

Migrating from UNIX*/RISC* to Red Hat Enterprise Linux® on Intel® processor-based Servers

Driving Higher Value Deep into the Data Center

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ABSTRACT:

Red Hat Enterprise Linux running on Intel® processor-based servers is helping companies cut TCO by up to 50 percent and more versus comparable UNIX*/RISC solutions, while providing a better foundation for growth. This white paper outlines the key benefits of migration and provides a step-by-step guide to planning and conducting a strategic and successful transition.

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Migrating from UNIX*/RISC* to Red Hat Enterprise Linux® on Intel® processor-based Servers

Driving Higher Value Deep into the Data Center

EXECUTIVE SUMMARY

“We believe that the combination of Red Hat Enterprise Linux 5.3 and the latest Intel Xeon processor-based servers surpasses the capabilities of proprietary high-end systems, while offering true affordability.”

– Tim Burke, Senior Director, Red Hat Enterprise Linux Engineering

The proven value of open source software running on industry-standard servers is driving adoption deep into the enterprise data center, enabling companies to replace aging UNIX*/RISC deployments with more powerful, flexible, and affordable solutions. A recent total cost of ownership (TCO) study by Alinean indicates that a cost savings of nearly 50 percent can be achieved in a typical migration to Red Hat Enterprise Linux on Intel® processor-based servers, and some of the success stories highlighted in this paper document much greater savings.

The first half of this paper introduces key aspects of the combined platform that are delivering high value in enterprise computing environments. It also discusses current and near-term advancements that are driving the value of a migration to Red Hat Enterprise Linux to new heights, including the exceptional performance and energy-efficiency provided by Red Hat Enterprise Linux running on the latest Intel® Xeon® processor-based servers.

The second half of this paper offers guidance for business and IT decision-makers who are interested in understanding the potential costs, benefits, and risks of migration for their specific applications and IT environments. It provides high-level guidelines for assessing cost and complexity and for planning a smooth, successful, and strategic migration. It also points to additional resources, including professional services that can help IT organizations transition with confidence toward a more flexible and cost-effective IT infrastructure.

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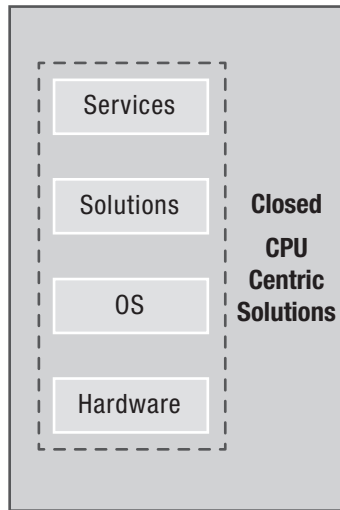
PART I: THE BUSINESS CASE FOR MIGRATION

Increasing Value across Your IT Infrastructure

IT costs and requirements are on a collision course for many businesses. Multiple software deployments over a span of many years have resulted in IT solutions that are costly to maintain and difficult to adapt yet essential to the business. Supporting existing infrastructure now accounts for roughly two-thirds of total costs for many businesses, and rising energy bills are pushing data center costs ever higher. Difficult economic conditions magnify these concerns, forcing IT budgets downward despite growing requirements.

The discrepancy between costs and requirements is the primary driving force behind the increasing adoption of open source software running on industry-standard servers. Capital and operating costs tend to be much lower than for comparable proprietary solutions running on RISC/UNIX architectures (see Quantifying the Benefits of Migration). Vendor support is also much broader for open source solutions, and includes a majority of today's leading hardware and software providers, which drives fast innovation and gives IT organizations greater flexibility for tailoring solutions and managing costs (Figure 1).

TRADITIONAL PROPRIETARY STACK (SPARC* & POWER*)



INDUSTRY STANDARD CHOICE (Red Hat® Enterprise Linux® on Intel® processor-based servers)

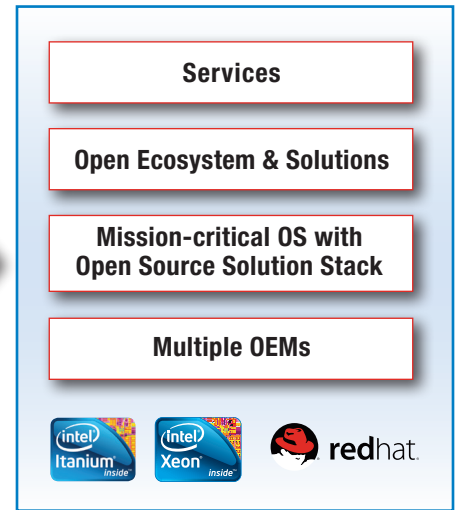


Figure 1. Open systems based on Red Hat® Enterprise Linux® and Intel® processor-based servers deliver greater choice, flexibility, and value than proprietary UNIX*/RISC* architectures and have matured to support today's most demanding and mission-critical applications.

Red Hat Enterprise Linux running on Intel processor-based servers offers a high value, low-risk path to realizing the benefits of open-systems computing. The combined platform is supporting some of today's most demanding applications for large corporations, including enterprise resource planning (ERP), decision support and multi-terabyte database implementations.

Complete Enterprise Solutions

Red Hat Enterprise Linux running on Intel processor-based servers gives organizations tremendous choice in vendors, systems, and applications, and it scales easily to support diverse requirements. Intel Xeon processor-based servers offer leading performance and energy efficiency for mainstream implementations, and a new generation of scalable systems targeting mission-critical enterprise applications will be available in early 2010 (see A Better Platform for Growth later in this paper). In addition, Intel® Itanium® processor-based servers offer mainframe-class scalability and availability for the most demanding requirements. Thousands of certified applications are available, and the latest versions often reach the

marketplace sooner than the same or comparable UNIX/RISC applications. This broad support simplifies migration and makes it easier for organizations to architect complete solutions, while optimizing total value with a best-fit combination of open source and third-party software.

Mission-Critical Service and Support

Intel and Red Hat have been working together for more than a decade to deliver complete enterprise solutions and have been offering mission-critical support options for many years. Their technology roadmaps are well aligned, engineering collaboration is extensive and ongoing, and customer service teams provide 24/7/365 service with a single point of contact. More recently, Intel and Red Hat are teaming up with select hardware vendors to provide an even higher level of support for the most demanding mission-critical applications. This advanced program allows IT organizations to:

- Standardize on a minor release for up to 60 months, so they can defer costly software stack revalidation testing.¹
- Rely on a 10-year advanced mission-critical life cycle²
- Receive advanced mission-critical service-level agreements²

For more information, visit:

www.redhat.com/promo/mc_program/

Built-in Virtualization

Virtualization has become an essential technology for delivering better service levels at lower cost, and Red Hat Enterprise Linux supports enterprise-class server virtualization with unlimited virtualized guests and high-availability clustering and failover. It also provides exceptional scalability with:

- Up to 126 processors and 1 TB of memory per physical server
- Up to 32 virtual processors and 80 GB of memory per virtual server

Intel® Virtualization Technology adds to that value by providing hardware assists for core virtualization processes throughout the server platform. In tandem with Red Hat Enterprise Linux, this provides simpler and more robust virtualization solutions and enables a given server to support more virtual machines and heavier workloads.

The performance advantages can be compelling. Intel and Red Hat have demonstrated up to 98 percent virtualization efficiency running some of today's most widely referenced industry-standard benchmarks in virtual machines (Figure 2).³ This low overhead enables higher consolidation ratios, which increases the cost benefits of virtualization. It also enables organizations to virtualize a wider range of applications, including those that require higher levels of absolute performance, such as mission-critical database and transactional applications.

THE OPEN SOURCE ADVANTAGE

“Open source gives organizations a really high-quality product for a very reasonable cost, along with a high return and low total cost of ownership.”

– Michael Fauscette
Group Vice President
Software Business Solutions
IDC, March 2009. (IDC_749)

Open source software is freely available, widely deployed, and supported by an enormous community of developers, including some of the computer industry's most respected firms. The extensive community of developers helps to ensure rapid software innovation with broad and extensive interoperability and security testing. It has also made Linux a top priority platform for independent software vendors, leading to unprecedented levels of choice for enterprise customers.

Industry-leading vendors such as Red Hat and Intel help take the risk out of deploying open source software, by integrating proven components into a stable, fully-integrated, thoroughly-tested, enterprise-class solution that supports certified hardware and software solutions from thousands of vendors. The combined platform is helping many of today's most successful businesses move away from the high costs of UNIX/RISC solutions, toward an open systems computing model that provides higher value and a better foundation for future growth.

¹ This support option is available globally to all Red Hat customers.

² To date, this support option is available only from specific vendors in some geographies.

³ System configuration for both benchmark tests: Red Hat Enterprise Linux 5.2 running as a guest on Red Hat Enterprise Linux 5.2 on an Intel® Xeon® processor X7460 (2.66 GHz, 16MB L3 cache) based server (4P/24C/24T). For complete test and configuration details, see the Principled Technologies reports at: http://principledtechnologies.com/Clients/Reports/Red%20Hat/RHEL52_SPECjbb2005.pdf and http://principledtechnologies.com/Clients/Reports/Red%20Hat/RHEL52_SPECint2006.pdf

CASE STUDY— MIGRATION IN ACTION:

YPF SA

“Our systems are more operationally efficient, and we still have the high performance our business demands, coupled with decreased costs.”

– Adriana Marisa Vazquez, UNIX administration group, YPF

YPF, Argentina’s largest oil and gas company, began moving critical business applications from multiple proprietary RISC/UNIX architectures to Red Hat® Enterprise Linux® on Intel® Xeon® processor-based servers as far back as 1999. The impact on cost and performance was immediate and positive, and the company now runs more than 80 percent of its Oracle databases and 90 percent of its SAP applications on the new platform.

YPF relies on Red Hat Network to simplify administration and Red Hat virtualization to greatly simplify new deployments, eliminate server sprawl and enable maintenance without downtime through live virtual machine migration. According to Adriana Marisa Vazquez, head of the YPF’s UNIX administration group, “Our systems have become more agile and flexible with the combination of Red Hat’s virtualization technology and Intel’s reliable platforms. We look forward to growing with Red Hat in the future.”

Read the complete case study at:
www.redhat.com/f/pdf/customers/RH_CS_YPF.pdf

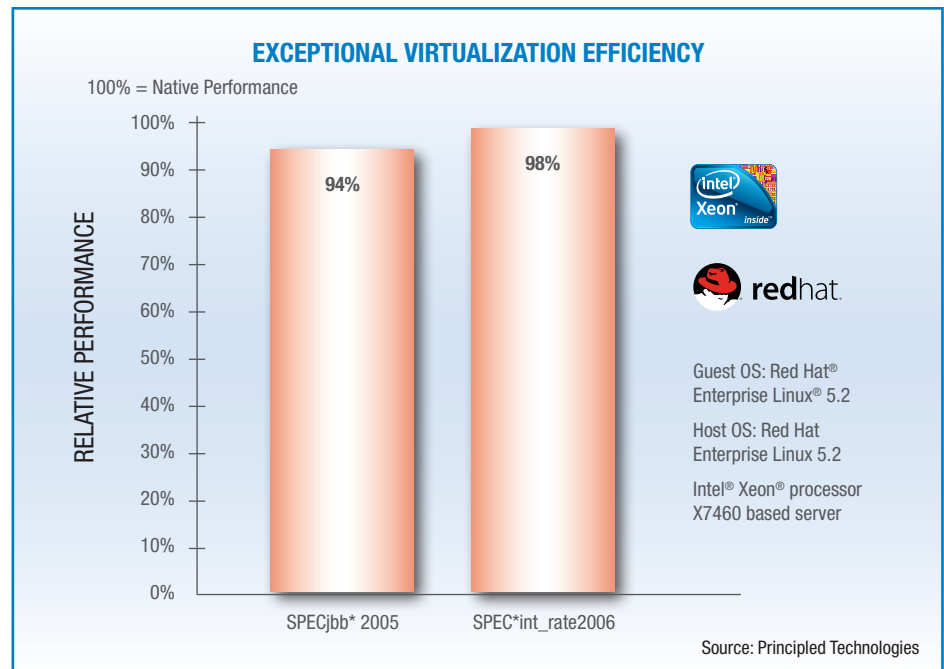


Figure 2. Intel® Xeon® processor-based servers running Red Hat® Enterprise Linux® support virtualization with exceptionally low performance overhead, enabling IT organizations to virtualize even their most demanding applications.

A Better Platform for Growth

A key pillar of the Red Hat and Intel value proposition is the investment protection provided by rapid innovation and performance scaling in successive product generations. Almost a year ago, an 8-socket, 48-core Intel Xeon processor-based server running Red Hat Enterprise Linux delivered the first one-million-plus TPC-C benchmark result for mainstream Intel processor-based server platforms, at a remarkable USD 1.99/tpmc (Figure 3).⁴ The latest generation of Intel Xeon processors (based on Intel® microarchitecture, code-named

Nehalem) is taking performance and energy efficiency to new heights. Two socket-servers based on this architecture are available today, and 4-socket and larger systems will be available in early 2010.

The 2-socket systems use the Intel Xeon processor 5500 series, which provides up to double the performance of previous generation processors for memory-intensive applications on Red Hat Enterprise Linux. These processors also provide breakthrough energy efficiency, by enabling dynamic and intelligent control of processor and platform resources to

⁴ For information about the TPC-C benchmark, visit the Transaction Processing Performance Council Web site at: www.tpc.org/tpcc/default.asp. For detailed reports on the individual tests, visit the following links:

- IBM Power 6 Result: IBM System p 570 running IBM DB2 Enterprise 9 on IBM AIX 5L V5.3. For complete information, visit: www.tpc.org/tpcc/results/tpcc_result_detail.asp?id=107052001

- Intel Xeon processor X7460 Result: IBM System x3950 M2 running IBM DB2 ESE 9.5 on Red Hat Enterprise Linux Advanced Platform. For complete information, visit: www.tpc.org/tpcc/results/tpcc_result_detail.asp?id=108081902

- Fujitsu SPARC64 Result: Fujitsu PRIMEPOWER 2500 running Oracle Database 10g Enterprise Edition on Sun Solaris 8. For complete information, visit: www.tpc.org/tpcc/results/tpcc_result_detail.asp?id=103103101

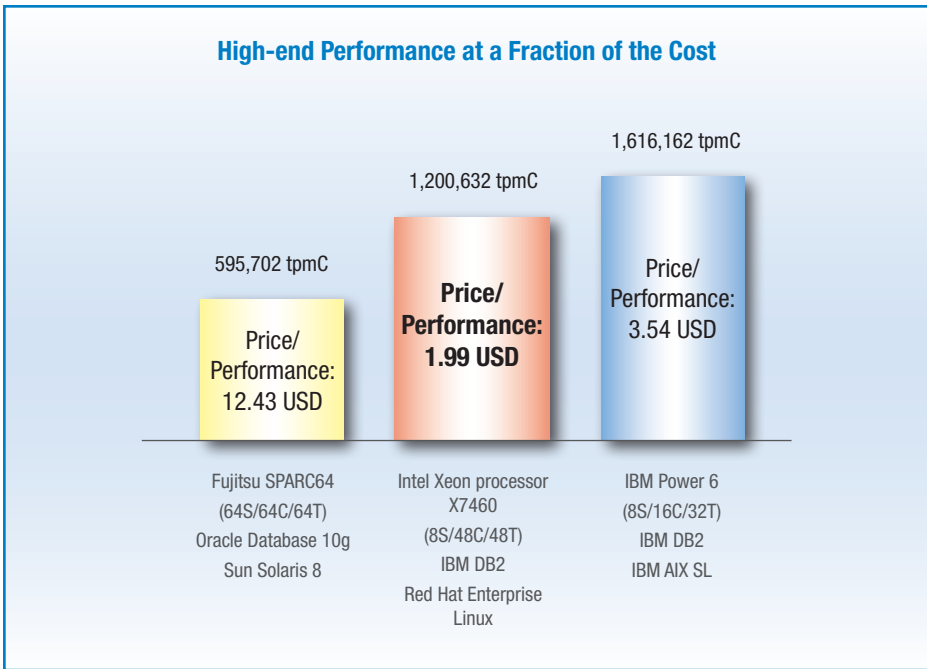


Figure 3. Almost a year ago, an Intel® Xeon® processor 7400 series based server delivered the first ever million+ TPC-C result for mainstream Intel processor-based servers, approaching the performance levels traditionally reached only by high-end RISC systems. Servers based on the next-generation Intel Xeon processor (code-named Nehalem-EX) will scale even higher and are expected to deliver roughly double the performance and memory capacity of the current generation.

optimize performance versus power consumption. Organizations can expect to see substantial performance improvements with improved energy-efficiency across virtually all workloads, with up to 50 percent lower power consumption when servers are idle.

Upcoming 4-socket and larger servers will be based on a next-generation Intel Xeon processor (code-named Nehalem-EX). This new processor is expected to deliver the biggest performance boost ever achieved in successive Intel Xeon processor generations, while doubling memory capacity, providing up to nine times the memory bandwidth and

delivering unprecedented support for high-availability in a mainstream server.⁵ It will support non-uniform memory access (NUMA) and provide breakthrough performance for demanding, memory-intensive applications. Red Hat Enterprise Linux fully supports these new capabilities, and Intel expects major server vendors will take advantage of this new processor to deliver a wider variety of system designs and configuration options for 4-socket and larger servers. These systems will be ideal for heavy workloads and large consolidation projects and will provide an estimated 2.5x increase in database performance.

Quantifying the Benefits of Migration

Many IT organizations are aware of the value delivered by Red Hat Enterprise Linux on Intel processor-based servers, but are concerned about the cost of migrating away from existing UNIX/RISC deployments. Although every migration is different, the cost of migration in the vast majority of cases will be considerably less than the cost of upgrading to new UNIX/RISC servers.

An example was provided by Alinean, a company that specializes in helping organizations optimize their IT

⁵ The Nehalem-EX processor will feature up to eight cores and 24MB of cache and will be capable of handling up to 16 simultaneous software threads. It will also include Machine Check Architecture (MCA) Recovery, for high-availability in mission-critical environments. It is scheduled for production in the second half of 2009. For more information, see the Intel Fact Sheet. www.intel.com/pressroom/archive/releases/20090526comp.htm

cost models. Alinean conducted a comprehensive TCO analysis comparing the cost of upgrading to new UNIX/RISC servers with the cost of migrating to Red Hat Enterprise Linux on Intel processor-based servers. The analysis was based on a customer in the financial services industry with approximately 1 billion USD

annual revenue. Although theoretical, the analysis was based on realistic assumptions that can be expected to hold true across a wide range of real-world migration scenarios.⁶

The results showed 47.2 percent lower total costs for migrating to Red Hat Enterprise Linux on Intel

Xeon processor-based servers, versus upgrading to new UNIX/RISC servers (Table 1). We believe this is a conservative estimate of potential gains. In many cases, substantial additional cost savings can be realized by using open source software more extensively across the enterprise solution stack (see Appendix B).

Table 1. Alinean RISC Migration TCO Study

TCO Comparison Average	Solution A: Alternative RISC Server	Solution B: Red Hat® Enterprise Linux® on Intel® Processor-based Servers	Difference (A-B)	Difference (A-B)%
Server Hardware Costs	USD 87,269	USD 21,151	USD 66,118	75.8%
Server Software Costs	452,133	302,745	149,388	33.0%
System Management Labor	211,782	70,505	141,277	66.7%
Power and Facilities Costs	16,810	3,215	13,595	80.9%
Migration/Project Change Costs	3,521	9,147	(5,626)	-159.8%
TOTAL	USD 771,516	USD 406,763	USD 364,752	47.3%

PART II: STRATEGIC MIGRATION PLANNING—AN OVERVIEW

Important: *The following is a high-level guide only and is not designed to provide comprehensive or detailed guidance. However, it should give you a good idea of what a successful migration entails. Additional information and resources are readily available (see Appendix A).*

Intel and Red Hat have developed proven methodologies and best practices for migrating UNIX/RISC applications to Red Hat Enterprise Linux on Intel processor-based servers across thousands of successful migration projects. Since Red Hat Enterprise Linux has been

designed as a UNIX replacement, it is relatively easy to migrate and maintain in existing UNIX/RISC environments.⁷ Depending on your current applications and operating environment, migration can be simple, even trivial. However, careful planning is essential to ensure you have realistic expectations and understand potential pitfalls so you can minimize your total cost and risk.

A successful migration begins with building a business case for migration, establishing technical viability, estimating cost and complexity, and overcoming any internal resistance among business and IT staff. The remainder of this paper offers insights into these issues and how you can address them.

Understand Your Business Goals

Before you get down to the practical matters of assessing your migration environment, it is important to clarify your goals for migration because they will have a significant impact on the decisions you make along the way. There are many reasons for migrating to Red Hat Enterprise Linux on Intel processor-based servers. A few high-level drivers include:

- **Cost Reduction.** Your migration can be expected to deliver considerable capital and operational cost savings. If cost is a key driver, there are many additional ways to increase your savings, such as consolidating more applications onto fewer and more powerful servers and increasing your use of open source software versus third-party vendor applications.

⁶ The Alinean TCO analysis is a theoretical example only. Actual savings will vary. Inputs: A theoretical customer in the financial services industry with revenues of USD 1 billion per year, expected growth of 15 percent, and 2,000 users. Current solution hypothesized as 10 Sun SPARC® V880 servers running Solaris®, Oracle EE®, Apache, and HP OpenView®. The theoretical customer had 5 systems administrators, 2.5 systems operators, 99.5 percent availability with 30 hours of scheduled downtime. Solution A hypothesized the customer remaining on SPARC, upgrading to 2 Sun Fire® M5000 servers. Solution B hypothesized the customer migrating to 2 HP BL680c servers with Intel® Xeon® processors 7340, Red Hat® Enterprise Linux® from Solaris, JBoss® from Apache, and IBM Tivoli® from HP OpenView. Oracle EE remained as the database. See www.alinean.com for examples of calculators.

⁷ “Moving as a user or administrator from Linux to UNIX, or vice versa, brings some inconsistencies, but overall is fairly seamless. Even though the filesystems or kernels might differ and require specialized knowledge to optimize, the tools and APIs are consistent. In general, these differences are no more drastic than variations among different versions of UNIX.” Source: Differentiating UNIX and Linux, by David Dougall, March 14, 2006. www.ibm.com/developerworks/aix/library/au-unix-difflinux.html

- **Migrating from aging hardware/software.** Solutions nearing the end of their useful life or vendor support cycles often offer particularly good candidates for migration, since they need to be upgraded or replaced anyway. Of course, high operating and maintenance costs often justify migration long before a solution reaches end-of-life or a lease comes up for renewal.
- **Changing business requirements.** Growing workloads, new performance requirements, and mergers and acquisitions can all trigger necessary changes and provide opportunities to inject higher value into the infrastructure.
- **Data Center Relief.** Migration to the latest Intel Xeon processor-based servers can often dramatically reduce data center space, power, and cooling requirements, especially if you take advantage of virtualization technologies offered in Red Hat Enterprise Linux and Intel processors to consolidate multiple workloads per server.

Define Your Deployment Strategy

Your migration strategy will depend not only on your business goals, but also on your long-term data center plans. In general, there are four basic deployment strategies, all of which can be used with Red Hat Enterprise Linux on Intel processor-based servers to deliver very robust solutions.

- **Consolidation.** Red Hat Enterprise Linux virtualization can be used to consolidate multiple workloads per physical server. Servers can be sized (2-socket, 4-socket, and larger) to optimize performance and value across the data center.
- **Dispersion.** Workloads running on one or more large systems can be distributed onto smaller servers in a very flexible and highly managed environment. Virtualized server blades are increasingly popular for this deployment strategy.
- **Aggregation.** Large numbers of existing applications can be migrated onto a single, highly scalable and fault-tolerant Intel processor-based server. With this approach, customers can use hardware (physical partitioning) or software (Red Hat Enterprise Linux virtualization) to control access to system resources.
- **Cloud Computing.** Customers can run some or all of their applications on third-party infrastructure. Red Hat Enterprise Linux on Intel Xeon processor-based servers is a widely deployed cloud computing platform and this trend can be expected to continue.⁸ Using the same operating environment in your own data center can make it easier to transition your in-house data center solutions toward a cloud computing

CASE STUDY— MIGRATION IN ACTION: Wall Street Systems

“Our clients are completely comfortable knowing that they can run their largest, most critical systems on Red Hat® Enterprise Linux® and that they’ll get enterprise-class support.”

– Mark Tirschwell
Chief Technology Officer
Wall Street Systems

As a global provider of mission-critical financial applications, Wall Street Systems needs its applications to deliver high-end performance, scalability, availability, and value. That’s why the company migrated all its flagship products from UNIX*/RISC to Red Hat® Enterprise Linux® running on Intel® Xeon® processor-based servers. According to Mark Tirschwell, the company’s chief technology officer, the new platform reduces capital costs for a typical customer implementation from around USD 1 million to about USD 250,000.

Wall Street Systems is also using the new platform to support its planned SaaS offerings and its internal development and quality assurance activities. The transition has enabled the company to consolidate 15 server racks down to 12 racks using built-in Red Hat Enterprise Linux virtualization. According to Tirschwell, his IT staff has been well satisfied with the move. “My administrators love the Red Hat Enterprise Linux interface—it’s intuitive and the tools are easy to use.”

Read the complete case study at:
www.redhat.com/f/pdf/customers/RH_CS_WallStreetSystems_web.pdf

⁸ “Open source is very much part of cloud computing. The benefit of open source to the cloud providers is clear at several levels.” Source: Open Source in the Next Computing Wave, by Gordon Haff, Illuminata, Inc., January 9, 2009. www.redhat.com/f/pdf/Illuminata_Open_Source.pdf

CASE STUDY— MIGRATION IN ACTION:

Florida Hospital

“We’d love to experience Red Hat® performance and reliability throughout the entire hospital.”

– Jack Velazquez
Senior Systems Engineer
Florida Hospital

With seven facilities and over 2,300 beds, business continuity is a life-critical issue for Florida’s largest hospital, yet the previous UNIX*/RISC disaster recovery system could have taken up to two days to restore file systems and data. Based on the success of a critical Web initiative, the IT organization turned to Red Hat® Enterprise Linux® running on Intel® processor-based servers. With help from Red Hat Professional Services, a unique disaster recovery solution was deployed in just two weeks, enabling recovery times to shrink “from days to just seconds.”

The organization now uses Red Hat Enterprise Linux on about 70 Intel processor-based servers to run a range of applications, including a two-terabyte Oracle data warehouse. Using Red Hat Network, new servers can be provisioned in minutes, and the entire Red Hat Enterprise Linux server infrastructure can be managed with only two engineers. According to Jack Velazquez, the hospital’s senior systems engineer, “Our parent company has been impressed by our efficiency, ROI, and performance gains using Red Hat.”

Read the complete case study at:
www.redhat.com/f/pdf/574607_308_FloridaHospitalCaseStudy_web.pdf

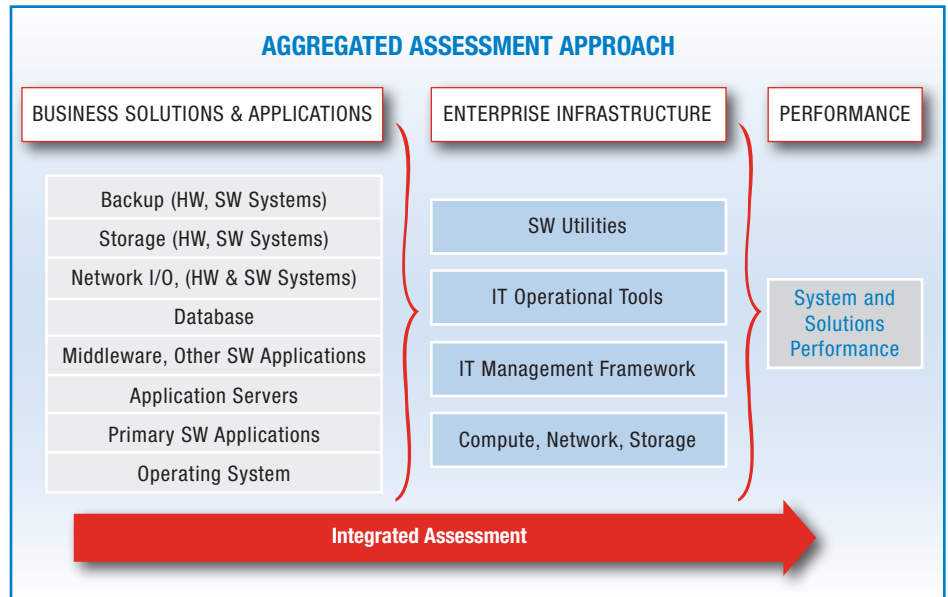


Figure 4. When assessing requirements and designing solutions, it is important to consider issues within the context of a comprehensive and integrated IT environment.

model when desired.

Create Your Strategic Migration Plan

The following five steps have been used successfully by Red Hat and Intel across hundreds of migration projects. While performing these steps, it’s important to evaluate requirements and design solutions within the context of an integrated environment that takes into account: applications, solutions, and systems; the enterprise IT infrastructure; system and solutions performance; and related interdependencies (Figure 4).

1. Infrastructure Application Analysis and Standard Build

The first step in migration is to assess your existing UNIX architecture and identify equivalent capabilities in the Red Hat Enterprise Linux ecosystem. In most cases, you’ll find that Red Hat Enterprise Linux provides the same or very similar functionality. You’re also likely to find additional functionality built into Red Hat Enterprise Linux,

and you may want to consider taking advantage of that functionality to simplify your target environment and reduce total costs. In addition, there is an extensive assortment of open source and third-party software available to address a wide range of issues.

As you begin to identify components and replacements, it is important to note any significant differences between the components built into your existing operating system (OS) and those built into Red Hat Enterprise Linux. There may be version differences, syntactic differences, or functional differences that will need to be considered during migration. The same may be true for third-party infrastructure components, such as a vendor-supplied storage and backup solution. By identifying differences between these components early in the planning stage, you can avoid potential disruptions during implementation.

The goal of this step is to create a standard build for your new environment that maps each of your existing infrastructure components to components in Red Hat Enterprise Linux or in third-party applications. An example is shown in Appendix C.

2. Functional Applications Analysis and High Level Cost Estimate

The next step in creating your strategic migration plan is to evaluate your third-party functional and business applications. As in step one, the goal is to identify equivalent capabilities in the Red Hat Enterprise Linux ecosystem and identify differences that might impact migration. The complexity of migrating these applications can range from trivial to highly challenging. Begin by examining documentation and conducting interviews with IT and business stakeholders to gather as much information as possible about the applications in question. This should be a comprehensive assessment, including factors such as version levels and independent software vendor (ISV) support, service level agreements, supporting hardware and software dependencies, development languages and platforms, external integration points, software optimization and tuning requirements, and testing and staging environment details.

Once you have this information, you can begin evaluating the complexity of the proposed migration. For example, migration would be extremely simple for a third-party application that is certified on

Red Hat Enterprise Linux at the same version level as your currently deployed application.

Migration is generally more complex for custom applications. However, it can still be relatively simple if the code is highly portable (for example, you have well-established porting methods, clean code, well-understood dependencies, good documentation, access to knowledgeable developers, and so on). The size of the code base should also be taken into account, because porting costs will be roughly proportional to the amount of code. For large and complex custom applications, it may be more cost effective to write a new application from scratch. You might also consider moving to an appropriate vendor or open source application. In this case, key stakeholders should be consulted to generate and prioritize a list of features.

With the application knowledge you have gathered up to this point, you can create a high-level cost estimate for migrating your application. You can also make a rough estimate of hardware requirements. This will depend on the workload and hardware information you have already gathered, and also on your planned deployment scenario (aggregation, dispersion, consolidation, or cloud computing). Putting all this together, you can create a reasonable approximation of your migration costs. In tandem with your business goals, you can use these estimates to identify the migration projects that will deliver the highest value to your business.

3. Readiness and Risk Analysis

Once you have a reasonable approximation of the cost and complexity of migration, it is important to consider the potential risks associated with the transition.

- **Workloads.** How will the migration impact service level agreements (SLAs), performance, security, and maintenance windows? How will you transition to the new solution with minimal disruption to your production environment? Do you have sufficient budget, staff, and other resources to keep the project on schedule?
- **Cost.** How portable is your software code, and how will migration impact software licensing, hardware requirements, and operating expenses (including data center floor space, power, and cooling)? Will you need training or new staff to address any skill gaps?
- **Acceptance.** Are there political, technical, or governance-related barriers to migration in your organization? Are business or IT personnel strongly attached to existing solutions because of historical experiences or personal familiarity?

For organizations with experience in deploying and managing Linux solutions, many of these risks may be negligible or irrelevant, because existing staff already have the knowledge and expertise required to mitigate them. Organizations that are new to Linux, on the other hand, are likely to experience greater internal resistance to migration, along with a skill gap that can add to overall risk. However, this is by

CASE STUDY— MIGRATION IN ACTION: City of Chicago

“Many of these [UNIX/RISC] servers are nearing the end of their life cycles, and when we replace them, we need to do so with cost-effective solutions.”

– Amy Niersbach
Platform Architect
Business & Information Services
City of Chicago

The City of Chicago had about 100 aging UNIX*/RISC servers running a large number of Oracle databases and applications, and it wanted to replace them with more cost-effective computing solutions. It began with a pilot project to test performance, scalability, and backup/recovery using Red Hat® Enterprise Linux® on Intel® processor-based servers. The new platform met all requirements, delivering roughly three times the performance of comparable UNIX/RISC systems on tested benchmarks and fifty percent better performance for the city’s long batch cycles.

Based on these positive results, the city has expanded beyond the initial project and recently migrated its Vehicle Registration System from a mainframe environment to Red Hat Enterprise Linux on Intel processor-based servers. According to Amy Niersbach, a platform architect for the city’s Business & Information Services department, “We’re optimistic about Red Hat Enterprise Linux and its ability to help us find a better way to deliver government services.”

Read the complete case study at:
<http://customers.redhat.com/2007/10/15/city-of-chicago/>

no means an insurmountable issue. Red Hat Enterprise Linux solutions can be purchased pre-configured from most server vendors, who have a detailed understanding of peripherals and integration requirements. In addition, Red Hat offers world-class training and support (including online courses and on-site workshops). UNIX professionals will find that a great deal of their existing knowledge is readily transferable. They will also find that Red Hat Enterprise Linux running on Intel processor-based systems offers a level of functionality and robustness capable of meeting virtually all requirements. Nevertheless, overcoming initial resistance can require a coordinated effort. Once you have determined that migration makes sense for your organization:

- Build a business case to enlist executive-level support. The steps described above will provide the information you need.
- Invest the time and resources to enlist broader support among business and IT decision-makers so they understand the value of migration and you have a chance to respond to any reservations they might have. (This can also be a valuable exercise in exposing potential risks you may not have considered.)
- Create and share your plan for training and transitioning IT personnel. Once people know their jobs are safe, their reservations will often subside, especially when they realize they will be learning skills that will open new career opportunities by extending their expertise across one of the world’s fastest-growing operating environments. With appropriate training, you are likely to gain enthusiastic supporters.

- Select low-risk applications for your first migration projects. Ultimately, your migration priorities should depend on a comprehensive look at cost, risk, and value, but choosing a low-risk target for initial migration can be instrumental in building support and developing skill sets that will serve you well during future migrations.

4. Strategic Migration Roadmap

At this point, you are ready to bring all the elements together to create a comprehensive migration roadmap. There are seven major steps in this process, and you will have already gathered much of the required information.

STEP 1: Detailed Analysis of Existing Hardware. Perform a detailed analysis of the hardware that is currently supporting the applications you will be migrating. For each application, include the following data for development, testing, staging, and deployment environments.

- Number of servers and processors per server
- Memory requirements
- Storage and file system requirements
- Network requirements (bandwidth and latency)
- Other I/O requirements (accelerators, management subsystems, and so on)

STEP 2: Consolidated Deployment Scenario and Virtualization Analysis. Assess your new hardware requirements based on your chosen deployment scenario: consolidation, dispersion, aggregation, or cloud computing. Be aware that today’s multi-core Intel processor-based servers are far more powerful than

older systems of similar size, so you may be able to significantly drive down costs by consolidating multiple applications per server using Red Hat Enterprise Linux virtualization. When assessing the consolidation potential, consider the following for each application:

- Application SLAs
- Average and peak hardware utilization rates (processor, memory, disk, bandwidth, etc.)
- Physical location of applications (if you have multiple data centers)
- Virtualization limitations (ISV support, regulatory and compliance issues, etc.)
- Operational type (development, testing, production, etc.)
- Security and network segmentation
- High availability and disaster recovery requirements
- Clustering requirements and limitations
- Specialized hardware requirements (storage area networks, tape drives, InfiniBand*, etc.)
- Power and cooling requirements
- Integration into server management infrastructure

STEP 3: High-level Hardware Redeployment Analysis. A key benefit of migration is the elimination of expensive RISC servers to reduce your total costs. However, most organizations do not migrate all their applications at once. As you migrate off one RISC server, consider using it to add capacity for an existing RISC/UNIX application that you are not yet ready to migrate. The savings can be appreciable.

STEP 4: Consolidated Risk Analysis and Risk Mitigation Plan Update. Revisit and update your risk analysis, based on the more detailed information you have now gathered. If risk factors have changed significantly, you may want to reconsider or re-prioritize your application migration list.

STEP 5: Training Plan. Determine which staff members will need training and identify appropriate resources. Red Hat offers comprehensive training for Red Hat Enterprise Linux, including online, classroom, and on-site workshops. You may need to identify additional training resources for new hardware or ISV applications.

STEP 6: Detailed Cost Estimate. Based on the information you have gathered, create a detailed estimate of direct costs and savings. Include each of the following:

Costs for:

- New ISV applications (infrastructure and functional)
 - New hardware
 - Application migration
 - Training
- Savings from:
- Replacing proprietary ISV applications with open source alternatives
 - Redeployed hardware

Note that this is not a complete return on investment (ROI) or TCO analysis because it does not include indirect savings, such as operational cost savings or the savings from not having to upgrade the existing RISC/UNIX environment.

STEP 7: Master Migration Roadmap. Use all the information you have gathered so far to create a project plan that details when, where, and how your migration will occur. The first step is to prioritize specific system and application migrations based on factors such as capital budget allocation timing, specific business priorities, and data center constraints. You can then create actual project timelines that include tasks and dates and match specific capital and operational expenditures to quarterly IT budgets.

5. Implementation

By carefully following the methodology described above, you should be well positioned to make the transition smoothly and with few if any unforeseen complications. An enormous variety of companies have successfully migrated mission-critical applications to Red Hat Enterprise Linux on Intel processor-based servers, and the relative ease and value of the migration has led them to standardize on the combined platform for future deployments and upgrades.

See Appendix A for additional resources.

CONCLUSION

Red Hat Enterprise Linux running on Intel processor-based servers is delivering exceptional value across a wide variety of enterprise workloads, all the way from the edge of the data center to the most mission-critical back-end applications. The combined platform provides a foundation for complete enterprise solutions without the high

costs and limitations of proprietary UNIX/RISC environments. Enterprise-class service and support are also widely available from Red Hat and Intel, and from many other hardware, software, and service vendors around the world.

Migration to this high-value computing platform can deliver substantial business and IT benefits, but requires careful planning to clearly understand

the costs, risks, and benefits, and to create a strategic migration plan for your business. More detailed migration guides are available, along with comprehensive services to support your assessment, planning, and implementation. See Appendix A for more information, or contact your Red Hat or Intel representative.

APPENDIX A: ADDITIONAL RESOURCES

Red Hat and Intel: The Intelligent Server Choice Web site—Access information and resources, including success stories, white papers, migration guides, webinars, and more. www.redhat.com/intelligence/

Red Hat and Intel Solutions Web site—Access detailed technical information and resources, including online forums for developers and IT professionals. You'll also find links to the global community of vendors that support Red Hat and Intel® technology-based solutions. <http://redhatonintel.com/>

Red Hat® Enterprise Linux® 5—Get detailed product information. www.redhat.com/rhel

Intel processor-based servers—Get detailed information, including performance benchmarks. www.intel.com/p/en_US/products/server/processor

Advanced Mission-Critical Program—Learn how Red Hat and Intel are teaming up with leading hardware vendors to deliver a new level of mission-critical service and support. www.redhat.com/promo/mc_program/

Red Hat Training—Learn more about Red Hat's comprehensive, award-winning training programs. www.redhat.com/training/

Red Hat Consulting Services—Learn about Red Hat's complete set of services for migration planning and implementation. www.redhat.com/consulting

APPENDIX B: THE OPEN SOURCE SOLUTION STACK

Red Hat offers and supports a complete open source solution stack for enterprise customers. All components are available on a subscription basis that includes software, support, updates, and upgrades—all delivered online through Red Hat Network.

Components include:

- **JBoss* Application Server**—the leading Java*-based runtime for Web and enterprise applications (includes Apache Tomcat*).
- **JBoss Hibernate**—the leading technology for object and relational mapping and persistence.
- **Red Hat® Enterprise Linux®**—the leading open source Linux* platform for enterprise computing.
- **Open source databases**—the world's most popular open source databases, including MySQL* and PostgreSQL*.
- **Web Server**—Apache HTTP Server, the most popular Web server on the Internet, and standard programming languages PHP* and Perl*.

APPENDIX C: SAMPLE STANDARD BUILD

The following provides an example of software components that can be used in a standard build. Many alternatives are available, including both open source and vendor products.

Infrastructure Component	Red Hat® Enterprise Linux® Environment
Provisioning	Kickstart*, Red Hat Network/Satellite
Network File Systems	NFS/NFSv4
Drive/Directory Mounting	Autofs
Package Management	RPM/YUM
Systems Management	Red Hat Network/Satellite
Monitoring	Red Hat Network/Satellite
Troubleshooting	SystemTap
Packet filtering firewall	Netfilter/IPtables
Intrusion Detection	Advanced Intrusion Detection Environment (AIDE)
Identity Management	Red Hat Directory Server, Red Hat Certificate System
File systems	Ext3/4, LVM, GFS, XFS
Virtualization	Red Hat Enterprise Linux Virtualization, Xen*, Kernel-based Virtual Machine (KVM), VMware* support
Storage Multipath	device-mapper-multipath
Job Scheduling	Red Hat Enterprise MRG Grid
Clustering	Red Hat Cluster Suite
Bare-Metal Recovery	Kickstart, Red Hat Network/Satellite

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