



# x86 Linux application consolidation on Power Systems platforms using IBM virtualization technologies

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## Executive summary

Complexity can work its way into your IT infrastructure. Potential culprits include introduction of new applications, unanticipated growth, and the need to support certain business functions with applications that have limited platform support. This complexity manifests itself as server sprawl, where simply to accommodate business needs, it is often less expensive, easier, and in some cases, the only option, to add a few new x86 processor-based servers—often running the Linux® operating system (OS). In addition to an abundance of applications and support resources, the Linux OS can provide your business with a reliable, secure platform that helps you stay ahead of the competition, meet customer demands, and manage your budget.

Of course, as server numbers grow, so does the cost of operations. In fact, a CIO Insight Magazine article said that “according to a recent report by research firm IDC, the labor required to maintain a single small application server can cost between \$500 and \$3,000 per month in a production environment—and that figure excludes costs associated with backup and recovery, network connectivity, power and air conditioning.”<sup>1</sup>

The answer is consolidation and virtualization. According to a 2007 Ronin Inc. survey<sup>2</sup> developed with IBM assistance, more respondents stated that they were using or planning to use virtualization than those that had no plans or were unaware of virtualization and based on surveys taken over successive quarters, virtualization use is on the rise. To do this, however, companies must mitigate the risks associated with running crucial business functions on fewer servers by using a platform with comprehensive reliability, availability and serviceability (RAS) features. The IBM Power™ Systems family of servers with Power Architecture™ technology and virtualization capabilities can help improve your IT efficiency and reduce the energy, space and system costs that can come with constantly adding x86 servers.

With these servers and advanced IBM PowerVM™ virtualization technologies, capabilities and offerings, you can now consolidate a larger portion of your infrastructure, offering the potential for realizing more value from IT investments. From Web applications to infrastructure applications to business applications, consolidation solutions on POWER™ processor-based servers allow you to select from a wide array of server capacity and performance as well as middleware components capable of satisfying consolidation requirements from configurations ranging from a few servers to hundreds of servers.

For applications that are written for x86 Linux OS-based servers, IBM provides the PowerVM Lx86 feature, allowing you to run these x86 Linux applications within a Linux on POWER environment. While you are carefully designing and porting x86 applications onto a new platform, they can be hosted in a virtual partition and run with minimal or no modification or upgrade with PowerVM Lx86. In essence, the system provides its own test environment,

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<sup>1</sup> Source: “Virtualization Can Save Departments, Not Just Servers,” by Karen S. Henrie, CIO Insight, January 6, 2006. <http://www.cioinsight.com/article2/0.1397.1914946.00.asp>

<sup>2</sup> Source: IBM Systems Directions, Marketplace study, questions 66 and 75B, Summer 2007

allowing you time to properly assess the changes needed for effective consolidation and transformation of your IT infrastructure for added business value delivery.

## **Fighting server sprawl and IT complexity**

No company sets out purposefully to create IT infrastructure complexity. Yet even with the best-laid plans, complexity can work its way into your IT infrastructure. You evaluate and introduce new applications and platforms, and choose those which best fit your business—and for many companies and many applications, the flexibility of the Linux OS on an x86 processor-based server is the right choice. By using the Linux OS on x86 hardware to build a flexible environment, you can help stretch your IT budget and confidently execute your business objectives—even as conditions change.

The cycle continues. You add a server each time you have a new demand, a new application. On the surface, small-scale server deployment to support new applications seems inexpensive. However, because each new application equals a new server—and often a new operating system platform—very quickly companies find themselves with a complex data center. With each new server, additional floor space, power, cooling, network interfaces, data storage and administrative staff may be required. Eventually, unimpeded sprawl can have real cost and manageability consequences—with increased total cost of ownership (TCO) and a reduced ability to respond to change and seize opportunities for innovation.

While data center complexity is costly and limits your ability to respond to change, it's also just plain inefficient. When additional servers are deployed merely to accommodate new applications or to handle spikes in demands for existing applications, the result is often underutilized processing power. This is the hidden cost of complexity—too many servers running at utilization rates that are far too low, potentially as low as 10% to 20%.

## **Improving the ability to respond to business demands**

You may not have intentionally created server sprawl in your own IT infrastructure, but you can certainly take steps to mitigate the resulting complexity. The first step is consolidation. In fact, consolidation is an ongoing priority for most companies. According to industry analyst Gartner Group, “Through 2010, IT infrastructure consolidation will remain the focus of IT infrastructure and operations cost reduction initiatives.”<sup>3</sup>

The same considerations you undertook when adding a single server, apply when considering consolidating all—or many—of your applications onto a large server. You must consider hardware that provides your company:

- The capability to start small and grow without disruption as needs expand.

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<sup>3</sup> Gartner, Inc. “IT Infrastructure Consolidation: Best Practices.” Gartner Symposium/ITxpo 2006. Jay Pultz. October 8–13, 2006.

- Flexibility in deploying new applications.
- Flexibility in integrating existing hardware and integrating old and new applications.
- The ability to incrementally add data and computing resources to the system at a low cost with minimum disruption as workloads increase.
- An easier-to-manage IT environment.

### ***Virtualization is the key***

To help optimize consolidation and reduce complexity, developers created virtualization solutions that allow organizations to consolidate multiple operating systems and software stacks on a single platform, and allocate the platform to meet specific business and application requirements. Virtualization is rapidly becoming a necessity rather than an option.

If you're an IT professional, you probably already know that virtualization can relieve the pressure caused by a complex IT infrastructure. According to a 2007 Ronin Inc. survey<sup>4</sup> developed with IBM assistance, more respondents stated that they were using or planning to use virtualization than those that had no plans or were unaware of virtualization and based on surveys taken over successive quarters, virtualization use is on the rise. But the latest IBM advances in virtualization may offer even more possibilities than you've heard about before.

The IBM Power Systems platforms— with mainframe-inspired IBM PowerVM virtualization technologies, offerings and capabilities—can help improve your IT efficiency and potentially reduce the energy, space and system costs that can come with constantly adding x86 servers with the Linux operating system.

### ***Choosing the right virtualization solution***

The ultimate UNIX® and Linux consolidation servers, IBM Power Systems servers include logical partitioning technology (LPAR), which allows the AIX® (IBM's industrial-strength UNIX OS) and Linux operating systems to run concurrently in separate partitions in any combination (i.e., zero or more AIX partitions along with zero or more Linux partitions). This capability enables the consolidation of workloads from several separate servers onto a single system, potentially increasing system utilization. Going a step further, dynamic logical partitioning offers the ability to change processor allocation to partitions without having to reboot the partition to help ensure applications get the system resources they need without having to compromise system availability.

A virtualization solution to a complex infrastructure problem must offer flexible features to support applications with diverse requirements, and ones which may need to evolve with your business. IBM Power Systems platforms with optional PowerVM Standard Edition<sup>5</sup>

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<sup>4</sup> Source: IBM Systems Directions, Marketplace study, questions 66 and 75B, Summer 2007

<sup>5</sup> PowerVM Standard Edition is standard on the IBM System p5™ 590 and 595 servers and BladeCenter® JS21 and JS22 Express blade servers and optional on all other Power Systems servers.

virtualization features such as IBM's Micro-Partitioning™ and Virtual I/O Server technologies is designed to support high levels of single-system utilization to help enable:

- Reduced costs by improving IT resource optimization.
- Improved service quality by increasing infrastructure availability, performance and security.
- The ability to adapt quickly to changing business needs by deploying a flexible infrastructure.

Systems available to run your applications when you need them are a key ingredient to an effective consolidated infrastructure. We all realize that changes are inevitable with IT. Yet with a less flexible virtualization solution, your IT staff is forced to choose between working on the weekend to upgrade an application or temporarily disabling the application during business hours. IBM virtualization solutions can help provide the best of both worlds—more application availability and less work on weekends.

For instance, Live Partition Mobility, a new feature included with the PowerVM Enterprise Edition offering, is designed to move a running partition from one IBM POWER6™ processor-based server to another—with no application downtime—resulting in even better system utilization, improved application availability, and energy savings. With Live Partition Mobility, application downtime due to regular server maintenance can be a thing of the past.

Hardware matters in another vitally important way: a virtual server needs to be as reliable as a physical server, or there's no advantage. As you migrate from the one-server/one-application environment to a consolidated environment with many applications hosted on a virtualized server, hardware reliability becomes more crucial than ever before. Organizations must mitigate the risks associated with running crucial business functions on fewer servers by using a platform with comprehensive reliability, availability and serviceability (RAS) features. The IBM Power Systems platforms include many innovative RAS features designed to provide near-continuous application availability and manage risk. These help keep the system up and running around the clock.

Even with a consolidated infrastructure, most organizations have more than one server to further improve availability. A selection of optional IBM and third-party high-availability software solutions for POWER provide flexible options for automatic failover which can help reduce the impact, or in some cases eliminate workload outages from planned and unplanned downtime. These solutions include:

- IBM High Availability Cluster Multiprocessing (HACMP™)
- IBM Tivoli® Systems Automation for Multiplatforms
- SteelEye LifeKeeper
- Veritas Cluster Server by Symantec
- Vision Solutions MIMIX HA Cluster

## Operating System Standardization

As you undertake the consolidation and virtualization process, you have to ask yourself if it also makes sense to standardize on a single operating system in order to reduce programming costs and minimize interoperability issues.

In the case of IBM Power Systems platforms, you can support AIX applications simultaneously with Linux on POWER applications. Both operating systems support thousands of applications—from Web servers to ERP, CRM to other database-intensive business applications.

For applications running on x86 Linux OS-based servers, you must ask yourself some questions:

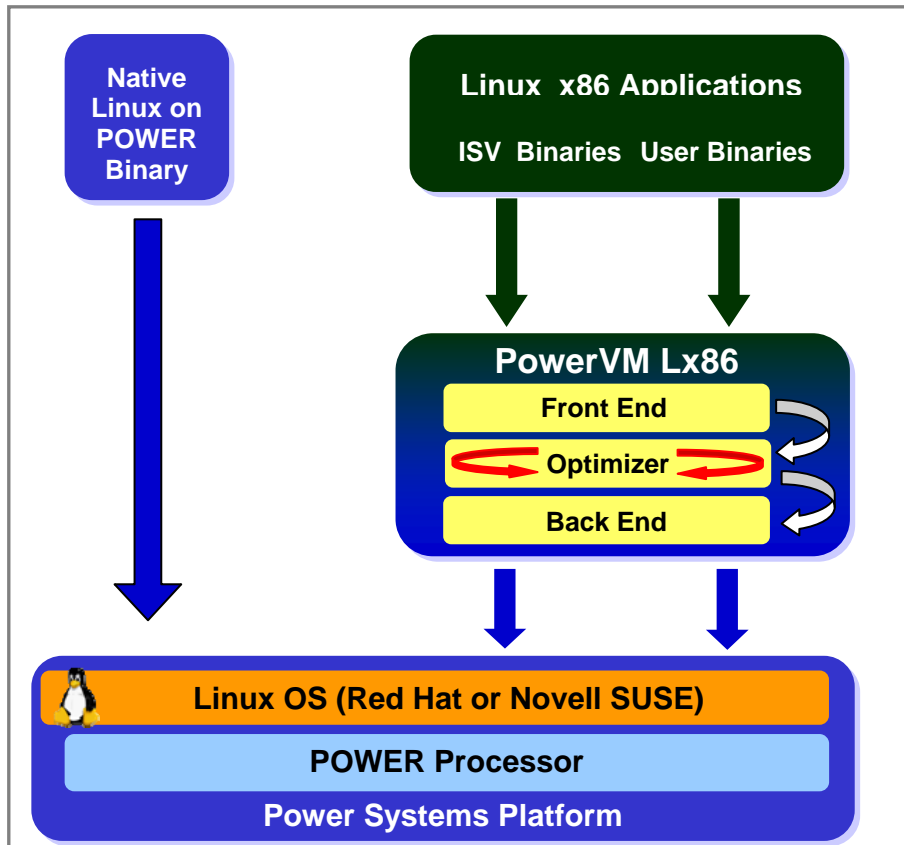
- Do you consolidate on a single operating system if certain applications aren't supported?
- Is there a similar application that is supported? Could your company switch to this application with minimal disruption to your business processes?
- Should you port your x86 applications?
- Should you remain on smaller x86 servers and forgo consolidation for certain applications?

### Transforming x86 Linux applications without porting

IBM understands the balancing act your company faces and offers a way for you to consolidate onto Power Systems platforms *and* continue running x86 Linux applications. The IBM PowerVM Lx86 feature creates a virtual x86 Linux application environment on POWER processor-based systems, so most 32-bit x86 Linux applications can run without requiring you to recompile the code. This brings new benefits to organizations who want the reliability and flexibility of consolidating on Power Systems servers yet use applications that have not yet been ported to the platform.

PowerVM Lx86 dynamically translates x86 instructions to Power Architecture instructions, operating much like the Just-in-time compiler (JIT) in a Java™ system. Translation technology has been used successfully in the computer industry over the past several years by many computer vendors. The technology creates an environment in which the applications being translated run on the new target platform, in this case Linux on POWER. This environment encapsulates the application and runtime libraries and runs them on the Linux on POWER operating system kernel. These applications can be run side by side with POWER native applications on a single system image and do not require a separate partition.

A diagram of the environment is shown in Figure 1



### ***Rounding out your server environment***

By allowing most Linux x86 binaries to run unchanged, PowerVM Lx86 enables consolidation of AIX and Linux on POWER applications—and most x86 Linux applications—on the same server. This allows organizations to expand their consolidation scenarios and future options. You can get more use out of your hardware investment and improve total cost of ownership by reducing time-consuming tasks involved in managing multiple servers, while at the same time, enhancing service quality and mission-critical application availability.

### ***Proof of concept for consolidation***

Because you can get applications running on a Power Systems server quickly—with no modifications—you also have the time to really evaluate how a consolidated environment will work for your company in the longer term. While you are carefully designing and porting x86 applications onto a new platform, they can be hosted in a virtual partition on the Power Systems platform. In essence, the system provides its own test environment, allowing you time to properly assess and transform your IT infrastructure for added business value delivery.

This also gives you sufficient time to consider how best to port your applications to the AIX or Linux on POWER OS, and time to research the differences between the x86 and Power Architecture platforms.

Applications expected to use PowerVM Lx86 most effectively fall into the following categories:

- Computationally-intensive applications which use integer (as opposed to floating-point) arithmetic.
- End user applications from Linux clients or other end user interface applications.
- Most types of I/O-intensive applications, including, security, systems management or other user-written applications.

### ***Weighing the opportunities vs. limitations of PowerVM Lx86***

PowerVM Lx86 runs most x86 Linux applications. However, some applications—such as those that need to directly access the hardware, with a 3D graphics adapter, for instance—will not run under PowerVM Lx86. This includes applications that:

- Require nonstandard kernel module access or use kernel modules not provided by the Linux on POWER operating system distribution;
- Do not use only the Intel® IA-32 instruction set architecture as defined by the 1997 Intel Architecture Software Developer's Manual consisting of Basic Architecture (Order Number 243190), Instruction Set Reference Manual (Order Number 243191) and the System Programming Guide (Order Number 243192) II dated 1997;
- Do not run correctly on Red Hat Enterprise Linux 4 starting with version 4.3 or Novell SUSE Linux Enterprise Server (SLES) 9 starting with version SP3 or Novell SLES10;
- Are Linux/x86 specific system administration or configuration tools.

As a translator, PowerVM Lx86 will introduce some overhead. The amount of this overhead will vary with many factors. The potential for “instant availability” of the application and “zero effort” to the programming staff with PowerVM Lx86 must be weighted against the ability to maximize performance with a natively ported application. Applications which depend heavily on the performance of the server should be deployed on the platform as a native environment. Supporting tools and utilities make excellent environments for enabling with PowerVM Lx86.

In addition to the application performance characteristics, IT managers should factor the current x86 server environment in designing their consolidation solution. Older servers whose leases have ended or those that have been depreciated should be the first to be evaluated for consolidation. As these servers are older, the performance of the applications would likely improve on the Power Systems platform even if they are initially enabled through PowerVM Lx86.

## **Comprehensive consolidation on a proven platform**

Consolidating and virtualizing compute resources just makes sense, and gives your on demand business the computing assets it needs to respond quickly to business opportunities and

competitive threats. The IBM Power Systems family of servers includes proven server consolidation platforms that help you control costs while improving overall performance, availability and energy efficiency.

The advanced PowerVM virtualization capabilities available for these servers provide the flexibility to dynamically adjust system resources to meet peak demands across workloads from Web servers to ERP, CRM and database-intensive business applications. High-performance processing enables greater operational efficiency by reducing the number of servers to be managed, while helping to ensure that mission-critical service level requirements are met.

And with the reliability, flexibility, and cost effectiveness of Linux on POWER technology your business-critical applications will always be up and running. No matter what performance level you need now—or to what level is needed to scale-up in the future, IBM offers a server to meet your Linux on POWER or UNIX requirements. From 1U, single-core to 64-core servers, the Power Systems family is ready for business-critical Linux applications. Simply choose the server needed for your applications and prepare for growth with flexible capacity upgrade options while having the confidence that IBM will be there when you are ready to expand.

### ***Easing the transition***

The right consolidation decision takes careful analysis of proposed consolidation options and architectures, required investments and potential savings. There are available today a large portfolio of native applications for a Linux on POWER OS and an even larger portfolio for the AIX OS. IBM PowerVM Lx86 can help run those applications not yet supported on a Linux on POWER OS, easing your consolidation onto a Power Systems platform. PowerVM Lx86 gives you the time to test x86 Linux applications and decide whether it makes sense to port them, as well as to assess the impact consolidation will have on your organization. In addition, PowerVM Lx86 can serve as a testing ground for new applications and system configurations—without adding more complexity to your data center. Should you decide that porting to Linux on POWER makes sense for your company, IBM offers a set of tools and utilities to help easily port, test and support applications across POWER processor-based platforms. And developing and deploying your application on the Linux OS for the POWER platform is similar to developing and deploying on other Linux OS-based systems.

Together, IBM Power Systems servers, PowerVM virtualization technologies, and the PowerVM Lx86 feature offer the potential to reduce total cost of ownership and improve IT responsiveness to business by providing flexibility and simplifying overall infrastructure management. Your organization is able to meet anticipated and unanticipated processing capacity demands with a more streamlined system infrastructure.



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When referring to storage capacity, 1 TB equals total GB divided by 1000; accessible capacity may be less.

The IBM home page on the Internet can be found at:  
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