Best Practices for Migrating Linux/x86 Applications to Linux on IBM Power Systems

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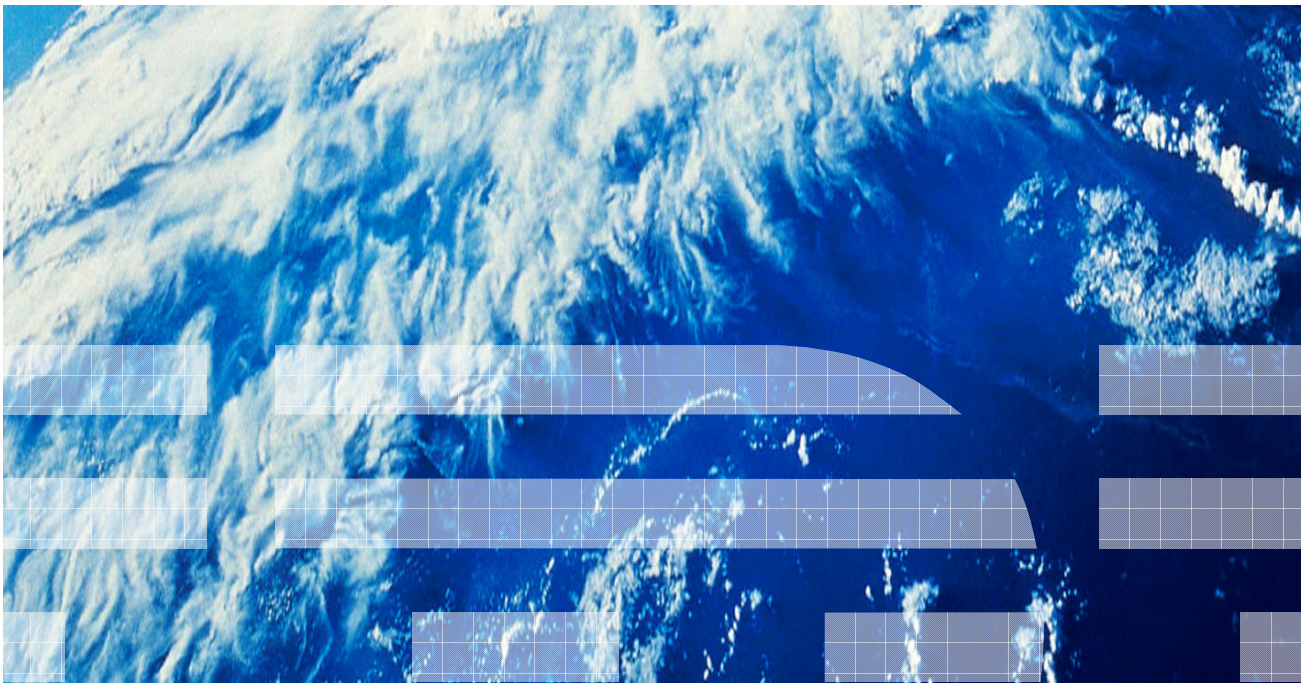

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1 Executive Summary

With its 2010 launch of a new generation of Power Systems servers and blades based on the POWER7 processor architecture, IBM has extended its market lead and elevated system performance, throughput and energy efficiency to unprecedented levels that far outpace competitors. Most importantly, the new architecture also provides the foundation for the integrated PowerVM virtualization solution to deliver unrivaled scalability, flexibility and robustness. As a result, enterprise workloads deployed in PowerVM virtual machines (VMs) not only run faster on POWER7-based platforms, but they can also scale further and be optimized more efficiently.

If you manage complex and energy inefficient x86-based server farms with each server dedicated to a single application or operating environment, you can consolidate dedicated and even virtualized Linux/x86 workloads and significantly reduce costs throughout your infrastructure, while dramatically improving your ability to meet changing processing demands.

Power Systems servers and blades based on the new POWER7 architecture provide the foundation for the integrated PowerVM virtualization solution to deliver unrivaled scalability, flexibility and robustness. As a result, enterprise workloads deployed in PowerVM virtual machines (VM) not only run faster on POWER7-based platforms, but they can also scale further and be optimized more efficiently.

This paper studies IBM's recommendations for best practices in the selection and migration Linux/x86 workloads and applications for migrating to Power Systems servers. Best practices discussed include:

- optimizing performance and scaling with PowerVM based virtualization
- when to migrate applications
- maximizing costs savings associated with energy, administration, license and maintenance, capacity on demand
- leveraging IBM offerings such as Migration Factory, IBM Power Rewards, PowerVM Lx86
- practices for application development

PowerVM is a complete virtualization solution that is integrated and packaged with Power Systems. This is a very robust implementation of virtualization developed by IBM during more than a decade of development, based on best practices developed for more then four decades of experience from the IBM mainframe. With each new Power system, IBM continues to grow its virtualization offerings, beyond just a hypervisor, such as Live Partition Mobility and Active Memory Sharing. Reducing costs, improving service, and managing risk are three focus areas of virtualization customers are interested in. Deploying virtualization can maximize scalability and thus reduce IT costs.

The following sections provide numerous best practices and references to additional material for your consideration, when selecting and migrating Linux/x86 workloads to Linux on Power.

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2 Best Practices for Workload Selection

Selecting Linux/x86 workload(s) to migrate to Power Systems requires an understanding and leveraging of the value of a Power System.

2.1 Linux Consistency across Platforms

Best Practice: *Leverage Linux/x86 compatible with Linux on Power*

IBM partners with Red Hat and Novell to provide Linux distributions that are consistent between x86 and Power platforms. Versions of RHEL and SUSE are available on Power simultaneously with x86, with the same package and driver levels. IBM also provides significant differentiation[17] with Linux on Power via PowerVM virtualization (see below), extensions to Linux reliability, availability and serviceability (RAS) and performance optimizations.

Select Linux/x86 workloads to migrate to Power Systems knowing that Red Hat RHEL and Novell SUSE are consistent with Linux on Power.

2.2 Improve Performance for Virtualized Workloads

Best Practice: *Select Linux/x86 virtualized workloads and migrate to PowerVM*

A recent study[6] of virtualized benchmark workloads shows Power Systems PowerVM integrated virtualization technology leads x86-based add-on virtualization, such as VMware vSphere 4 in performance. Key findings from the study include the following about **PowerVM on Power 750**:

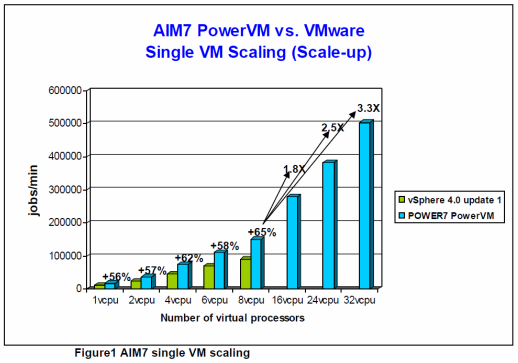

Figure1 AIM7 single VM scaling

- **performs** up to 65% better than VMware
- **scales to four times more** virtual CPUs than VMware in a virtual machine
- **scales linearly** to use <u>all</u> CPUs, while VMware does not

It is clear from the study's published benchmark results that PowerVM on POWER7-based platforms not only offers vastly superior scalability than VMware vSphere on Intel x86-based servers, but it also makes more efficient use of system resources and imposes a negligible impact on performance. Many of these advantages relate to the fact that PowerVM is built directly into the firmware of all Power Systems servers, as opposed to x86-based virtualization products such as VMware vSphere, which are typically third-party software add-ons that are sold and installed separately.

Selecting existing workloads running on x86 servers using VMware for virtualization can realize significant performance improvements and scaling with PowerVM. Up to 65% performance improvement, 32

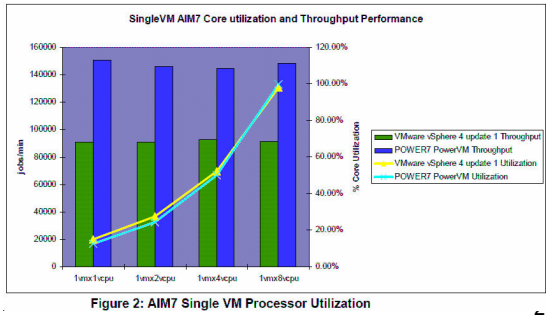

Figure 2: AIM7 Single VM Processor Utilization

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times increase in virtual processors and higher CPU utilization.

As you will see in the next section, when software licenses and maintenance costs are based on number of processors assigned to virtual machine(s), a savings can occur by using PowerVM to increase processor utilization with fewer processors. For examples, a software savings of up to 50% could occur when doubling processor utilization on half the processors.

2.3 Maximize System Utilization to Reduce System Costs

Best Practice: *Select workloads from underutilized x86 systems*

Select a Linux/x86 workload running on multiple servers that are underutilized. In many cases, workloads running across multiple x86-based servers leave the system under 20% utilized. Consolidating these workloads to a single Power Systems server can reduce total cost by leveraging the ability of a Power Systems server to run at higher utilization levels.

Many data centers today have small, single-purpose Linux servers. In addition to high energy costs and management headaches, these servers are frequently underutilized yet under-perform at peak loads. This creates both efficiency and user satisfaction issues. In the end, these issues cost money. Maximize the return on your IT investments (including floor space and operational costs) by moving workloads from underutilized systems onto a single, larger system. You can significantly lower operational costs with Power servers running all Linux applications, while others are running Linux applications alongside IBM AIX® and IBM i applications. Some clients are increasing utilization by more than 60%[1] to eliminate the need for multiple, small, single-purpose servers by running Linux applications on Power.

Power can achieve an average investment payback period of 6.3 months[2] through reduction of various costs including energy, cooling, and management. Realizing cost savings is the result of Power Systems advanced features. Power is designed to cut costs and increase system utilization while ensuring applications get the resources they need when they need it. Reducing costs by maximizing the use of physical resources by sharing processors, memory and I/O between clients' logical partitions within the server. At peak time, Power Systems can even borrow extra "capacity" from development or test partitions to effectively meet demand. IBM Energy Scale™ technology provides functions that help the user to understand and control IBM server power and cooling usage. This enables better facility planning, provides energy and cost savings, enables peak energy usage control and increases system availability. The client can leverage Energy Scale capabilities to customize the power consumption of their IBM Power processor-based system and tailor it to their particular datacenter needs.

2.4 Improve Reliability, Availability, Serviceability (RAS)

Best Practice: *Select workloads based on RAS requirements*

From an IDC study[2] of Linux workloads that states "…*All of these workloads have high uptime requirements because any downtime would impact user productivity and therefore business productivity*" we understand that many Linux/x86 workloads are considered mission critical. Migrating mission critical workloads aligns with the high RAS provided by Power Systems[23].

Linux on Power applications benefit from Power Systems RAS features including:

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- Enterprise Hardware - Redundant and hot swap hardware, dynamic processor and memory sparing.

- PowerVM provides RAS related virtualization features such as Live Partition Mobility allowing workloads to quickly move between systems for availability and service and virtual I/O (storage, LAN) to reduce risk of failing hardware components. You can also use Live Partition Mobility to manage bringing online a workload, such as processing a weekly payroll, only when they it is needed to save system resources.

- Capacity Upgrade on Demand provides try-and-buy to dynamically activate processors and memory.

2.5 Learn from experience of others

Best Practice: *Select high ROI workloads based on experiences of others*

IDC published[2] results from research data and analysis demonstrating the high return on investment (ROI) of running Linux workloads on IBM servers. Customers involved with this study reported a total annual value of $30,000 per 100 users for benefits migrating to Power Systems and IBM System z servers. Major contributors to the savings were; IT staff productivity increase (14%), User productivity increase (25.4%) and IT infrastructure cost reduction (60.6%). Based on this study, selection of workloads with high costs in these areas could result in substantial ROI.

Leverage Linux for IBM Power Customer Testimonials[22], a case study of the benefits realized by a large number of customers moving to Linux on Power. Each case study includes information about the type of workloads and specific benefits the customer obtained moving to Power Systems.

2.6 Simplify Workload Deployments

Best Practice*: Co-locate applications with their database*

Consider selecting workloads where the application is running on Linux/x86, but the application's data is located on Power. For example, SAP or web serving applications using IBM DB2 with AIX, IBM i or Linux on Power. Co-location reduces hardware elements to improve overall system availability. A virtualized network helps reduce network paths to improve both workload performance throughput and response times.

When an application and its data can't be migrated at the same time, it might be easier to start with the data servers, allowing for your IT staff to get familiar with Power Systems and to prove its value. Note that by migrating applications and data in stages, a remote connection is usually required from the application to the data.

2.7 Use IBM Supported Applications

Best Practice*: Leverage software supported by IBM and its partners*

Some workloads stand by themselves without application dependencies on middleware or provide their own. However, when selecting applications to migrate that rely on middleware infrastructure from IBM or third parties the target environment needs to; support the middleware, replaced the

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middleware, stand on its merits with less. Depending on the requirements, some options will be easier and more attractive than others. Sometimes function can be staged to get a solution to market quicker, and then enhance functionality in a later release.

IBM and its partners have a large number of software applications and middleware available for Linux on Power. Selecting from existing Linux/x86 workloads utilizing this software not only eases migration, but also helps insures optimal software performance and support.

Starting with the operating system, IBM has partnered with leading Linux distributors to provide Red Hat Enterprise Linux (RHEL) and Novell SUSE Linux Enterprise Server (SLES) x86_64 offerings for POWER. These two Linux distributions have also partnered with IBM to exploit many of the Power Systems features such as dynamic logical partitions (DLPAR), virtual I/O, application mobility and active memory sharing. Refer to Supported features for Linux on Power Systems™ servers[17] for details on Power Systems features supported.

You can see from the IBM Middleware Available on Linux[11] that IBM Power Systems support most of IBM's middleware. Selecting Linux/x86 workloads utilizing this middleware can significantly ease migration to Linux on Power.

Consider selecting workloads with applications leveraging the Linux provided LAMP infrastructure (PHP, Pearl and Python applications using MySQL with an Apache HTTP server). These applications and their data migrate easily to Linux on Power using the IBM Installation Toolkit for Linux[19].

2.8 Minimize Software License and Maintenance Costs

Best Practice: *Select workloads with processor based software pricing*

Many workloads utilize processor based software license and maintenance costs. Selecting these workloads to consolidate to fewer cores on Power maximizes your software investment and speeds your return on investment (ROI) in Power.

For example, in a recent study of consolidating a workload from 41 x86 servers to a single Power server, saved $360K (95%) in software costs over a 3 year period[5]. The study revealed that 41 quad-core x86 Xeon based servers running IBM middleware require 8200 Processor Value Units (PVUs) to be purchased (41 servers * 4-cores per server * 50 PVUs per core) for licenses and maintenance at a 3 year costs of over $400K. When consolidated to a single Power 750, only 1200 PVUs, at cost of $43K, are required for maintenance (12-cores * 100 PVUs per core) since PVUs for licenses can be transferred between servers.

2.9 Leverage PowerVM Lx86

Best Practice*: Select workloads without porting Linux/x86*

IBM Power Systems has made it possible to even select Linux/x86 workloads for Power Systems that have not yet been ported to Linux on Power. Power Systems PowerVM Lx86 feature provides a virtual environment to meet the requirements of many of these types of workloads.

IBM PowerVM Lx86 simplifies the migration of Linux/x86 applications to Power servers by creating a virtual Linux/x86 application environment on Power processor-based systems, so most 32-bit Linux/x86 applications can run without

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requiring clients or ISVs to recompile the code[3]. PowerVM Lx86 dynamically translates x86 instructions to Power Architecture instructions and caches them to enhance performance, as well as maps Linux/x86 system calls to Linux on POWER system calls. No native porting or application upgrade is required for running most Linux/x86 applications

The PowerVM Lx86 feature provides you options for selecting workloads;

- that have not yet been ported to Linux on Power
- with dependencies on software not yet ported to Linux on Power
- are candidates for quick proof of concepts
- as a first step in a migrating to Linux on Power

There is a small class of x86 Linux applications that PowerVM Lx86 does not support:

- Directly access the hardware
- Require nonstandard kernel module access or use kernel modules not provided by the Linux on Power Systems 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
- Are x86 Linux specific system administration or configuration tools
- Require x86 real-mode

PowerVM Lx86 is included at no additional charge with the purchase of PowerVM Editions. For additional information, see the IBM Web site for PowerVM Lx86[3] and the IBM Redbook on Getting Started With PowerVM Lx86[8].

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3 Best Practices during Workload Migration

3.1 Migrate before it's required

Best Practice: *Select Linux/x86 workloads to migrate before it's required*

If you wait until you need to migrate, you've waited too long[7]. This is true for all types of workloads, including 3rd party, custom written and databases. Consider migrating workloads that "aren't yet broken", before a critical situation occurs such as workload demand exceeding current system capacities, datacenter becoming exhausted, software budget reductions, software going out service.

3.2 Plan Workload Migrations

Best Practice*: Develop a comprehensive plan*

Moving data requires a comprehensive migration plan that includes; budget, transition of skills, capacity of staff and equipment, and availability to end users[14]. The plan needs to cover all aspects of the migration, from beginning to end. How are external third-party software dependencies to be addressed or 24-7 availability?

3.3 Leverage the IBM Migration Factory Expertise

Best Practice: *Leverage migration expertise built over two decades*

IBM Migration Factory[9] is an IBM world-class migration services offering that has helped thousands of customers migrate their workloads. The IBM Migration Factory brings extensive experience in analysis and implementation of platform migration projects. The IBM Migration Factory has developed strong tools, coupled with proven methodologies, to achieve the comprehensive coverage of requirements within a short period of time. Each step of the migration process is designed to build upon the previous step and move seamlessly into the next.

Capabilities

Over the last 20 years, the IBM Migration Factory has developed many skills all associated with migration and consolidation. Because the Factory is dedicated to migration and consolidation, it has produced significant intellectual capital to ensure the success of large enterprise migration and consolidation projects. Migration capabilities include porting of x86 custom code applications, Databases, typical Enterprise applications (e.g. SAP, PeopleSoft, Oracle EBS) and middleware (e.g. WebSphere).

Valuable Intellectual Property

The IBM Migration Factory has developed vast amounts of Intellectual Property for migration and consolidation. This includes:

- Knowledge databases that have captured years of data and experience that are used to reduce the cost and time and improve the quality of analysis.
- Tools for collecting data, migrating, remediation of code and testing. These reduce the time, cost and risk of implementation.
- Proven process for each phase that provides a roadmap for success.
- Years of migration and consolidation experience

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To help mitigate development risks, the Migration Factory uses these best practices when migrating custom code applications[7].

1. Use tools wherever possible. There are many commercial tools available for migration projects. There are standard UNIX tools, tools to convert older languages to C++ or Java™, tools to help migrate large databases with minimal downtime windows and many IBM proprietary tools.

2. Always reuse code wherever possible, and don't rewrite, unless necessary. If changes must be made to custom code, they must be documented at the completion of the migration. Recoding is almost always a result of something working a bit differently in the target environment than it did in the source environment. It usually doesn't require changes to the application's business logic.

3. Next to the initial planning of the migration, testing is one of the most-critical elements for a successful migration. A formal, written test plan must be created and closely followed. It's a living document that's useful throughout an application's entire lifetime, serving a critical role in everything from validating the source or baseline system to providing the framework for final acceptance testing.

4. Always do a like-to-like migration when migrating custom code. Migrating applications still under development involves too much risk, as does trying to migrate an application currently in production and trying to add a major new feature at the same time.

While no two projects are identical, the Migration Factory process helps ensure that each engagement is a success whether it's an infrastructure migration, database migration, ISV package, custom applications, or combination of all four. Migration Factory uses a five-step process that has been meticulously refined over 25 years, helping clients migrate to IBM Systems running any supported operating system, including Linux. The Migration Factory provides several levels of service:

1. Full Service Migration – IBM owns the project and client provides the resources to assist.

2. Migration Workshop – Client owns the project and IBM provides a workshop to assist.

3. Third Party Integrator – IBM will assist the client in finding a migration partner.

Leverage your Power Rewards[10] and get a free IBM Migration Factory “Migration Assessment”.

3.4 IBM Installation Toolkit for Linux

Best Practice: *Leverage IBM tools for installing and migrating to Linux on Power*

IBM Installation Toolkit for Linux[19] is a free set of tools that includes a wizard to simplify the installation and configuration of SLES and RHEL Linux distributions and PowerVM Lx86 on Power Systems. Included are over 20 IBM value-add RAS tools for; upgrading of firmware, diagnostics, bootable rescue DVD,

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maintenance, improving application performance, migration of LAMP stack (Linux - Apache - mySQL - Perl, Python, and PHP) and data from x86 servers, and access to over 60 Linux user documents.

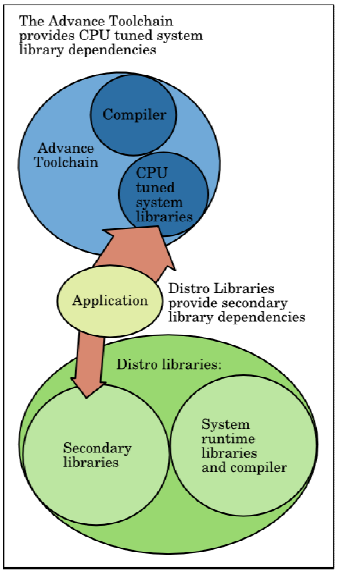
3.5 Advanced Toolchain

Best Practice: *Leverage IBM supported Linux libraries for performance*

Advanced Toolchain[18] is a standalone POWER open source GNU toolchain from Free Software Foundation. IBM provides this cross platform set of system libraries and tools tuned for POWER application development that deliver better performance than the Linux distribution toolchains.

Optimized packages, such as GCC, glibc, gdb, oprofile (and more) are optimized for all POWER systems.

Standard IBM Linux support includes use of the IBM Linux Advanced Toolchain.



3.6 Porting C Applications from Linux/x86 to Linux on Power

Best Practice: *Code, compile, make C applications for Power*

3.6.1 Power Architecture Differences

In most cases when the same release of Linux is used during migration from x86 to Power Systems, most Linux applications simply need to be recompiled using Linux distribution provided tooling.

When migrating Linux/x86 to Linux on Power it may be necessary to understand several areas of application development associated with the differences between x86 and Power architecture and how to address them. Minor changes and a recompile may be necessary unless the application has hardware specific dependencies such as 'endianness' (or byte ordering), data type length and alignment.

3.6.2 Compilers (GCC and IBM XL C/C++)

Support from both IBM and non-IBM compilers and make utilities help address the differences between x86 and Power architecture. Recommendations and examples of methods to address these differences are covered in articles; Linux *on POWER: An overview for developers*[24] and *Guide to porting Linux on x86 applications to Linux on POWER*[25].

By leveraging optimization options of compilers, you can keep portable code performing well on both x86 and Power Systems platforms.You can optimize your application for performance by selecting the latest Linux kernel and compilers[32].

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IBM partners with Novell and Red Hat to insure their Linux distributions are optimized for each release of Power Systems, including POWER7.

If application portability is most important, use of GCC is recommended since it supports both x86 and Power platforms. Applications compiled with the latest versions of GCC with optimization level 3 (-O3) perform comparable to IBM XLC/C++ compiler. Note that IBM XLC/C++ does not support x86 platforms.

If application performance is more critical than x86 and Power portability, consider using IBM XL C/C++, which provides more performance optimizations than GCC for Power Systems. The IBM XL C/C++ compiler for Linux on POWER is derived from the high performance compiler for AIX but uses the GNU linker and assembler to create ELF objects that are fully compatible with objects produced by GCC. Refer to Application optimization with compilers for Linux on POWER[34] for a comparison of GCC and IBM XL C/C++ compiler features, including the –O5 performance optimization level.

For example, IBM XL C/C++ Version 9, available for RHEL5 adds performance improvements for Power Systems. The `-qarch` option is used to optimize performance for Power Systems architecture. See *POWER7 tolerance for IBM XL Compilers*[33] for POWER7 details.

3.6.3 Optimizers (FDPR-Pro)

After porting your application to Linux on Power, consider a final step in optimization using IBM Post-Link Optimization for Linux on POWER[35], also known as FDPR-Pro. FDPR-Pro is a post-link optimization utility for the POWER architecture that optimizes an executable program or a shared library, based on its run-time profile.

3.7 IBM Systems Application Advantage for Linux (Chiphopper)

***Best Practice**: Leverage IBM offerings to migrate 3rd party software*

When selected Linux/x86 workloads have dependencies on software from a 3rd party, IBM can help you work with the 3rd party company to enable their software on Linux on Power.

IBM Systems Application Advantage for Linux (Chiphopper)[4] is an IBM PartnerWorld offering designed to help 3rd party companies in porting, testing, and supporting their existing Linux/x86 applications written in C/C++, Java, or both on Power Systems. The Chiphopper offering can help 3rd party companies maximize their Linux market opportunity while minimizing your expense. This no-charge offering provides them the added assurance of assistance for up to eighteen months after their port to Linux on Power. With this assurance, IBM stands behind their support team with access to system and Linux distribution resources, middleware, and troubleshooting help.

In the Chiphopper program, IBM works with the partner to determine the compatibility of the 3rd party software with Power using Linux Standard Base (LSB)[37] tooling from The Linux Foundation. LSB Linux Application Checker[12] checks Linux/x86 application code against the LSB standard. Also, Chiphopper program provides tooling to check applications for code effected by x86 and Power architectural differences.

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3.8 IBM Consultants

Best Practice: *Leverage the team of IBM consultants*

IBM Systems Lab Services and Training[13] is a team of consultants that can help with many aspects of workload migration from Linux/x86 to Linux on Power. Consulting services are available for datacenter consolidation, Power Systems hardware/software, Linux on Power and more.

Linux on Power consultants offer services for architecture, custom application design, custom application porting, performance analysis & tuning, virtualization (PowerVM), middleware consulting, implementation, training, health checking, and integration with IBM i.

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4 Highlights of Power Systems Architecture

Leadership POWER performance

The leadership performance of the POWER7 processor makes it possible for applications to run faster with fewer processors, resulting in lower per core software licensing costs. In addition, a single system can now run more applications and reduce the number of required servers lowering infrastructure costs.

Outstanding scalability and capacity

The IBM Power 750 Express offers tremendous configuration flexibility to meet the most demanding capacity and growth requirements by supporting up to 32 POWER7 processor cores and 512 GB of memory. Take advantage of this scalability and capacity by leveraging our industrial strength PowerVM technology to fully utilize the capability of the Power. PowerVM allows any individual LPAR to access the maximum amount of memory and CPU cores that are available on the server.

Innovative Technologies

The introduction of POWER7 servers includes several new innovative technologies that provide the flexibility to maximize performance based on client workloads and computing needs potentially delivering business advantages and higher client satisfaction.

POWER7 **Intelligent Threads** technology enables workload optimization by selecting the most suitable threading mode: Single Thread (per core) or Simultaneous Multi Thread-2 or 4 modes. Consequently, **Intelligent Threads** technology can provide improved application performance. In addition, POWER7 processors can maximize cache access to cores, improving performance, using **Intelligent Cache** technology.

Delivering on RAS and Diagnostics

The Power 750 Express is designed with capabilities to deliver leading edge application availability and allow more work to be processed with less operational disruption. RAS capabilities include recovery from intermittent errors or failover to redundant components, detection and reporting of failures and impending failures, and self-healing hardware that automatically initiates actions to effect error correction, repair or component replacement.

Enhanced Energy efficiency with ENERGY STAR

POWER7 delivers the first RISC-based ENERGY STAR-qualified servers designed with features to help clients become more energy efficient. ENERGY STAR-qualified products use less energy and reduce greenhouse gas emissions by meeting strict energy-efficiency guidelines. Supported by the AIX, IBM i and Linux operating systems, PowerVM Editions provide an innovative set of comprehensive systems technologies and services designed to enable you to easily aggregate and manage virtualized resources.

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Lowering Total Cost of Acquisition and Ownership

Consolidating x86 workloads to Power provides the floor space, energy, and software license cost savings, to justify moving up to Power Systems for your mission-critical workloads[12]. Power may provide not only lower total cost of ownership (TCO), but also may lower total acquisition costs compared to the alternative x86 based systems[5].

4.1 Features and Benefits

Features	Benefits
Linux on Power	▪ Supports Linux versions consistent with x86 ▪ Differentiated to leverage Power Systems; PowerVM virtualization features, Power Systems RAS and performance optimizations
Leadership POWER performance	▪ Access data faster and improve response time ▪ Do more work with fewer servers and experience infrastructure cost savings from a reduction in the number of servers and software licenses
PowerVM Virtualization	▪ PowerVM Lx86 minimizes migration of most Linux/x86 applications to Power without application changes ▪ Easily add workloads as your business grows ▪ Utilize the full capability of the system to reduce infrastructure costs by consolidating workloads running the AIX, IBM i or Linux operating systems. ▪ Provides ability to handle unexpected workload peaks by sharing resources ▪ Dedicated and virtualized processors, memory, and I/O ▪ Dynamic LPAR of CPU, memory, and I/O ▪ Heterogeneous partition mobility ▪ Flexible scalability from smallest partition to full system size ▪ Live Partition Mobility for moving running workload between Power processor families
Virtual I/O Server (VIOS)	▪ Device virtualization (sharing) for SCSI, SAS tape, CD
Active Memory Expansion	▪ Enables more work to be done with existing server resources
RAS Features	▪ Keep applications up and running so you can focus on growing your business
Light Path Diagnostics	▪ Keep applications up and running so you can focus on growing your business
ENERGY STAR-compliant	▪ Use less energy and reduce greenhouse gas emissions
IBM Systems Director Active Energy Manager with EnergyScale Technology (for AIX)	▪ Dramatically and dynamically improve energy efficiency and lower energy costs with innovative energy management capabilities ▪ Enables business to continue operations when energy is limited

Table 1. Features and Benefits – IBM Power 750 server

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4.2 IBM Systems Director

IBM Systems Director will play a key role in your migration of Linux/x86 workloads to Power as you leverage PowerVM for consolidating the workloads using virtualization.

The IBM Systems Director Express, Standard and Enterprise Editions each provide an integrated set of tools to help your IT organization address major concerns associated with managing both physical and virtual server infrastructures: reducing operational complexity, improving the efficiency of IT staff and systems, and controlling costs while meeting business requirements for service delivery.

4.2.1 IBM Systems Directory Express Edition

The Systems Director Express Edition includes a set of management tools which can reduce operational complexity by providing a clear view of the relationships and health status of IT system components. It provides:

- Automated discovery and topology views to simplify troubleshooting across physical and virtual server and storage resources
- Heterogeneous virtualization management across Power servers running AIX, IBM i, and Linux workloads
- Simplified deployment, installation, and update processes
- Automatic reporting of hardware problems and collection of system service information for monitored systems
- Single-system, platform-level management for AIX and IBM i and through industry standards
- Launch-in-context integration with the Hardware Management Console
- Easy to learn new tasks with intuitive wizards, tutorials, and integrated help

4.2.2 IBM Systems Director Standard Edition

IBM Systems Director Standard Edition includes features which can reduce the time and effort for workload deployment, as well as optimize energy usage and capacity. It provides:

- All features of the Systems Director Express Edition
- Capture/import, create/remove standardized virtual images
- Deploy standard virtual images
- Maintain virtual images in a centralized library
- Monitoring and trend analysis of electrical energy usage and thermal characteristics
- Monitoring of legacy systems via supported facilities equipment such as uninterruptible power supplies, power distribution units, sensors and probes as well as interfacing with applications that monitor computer room air conditioning (CRAC) units
- Features for setting energy usage caps across one or more servers
- Energy saving modes that can take into account processor utilization and the altitude of the data center facility
- Discovery and health monitoring for networking systems

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4.2.3 IBM Systems Director Enterprise Edition

The IBM Systems Director Enterprise Edition features enable superior performance and availability management, and the automated resource balancing required for a dynamic infrastructure. It provides:

All features of the Systems Director Express and Standard Editions

- Creation/removal of system pools and resource management in system pools as if they were a single system
- Addition/removal of physical servers within system pools
- Creation and management of Workload Partitions (WPARs)
- Visualization of the relationships of LPARs to servers to applications
- Proactive real-time and predictive monitoring of the virtualized environment
- Predictive performance management and capacity estimation

4.2.4 IBM Systems Director VMControl

IBM Systems Director VMControl™ helps you move beyond managing virtualization to using virtualization to better manage your IT infrastructure. VMControl is a leading multi-platform virtualization management solution that is included with IBM Systems Director Editions or available separately as a plug-in option for IBM Systems Director. Use VMControl to provide consistent virtual server lifecycle management, image management and system pool management across multiple hardware platforms, including all IBM server environments (IBM System x, Power Systems, IBM System z). VMControl provides management from one location, allowing you to manage virtual servers and images that are configured with the operating system and software applications that you desire. Use IBM Systems Director VMControl Image Manager to assist you in rapidly create images of virtual appliances from running virtual servers, deploy these virtual appliances and manage repositories of these images.

VMControl features include:

- Supports Linux and AIX
- Discover virtual resources
- Display inventory and topology
- Monitor virtual resource health
- Relocate virtual resources
- Create and manage virtual servers
- Deploy and manage workloads
- Provision and manage virtual images
- Manage virtual resource pools

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5 Conclusion

There are many considerations for selection of Linux/x86 workloads for migration to Linux on Power to speed the return on investment in migration to Power Systems. Leverage PowerVM performance and scaling to consolidate existing workloads that use VMware and also workloads on under utilized x86 systems to fewer systems to provide better availability and lower hardware and software costs. Review middleware from both IBM and its partners to minimize dependencies during migration and leverage the IBM Chiphopper program aid 3rd party support for Linux on Power.

IBM provides tools that help port Linux/x86 without changes (PowerVM Lx86), port LAMP applications and data, and optimize C/C++ applications for Power.

To help get you started with migrating to Linux on Power, IBM provides free migration assessments (Power Rewards and Migration Factor) and consulting from the IBM Lab Services team.

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