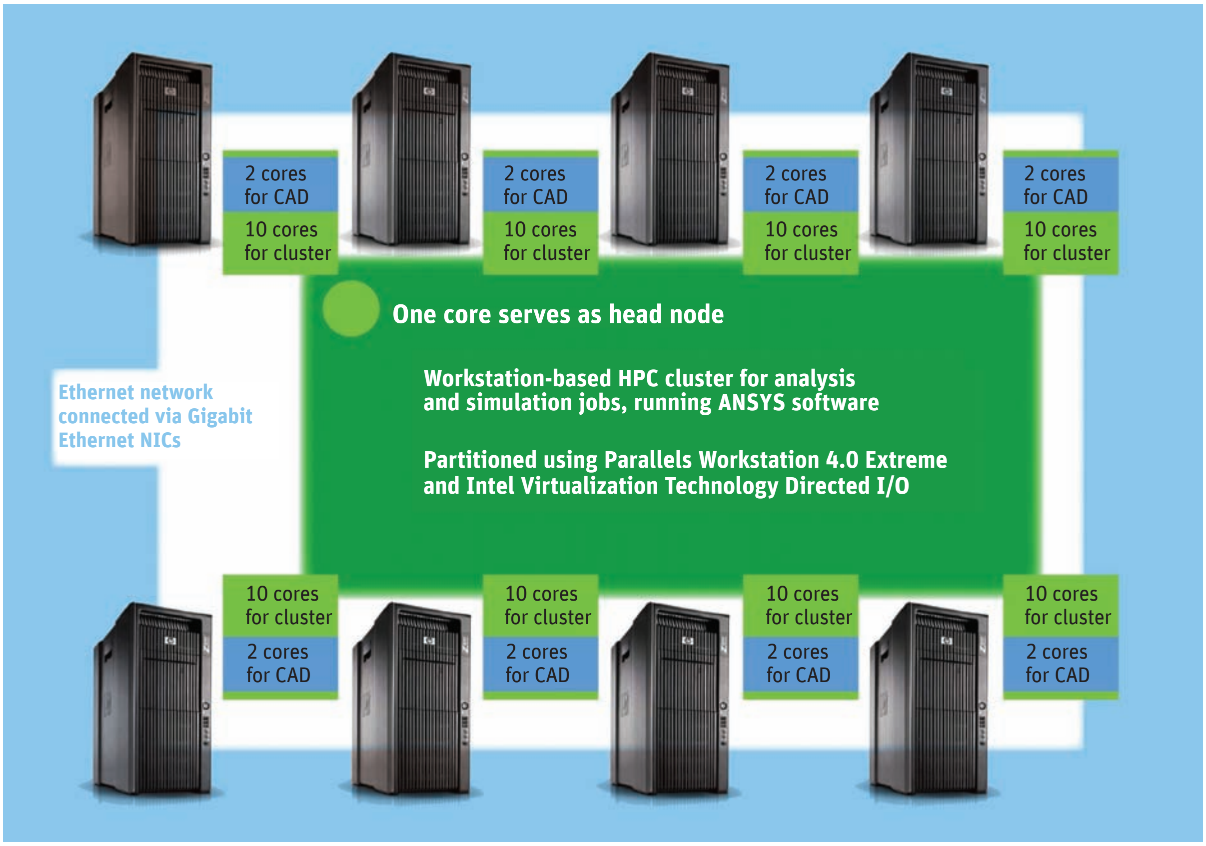
Parker Aerospace, part of Parker Hannifin Corporation, methodically applies engineering simulation to the products it designs: flight control, hydraulic, fuel, fluid conveyance, thermal management, and engine systems and components for aerospace and other high-technology markets. The organization uses ANSYS Mechanical, ANSYS CFX and ANSYS Icepak products for structural, fluids and electronics thermal management, respectively. Because of the way ANSYS HPC licensing is structured — designed to encourage customers to leverage computational power to examine designs from the system level, not just at the component level — Parker Aerospace gets extreme scalability at an incremental cost in an off-the-shelf package. "Some software we use becomes prohibitively expensive when running on dozens of cores, because we'll need a license for each core," said Deragisch. "The ANSYS HPC Pack licensing offered us a significant advantage."

Shorter Queues, Better Design

The supplementary computing capacity from the workstation-based cluster came at a modest investment in additional hardware. However, it freed up the dedicated HPC server to concentrate on larger jobs with fewer interruptions, and it allows the company to explore more design alternatives.

Once the cluster came online, Parker Aerospace engineers began to see relief in the bottleneck. Deragisch clarified: "On the basis of individual jobs, the workstation cluster offers little or no improvement, maybe even a slight degradation, compared with the HPC server. But it's not just about individual jobs; it's about substantially reducing the queue of jobs sitting on what was previously a single resource, by offloading small and medium jobs to the workstation-based cluster."

Parker Aerospace believes that effective deployment of HPC for its engineers will eventually lead to better designs, as users will be able to examine models with higher fidelity, greater mesh density and more geometric details — leading to a more accurate depiction of designs under consideration. In addition, the team can conduct simultaneous studies of multiple design iterations, allowing them to select the best



Workstation-based cluster of Multicore HP Z800 workstations with two six-core Intel Xeon 5600 processors (12 processing cores per machine) option. The affordable HPC setup means that the use of this technology is no longer confined to validating a concept, or proving that a product would perform as intended in practice. ■

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The Setup

Access to sophisticated HPC resources for computer-aided analysis and simulation may be as close as the workstations your organization uses for CAD. With HPC setups like the one at Parker Aerospace, designers and engineers can identify the most promising concepts in the early phase, then spend the rest of the development cycle perfecting the design.

"Workstations are becoming extremely powerful. They are cluster nodes in their own right," noted Deragisch. He estimated that adding additional processors to the workstations would be far less expensive than expanding the HPC server with additional racks or processors. His choice was the HP Z800 Workstation, equipped with a pair of six-core Intel® Xeon® 5600 processors. Each workstation node has two gigabit-ethernet switches connecting it to the network. Parker Aerospace dedicates one NIC to the enterprise network; the other acts as HPC fabric, enabling communication between workstations for jobs that use multiple machines.

The engineer's 3-D mechanical CAD software, which performs single-threaded operations most of the time, ate up 10 percent to 20 percent of the workstation's horsepower. So in each workstation, Deragisch reserved two to four cores for the engineer's primary workload. He delegated the remaining eight to 10 cores to the pool of computing resources that constitute the cluster. This workstation-based cluster's function was to process small and medium-sized jobs, relieving pressure on the HPC server.

Whereas most clusters are assembled in the UNIX® or Linux® environment, standard workstations almost always come with Windows Operating Systems (OS). The HP Z800 Workstation runs 64-bit Windows 7 OS. Therefore, Deragisch's solution was to use Windows HPC Server 2008 DCC, which lets users preserve Windows 7 on their desktops while the rest of their computing cores function as parts of an HPC cluster. Partitioning the virtual cluster into head nodes and processing nodes was done using Parallels® Workstation 4.0 Extreme (PWE) and Intel® Virtualization Technology for Directed I/O (Intel® VTd), which created an environment in which workstations could share resources.

"Parker Aerospace's simulation software is Microsoft HPC-enabled," observed Mike Long, technical solution specialist, Microsoft Technical Computing. "There's a built-in job scheduler in the HPC product that allows ANSYS product users to specify, via the graphical user interface, the number of cores they want to use." Long believes that building the cluster as a Windows environment gives users an advantage because "you start out with people who are already familiar with Windows, so they're not required to learn or to submit jobs to a UNIX or Linux cluster."

With HPC setups like the one at Parker Aerospace, designers and engineers can increase the amount of simulations they tackle, identify the most promising concepts in the early phase, and use simulation to perfect the design.

David Rich from Microsoft's technical computing division observed, "Certainly there are many engineering shops that don't have access to HPC today, because they struggle to justify buying a dedicated cluster. But if they get started using a cluster built on workstations, they will discover the significant return on investment when you combine HPC and engineering simulation."

HP Z800 Workstation with duel six-core Intel Xeon 5600 processors