Historic railroad stays on the cutting edge

AMD processors put Union Pacific on the fast track

Challenge:

→ Maintaining its position on the cutting edge of train technology, Union Pacific has launched a multi-million-dollar, multi-year transition from a mainframe to a distributed computing environment.

→ The success of the new distributed environment depends on the performance of the servers in Union Pacific's data centers.

→ Early Union Pacific attempts at virtualization cast doubts about the dependability of server performance.

Solution:

→ Dell PowerEdge™ R905 and 6950 servers, powered by the AMD Opteron™ processor for all of Union Pacific's virtualization, and mission-critical applications.

→ Operating-system-based virtualization software, including Microsoft® Windows Server® Hyper-V and RedHat Xen.

Impact:

→ Performance problems decreased dramatically while hardware and operating costs were lowered.

→ Easier IT management.

→ Increased efficiency and faster response to change.

AMD

The future is fusion

"We want to enable the best possible decision-making throughout our operations, so we can consistently deliver the best possible service at the lowest possible cost to our customers."

—Marty Malley, Assistant Vice President of Information Systems at Union Pacific

Few companies in America can claim as long and rich a history as Union Pacific. The railroad got its start in the midst of the Civil War, when President Abraham Lincoln signed the Pacific Railway Act of 1862. Seven years later, the Golden Spike was driven at Promontory, Utah, to link the Union Pacific and Central Pacific tracks, creating the Transcontinental Railroad – a singular technological achievement that ushered in the Industrial Age.

Nearly 150 years later, Union Pacific remains America's premier railroad franchise. It has 8,400 locomotives that travel across 32,000 miles of track in 23 states. With 45,000 employees and 2008 revenue of more than $18 billion, it ranks among the Fortune 200.

And, as rich in history as the company is, Union Pacific has maintained an extraordinary ability to adopt the latest technology to improve business performance. In the 1960s, it implemented an IBM mainframe that enabled it to become the first railroad in the world to schedule, route and track shipments automatically. "It set the bar in the industry for sophistication and automation," says Lynden Tennison, Union Pacific senior vice president and CIO.

Now the company is raising that technological bar again. Union Pacific is in the midst of a multi-year, $150-million transition from its mainframe to a new, distributed information technology platform based on a service-oriented architecture, and open-source technology. The company has also designed a revolutionary new train-control system, called NetControl, parts of which are already running on the distributed platform. The ultimate goal, which the company expects to reach by 2015, is to more tightly integrate train operations with the company's other key business processes to increase productivity, gain efficiencies and enhance responsiveness to its customers.

"We want to enable the best possible decision-making throughout our operations, so we can consistently deliver the best possible service at the lowest possible cost to our customers," says Marty Malley, assistant vice president of information systems at Union Pacific. "We think this system should put us well ahead of anybody else in the industry."

A key to the success of the initiative is the horsepower and reliable performance of the servers in Union Pacific's two data centers in Omaha. "The entire environment is based on small servers, in a loosely-coupled network," says Tennison. "There is no big iron, and we're going with the smallest footprint rather than with big, multi-CPU, large-scale servers." To ensure that it gets the performance it needs from the system, Union Pacific is relying on AMD processor-based servers.

Finding the right hardware and software

It took some trial and error with different servers and virtualization software to find the kind of price/performance balance the company needed. Union Pacific was an early adopter of virtualization technology. It started using VMware in 2004 on eight-socket machines that cost more than $100,000 each, according to Alan Fisher, Union Pacific's Director of Distributed Systems Engineering. But as the company loaded more virtual servers onto these machines, users began to notice performance problems. Specifically, a chorus of complaints arose from the company's contracted developers, who connected to virtualized workstations at the data centers.

"They told us it was taking a minute and a half to load some applications," says Fisher. "That was unacceptable."

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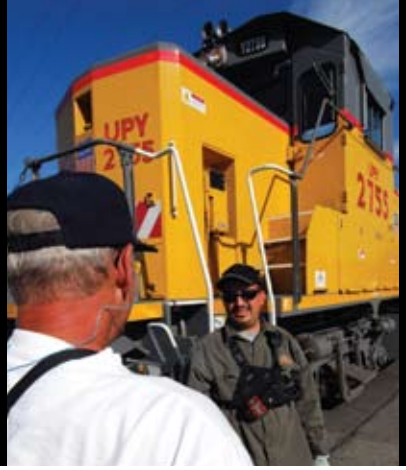

In fact, the problems were giving virtualization a bad name around Union Pacific, Fisher reveals. "I felt that someone might soon tell me we had to stop virtualizing until we achieved better performance out of our servers."

So Fisher's group started looking at alternatives. When it tested virtualized workstations on a $25,000 server based on a Dual-Core AMD Opteron™ processor, the performance problems decreased dramatically and the complaints stopped, Fisher explains. The combination of price, performance and quality AMD technology offered "changed our world overnight," he says. "We immediately started moving to AMD servers, and since then we haven't purchased a single server for the purpose of virtualization that wasn't based on an AMD processor."

Indeed, the company has now standardized on Dell servers using AMD Opteron processors. Today, about 30 percent of Union Pacific's 2,300 data center servers are based on AMD technology, including a large number of servers based on Quad-Core AMD Opteron processors. In addition, the company is now testing key applications on the Six-Core AMD Opteron processor. As the company retires legacy servers, it is replacing them with Dell servers running on AMD technology. "At this point, 98 percent of all new servers I buy are AMD," says Fisher. Union Pacific has run successful tests of the Six-Core AMD Opteron processor, as a drop-in replacement, and is hoping to upgrade some of its servers to it.

Because of their performance, AMD Opteron processor-based servers also became the company's defacto platform for Terminal Services, according to Roger McCord, Union Pacific Senior Systems Engineer for Windows architecture and infrastructure. The company averages about 1,200 concurrent connections on its Terminal Services servers.

The performance problem decrease seen with AMD processors helped renew the company's faith in virtualization. Until 2008, Union Pacific virtualized only development and test machines running versions of Microsoft® Windows® operating systems. Last year's virtualization experience gave the Union Pacific staff enough confidence to expand to their production servers as well, Fisher explains. The company runs both Windows and Linux servers, and for both platforms the company wanted to move to virtualization software provided by operating system vendors. "We believe that the operating system vendors will be able to provide the best product to manage their operating systems virtually," says McCord. For the Windows servers, the company moved from VMware to Microsoft Virtual Server® 2003 initially, then later to Windows Server® 2008 Hyper-V. For the Linux servers, it moved to RedHat's Xen.

"We started out slowly, taking the low-hanging fruit such as applications that we were moving off of obsolete hardware with low memory requirements," says McCord. "Then we started to put more and more capacity on them."

Virtualization already has saved Union Pacific significant costs. In particular it saves as much as $3,000 on hardware costs every time it virtualizes a Windows server. The company is finding it simpler and less expensive to use OS vendors' virtualization platforms. When it comes to cost per server, Microsoft is the more economical choice for Union Pacific, reveals Fisher. In addition, the company already had the tools and the experienced staff it needed to manage a Windows environment. The company has had excellent results in doing real-time migration onto the Hyper-V Server 2008 environment and plans to implement live migration when Hyper-V R2 is available, says McCord.

"I've seen better availability from the Hyper-V farm than we experienced from VMware," says Fisher, while feeling fewer "growing pains."

The only challenge has been a lack of third-party tools for Hyper-V. "We've had to do some things manually for Hyper-V that we'd typically do with tools for VMware," says McCord.

AMD handles mission-critical systems

These virtualized, AMD processor-based servers are handling the first mission-critical applications to be moved off the mainframe and onto the distributed processing platform. "We're taking our most important functions, and running them on AMD technology," Fisher says. The first components of NetControl, for example, operate exclusively on the AMD processor-based servers. And in early 2009, the company launched a new SAP ERP system on the distributed platform.

Although NetControl is only 35 percent complete, Union Pacific already is benefiting from its increased efficiency. For example, one of the first transactional applications moved from the mainframe to NetControl was bill-of-lading processing, explains Malley. A bill of lading is like a purchase order, where the customer tenders a shipment and gives instructions on where to pick up and drop off the commodity. The data from bills is critical, because it determines the movement and configurations of trains and drives the billing process. Union Pacific receives hundreds of thousands of inbound bills a month, according to Malley. In the past, slight errors such as misspellings would cause the mainframe to dump bills into an error queue, requiring several billing clerks to sort through them and resolve the problems. Because NetControl has a rules-based engine, Union Pacific can configure the system to recognize and correct many common problems found in the bills, allowing for greater automation of shipment handling.

In addition, the system is enabling Union Pacific to respond more quickly to change. When extensive flooding in Iowa in 2008 required the railroads to embargo or reroute traffic around the affected areas, most of Union Pacific's competitors had to manually change the information in their systems and then monitor them to make sure the changes were successfully implemented.

"We made a couple of minor changes in the flexible rules engine in our new system, and we were up and running within eight hours," says Tennison.

Eventually, Union Pacific's new train control system will tie in with a technology called Positive Train Control, an industry-wide collision avoidance system. Union Pacific locomotives already contain onboard computers, GPS devices and other types of radio transmitters that monitor operations. Positive Train Control is designed to establish communications between trains and the signals, with sophisticated technology and braking algorithms that will automatically bring both passenger and heavy freight trains to a safe stop. This is expected to help prevent train-to-train collisions, derailments and casualties or injuries to the public and railway workers.

Union Pacific is depending on AMD processors to help it reach that goal. If all goes as planned, history may mark another milestone as Union Pacific helps usher in yet another new era – this one based on distributed computing – for railroads and America.

About AMD

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