SOLUTION BRIEF

MIGRATING FROM UNIX TO A FUTURE-READY OPEN PLATFORM

Moving beyond proprietary infrastructure with solutions from Dell EMC is a key component of IT transformation that sets the stage for innovation.

OPEN PLATFORMS ARE A KEY REQUIREMENT FOR ENTERPRISE TRANSFORMATION. DELL EMC ENABLES CUSTOMERS WITH OPEN SOLUTIONS THAT ENHANCE FLEXIBILITY AND CURB TOTAL COST OF OWNERSHIP.

Transforming IT into a Key Business Asset

Many IT organizations have undertaken initiatives to transform themselves from cost centers into drivers of strategic value for the business as a whole. Gartner reports that enterprise IT budgets began growing again in 2018, and that higher rates of IT budget increase exist among companies where senior management sees IT as core to the business or agency strategy.[1]

These trends reveal the opportunity for IT to improve its outlook for long-term viability through innovation. One of the key challenges to IT organizations as they try to adopt a forward-looking mindset is their continuing obligation to spend money to maintain legacy systems.

At the same time those budget outlays reduce the capacity for innovation, they can also force IT to pass on higher costs to business units. Line-of-business workloads hosted on legacy systems are hampered by high expenses associated with proprietary hardware and software.

Modernizing by moving to open-standards technologies can therefore not only save on immediate expenses but also open up the potential for innovation and a more strategic role for IT. Businesses can advance along this path to modernization by migrating workloads from UNIX-based operating systems to Red Hat® Enterprise Linux® and replacing RISC hardware with Dell® PowerEdge™ servers. This complete portfolio of rack servers is designed to optimize application performance and ensure a stable, worry free environment with intuitive tools that simplify and automate throughout the entire server lifecycle.

This solution brief supports IT decision makers in the early stages of considering the potential for legacy migration in their environments. While guidance for the migration itself is outside the scope of this document, it outlines the generalized business case for decommissioning proprietary legacy platforms in favor of open standards and helps put migration into the context of an individual organization's environment.

Compelling Reasons to Modernize Legacy Infrastructure

As data center operators survey their legacy infrastructure, they may feel hampered by the limited availability of hardware and software solutions, as well as the complexity and expense of integrating their legacy environments with newer systems. They often find that the former benefits of these environments are disappearing, with difficulty in finding expertise to perform day-to-day operations, as well as security issues raised by unsupported end-of-life solutions. In addition,

limitations arise because of the lack of application portability among expensive proprietary platforms and the lack of a unifying set of standards and supporting ecosystem. These factors tend to hamper interoperability, significantly limiting innovation. At the same time, they see that open technologies are increasingly reaching parity or even superiority in terms of performance, reliability, and security.

Improved Performance and Server Consolidation

Dell PowerEdge servers equipped with Intel® Xeon® Scalable processors offer performance headroom that may be superior to proprietary competitors. That advantage potentially offers the ability either to scale up workloads in response to emerging business needs or to consolidate collections of legacy servers onto a smaller number of open-standards systems.

Mission-Critical Reliability

Traditionally, proprietary systems were favored for reliability on mission-critical applications, especially in regulated environments such as financial services, healthcare, and utilities. That advantage has shrunken or disappeared as reliability, availability, and serviceability (RAS) of open-standards hardware has evolved to its present high level. Factors such as redundant and hot-swappable components are augmented by capabilities such as memory mirroring and sparing to guard against and limit the impacts of outages. In addition, Dell PowerEdge servers with Intel® Run Sure Technology offer automated system recovery from otherwise-unrecoverable memory errors, further improving uptime. Red Hat augments these hardware capabilities with the Red Hat Enterprise Linux High Availability Add-On, a clustered system that provides RAS capabilities to critical production services.

Advanced Security Capabilities

Security capabilities built into both the hardware and software of open standards systems have also made significant advances in recent years. For example, Dell PowerEdge servers with Intel® Trusted Execution Technology verify the integrity of the pre-boot environment of servers to detect any tampering that may have occurred against a known good image. Intel® AES New Instructions accelerate critical portions of encryption algorithms in hardware to make pervasive encryption feasible in implementations where it would otherwise not be. In addition, Red Hat Enterprise Linux builds on the data-protection capabilities of open source with enterprise-grade hardening and support that help secure the operating system for the most sensitive and critical usages.

Realizing the Business Value of Legacy Migration

Red Hat Enterprise Linux running on Dell PowerEdge servers provides a compelling combination of building blocks for IT organizations to use as the basis of data center modernization. The capabilities of this solution stack go beyond the general advantages of migration away from legacy infrastructure, to improve the bottom line, enhance day-to-day operations, and future-proof infrastructure.

Lower Operating Expense and Superior Return On Investment

As described in previous sections of this document, a range of advantages beyond financial benefits are available to businesses that migrate their legacy environments to modernized ones based on open standards. Nevertheless, adoption of Red Hat Enterprise Linux as a replacement for legacy UNIX operating systems such as IBM AIX, HP-UX, or Oracle Solaris can provide compelling improvements in total cost of ownership (TCO) and return on investment (ROI).

Enhanced Server Capabilities to Improve Operations

Modernized data centers benefit directly from capabilities built into Dell PowerEdge 14th Generation servers to support emerging workloads and deployment models. These systems are designed specifically to overcome the inflexibility of legacy systems, reduce the amount of time IT personnel spend on routine tasks, and enhance data protection. Key design features of 14th Generation Dell PowerEdge servers that modernize data center operations include the following:

- **Scalable business architecture** includes simplified platform tuning for specific workloads, increased storage capacity and flexibility, and enhanced I/O to support the full range of accelerator devices.
- **Intelligent automation** uses a purpose-built chip installed in the server that enhances server deployment, management, and automation to help increase productivity and simplify lifecycle management.
- **Integrated security** offers a cyber-resilient architecture with features that provide a deep layer of defense, detect breaches quickly, and rapidly recover from unplanned firmware or configuration changes.

Ongoing Growth in Performance and Energy Efficiency

PowerEdge 14th Generation servers offer substantial improvements in performance and energy efficiency over their 13th Generation predecessors, as shown in Figure 1. These results demonstrate the value of architectural improvements built into the Intel Xeon Scalable processor, relative to previous architectures. Key among those factors is a redesigned six-channel memory subsystem, a new hierarchical cache architecture, and increased parallelism based on up to 28 cores per socket.

These results include a 51 percent generation-to-generation improvement in the SPECint_rate_base 2006 benchmark, which measures performance of integer operations as a widely used approximation of a server's ability to run general business applications. The newer server generation also shows a 64 percent improvement in the SPECfp_ratebase2006 benchmark for floating-point operations, which approximates computationally intensive workloads in fields such as scientific computing. This testing also shows a 41 percent improvement in the SPECjbb2015 benchmark, which approximates Java-based business applications. In addition, the results also show a 78 percent improvement in performance per watt using the SPECpower_ssj2008 benchmark.

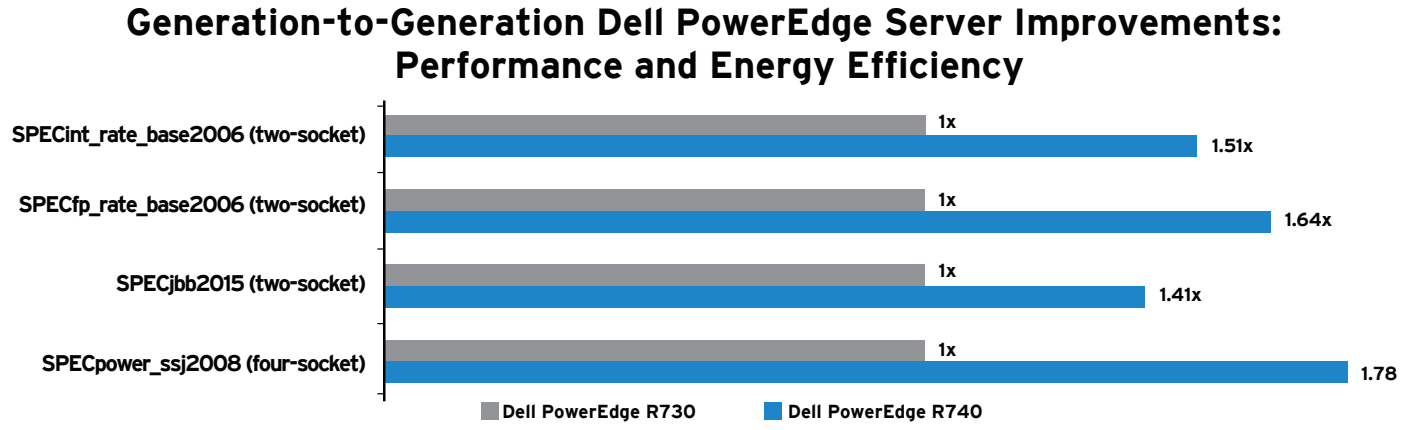

Figure 1. Generation-to-generation improvements in performance and energy efficiency.[2]

These performance and energy-efficiency increases in the latest generation of Dell PowerEdge servers demonstrate the ongoing enhancements to data center results that are being delivered by successive generations of Dell hardware technologies.

Successful migrations require consideration of the tradeoffs 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 mission-critical business applications and selecting necessary operating system components from available options based on open standards.

Assessing the Potential for Migration

For most organizations, the optimal timing for a migration is at the end of the maintenance contract for servers that host the relevant workloads, typically between three and six years from their date of procurement. Due consideration of the potential for migrating those workloads should be undertaken well in advance of that milestone, to avoid the need for rushed decision making or accelerated project timelines.

Potential Approaches to Workload Conversion

Most IT decision makers view their migration projects as multi-stage endeavors, rather than seeking to migrate every workload in the enterprise at once. In addition to mitigating risk, this approach allows prioritization of the changes that will generate the most benefit for the least effort. Toward that end, identifying the workloads that are particularly good candidates for migration is an early consideration toward assessing the potential for migration in a given environment.

As mentioned above, workloads hosted on hardware that is nearing its end of life are potential candidates for migration. It is also important to consider which applications may be capacity-constrained or otherwise not adequate to meet business needs. Beyond those considerations, the conversion approach required to migrate specific applications or workloads should contribute to decisions about the value, timing, and scope of migration.

Analyzing Existing Applications and Workloads

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 re-hosting 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, Lightweight Directory Access Protocol (LDAP), or firewalls? These migrations are typically the simplest, providing the highest value at the least risk.

In many cases, external dependencies and integrations, as well as other architectural factors in the environment, may make migration more complex than it at first seems. Nevertheless, the availability of Linux versions of existing UNIX software provide a useful first pass at identifying migration candidates. In addition, databases that underlie core business applications and that are running on legacy systems may be good candidates for migration. Despite the relative complexity of multi-tier migrations, Linux versions of the needed software are typically available, as is consulting expertise to assist with the migration, in most cases.

Your decisions about 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 mission-critical software essentially defines your hardware requirements, as well as the most effective code and data conversion approach.

Code Conversion

When suitable versions of legacy applications are not available for Linux, code conversion by in-house, outsourced, or consultant developers may be required. The complexity of such conversion can vary significantly from application to application. Initial considerations include the availability of source code for the legacy application, as well as development tools and other technologies to assist in the conversion.

The level of effort required to complete this conversion can vary depending on several considerations, including the following:

- 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 (JCL) 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.

In moving from RISC architecture to Dell servers, 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.

Complexity of Migrating Various Workload Types

In addition to the conversion approach required, the relative complexity of migrating various types of applications and workloads depends in part on the roles they play in the broader IT environment. For example, moving infrastructure applications such as web servers, firewalls, and backup/restore utilities to Linux hosts typically requires little or no code conversion and carries little risk, despite providing high value to the organization. Conversely, custom mission-critical applications may require significant recoding to make them compatible with the post-migration environment while also involving higher potential risk for business disruption. Table 1 provides a point of departure for considering the ease of migration for various application types, based on the associated likely magnitudes of risk, effort, cost, and downtime.

	Infrastructure applications	Remote office/retail computing applications	Mission-critical COTS applications	Mission-critical custom applications
Code / Data conversion	Little or no code coversion 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	Pilot then replicate	Varies from easy to moderate, depending on apps involved	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 risk and cost, depending on applications
Examples	Domain Name System servers, Lightweight Directory Access Protocol servers, web servers, firewalls, backup and restore, file and print	Business applications running at multiple locations, such as remote offices, bank branches, and retail stores	Re-hosting core business applications such as ERP, CRM, and associated databases	Applications written to support unique business processes

Table 1. Ease of migration for various application types.

The easiest migrations involve moving infrastructure applications to a new host with minimal code conversion. Remote office applications and core 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.

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 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 an 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 Dell 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.

Migration as Part of Ongoing Modernization

Digital transformation is a process, rather than a destination. Fitting the migration of workloads from legacy UNIX systems to open-standards Red Hat Enterprise Linux on Dell PowerEdge servers into the broader sphere of modernization is an important aspect of gauging its value. In this context, migrating away from proprietary platforms in favor of standards-based infrastructure is a foundational step for additional modernization. A simplified view of some waypoints along this modernization path are illustrated in Figure 2.

This series of stages is not intended as a prescriptive model for every enterprise to emulate. Rather, it provides a hypothetical framework that IT decision makers can use to visualize how the migration of legacy workloads from proprietary infrastructure enables the broader modernization effort. Many organizations will consider some or all of these topologies as they conceive their long-term IT planning:

- **Legacy migration** involves the transition described in the body of this document, from proprietary UNIX on RISC to open-standards-based infrastructure.
- **Enterprise virtualization** allows workloads to be decoupled from the hardware they run on, enabling server consolidation for a smaller data center footprint, accelerating resource provisioning, and increasing IT agility, flexibility, and scalability.
- **Hybrid cloud** enables internal data center workloads to add capacity on demand using one or more public cloud services. The entire pool of internal and external resources is centrally managed and tailored using specified cloud instances for the needs of each individual workload.
- **Software-defined data center** establishes pools of compute, networking, and storage resources from throughout the enterprise and delivers them as on-demand services, to maximize automation, streamline operations, and accelerate delivery of new services.

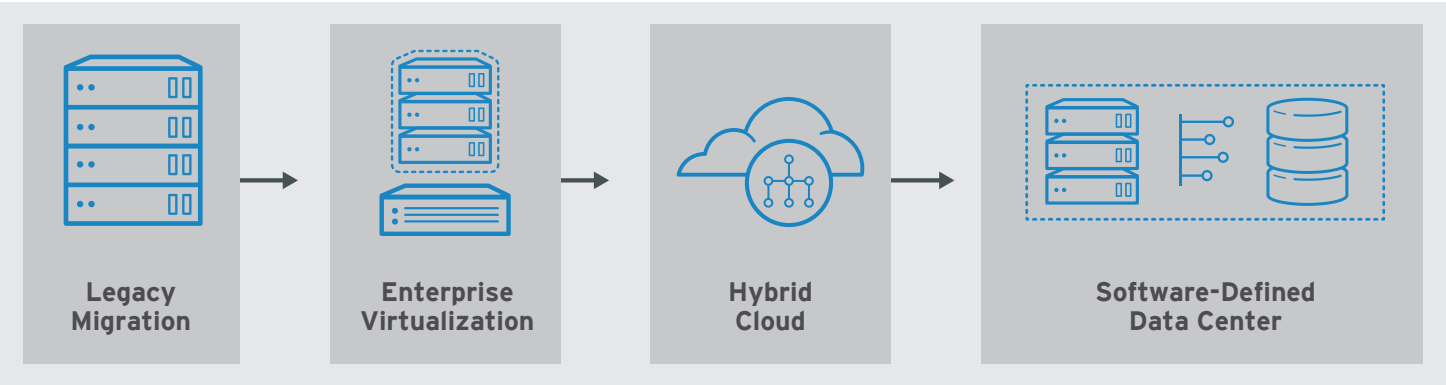

Figure 2. Common stages of data center modernization.

Re-hosting applications on Dell servers 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 (SOE) and standards-based virtualization. Proceeding through the migration and modernization stages adds efficiency, agility, automated orchestration, and centralized control over operations.

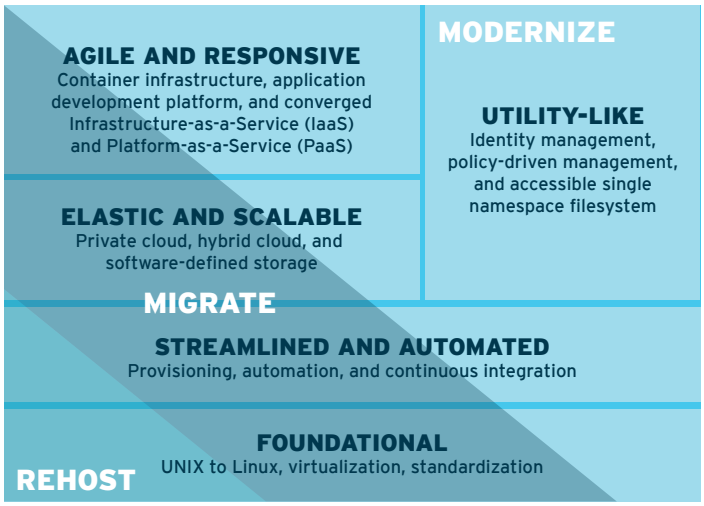

Figure 3. IT modernization paths and characteristics.

Throughout the IT modernization journey, virtualization capabilities can more easily be added to your IT infrastructure — whether software-defined networking (SDN), software-defined storage (SDS), containerized infrastructure, or software-defined infrastructures (SDI). 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 re-hosting to migration to total modernization.

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

Conclusion: A Guided Journey into the Future

IT organizations face rising costs, increasing demand to roll out applications to meet business objectives faster than ever, and ongoing maintenance and management issues for traditional systems. Migration of legacy workloads to Dell servers running Red Hat Enterprise Linux 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.

"To stay efficient and competitive in a world where cloud grows more pervasive, [infrastructure and operations] leaders must reduce infrastructure complexity and standardize around commercial off-the-shelf infrastructure."

- PHILIP DAWSON AND ROSS WINSER, ANALYSTS, GARTNER[3]

As proprietary legacy UNIX and RISC systems near end of life, migrating them to Red Hat Enterprise Linux running on Dell PowerEdge servers offers a compelling path to modernization. Enterprises can now achieve higher performance, better cost efficiency, and greater efficiency by moving to open-standards solutions, without compromising on mission-critical reliability and security.

The forward-looking approach to enterprise design based on Red Hat and Dell building blocks delivers both business and technical advantages that also set the stage for further modernization, including hybrid cloud and the software-defined data center.

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[1] http://searchcio.techtarget.com/feature/The-2018-CIO-budget-plan-The-goal-is-lofty-but-is-the-money-there.

[2] http://en.community.dell.com/techcenter/extras/m/white_papers/20444326.

[3] https://www.gartner.com/doc/3748992/simplify-bimodal-delivery-commercial-offtheshelf.

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