Intel/OST/Epic Success Story

Running Mission-Critical EMR Applications on Linux* and Intel® Architecture

Open Systems Technologies (OST) Deploys Epic Software on Intel® Xeon® Processor-Based Blade Servers for a New York Hospital

Healthcare organizations nationwide are moving quickly to implement electronic medical records (EMR) and other advanced information technologies to improve the quality and efficiency of patient care. However, many hospitals and clinics are daunted by the high cost of the UNIX/RISC architectures that have traditionally been used to host these applications. More cost-effective infrastructure solutions are needed to enable broad adoption, yet the highest levels of performance and uptime are essential, since lives often depend on clinicians having quick, always-available access to patient information and clinical tools.

Linux* running on the latest generation of Intel® Xeon® processor-based servers offers a solution, providing mission-critical capabilities at a fraction of the cost of UNIX/RISC architectures. Yet healthcare organizations and the vendors that support them need more than capabilities—they need proven solutions that have demonstrated their reliability and value in real-world clinical settings. One such solution was recently designed and implemented by Open Systems Technologies (OST). Based on Epic software, it provides a scalable and highly-resilient EMR solution running on affordable Intel Xeon processor-based servers and the Linux operating system.

Driving Affordability into Mission-Critical EMR Solutions

OST has extensive experience designing and implementing mission-critical computer hardware systems, including EMR solutions based on Epic software. However, although Epic technical teams had some experience with Linux in a laboratory setting, they had never deployed it in a production environment and were hesitant to suggest it to customers.

OST had no such reservations. "Having worked extensively with Linux running on Intel Xeon processors, we were convinced a correctly designed solution would meet Epic's reliability requirements," explains Dave Spieker, Healthcare Business Development Manager for OST. "We just needed the right opportunity to display its dependability."

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Bhaskar Gunda, Principal Consultant and Technical Lead for the EMR project

OST discovered that opportunity in a 120-bed hospital in Cooperstown, New York. They were looking for a way to implement Epic software in a cost-effective but reliable way and turned to OST for help. Epic gave OST the go-ahead on short notice to design a solution running on Linux and Intel Xeon processor-based servers.

"We have a strong relationship with Epic as a company, and solid experience with Epic software, so we knew what to expect," says Spieker. As part of an Epic implementation, the software often runs in a practice, non-production mode for up to a year before bringing it online. Every effort is made to test the system while focusing on key milestones throughout the year. In this particular case, OST had weeks rather than months for system set-up and testing prior to taking it live.

"We had to create a system that Epic would approve and accept, and we didn't have much time to do it," Spieker explains. "Epic had to be happy, the customer had to be happy, the system had to be stable and reliable, and the pricing had to work. Epic is the only company that guarantees performance for their software, so we knew their reputation, as well as our working relationship, was on the line." Through careful planning and precise execution, OST was able to design and implement a system that met Epic's stringent requirements.

Using Linux for Mission-Critical Solutions

Open source Linux used to present a lot of design challenges, because there were so many ways to do things. Today, Linux is available in vendor distributions that include integrated support for mission-critical requirements, such as high availability clustering and advanced monitoring and management. Leading vendors optimize their distributions for Intel Xeon processors and offer mission-critical service and support options. OST chose Red Hat Enterprise Linux* for the Epic solution. According to Bhaskar Gunda, Principal Consultant and technical lead for the EMR project, "Red Hat provides a proven solution we've used many times before and can deploy with confidence. Expertise is still necessary to achieve the highest levels of availability, but Red Hat gives us a strong starting point."

A Powerful and Resilient Hardware Infrastructure

OST chose HP BladeSystem c7000* Enclosures to provide a scalable and resilient hardware infrastructure for the implementation. The enclosures are built for high availability, with redundant power supplies, fans, and switches, advanced management capabilities, and a high-speed backplane for balancing workloads across multiple blades in a clustered environment.

The HP blade enclosure supports both two-socket and four-socket Intel Xeon processor-based server blades. Based on workload requirements, OST chose two-socket server blades for the EMR implementation, each configured with the Intel® Xeon® processor 5600 series. These processors deliver up to 15 times the performance per server[1] of single-core processors that were available just a few years ago, so they provide substantial capacity for heavy EMR workloads. They also adapt intelligently to workloads, so they deliver higher performance for peak workloads without increasing power consumption for lighter workloads. This can help to reduce overall power and cooling costs.

Four-socket HP blade servers offer a potential upgrade path as workloads grow. These higher capacity blades can be configured with the top-of-the-line Intel® Xeon® processor E7 family, which provides substantially more computing resources (cores, threads, cache, and system bandwidth). A single four-socket server provides up to 40 cores, 80 threads, and 2 TB of memory, so a cluster of blades can support even the largest EMR workloads. These processors also provide an array of advanced reliability features designed specifically for mission-critical environments, which can be important when each server is supporting a heavier workload.

"In our experience, the latest generation of Intel Xeon processors provides a solid foundation for mission-critical applications, and the redundant architecture of the HP blade enclosure adds to these advantages," says Gunda. "Hardware failures have to be planned for in any computing environment, but the reliability and resilience we're seeing from this platform is excellent. We're also taking advantage of some of the more recent reliability features Intel integrates into its processors and chipsets. For example, we're using mirrored memory which provides strong protection against memory component failures."

Designing for Rock-Solid Reliability

OST's solution includes a total of 13 blade servers running the Epic software: four blades in one enclosure for the production environment, four in a separate enclosure for high availability failover, and five blades in a third enclosure. If both the production and failover nodes have problems at the same time, the production environment can failover onto a third blade (in this case, reporting functions would be suspended until normal operations were restored). The third enclosure is hosted in a different facility for disaster recovery.

This architecture provides redundancy and failover within each blade enclosure, and also among the different enclosures. It is designed to maintain operations through a wide array of challenges, including natural disasters, hardware failures, software glitches, and power outages. The InterSystems Caché* database and Citrix servers for the Epic implementation are hosted in the same blade enclosures. SAN-based replication is used to ensure high availability for the database across local and remote locations.

The hardware environment is both flexible and scalable. The blade enclosures support up to 16 blades and include two 10 Gigabit Ethernet ports, each of which can be configured as four independent, variable-speed, virtual links. The virtual links can be dynamically reconfigured without rewiring the system, so it's easy to install and integrate new server blades as workloads grow. Each virtual link is connected to two physical switches for resilience. Altogether, there are eight network cables. Removing any of the cables has no impact on operations. In fact, OST found they had to disconnect seven cables during testing to bring down the system.

The resilience of the network is important for another reason. A broken network connection in a traditional cluster can result in a "split-brain" scenario, in which two parts of the cluster try to recover simultaneously but independently and corrupt the database. The robustness of the virtualized network makes a split-brain cluster highly unlikely, especially in combination with the three-way cluster (production node, failover node, and reporting node). To completely eliminate the possibility, OST has implemented a "disk-based heartbeat." If the cluster goes down, the heartbeat identifies which node is managing storage and ensures that only that particular node is allowed to control the recovery process.

Passing All Tests with Flying Colors

OST put the Epic solution through extensive performance, scalability and reliability tests to ensure it could meet the stringent requirements of Epic and the customer. Epic also tested the system for a range of issues, including network failure, fiber failure, sudden reboot of a server, sudden power off, and planned and unplanned shutdown scenarios. Through three months of testing, the system's reliability never faltered.

The Epic EMR solution went live in April of 2011. According to Jim VanderMey, Chief Innovation Officer at OST, "Performance has been great, reliability has been rock solid, and it will be easy to scale capacity as workloads grow. The combination of Linux, Intel Xeon processor-based servers, and OST's resilient design has provided the EMR infrastructure need, with flawless implementation and at much lower cost than originally thought possible."

Cost Savings Across the Board

Cost savings are realized in many ways by running Epic on Linux and Intel Xeon processor-based servers. Server hardware and OS licensing costs are much lower than for UNIX/RISC solutions. The blade solution helps to lower costs even more, by reducing the number of network cards, fans, and power supplies required, along with associated space, power, and cooling requirements.

IT staffing also tends to be less costly, since there are more professionals available with the necessary skill sets. According to Gunda, this is a significant advantage. "Suppose, for example, the customer wants to add memory to expand capacity at some time in the future. IT staff can buy off-the-shelf memory, pull out the blades, and install it themselves. No special components or skill sets are required, so the cost savings can be substantial."

Conclusion

Based on their successful implementation, Spieker believes more organizations will choose its open-source platform in place of its costlier UNIX/RISC alternatives. "I think our achievement here presents a new opportunity, especially for smaller healthcare institutions. Price and solution have come together, opening the door for hospitals and clinics to implement the Epic EMR application at lower cost and without sacrificing reliability. This is an important step in helping to make EMR adoption truly pervasive."

See how HP and Intel are helping achieve IT excellence in healthcare:
www.healthcareexcellence.techweb.com

For more information about OST's Epic/Linux solution,
please contact: David Spieker at **dspieker@ostusa.com**

For more information about Intel Xeon processors, see:
http://www.intel.com/itcenter/system/server/index.htm

For more information about Intel in Healthcare, see:
www.intel.com/healthcare

1. 15:1 consolidation and 5 month ROI claim estimated based on comparison between 2S Single Core Intel® Xeon® 3.80 with 2M L2 Cache and 2S Intel® Xeon® processor X5680 series-based servers. Calculation includes analysis based on performance, power, cooling, electricity rates, operating system annual license costs and estimated server costs. This assumes 8kW racks, $0.10 per kWh, cooling costs are 2x the server power consumption costs, operating system license cost of $900/year per server, per server cost of $7200 based on estimated list prices and estimated server utilization rates. All dollar figures are approximate. Performance and power comparisons are based on measured server side java benchmark results (Intel Corporation Feb 2010). Platform power was measured during the steady state window of the benchmark run and at idle. Performance gain compared to baseline was 15x. Baseline platform: Intel server platform with two 64-bit Intel® Xeon® processor 3.80 Ghz with 2M L2 Cache, 800 FSB, 8x1GB DDR2-400 memory, 1 hard drive, 1 power supply, Microsoft Windows* Server 2003 Ent. SP1, Oracle JRockit* build P27.4.0-windows-x86_64 run with 2 JVM instances. New platform: Intel server platform with two Intel® Xeon® processor X5680 (12M Cache, 3.33 GHz, 6.40 GT/s Intel® QPI), 24 GB memory (6x4 GB DDR3-1333), 1 SATA 10krpm 150GB hard drive, 1 800w power supply, Microsoft Windows* Server 2008 64 bit SP2, Oracle JRockit* build P28.0.0-29 run with 4 JVM instances.

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