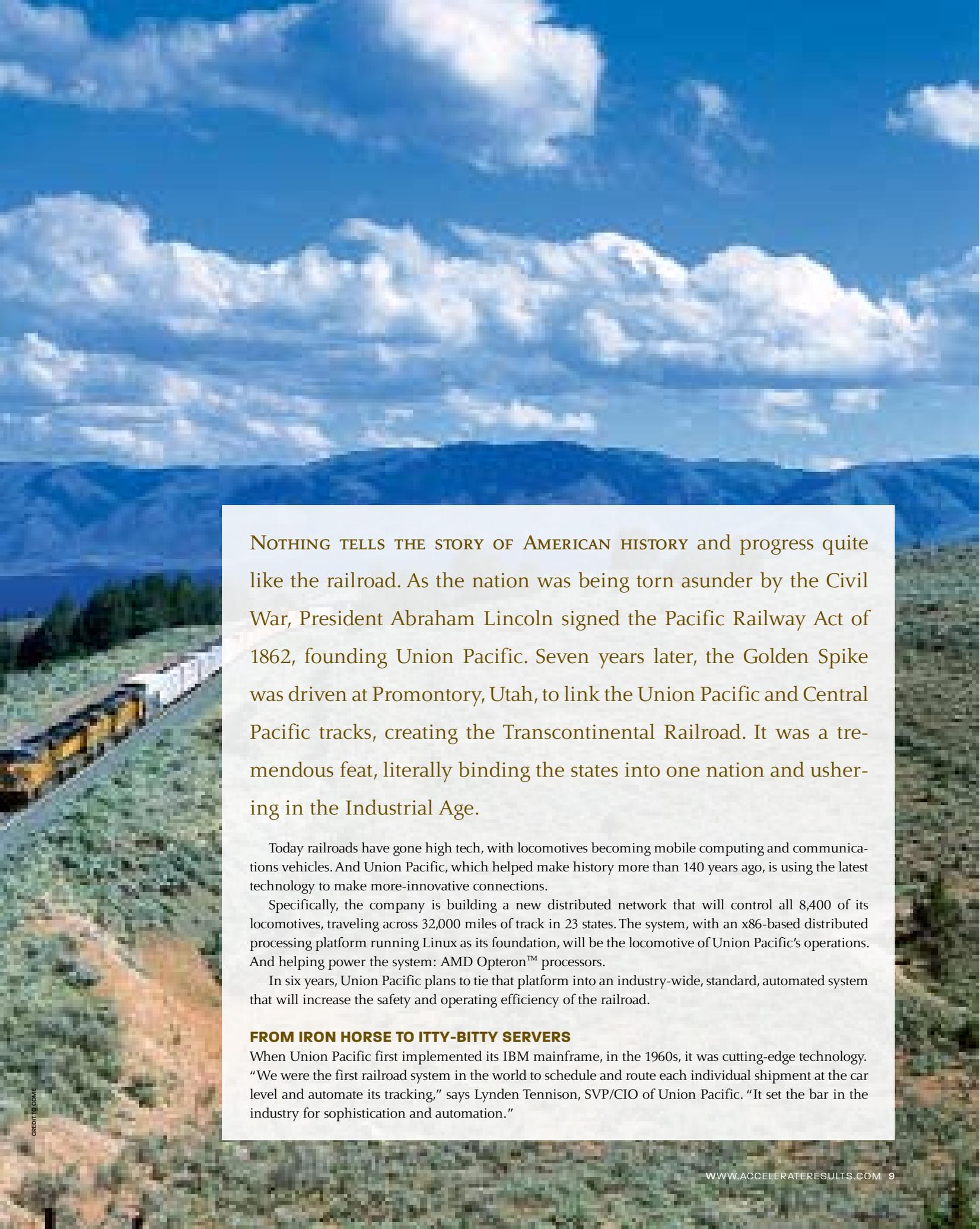


# TECHNOLOGY KEEPS UNION PACIFIC ON THE *FAST TRACK*

**AMD PROCESSORS HELP THE LARGEST  
RAILROAD IN NORTH AMERICA POWER  
ITS CRITICAL SYSTEMS AND INNOVATE.**

**BY TAM HARBERT**



NOTHING TELLS THE STORY OF AMERICAN HISTORY and progress quite like the railroad. As the nation was being torn asunder by the Civil War, President Abraham Lincoln signed the Pacific Railway Act of 1862, founding Union Pacific. Seven years later, the Golden Spike was driven at Promontory, Utah, to link the Union Pacific and Central Pacific tracks, creating the Transcontinental Railroad. It was a tremendous feat, literally binding the states into one nation and ushering in the Industrial Age.

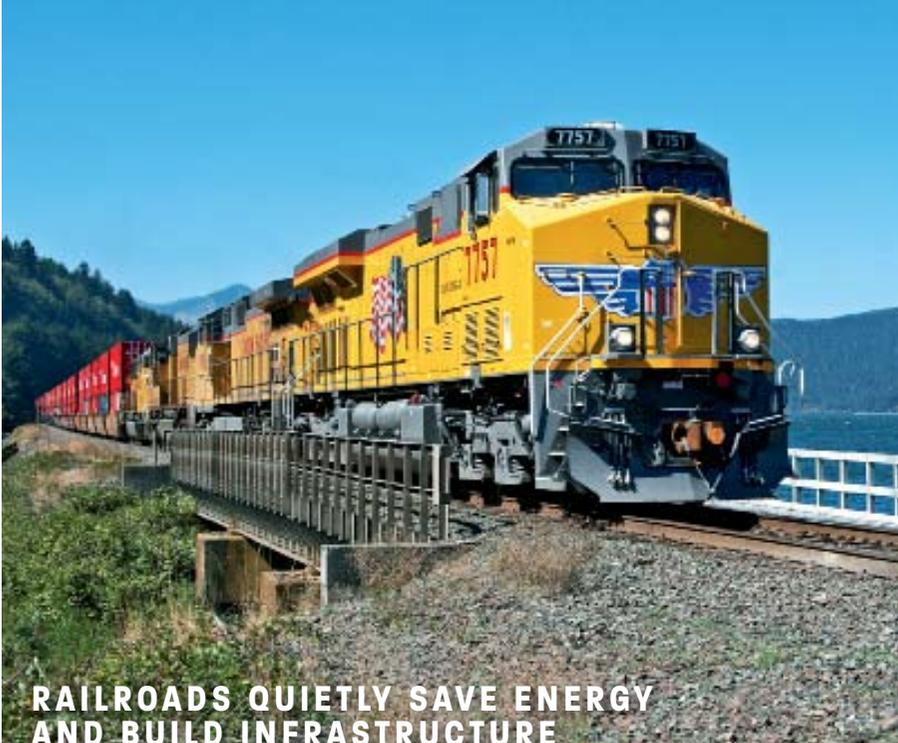
Today railroads have gone high tech, with locomotives becoming mobile computing and communications vehicles. And Union Pacific, which helped make history more than 140 years ago, is using the latest technology to make more-innovative connections.

Specifically, the company is building a new distributed network that will control all 8,400 of its locomotives, traveling across 32,000 miles of track in 23 states. The system, with an x86-based distributed processing platform running Linux as its foundation, will be the locomotive of Union Pacific's operations. And helping power the system: AMD Opteron™ processors.

In six years, Union Pacific plans to tie that platform into an industry-wide, standard, automated system that will increase the safety and operating efficiency of the railroad.

#### **FROM IRON HORSE TO ITTY-BITTY SERVERS**

When Union Pacific first implemented its IBM mainframe, in the 1960s, it was cutting-edge technology. "We were the first railroad system in the world to schedule and route each individual shipment at the car level and automate its tracking," says Lynden Tennison, SVP/CIO of Union Pacific. "It set the bar in the industry for sophistication and automation."



## RAILROADS QUIETLY SAVE ENERGY AND BUILD INFRASTRUCTURE

President Barack Obama's focus on rebuilding infrastructure and increasing energy efficiency in America may bring the U.S. railway system to the forefront of transportation discussions.

Railroads provide significant fuel efficiency and environmental benefits over other modes of freight transportation. According to Union Pacific:

- A train can move one ton of freight 830 miles on a single gallon of diesel fuel. That's the equivalent of an automobile getting 400 miles per gallon.
- A single train can do the work of as many as 300 trucks, taking them off the nation's highways.
- Trains move 43 percent of the nation's freight, yet railroads account for only 8 percent of freight energy consumption.

The American Recovery and Reinvestment Act of 2009 includes \$9.3 billion for investment in rail transportation, yet it's unclear whether much of that will go to freight railroads. In fact, the industry prides itself on its record of investing private funds in its infrastructure. As Union Pacific Chairman and CEO Jim Young recently noted in his testimony before the U.S. House of Representatives' Transportation and Infrastructure Committee, freight railroads invested approximately \$420 billion in infrastructure and equipment from 1980 to 2007, more than 40 percent of industry revenue.

But 40 years and 11 million lines of macro assembler code later, it was time to rethink the system from the ground up. Not only did the company need an integrated system based on modern technology—over the years, various client/server applications had grown up around the mainframe—but the clock was also ticking on the know-how to keep the big iron running.

"Most of the few people who know anything about that code are counting their days to retirement," says Marty Malley, assistant vice president of information systems at Union Pacific. "We realized that if

we didn't get this thing replaced, we were going to come to work one day and it would be broken and we'd have nobody who could fix it."

The mainframe was still doing the heavy lifting—that is, running many of the key processes within the company, including rail car scheduling and train management. So the company made a strategic decision and mapped out a multiyear plan to spend \$150 million to \$200 million to design and build an information technology platform based on a service-oriented and event-driven architecture that leverages open source tech-

nology. The heart of the platform would be a new transportation control system called NetControl. Over the next several years, that system would replace Union Pacific's mainframe-based Train Control System (TCS) to take orders, schedule and track shipments, manage the schedules for the trains and the resources needed to run them and optimize response to service interruptions.

NetControl was not the only system to run on a distributed, x86-based platform using Linux. "This 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 multi-CPU, large-scale servers."

By tightly integrating train operations with the company's other key business processes onto one distributed platform, Union Pacific expects to increase productivity, gain efficiencies and enhance responsiveness to 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 Malley. "We think NetControl should put us well ahead of anybody else in the industry."

## AMD OPTERON™ PROCESSORS PROVIDE THE POWER

Moving critical business processes such as core financial systems off the mainframe and onto a distributed platform means increasing the horsepower at the company's two data centers in Omaha. An early adopter of virtualization, Union Pacific started using VMware on eight-socket machines that cost more than \$100,000 each in 2004, according to Alan Fisher, Union Pacific's director of distributed systems engineering. But it 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 Lotus Notes," says Fisher. "That was unacceptable."

So Fisher's group started looking at alternatives. In testing of virtualized workstations on a \$25,000 server based on a Dual-Core AMD Opteron processor, the

performance problems decreased dramatically and the complaints stopped, says Fisher. The combination of price, performance and quality AMD technology offered “changed our world overnight,” he says. “Since then we haven’t purchased a single server for the purpose of virtualization that wasn’t based on an AMD processor.” Union Pacific is currently deploying quad-core systems to

then Windows Server® 2008 Hyper-V—for Windows.

Today about 30 percent of the 2,300 data center servers are based on AMD processors, says Fisher, and as the company retires older servers, it plans to replace them with AMD processor-based servers. Most important, NetControl and other critical business functions will run on AMD processor-based

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. Last year extensive flooding in Iowa required the railroads to embargo or reroute traffic around the affected areas. Most of



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– LYNDEN TENNISON,  
SVP/CIO, UNION PACIFIC

its data center, with plans to include AMD new product offerings such as the Six-Core AMD Opteron™ processor.

Until 2008 Union Pacific virtualized only development test machines running Microsoft® Windows®. But last year it began expanding to production servers, says Fisher, and moved from VMware to operating-system-based virtualization platforms. It has adopted Red Hat’s virtualization technology for the Linux environment and Microsoft software—initially Virtual Server® 2003 but

servers when they are transferred from the mainframe to the distributed network, says Fisher. At the start of this year, for example, the company switched to a new SAP ERP system that is running on the distributed platform.

“We’re taking our most important functions, such as NetControl and our ERP system, and running them on AMD technology,” Fisher says.

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 NetControl system, and we were up and running within eight hours,” says Tennison.

Ultimately, NetControl will tie in with a technology called Positive Train Control, an industry-wide collision avoidance system whose implementation the U.S. government has mandated by 2015. Already Union Pacific locomotives contain onboard computers, GPS devices and other types of radio transmitters that monitor operations. Positive Train Control will 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 will help prevent train-to-train collisions, overspeed derailments and casualties or injuries to the public and railway workers.

It’s one more way Union Pacific is leading the way in innovation. ■

**GAINING STEAM OVER THE COMPETITION**

NetControl is about 35 percent complete, and Union Pacific is already benefiting from its increased efficiency. For example, one of the first transactional applications moved from the mainframe to NetControl was bill-of-lading processing, says 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

**UNION PACIFIC CORPORATION AT A GLANCE**

- FOUNDED:** 1862
- COMMODITY REVENUE:** \$18 BILLION
- ROUTE MILES:** 33,000 IN 23 STATES
- EMPLOYEES:** 48,000
- ANNUAL PAYROLL:** \$3.9 BILLION
- CUSTOMERS:** 25,000
- LOCOMOTIVES:** 8,400

TENNISON PHOTO: ANDREW MARINKOVICH

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