



# Maximizing the Performance of SUSE Linux® Enterprise Real Time for Financial Services Applications on AMD64 Technology

**Novell.**



In the financial services industry, literally millions of dollars can be earned or lost in a few milliseconds. Trades and transactions must execute immediately, accurately, and predictably every time, or opportunities can be missed in the competitive world of financial services. One proven solution is SUSE Linux Enterprise Real Time from Novell®, optimized for the new HP BladeSystem solutions running on Second-Generation AMD Opteron™ processors.

SUSE Linux Enterprise Real Time is comprised of two core technologies: SUSE Linux Enterprise Server 10 and Concurrent Real Time Extensions (CRTE). SUSE Linux Enterprise Server 10 is a Linux OS offering robust flexibility for enterprise applications. The addition of Concurrent Real Time Extensions to SUSE Linux Enterprise Server reduces latency spikes and provides predictable response times. Through the combination of Second-Generation AMD Opteron processors with HP BladeSystems, AMD and Novell are offering the financial services industry an ideal technology solution—an inexpensive, industry-standard combination that's capable of performance formerly found only on proprietary mainframes.

**Financial services enterprises:  
Real time is real money**

The technology needs of financial services companies offer a remarkable challenge for computer hardware and software vendors. The central requirement is deterministic, real-time computing for high-priority transactions that must execute accurately and predictably every time. However, a real-time computing solution must also offer rock-solid stability and reliability, since there is zero tolerance for missed transactions, lost records, or system downtime.

Nowhere is this truer than in the world of online trading, where literally microseconds count, and a fraction of a second can have immediate financial repercussions. It has been reported that one large investment bank

says that for every millisecond their program-trading applications can beat the market, the company would earn an additional \$100 million per year! Additionally, other financial firms are seeing performance improvements outside the trading floor. Some of the benefits include performance improvements ranging between 10% to more than 150% under heavy loads in areas like enterprise identity management solutions, which have decreased overall physical server footprints by as much as 75%.

**Open source operating systems:  
Flexible, but fast enough?**

In the financial services sector, as in other industries around the world, a growing number of businesses are turning to Linux for its combination of robustness and application flexibility. It gives enterprises the ability to adapt to changing market demands with applications that are fine-tuned to their operations. And unlike proprietary applications that often require specialized hardware, Linux allows for the use of low-cost, commodity hardware based on the industry-standard x86 processor architecture.

Now, with the introduction of SUSE Linux Enterprise Real Time, businesses have the option of using Linux to handle business-critical, real-time applications in the enterprise. Adding Concurrent Real-Time Extensions from Concurrent Computing Corporation to the SUSE Linux Enterprise Server 10 kernel allows Novell to achieve predictable interrupt response times. The Concurrent real-time technology was developed for military and aerospace applications that need guaranteed response to external events, deterministic program execution times, and low latency communication. The Concurrent real-time technology, fused with SUSE Linux Enterprise Server, makes SUSE Linux Enterprise Real Time ideal for the high-speed, high-frequency world of financial trading and transactions.

***“Capital markets customers demand low latency, high-performance solutions for their market data needs. SUSE Linux Enterprise Real Time, coupled with leading technologies from Concurrent and AMD, combines the power of low latency computing and an open architecture optimized for exceeding performance requirements of capital markets customers around the world.”***

— Moiz Kohari, Director of Real Time Solutions, Novell

## WHERE REAL TIME MAKES A DIFFERENCE FOR FINANCIAL FIRMS

- Applications requiring predictable, low data latency, such as market data delivery
- Assuring fair access to price information
  - Trading/algorithmic trading
  - Maximizing stock trading profit
  - Minimizing time from receipt of new market information to re-calculation of risk and subsequent trade execution
  - Faster trade matching and execution
  - Examples include foreign exchange, bond, MBS, equity, and derivatives trading
- Other high-volume transaction processing applications
  - Database-intensive applications (OLTP)
  - Examples include ATM transactions, credit-card authorizations, Web sites, etc.

The proven Novell real-time technology reduces latency spikes and provides predictable response times for high-quality service. SUSE Linux Enterprise Real Time is already being used in trading-floor and market-data servers in the financial services community. Increasingly, other enterprise data centers with time-critical requirements are finding use for SUSE Linux Enterprise Real Time, such as healthcare companies with advanced imaging needs for patient healthcare.

No special features are required to run SUSE Linux Enterprise Real Time on industry-standard x86 hardware. Furthermore, SUSE Linux Enterprise Server ships with full support for AMD64 processors and is optimized and tuned to take full advantage of AMD64 technologies, offering cutting-edge performance and stability. Minimum configurations for SMP machines include at least one dual-core CPU based on a 32- or 64-bit architecture. SUSE Linux Enterprise Real Time is also scalable up to 1,024 processors and up to 10 TB of RAM.

### Real-time performance: SUSE Linux Enterprise Real Time scores with benchmarks

SUSE Linux Enterprise Real Time has already set several new performance benchmark records. In tests with Wombat Financial Software, customers were able to achieve aggregate simultaneous publishing rates of 50,000 messages per second per connection from the feed handler.

SUSE Linux Enterprise Real Time also set a new record for query response time with the Ingres database. In tests performed at the Ingres Performance Center, the average response time of SUSE Linux Enterprise Real Time was as little as one-third that of a competing standard Linux distribution under heavy loads. This test simulated 16 threads of complicated queries hitting the Ingres database. With the CPU shielding in SUSE Linux

Enterprise Real Time, no other system activity can interrupt the database thread, allowing queries to finish more quickly compared to unshielded environments.

### Second-Generation AMD Opteron™ processors: Outstanding performance for real-time server applications

SUSE Linux Enterprise Real Time is designed specifically for x86-based multiprocessor servers, like those featuring Second-Generation AMD Opteron processors with Direct Connect Architecture.

The first generation of AMD Opteron processors with Direct Connect Architecture have already proven themselves in major enterprise deployments, demonstrating industry-leading performance, reliability, and scalability. Now, significant enhancements to the Second-Generation AMD Opteron processor family make them ideal for business-critical, real-time server applications.

### AMD Direct Connect Architecture: Reducing the front-side bus bottleneck

The Direct Connect Architecture of Second-Generation AMD Opteron processors is designed for superior scaling linearity in up to 8-way systems. Direct Connect Architecture helps eliminate the bottlenecks inherent in traditional front-side bus architectures by directly connecting processor cores, memory controllers, and I/O for improved overall system performance and efficiency.

### HyperTransport™ technology: Ultra-high bandwidth for high speed

Multi-core processor architectures are ideally suited to virtualization applications. HyperTransport™ technology is an interconnect that provides high-speed, high-performance, point-to-point links for directly connecting processors, and providing improved scalability and I/O capabilities to support more guest OS sessions and

user access applications. With two distinct, unidirectional channels per link, HyperTransport technology in AMD Opteron processors facilitates direct communications between processors and I/O at a rate of up to 8GB/s bandwidth per link. Support for up to three coherent HyperTransport links provides up to 24GB/s peak bandwidth per processor.

**AMD Virtualization™:**  
**A balanced approach to improved virtualization performance**

Hardware-assisted AMD Virtualization™ (AMD-V™) helps streamline virtualization deployment, improving virtualization support and helping guest x86 operating systems run unmodified at industry-leading execution speeds. AMD-V reduces overhead by selectively intercepting instructions destined for guest environments, and provides easy implementation and support for better system performance. An integrated memory controller enhances virtualization and provides efficient isolation of virtual machine memory for improved security and support of virtual users. As virtualization increases system utilization, the efficient power handling of Second-Generation AMD Opteron processors helps scale server power consumption.

**AMD PowerNow!™ technology:**  
**Better power management for lower operation costs**

One of the benefits of server virtualization is reduced power and cooling requirements in the data center. AMD PowerNow!™ technology with Optimized Power Management (OPM) can further improve power savings by delivering processing performance when needed, while lowering power consumption during times of reduced processor demand.

**High-bandwidth DDR2 memory: Better performance for floating-point applications**

The use of high-bandwidth DDR2 memory provides significantly better performance for floating-point applications commonly used in the financial services industry. Looking forward, Quad-Core AMD Opteron processors, planned for introduction in 2007, should provide even higher performance-per-watt than current Dual-Core Second-Generation AMD Opteron processors with DDR2 memory. This seamless upgrade path to quad-core performance can help companies further optimize business applications and increase capacity without incurring additional data center infrastructure costs.

**The new HP BladeSystem C-Class:**  
**Adaptive infrastructure for time-critical environments**

Real-time environments demand predictable operating system behavior and align perfectly with the adaptive infrastructure of the new HP BladeSystem.

Every device in an HP BladeSystem is modular, highly responsive, and easy to deploy and control. And the HP BladeSystem based on Second-Generation AMD Opteron processors offers a cost-savvy, change-ready, and energy-thrifty solution. It lets you focus on optimizing all of your resources to maintain performance in time-critical environments.

With the HP BladeSystem, your business can benefit from features such as:

**HP Virtual Connect architecture** — Gives you the freedom to move your resources around as necessary to meet demand at any given moment in a financial trading application, with scaling to accommodate spikes in demand and avoid delays or interruptions.

**SUSE LINUX ENTERPRISE REAL TIME: THE RIGHT OPERATING SYSTEM, RIGHT NOW**

Built on the SUSE Linux Enterprise kernel, an enterprise-quality server designed to handle mission-critical workloads in the data center, SUSE Linux Enterprise Real Time offers:

- Support for 32- and 64-bit processor architectures
- Predictable interrupt response time
- High-resolution timer support for enhanced scheduling
- User-level control of simultaneous multithreading
- Processor shielding

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### THE MICROSOFT/NOVELL ANNOUNCEMENT IN NOVEMBER 2006

In November 2006, Microsoft and Novell announced that Microsoft and Novell would jointly develop a compelling virtualization offering for the Linux and Windows® operating systems. As a result of this collaboration, customers will now be able to run virtualized Linux on Windows or virtualized Windows on Linux.

Microsoft has announced that it will officially recommend SUSE Linux Enterprise to people who want to run both Windows and Linux, and will distribute coupons for maintenance and support for the SUSE Linux Enterprise Server operating system from Novell.

**HP Thermal Logic Technology** — Allows you to assess your power usage and system temperature to respond quickly to changing needs. A graphical thermal dashboard provides an instant snapshot of the power consumption, heat output, and cooling capacity of your environment — all in one screen. HP Thermal Logic Technology can help you lower power usage and heat while maintaining high performance. You may be able to benefit from efficiency improvements of as much as 38 percent less space and up to 23 percent less power, and reduce cables up to 92 percent, versus 1U rack mounted servers.

**The HP Dynamic Power Saver** — Runs continuously in the background, pooling power distribution to maintain system performance at higher application workloads, and provide power savings at lower application workloads.

**HP Insight Control management** — Provides intelligence and control directly into the enclosure with the HP Onboard Administrator, and into every blade with Integrated Lights-Out (ILO). These tools save valuable time from set-up through day-to-day maintenance and contribute to lower operational expenses over time.

### AMD, HP, and Novell: Proven in the financial services market

For the financial services industry, SUSE Linux Enterprise Real Time optimized for the new HP BladeSystem running on Second-Generation AMD Opteron processors offers an ideal solution. This cost effective, industry-standard combination delivers outstanding performance and reliability to an industry where fractions of a second count.



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