TECHNOLOGY BRIEF

MIGRATING FROM UNIX TO LINUX ON AN OPEN-STANDARDS PLATFORM

Intel and Red Hat Enable Future-Proof Business Opportunities

To address the challenges of aging UNIX and RISC infrastructure, Intel and Red Hat have partnered to co-engineer solutions that offer robust alternatives for businesses to modernize their IT systems.

TABLE OF CONTENTS

BEGINNING THE MODERNIZATION JOURNEY

At some point, enterprises running core business applications on traditional, proprietary UNIX* platform architectures find that these architectures are negatively affecting business operations. UNIX solution availability is limited, and most options are costly. Additionally, maintenance of hardware and software platforms is costly and difficult, as availability of compatible agile tools and infrastructure technologies is limited or nonexistent, and integration is challenging.

As a result of these restrictions, Gartner forecasts that independent software vendor (ISV) investment and support in UNIX will shrink 75 percent between 2015 and 2020.[1] Typically, companies are hesitant to abandon existing systems that have served them well but recognize the value of migration. These organizations face the challenge of determining the steps involved in migrating from UNIX to Linux® and how to begin the process.

There is no single path to IT modernization. Instead, a series of stages can be completed to progressively benefit from modern technology without disrupting vital IT operations that support an organization's success. By establishing a modern IT foundation, organizations can prepare to integrate the latest technologies to support agile development, task orchestration, rapid application deployment, and centralized management capabilities. The combination of a standards-based hardware platform based on Intel® architecture and the stable, proven capabilities of Red Hat® Enterprise Linux meets the demands of the modern datacenter with next-generation IT requirements.

1 *Butler, Andrew, George J. Weiss. "Is It Time to Migrate from Unix?" Gartner. 2015.*

IDENTIFYING THE BUSINESS VALUE OF MIGRATION

UNIX has been the mainstay of enterprise applications for more than two decades but has lost market share rapidly in recent years. Numerous problems led to this decline, including the lack of application portability—as many competitors developed their own proprietary solutions—reliance on expensive custom hardware, and the lack of a standards-based framework and supporting ecosystem. As market share for UNIX continues to plummet, enterprise decision makers and IT teams are seeking to move to a more agile framework to better support business operations.

Related to this market shift, the perception that reduced instruction set computer (RISC) platforms are inherently more reliable and secure has diminished as the latest x86-based platforms have incorporated new, advanced reliability, accessibility, and serviceability (RAS) features focused on system resilience. For example, Machine Check Architecture Recovery—part of the Intel® Run Sure Technology features built into Intel® Xeon® Scalable processors—offers automated system recovery from many errors to maximize uptime. Intel® Trusted Execution Technology enhances security by providing root-level integrity checks at the pre-boot stage, and Intel® Advanced Encryption Standards New Instructions accelerates encryption to deliver stronger data protection without overloading servers. With these innovative enhancements, the reliability gap between RISC and x86-based servers has largely disappeared. According to the ITIC 2015-2016 Global Server Hardware, Server OS Reliability Report, Linux/x86 platforms demonstrate reliability that is on par with IBM AIX/Power platforms and higher than Oracle Solaris* and SPARC* offerings.[2]

In addition to hardware developments that have decreased UNIX market share, skilled staff personnel—capable of maintaining RISC environments and supporting applications written in COBOL (common business-oriented language) and other early languages—are retiring or moving into other fields. As a result, organizations have shrinking access to expert support and development personnel resources.

To address the challenges of aging UNIX and RISC infrastructure, Red Hat and Intel have partnered to co-engineer solutions that offer robust alternatives for businesses to modernize their IT systems.

With Red Hat Enterprise Linux, an enterprise-grade operating system, running on Intel architecture-based platforms, organizations have achieved greater flexibility, reduced total cost of ownership (TCO) of IT assets, and established frameworks for rapid application development and deployment using the latest technology advances.

REDUCING OPERATIONAL COSTS AND TOTAL COST OF OWNERSHIP

There are substantial financial and performance benefits to deploying standard high-volume servers (SHVS) based on x86 frameworks and open-source operating systems and software.

Figure 1 compares the operational costs of a system based on the Intel® Xeon® Platinum 8180 processor and a system based on the IBM POWER8*.

2 *"ITIC 2015-2016 Global Server Hardware, Server OS Reliability Report." IBM. 2016. https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=ZSL03380USEN*

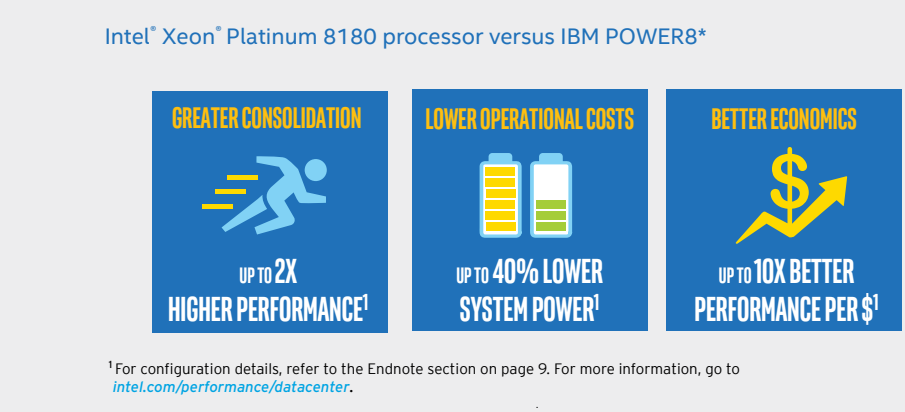


*Figure 1. Performance and power comparison between Intel® Xeon® Platinum 8180 processor and IBM POWER8**

Migrating to Red Hat Enterprise Linux offers TCO and return-on-investment (ROI) improvements. Figure 2, based on a study conducted by Alinean, shows the benefits of migrating from proprietary systems to Red Hat Enterprise Linux, for five organizations in various industries.

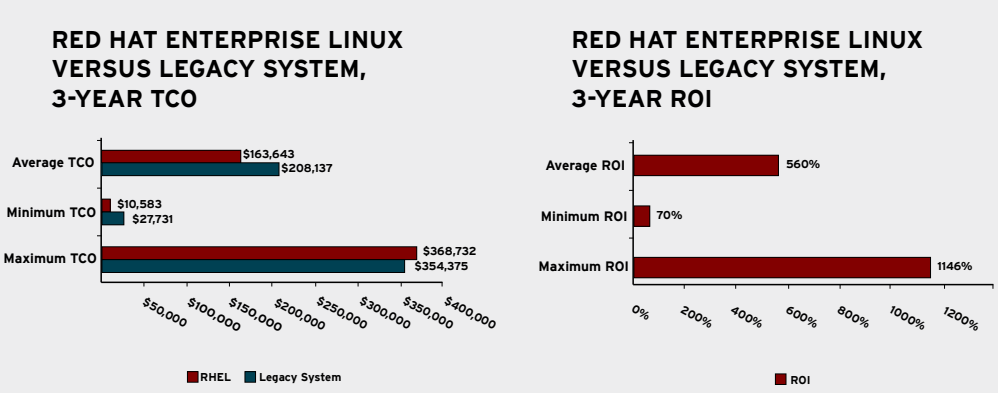


Figure 2. TCO and ROI after migration to Red Hat Enterprise Linux on x86-based hardware

With these financial savings, enterprises can invest in new, innovative projects and technologies to strengthen their competitive market positions.

Beyond cost savings, study participants also reported other reasons for migrating, including the need for additional capacity or performance, a current system reaching end of life, and improved business continuity across the enterprise.

IMPROVED MIGRATION STRATEGIES

Previously challenging migration tasks have been refined and enhanced, with accrued migration experience, familiarity with x86-based tools, and a rich, supporting software ecosystem helping to streamline the migration process. With an open standards-based foundation, enterprises have a clear path to complete virtualization and cloud-native applications. As another benefit, the cost savings associated with the new platform make it possible for enterprises to invest in new, innovative projects and technologies to strengthen their competitive position in the market.

Intel and Red Hat have guided thousands of companies through UNIX to Linux and RISC to Intel architecture migrations. Successful migrations require consideration of the trade-offs involved—for both hardware and software—before actually migrating to the new platform. For example, when building a foundational hardware platform to support an enterprise Linux environment, the main focus should be on creating an environment to support key business objectives. Initial optimization efforts should focus on determining the best way to convert business-critical business applications and selecting necessary operating system components from available options based on open standards.

Your decisions on which apps to migrate will affect the selection and the configuration of a hardware platform to meet your business needs.

RESOLVING CODE AND DATA CONVERSION ISSUES

The first consideration when migrating from a traditional to an optimized environment is the software running on your existing, traditional framework.

- If you have a business application developed in-house, you can often recompile the source code for rehosting on the new Linux platform.
- If you have a commercial application from an ISV, is it available in a version that will run on your platform? If a compatible version is not available now or in the near future, what is the best replacement?
- If you are running a database-intensive core business application, you can convert the data structures to a Red Hat Enterprise Linux environment on an x86 architecture.
- Are your traditional applications adequately serving their purpose? If not, it may be an ideal time to switch to an open-source solution that better meets your requirements on the new platform.
- Are you primarily interested in migrating infrastructure applications—such as web servers, domain name servers, Light Directory Access Protocol (LDAP), or firewalls? These migrations are typically the simplest, providing the highest value at the least risk.

Your decisions on which apps to migrate will affect the selection and configuration of a hardware platform to meet your business needs. For example, moving an older application that does not take advantage of multithreading to the platform will not necessarily require a processor configuration with massive numbers of cores. A business objective that involves analytics and big data may require large amounts of memory and flexible, software-defined storage. If the performance of a specific, single-threaded business application is important, processor clock frequencies and accelerator tools will likely be more important than the total number of available cores. In other words, the nature, capabilities, and demands presented by your business-critical software essentially defines your hardware requirements, as well as the most effective code and data conversion approach.

Whenever a required business application is not available in a version that is compatible with the new environment, code conversion is the primary migration task. The same priority applies to any custom code components or shell scripts. The level of effort required to complete this conversion can vary depending on several considerations, including:

- Quality and availability of source code documentation
- Availability of porting tools equipped for conversions
- Availability of developers with the requisite migration skills and experience
- Application age and complexity

In some cases, the excess time and effort required to convert a traditional application to a version that will run on an open standards platform will negate any potential benefits. An older, poorly documented mainframe application, patched over many years and written in COBOL, PL/1, or Job Control Language with multiple interdependencies, may be indecipherable to a modern development team. In such cases, organizations may want to continue running the business application on the original platform until its end of life while preparing a modernized, replacement platform based on open standards.

CONTENDING WITH ENDIAN CONVERSION

In moving from RISC architecture to an x86 platform, conversions must be designed to handle a fundamental difference in the byte order of instructions and data, whether big endian or little endian. Depending on the original host and the applications in use, and the network communications that have been established, steps need to be taken to ensure that byte order undergoes conversion to map to the new host's requirements.

Conversions can take advantage of the byte swap (BSWAP) instruction supported by Intel processors, which reverses the byte order in a 32-bit register operand, making it valuable for conversions involving big endian and little endian data formats. The complexity of endian conversion should be evaluated as a part of the migration strategy and addressed accordingly.

RELATIVE EASE OF MIGRATION

Table 1 illustrates the magnitude of risk, effort, cost, and downtime for different application migration scenarios. The easiest migrations involve moving infrastructure applications to a new host with minimal code conversion. Remote office applications and vital commercial-off-the-shelf applications (COTS) are next in complexity. The most difficult migrations involve critical, custom applications, as they may require substantial recoding to operate on the new host.

TABLE 1. RELATIVE EASE OF APPLICATION MIGRATION

SIMPLEST MIGRATIONS ON THE LEFT TO THE MOST COMPLEX ON THE RIGHT

	Infrastructure applications	Remote office / retail computing applications	Vital COTS applications	Vital custom applications
Code / data conversion	Little or no code conversion required	Complexity varies depending on the applications	Low complexity	Moderate complexity
Downtime / outage	Not significant	Can be controlled or scheduled	Downtime sensitive	Downtime sensitive
Replication across environment	Easy to replicate	Create pilot and then replicate	Varies from easy to moderate, depending on complexity or replacement of applications	Varies from moderate to complex depending on the apps involved
Cost and risk	High value with low cost and risk	Cost and risk are defrayed	Moderate risk and cost, depending on recoding complexity or replacement of applications	Potentially significant cost and risk based on availability of expertise for reworking applications
Examples	DNS, LDAP, web servers, firewall, backup and restore, file, and print	Business applications running at multiple locations, such as remote offices, bank branches, retail stores, and so on	Rehosting core business applications, such as SAP*, Oracle eBusiness Suite*, and associated databases	An application written to support unique processes for a single business (often in C++, C, Java™

IT organizations face rising costs, increasing demand to roll out applications to business objectives faster than ever, and ongoing maintenance and management issues for traditional systems. Migration from RISC to Intel architectures simplifies maintenance and management across a homogenous, industry-standard server environment. With advanced development tools for x86 platforms, developers can design and deploy applications more rapidly. When this hardware platform is supported by the agile development framework and DevOps principles of a Red Hat Enterprise Linux ecosystem, organizations can accelerate creation of the core business applications to stay competitive.

OPTIMAL MIGRATION STAGES

Following code conversion, migration from UNIX to Linux on an Intel processor-based platform can proceed through several stages, with thorough testing and refinement at each level:

- **Proof-of-concept (PoC) migration**. During this stage, the converted application is tested on the new hardware platform to verify that it runs reliably. This test helps determine performance criteria, platform tuning needs, and production migration processes. This stage can also help identify any solution architecture issues affecting scalability and availability.
- **Rehearsal migration**. Informed by the results of the PoC migration, this stage determines a streamlined process for optimal migration efforts and validates the steps involved for a large production deployment. The goal of this stage is to minimize potential downtime during the full migration.
- **Production migration**. Once you have confidence in the migration process and tools, notify all business units of the deployment. You can then either move immediately to the new platform or operate in parallel, depending on requirements. Experienced guidance available from Intel and Red Hat can make the migration process simpler and more efficient.

For deployment across multiple business sites, a pilot migration performed before the PoC stage can help identify any issues that may apply to these different environments.

CONTINUING YOUR MODERNIZATION JOURNEY

Rehosting applications on a Intel architecture-based hardware platform, running Red Hat Enterprise Linux and other open-source software solutions, frees businesses to begin adopting additional modern technologies (see Figure 3). A foundational layer is provided by moving from UNIX to Linux to establish a standard operating environment and standards-based virtualization. Proceeding through the migration and modernization stages adds efficiency, agility, automated orchestration, and centralized control over operations.

Throughout the IT modernization journey, virtualization capabilities can more easily be added to your IT infrastructure—whether software-defined networking, software-defined storage, containerized infrastructure, or software-defined infrastructures. An optimized, integrated hardware and software platform is ready to support hybrid frameworks and future deployment of cloud-native applications. This optimized environment offers better use of compute resources, easier scalability, and improved manageability. Figure 3 compares IT modernization paths and the characteristics of each level, from rehosting to migration to total modernization.

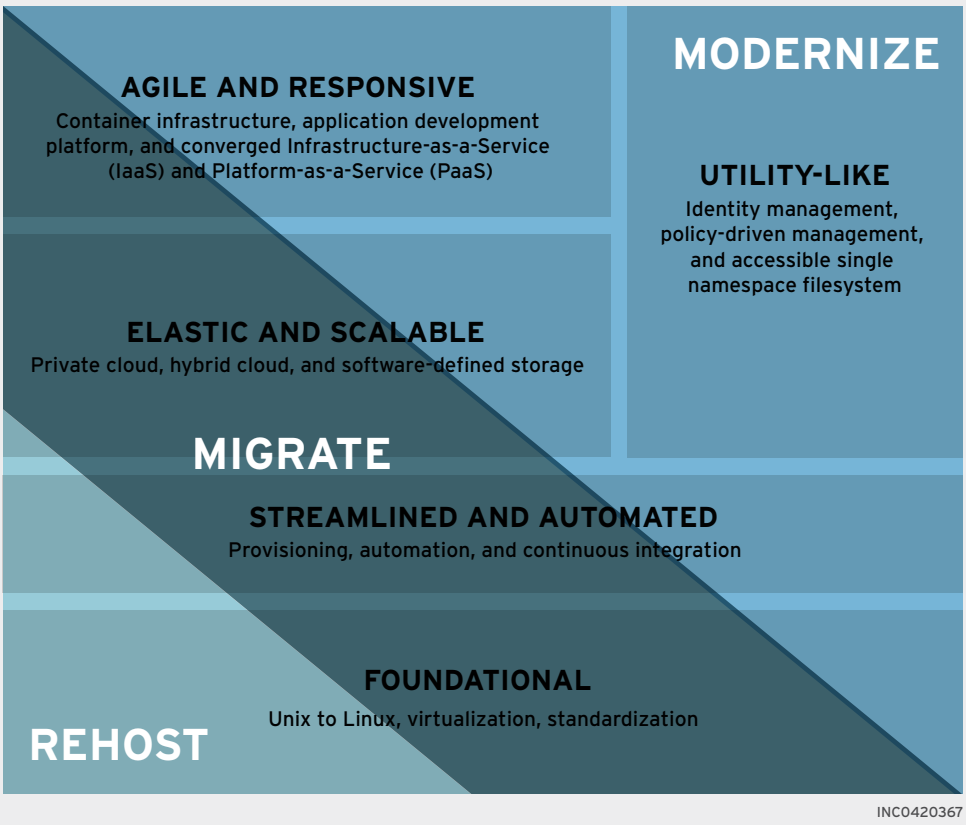


Figure 3. IT modernization paths and characteristics

The trend toward enterprise digital transformation has led to widescale innovation across IT infrastructures, helping businesses capitalize on technology advances, open standards, and open source approaches. Over many years, Intel and Red Hat have worked collaboratively on Intel architecture-based platforms running Red Hat Enterprise Linux to optimize reliability, security, and performance. Reference architectures developed by both companies offer robust, stable IT infrastructures for the most demanding enterprise workloads.

To get started on your digital transformation journey and learn more about modernizing your IT infrastructure, contact Red Hat, Intel, or an authorized Red Hat partner.

ENDNOTE

CONFIGURATION DETAILS FOR INTEL® XEON® PLATINUM 8180 PROCESSOR VERSUS IBM POWER8* COMPARISON

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark* and MobileMark*, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

Intel does not control or audit third-party benchmark data or the web sites referenced in this document. You should visit the referenced web site and confirm whether referenced data are accurate.

"Up to 2x higher performance" compared to IBM POWER8*-based solutions' claim is based on Intel estimated SPECint*_rate_base2006 performance of an 8-socket server using Intel® Xeon® Platinum 8180 processor scoring 10,600 priced versus an 8-socket IBM Power* E870 scoring 4830. "Up to 40% lower system power" compared to IBM POWER8*-based solutions' claim is based on estimated system power of 8-socket server using Intel® Xeon® processor E7-8890 v4, 2,816 watts max power, versus an 8-socket IBM Power E870, 5,068 watts max power. "Up to 10X better performance per dollar" compared to IBM POWER8*-based solutions' claim based on estimated SPECint_rate_base2006 performance of an 8-socket server using Intel® Xeon® Platinum 8180 processor scoring 10,800 priced at a list price of USD 265,000 to an 8-socket IBM Power E870 scoring 4,830 priced at a public list price of USD 1,217,756.

SPECint_rate_base2006 benchmark results:

8-chip IBM POWER8*-based Power E870 (4,830 baseline score) with 4 TB of memory. Source: http://public.dhe.ibm.com/common/ssi/ecm/po/en/poo03017usen/POO03017USEN.PDF.

Intel estimated SPECint*_rate_base2006 performance of an 8-socket server using Intel Xeon Platinum 8180 processor scoring 10,800 with 3 TB memory.

Estimated power:

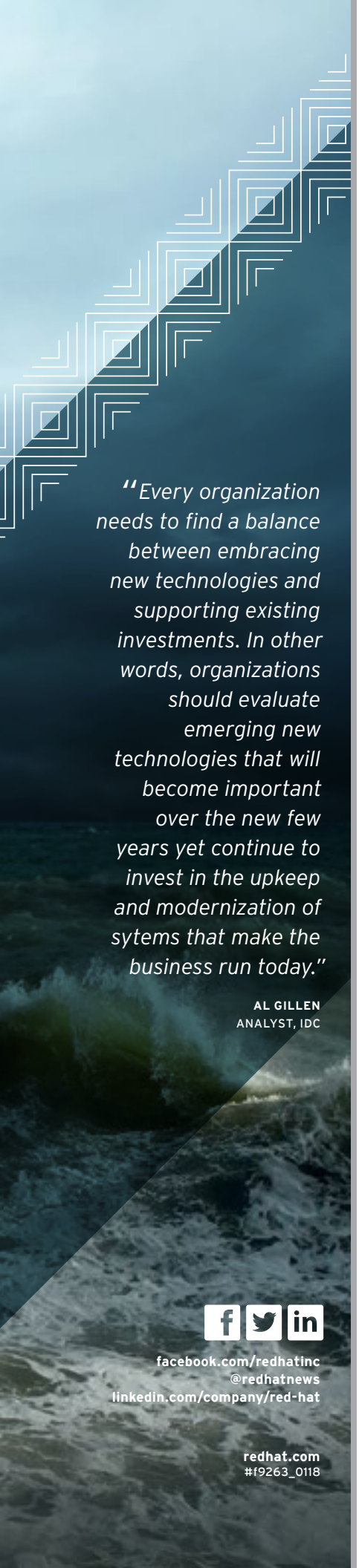
8-chip IBM Power E870 with 8 x 4.19 GHz POWER8* processors, 4 TB memory, 2 HDDs (5068 watts max power). Source: http://www-912.ibm.com/see/EnergyEstimator.

Intel estimate for 8 socket x Intel® Xeon® Platinum 8180 processor, 3 TB memory, 2x146G 15K SAS drives (2,816 watts max power).

Estimated pricing:

8-chip IBM Power E870 pricing of USD 1,217,756: 8 x 4.19 GHz POWER8* processors, 4 TB memory, 2 HDDs. Source: IBM United States Prices 114-160, dated October 6, 2014 (hardware list prices). Source: As of May 23, 2016, IBM System P Power Based Products List Price File - July 2015: https://www-304.ibm.com/shop/americas/content/pdfs/california/CA_System_P_HW_July_2015.pdf.

For an 8-chip platform, Intel estimates a list price of US$265,000 with 8x Intel Xeon Platinum 8180 processors, 3 TB memory, 2 HDDs.



ABOUT INTEL

Intel Makes Possible the Most Amazing Experiences of the Future

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Harnessing the capability of the cloud, the ubiquity of the Internet of Things, the latest advances in memory and programmable solutions, and the promise of always-on 5G connectivity, Intel is disrupting industries and solving global challenges. Leading on policy, diversity, inclusion, education, and sustainability, we create value for our stockholders, customers, and society.

2200 Mission College Blvd.
Santa Clara, CA 95054-1549
USA
Phone: (408) 765-8080

ABOUT RED HAT

Red Hat is the world's leading provider of open source software solutions, using a community-powered approach to provide reliable and high-performing cloud, Linux, middleware, storage, and virtualization technologies. Red Hat also offers award-winning support, training, and consulting services. As a connective hub in a global network of enterprises, partners, and open source communities, Red Hat helps create relevant, innovative technologies that liberate resources for growth and prepare customers for the future of IT.

NORTH AMERICA
1 888 REDHAT1

EUROPE, MIDDLE EAST, AND AFRICA
00800 7334 2835
europe@redhat.com

ASIA PACIFIC
+65 6490 4200
apac@redhat.com

LATIN AMERICA
+54 11 4329 7300
info-latam@redhat.com

facebook.com/redhatinc
@redhatnews
linkedin.com/company/red-hat

redhat.com
#f9263_0118