University Finds Windows HPC Server Matches Linux in Validated SPEC Benchmarks

PERVASIVE TECHNOLOGY INSTITUTE
INDIANA UNIVERSITY

Customer: Indiana University
Website: www.iu.edu, www.pti.iu.edu
Customer Size: 75,000
Country or Region: United States
Industry: Education

Customer Profile
Indiana University, with campuses in Indianapolis, Bloomington, and across the state, is grounded in the liberal arts and sciences, and a leader in professional, medical, and technological education.

Software and Services
- Microsoft Server Product Portfolio
  - Windows HPC Server 2008

For more information about other Microsoft customer successes, please visit: www.microsoft.com/casestudies

"The most important takeaway from our research is that Windows HPC Server and Linux offer almost identical performance across a range of applications and cluster sizes up to 512 cores."

Craig A. Stewart, Executive Director, Pervasive Technology Institute and Associate Dean, Research Technologies, Indiana University

Indiana University (IU) ran the first published, validated high-performance computing (HPC) benchmarks on Windows HPC Server and Linux, and found the two perform about the same across applications and cluster sizes. But Windows HPC Server opens new possibilities when it comes to market options and use beyond the traditional science uses of HPC. IU is planning to implement Windows HPC Server in its overall HPC strategy.

Business Needs

Almost since the invention of electronic computing, Indiana University (IU) has been at the forefront of high-performance computing (HPC). The university's research center provided the access to a digital computer starting in the 1950s. During the 1970s, IU was a leader in use of Control Data Corp. systems, and then clusters of VAX and Prime systems in the 1980s. IU focused on bringing computing power to the broadest number of students and faculty to address the research issues they faced.

As part of its focus on real-world applications, IU in 2001 implemented the first 1 TFLOPS supercomputer owned by a U.S. university; the first distributed Linux cluster to achieve 1 TFLOPS on the HP Linpack Benchmark; and the Big Red cluster, which was the largest unclassified supercomputer in the western hemisphere in June of 2006. This interest in solutions that meet research needs led IU to consider HPC clustering with Windows HPC Server.

Ten years ago, the university was among the first to experiment with dual-boot computers running the Linux and Windows Server operating systems. The experiment was successful, but the early versions of HPC resources for Windows Server, as well

as the hardware to run that software, remained underpowered for massive applications in astronomy, physics, and other "hard" sciences. Linux remained the preferred platform for such advanced research.

But university researchers continued to watch the advances being made in Windows Server. "Never underestimate the resources that Microsoft can bring to a problem," says Craig A. Stewart, Executive Director of the Pervasive Technology Institute and Associate Dean for Research Technologies at Indiana University. "Microsoft employs top talent, and it was clear that they were serious about HPC. It was only a matter of time before they delivered competitive high-performance computing."

Solution

When the university received a grant to create FutureGrid, an experimental grid and HPC test bed (www.futuregrid.org), Stewart and his colleagues were ready to put Windows HPC Server 2008 to the test against Red Hat Enterprise Linux 5.4.

"We wanted a rational way to compare them," says Robert Henschel, Manager of High Performance Applications at Indiana University. "Given our emphasis on practical uses of HPC, we wanted to understand the performance of each with real scientific application benchmarks."

Researchers chose a series of widely recognized benchmarks:

- **NSF Application Benchmarks**—includes atmospheric models, advanced mathematical modeling, and weather forecasting.
- **HPC Challenge Benchmark**—includes seven benchmarks included for due diligence in testing kernel performance.
- **SPEC MPI2007 Benchmark Suite**—includes tests that compute processes across cluster and symmetric multiprocessor hardware.

The SPEC benchmarks may be the most significant, according to Stewart. They include applications from diverse disciplines, and results are independently reviewed and published at www.spec.org. The university was the first to investigate the SPEC suite, long used to measure Linux performance, on any version of Windows Server.

Benchmark comparisons were run in a series from 32 to 512 cores on up to 64-bit IBM System x iDataPlex dx340 computers, in an 84-node cluster with 32 gigabytes of memory per node.

At 512 cores, Windows HPC Server outperformed Linux on nine of the SPEC benchmarks. The faster speeds for Windows HPC Server ranged from about 1 percent for the LU benchmark for differential equations, to 41 percent for the Weather Research and Forecasting benchmark. Overall, Windows HPC Server and Red Hat Enterprise Linux 5 were consistent within 2 percent.

Benefits

The Indiana University research demonstrates the ability of Windows HPC Server to match and even beat Linux performance, making it a great choice to expand HPC capacity and to bring HPC computing to broader audiences.

"The most important takeaway from our research is that Windows HPC Server and Linux offer almost identical performance across a range of applications and cluster sizes," Stewart says. "You have to look at the application in which you're interested before you can say which operating system handles it better. With performance essentially a non-issue, the conversation changes to 'what opportunities does each HPC operating system provide to the IU scholarly and artistic communities?' In that discussion, Windows HPC Server has a lot to recommend it, particularly in expanding the reach of HPC beyond the sciences that have traditionally been the core of the HPC community."

Stewart points to the markets for Windows-knowledgeable professionals and Windows-based third-party products, which are larger and thus more competitive than their counterparts for Linux—and which will enable more cost-effective high-performance computing.

"Our users take all the HPC cycles we can give them," says Scott McCaulay, Director, Research Technologies Applications at Indiana University. "So anything we can do to boost capacity is great."

IU is now planning to use Windows HPC Server in its large-scale parallel computing environment, and Stewart and his colleagues hope that will enable HPC use by faculty in business, public health, and public policy.

"There are academic fields where researchers are unfamiliar with Linux, but very familiar with Windows; their applications already run on it," says Stewart. "Windows HPC Server is the ideal way to bring the benefits of high-performance computing to them."

For further information in a full technical report see Teige, S.; Henschel, R.; Li, H.; Doleschal, J.; Mueller, M.S. 2011. A Performance Comparison Using HPC Benchmarks: Windows HPC Server 2008 and Red Hat Enterprise Linux 5.

Document published March 2011

Microsoft