



IBM's PowerLinux Increases Efficiency and Reduces TCO and TCA

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Management Summary

With an economy in disarray, the typical consumer is trying to make everything last a little longer. The more expensive the purchase, the longer we expect it to last. Outside of your house, there are few purchases that are more significant than the family car. You expect your automobile to perform efficiently, be reliable, always available, and very serviceable. Our cars have different engines, different transmissions, and different suspensions; each has a unique infrastructure. However, there is one thing that is common to all of them, or at least for those with internal combustion engines: gasoline. Gasoline is a constant, the fuel that drives that infrastructure – the better (more efficient) the engine, the better the vehicle's performance (efficiency, as measured in terms of MPG or KM/L).

There is a similar scenario in every enterprise data center: access to an open systems environment that can be a constant for every IT platform. One of the advantages (for the data center) of open systems is that the IT staff can get an open systems solution to run their applications from just about anyone. One of the disadvantages of an open systems solution (for the vendor) is that the IT staff can get one from anyone. Today, the most common environments for open systems servers are *Windows* from Microsoft and *Linux* from a variety of sources. These are open environments that the data center can deploy on just about any server. In the case of Linux, that platform can be based on commodity or proprietary microprocessors. The most common server platform for the deployment of an open environment is based on the x86 architecture, with a CPU from Intel (*Xeon*) or AMD (*Opteron*). However, **just because x86 is the most common platform does not necessarily mean that it is the best one for every use.** The whole solution environment, especially the quality of the underlying infrastructure, can greatly affect the performance, reliability, and security of your mission- and business-critical applications. **The better the infrastructure, the better that your applications will perform and the lower the total cost of ownership will be.**

Many data centers continue to run their *most critical* applications using some variant of the *UNIX* operating system, in order to achieve the performance, functionalities, and qualities of service (QoS) needed to deliver the right business solution. UNIX runs on multiple platforms, some based upon x86 and others on proprietary platforms, depending on the needs for a more mission-critical environment and the ability to scale. The commonality of Linux across platforms is even stronger than the commonality of UNIX. One UNIX environment that continues to thrive, despite the migration to Linux on x86, is IBM's *AIX* running on their *Power Systems*. Why? Because Power Systems provide a better infrastructure for many of the enterprise's mission-critical requirements. If you are running Linux on x86, perhaps you shouldn't be running all of your workloads there. If you have rapid growth in your Linux workloads, along with tight budget requirements, perhaps you should consider moving your critical Linux applications to an IBM Power System solution running Linux.

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To enable you to do this, IBM is offering new *PowerLinux* solutions for the enterprise and SMB data center. Based upon the *Red Hat* or *SUSE Linux* operating environments, along with IBM POWER servers and software, IBM has developed a better and less expensive infrastructure for the deployment of your mission- and business critical Linux applications in any data center. To learn how your enterprise can take on emerging challenges with a flat budget and why a better infrastructure matters, please read on.

The Open Systems Data Center

Today's IT staff is faced with a myriad of problems, not the least of which is delivering basic IT services while enabling the highest level of compute performance required in high-performance computing environments *and* remaining within rigid budget constraints handed down by an unforgiving management. In order to help satisfy these requirements for efficiency and to lower the total cost of ownership (TCO) of each VM, many data centers either are looking to transition or have transitioned to a more efficient open systems Linux framework. The data center is also being challenged to deliver scalability along with reliability, availability, and serviceability (RAS). These rising demands require more compute power, while the data center is strapped for floor space and the energy required to power and cool the data center environment.

Do you need to run more and/or bigger applications? If the answer to either is yes, then your data center needs to deploy compute nodes with more cores that support more memory, but also which can lower the energy requirement of the IT infrastructure. You need a compute node that can be highly virtualized to reduce the TCO of that infrastructure. Virtualization will enable the IT staff to consolidate more applications onto a single core, helping to improve the utilization of computing resources and reducing the complexity of the IT infrastructure. The IT staff needs an environment that is easier to manage than what they have today, to dedicate more resources to new applications.

While the number of installed servers grew by a factor of six times from 2000 to 2010, the CAGR for Virtual Machines (VMs) was 51% from 2004 to 2010¹. **This growth in the number of VMs requires that the data center get better utilization from their CPUs and memory than what they are receiving from their existing x86 servers, whether Intel- or AMD-based.** Achieving a higher efficiency is just one of the speed bumps to

success, often due to the limitations on the amount of virtualization delivered from an x86 environment. It does not matter whether you measure this efficiency as *VMs per core*, *cost per VM*, or *cost per virtualized core*, as the IT staff is always striving to reduce the TCO. Another speed bump is the cost of licensing software. If the enterprise is paying for software based upon the number of cores installed or deployed, then cost efficiency can be optimized by using fewer cores, as long as the same work gets done in a timely manner. These days, some hypervisors, such as VMware's, charge its customers based upon the amount of memory installed and not the number of cores. If the data center is paying for that software based upon the amount of virtualized memory, then cost efficiency is gained by using less memory – *which usually is not the way to improve the efficiency of each VM* – or by not using middleware that bases its charges on the amount of memory used.

Additionally, the IT staff needs to get better performance from its infrastructure, in order to provide users with instant answers, and access from everywhere and everything². **Of course, these demands need to be met by infrastructure with the lowest TCO, because there are no surpluses in IT budgets to pay more than needed.** Additionally, the IT staff needs to manage more servers and applications with less effort, to improve efficiency.

Because Linux can run on most x86 servers, this has become an important market for server vendors that can provide x86 hardware and software resources to the data center. This contributes to a more competitive environment, lowering acquisition costs while, at the same time, Linux can lower operational expenses, such as software licensing and maintenance fees, contributing more to the bottom line. Now, however, the enterprise needs to do more, possibly beyond the limitations of an x86 framework, in order to reduce the TCO even more.

While both *Windows* and *Linux* satisfy most of the data center's needs in terms of performance and scalability, the licensing costs for *Windows* and *VMware's* virtualization have made *Linux* the fastest growing operating system worldwide, estimated by IBM to be greater than \$10B by 2013. The increased licensing cost often associated with virtualizing on x86 has created an increasing demand for *Linux* applications. Increased pressure on the data center for more cost efficiencies is forcing a reconsideration of traditional data center practices, including which applications are used and where they are run.

¹ According to IBM.

² Like *iPhones*, *iPads*, and other edge devices.

Constantly increasing compute demands requires additional server resources and higher levels of throughput than may be available with typical scale-out servers. Delivering higher and higher performance in a scale-out x86 server environment often requires a significant number of additional x86 servers. This requires additional investment in floor space and energy costs to both power and cool the data center environment. It also requires additional investment in expensive software licensing, especially when it comes to virtualization and management software.

The primary objective for most enterprise data centers today is to do more for less, thus lowering the TCO, not increasing it. Expanding your existing server environment with more x86 platforms may increase complexity and inefficiencies, moving TCO in the wrong direction. It also might have a higher TCA (total cost of acquisition), which may be more important to the data center in the short term.

Linux is available on every x86 platform known to the data center, including IBM's own *System x*. Linux on x86 may be an excellent solution for the typical file or web server application. However, when business- and mission-critical applications need to be deployed using Linux, it may be important that the IT staff deploy those applications on a truly mission-critical hardware platform. This platform must have more scalability, bandwidth, security, and RAS, all of which can be found in IBM's POWER architecture.

The IBM POWER Infrastructure

IBM has been focusing on using open technologies to develop high-value solutions. As part of this, it has been working to drive the adoption of Linux in the enterprise, thus making it a cornerstone of its cross-platform data center strategy. More specifically, IBM has worked to integrate the Linux operating system with applications that run on the same hardware platform that has been used to deploy their AIX and *i/OS* solutions. As a result, IBM recently introduced new, integrated, Linux-only, *POWER7* servers³, software, and solutions.

What is required to lower the TCO of the IT infrastructure without impacting performance? The enterprise data center needs a virtual, scalable environment, using Linux on a high-performance platform, with a cost-lowering, high-performance virtualization solution. IBM has taken advantage of the

improved speed and functionality of *POWER7* to enhance their POWER server family. Today's *POWER7* may not be faster than a speeding bullet, but now it delivers more performance than each *POWER7* CPU that was used in *Watson*, IBM's *Jeopardy* champion, to provide instant and accurate questions for typical *Jeopardy* answers.

In benchmarks commissioned by IBM for their *POWER7* and x86 platforms, AIX and Linux delivered near-equivalent performance in leveraging *PowerVM*, IBM's POWER virtualization hypervisor.⁴ It also demonstrated that *PowerVM* on *POWER7* servers offers a higher utilization rate and, therefore, delivered more performance per core than that offered by *VMware vSphere 5* on the same number of cores on an x86 platform. Thus, *PowerVM* on a *POWER7*-based platform can support more workloads now or you can add more workloads as your business grows. The new, higher-speed *POWER7* servers can access data faster and improve response times, when compared to a server based upon Intel's Xeon CPU.

Above, I mentioned that information must be available both readily and rapidly. Well, the current emphasis is on *rapidly*. **Today's data center requires a more efficient server than typically available with x86 environments, while still remaining within budget constraints.**

IBM PowerLinux

Responding to the need for a low-cost, high-performance open source solution to help the data center exploit the cost efficiencies of Linux and virtualization for business-critical workloads, IBM has created new *PowerLinux* strategic solutions for those data centers with demanding Linux-based applications. **PowerLinux systems are Linux only⁵, enabling IBM to deliver the many benefits of a POWER7 architecture at a price in line with Linux on x86.** If you have code that only will run on x86 processors, or are committed to running one of the x86 virtualizers (e.g., *VMware's ESX* or *Microsoft's HyperV*), then *PowerLinux* is not for you.

An IT staff that has only worked with an x86 environment for their entire career might presume that migrating to a *POWER* architecture for Linux will require a significant amount of time and cost for the data center to rework and test their applications. That is not correct, because Linux applications are made very portable by the homogeneity of Linux.

³ For more on *POWER7*, see **The Clipper Group Navigator** entitled *With Enhanced POWER7 Systems, IBM Raises the Ceiling, Again* dated May 10, 2011, and available at <http://www.clipper.com/research/TCG2011018.pdf>.

⁴ See **The Clipper Group Navigator** entitled *Raising the Ceiling on Data Center Performance – and Lowering the Entry-Level, as Well*, dated September 27, 2010, and available at <http://www.clipper.com/research/TCG2010043.pdf>.

⁵ They cannot run AIX.

Exhibit 1 — Benefits of Linux on POWER7 Servers

- More operational VMs per core;
- Architecture that runs at a higher level of utilization;
- Fewer total cores required for comparable compute capability;
- Reduced cost for licensing of operating system, hypervisor, virtualization, middleware, and application software;
- More usable memory per core, which is not the billing unit for virtualization;
- Reduced footprint and energy requirement;
- Reduced TCO than running the same workloads on x86 Linux servers; and
- Availability of a rich, integrated system administration suite for simplified management and energy efficiency.

Source: IBM

More importantly, IBM has worked with Red Hat and SUSE to provide the enterprise with a Linux operating environment tuned for, POWER7, but at the same price as an x86 server, providing the data center with significantly more “bang for the buck” in many ways. (See Exhibit 1, above.) These new PowerLinux systems are geared for meeting the challenges of analyzing big data, delivering industry-specific workloads, and managing open source infrastructure to gain control over both physical server growth and virtual image sprawl. **This makes IBM’s POWER7 architecture a significant vehicle for improving TCO for any data center deploying Linux-centric workloads on a large scale.**

Initially, IBM has released two POWER7 platforms for PowerLinux with *PowerVM* integrated at the factory: the *Flex System p24L* and the *PowerLinux 7R2*. The *Flex System p24L* is a member of the *IBM PureFlex System* family. The *PowerLinux 7R2* is a standalone, high-performance, energy-efficient platform that is value-priced for any enterprise. (See Exhibit 2, on the next page, for the details on both.)

Both are designed to deliver lower deployment time and cost, improved performance, reliability, and server utilization than comparably-priced x86 systems, enabling IBM to deliver a better TCA. Both take advantage of *IBM’s System Director Active Energy Manager with EnergyScale* to improve energy efficiency and lower energy costs dynamically.

IBM PowerVM for PowerLinux

Successful enterprises design their data centers to use virtualization to consolidate their application set upon fewer and more powerful servers. IBM’s *PowerVM* enables the data center to deliver and take advantage of the higher consolidation rates that are not available on a typical x86 server. The advanced virtualization features within *PowerVM* for PowerLinux are optimized for POWER7 to maximize IT investment and reduce the TCA and TCO of the IT infrastructure. *PowerVM* has a single point

of management, to balance server workloads easily and to improve overall utilization. *PowerVM* can optimize response times for each workload. It enables the enterprise to scale the data center with virtual machines rather than physical x86 servers.

IBM’s *PowerVM for PowerLinux* provides the data center with a simplified, solid virtualization foundation that is required for a high-performance environment, while providing the flexibility to add new workloads without having to invest in additional hardware and software licenses. This enables the IT staff to remove complexity from the IT infrastructure. PowerLinux platforms support multiple operating environments (Linux only, of course) on a single system, thus enabling the IT staff to consolidate multiple x86 (or other) servers onto a single PowerLinux server through micro-partitioning⁶. *How many?* *PowerVM* enables the data center to partition a core into ten VMs, depending upon the workload mix. IBM’s *Dynamic Logical Partitioning* allows processors, memory, and I/O resources to move between VMs. In fact with PowerLinux, VMs can be moved live between servers via *Live Partition Mobility*, eliminating planned downtime with no effect on running applications or end users. **PowerLinux with PowerVM is a completely integrated solution for a POWER7 server platform with Red Hat or SUSE Linux, including storage and networking.**

With advanced management tools such as *IBM Systems Director for PowerLinux*, the data center can reduce management costs, enabling the enterprise to invest in new applications rather than sinking more money into continuing operational costs. It has easy-to-use, integrated management features to visualize and communicate the relationships between physical and virtual systems in order to discover, monitor the health, and define and receive threshold alerts for all of the VMs. *Systems Director* also has optional features to control energy use

⁶ Micro-partitioning enable the subdividing of a core (or a fraction of a core) where applications can run independently and securely.

Exhibit 2 — Available PowerLinux Platforms

Flex System p24L

This IBM PureFlex system is a balanced system designed for use right out of the box. Its compute nodes (where the processors are housed) are deeply integrated with storage, networking, and management resources to facilitate a quick and easy application deployment. With built-in configuration expertise, the data center can extract the full capabilities of IBM's POWER7 processor to provide the data center with higher performance at a lower cost, just what your enterprise requires.

The Flex System p24L compute node is a two-socket POWER7, which supports up to 16 POWER7 cores running at up to 3.72GHz, up to 256GB of ECC IBM Chipkill DDR3 memory, and up to either two 2.5" hard disk drives or two 1.8" SSDs. The p24L runs either *Red Hat Enterprise Linux 5.7* or *6.2* or *SUSE Linux Enterprise Server 11 SP2* and also includes an integrated *PowerVM for PowerLinux*.

The PowerLinux p24L is very reliable platform with the following RAS features:

- Redundant/hot-plug dual power supply and cooling fans
- Concurrent code update
- Internal and chassis-external temperature monitors
- Processor de-allocation
- Auto reboot on power loss
- System management alerts

PowerLinux 7R2

The PowerLinux 7R2 system is a two-socket, high-performance, energy-efficient 2U rack server that supports 16 POWER7 cores running at up to 3.55GHz, with up to 20 PowerLinux 7R2s in a single rack. The 7R2 supports either *Red Hat Enterprise Linux 5* or *6*, or *SUSE Linux Enterprise Server 11*, and an integrated *PowerVM for PowerLinux*. The 7R2 supports up to 256GB of DDR3 memory with Active Memory Sharing to dynamically allocate additional memory. The 7R2 also supports up to six Small Form Factor drives, either SSD or hard disks, for up to 3.6TB of storage. It is designed and optimized as an economical base for scale-out Linux workloads.

The PowerLinux 7R2 is a very reliable platform including the following RAS features:

- ECC memory with *Chipkill*
- Service processor with fault monitoring
- Dynamic component de-allocation
- Hot-plug and redundant power supplies and cooling fans
- Processor instruction retry
- Alternate Processor Recovery
- Hot-plug disk bays

The 7R2 has a list price that is extremely competitive with comparable systems deployed with an x86 architecture. In fact, in many instances, the PowerLinux 7R2 will cost less than the competition on a TCA basis. A standard 7R2 with a pair of POWER7 servers, virtualization, and the Linux operating system has a U.S. list price of \$21,282.

Source: IBM

within existing capacity, to monitor the network system health with servers and storage, to automate the configuration and placement of new workloads, and more.

Conclusion

The beauty of open systems is the commodity nature of the platform. The IT staff can acquire separate components, or even an integrated x86 solution, from many sources. This usually is good enough to run many basic services provided by the data center. However, many times when you acquire a platform that is "just good enough", it turns out "not to be good enough". That's because the infrastructure really does matter! This is especially true for the data center deploying business- and mission-critical applications on Linux. Linux may well be the answer for your operating environment, however, x86 may not be the best answer as the engine, either measured by performance, TCO or TCA.

For a Linux environment where a "better" solution is required, this is exactly what you get with IBM's POWER architecture, especially true for

POWER7 with its time-tested performance, reliability, and scalability. **Combined with PowerLinux, a version of Linux tuned for the POWER architecture, IBM can deliver an integrated platform to improve the functionality and lower the TCA for the open source environment of any enterprise, regardless of size.** In fact, it probably won't cost you any more for a better Linux solution, and likely will cost less.

If your enterprise is either transitioning to a Linux environment or upgrading an existing one (or doing both at the same time), the IT staff needs to evaluate how much IBM's PowerLinux with PowerVM can provide. IBM chose PowerLinux on a POWER7 architecture for Watson. You may discover an open systems solution that truly is good enough for your enterprise and high-performance applications and high now and into the future. Check out PowerLinux today!



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