

Server Virtualization with SUSE[®] Linux Enterprise Server for System z*

Table of Contents:	2 Reduce Costs through Server Virtualization
	2 Mainframe Computing and System z
	3 Take Control with IBM System z
	8 SUSE Linux Enterprise Server for System z: Reliable, Flexible, Open
	9 Total Cost of Ownership (TCO)
	12 Enterprise-class Linux from Novell
	12 Benefits and Value Proposition
	13 Conclusion



Reduce Costs through Server Virtualization

What is the best way to consolidate your servers? By using SUSE Linux Enterprise Server for System z, you can improve business continuity while reducing risk.

¹ System z is the family name for both the current IBM System z9 processors and the predecessor IBM eServer zSeries processors.

Increasing complexity and new business demands are testing the limits of today's IT systems. At the same time, CIOs are looking for innovative ways to cut costs and reduce risk.

One of the most effective ways to reduce costs is through server virtualization. In fact, server consolidation has one of the highest cost-savings impacts of all methods. Why? Servers within large enterprises tend to be underutilized. On average, Microsoft* Windows* servers are utilized at about five percent of capacity, while UNIX* servers are utilized in the range of 15–20 percent.

As a CIO or IT manager, you must cope with a growing number of IT demands in order to improve productivity and increase revenues. You are also tasked with driving down costs and reducing risk. Server virtualization is an ideal way to work toward these goals. Server virtualization improves server utilization, reduces the requirement for additional hardware and potentially frees up your IT support staff—all of which results in increased productivity and reduced costs.

So, what is the best way to consolidate your servers? The answer will be unique to your organization, but many of today's leading enterprises are turning to SUSE® Linux Enterprise Server for System z*¹ (IBM* mainframes). By using SUSE Linux Enterprise Server for System z, you can improve business continuity while reducing risk. More specifically, you can take advantage of the high availability and reliability of mainframe virtualization technology (z/VM) and the security and performance gains provided by SUSE Linux Enterprise Server. It's

time to see how SUSE Linux Enterprise Server for System z can improve your existing server infrastructure while helping you reduce costs and minimize risk.

Mainframe Computing and System z

Many organizations—including banks, airlines, hospitals and other key institutions—provide essential services and cannot afford a single minute of downtime. They have mission-critical applications that require fault-tolerant systems, which is why they've historically used mainframes. Does this sound familiar? If so, you know that mainframes can and do run for years without interruption, and maintenance can often take place without disruption of service.

RAS Design Features

Mainframe computers have many features that help them avoid unscheduled downtime due to system faults. This robustness is commonly referred to as RAS, or Reliability, Availability and Serviceability.

- **Reliability** refers to design features that detect faults in a system, then stop the system and report problems instead of continuing operations and delivering incorrect results and calculations.
- **Availability** refers to design features that allow the system to continue functioning despite the occurrence of a system fault.
- **Serviceability** refers to the ease with which a system can be diagnosed when faults occur. Early detection decreases or even eliminates downtime.

The following is a list of some RAS features:

- RAID configurations for magnetic disk storage
- Journaled file systems for file repair after faults
- Redundant components to avoid single points of failure such as power supplies
- Hot swapping of components and concurrent updating of microcode
- Concurrent upgrades of system resources
- Failover capabilities and single-error toleration
- Surge protection and auxiliary power
- Partitioning of computer components to allow one large system to act as several smaller systems
- Computer clustering capability

- Virtual machines to decrease the severity of operating system software faults and to enable maintenance of operating systems without affecting the other virtual machines.
- Automated and system-assisted fault isolation and repair-scenario guidance

Take Control with IBM System z

Today, IBM leads the mainframe market with System z servers. In a recent survey of more than 700 existing customers, IBM learned that those customers perceived a distinct performance gap between mainframes and other platforms.

Note: A higher number denotes a more positive rating.

- 2 Question: For each attribute shown below, please rate each platform based on your experience / perceptions. (Note that you may rate different platforms as having equivalent levels). 0 = Not sure; 1 = Poor, 2, 3 = Average, 4, 5 = Best-in-class
- 3 Elliott, J. *IBM System and Linux: Enhancing the value of mainframe investments*, IBM Corporation, 2006
- 4 Geiselhart et al. *Linux for IBM System z9 and IBM zSeries*, IBM Redbooks, 2006

Attribute	Rating by Platform		
	Mainframe	UNIX	"Wintel"
Availability	4.81	3.59	2.64
System integrity / Security controls	4.65	3.30	2.27
Backup and recovery (including disaster recovery)	4.54	3.35	2.70
Workload management	4.49	3.07	2.23
Average response time	4.15	3.60	2.96
Data and transaction processing	4.49	3.61	2.75
Integration of data, applications across business processes	3.59	3.47	3.09
Average	4.39	3.43	2.66

Table 1. Survey² of more than 700 existing System z customers³

The respondents clearly found the mainframe superior to the other platforms.

The architecture of System z is referred to as z/Architecture. Even if your organization currently uses an earlier IBM mainframe model (i.e., System/390 and below), you will still find it easy to migrate to System z, since all models are based on an evolution of the same architecture.⁴

Within System z, there are many different types of processor units—differing only in microcode—that perform specific functions. This paper focuses on two of these processor units, the Central Processor (CP) and the Integrated Facility for Linux (IFL):

Highlights of the IFL⁵

- An IFL enables you to exploit the integration capabilities and core strengths of the System z server for Linux at a cost-effective price point.
- An IFL has the functionality of a general-purpose System z processor and operates at full capacity.
- The consistent IFL price point for all System z generations can help successive technology generations deliver price/performance gains.
- Running your Linux workloads on an IFL will not incur any increased IBM software charges for the traditional System z operating systems and middleware.
- Conveniently, z/VM 5.x—and most IBM middleware products that run on SUSE Linux Enterprise Server for System z—are priced per processor.
- Many software vendors have adopted the IBM pricing model for traditional and Linux workloads.

- A CP is a general-purpose processor for operating systems and applications.
- An IFL handles workloads specifically for Linux. Both z/VM and Linux* can run on an IFL.

Traditionally, organizations deployed mainframes into production with a defined number of CPs appropriate to company workloads. To add more workload capacity, these organizations often had to purchase additional physical CPs and incur higher costs. In contrast, the IFL in System z architecture adds processing capacity for less than it would cost you to deploy additional CPs.

Today, IFLs are priced so customers can purchase additional processing capacity exclusively for Linux workloads without affecting the MSU rating (used in software pricing for traditional workloads) or the IBM System z software model designations. This means that an IFL will not increase charges for System z software running on CPs in the server.

IFLs also lead to performance advantages. CPs can run at different clock speeds—which results in different MSU—but IFLs always run at full speed.

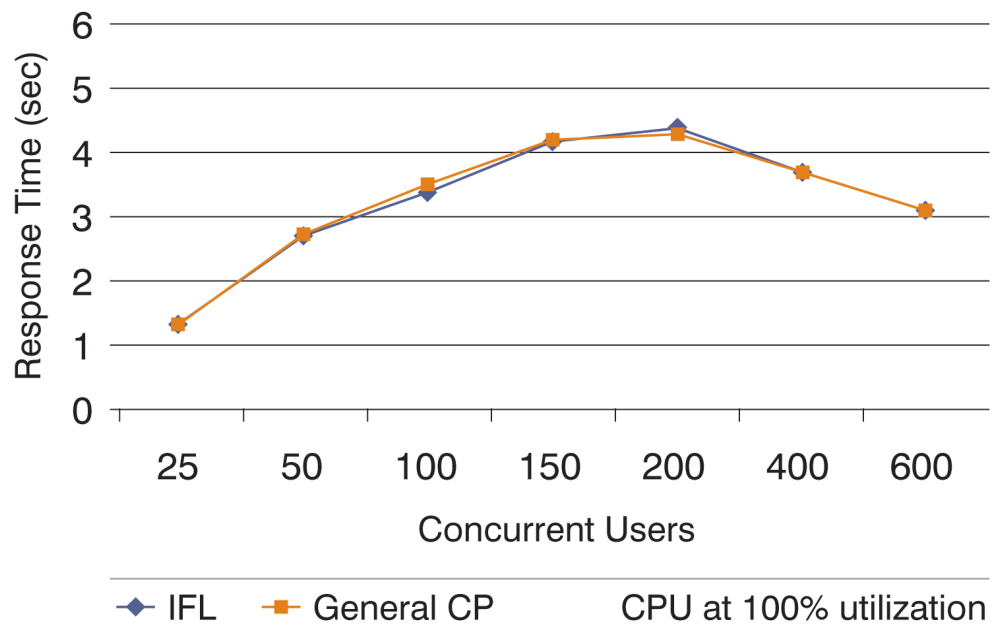


Figure 1. IFL vs. General CP

You can now consolidate large numbers of Linux servers on IFLs rather than on CPs. It's an easy decision because IFLs are priced substantially lower than traditional CPs, yet they offer an equivalent or greater amount of CPU capacity (see Figure 1).⁶

For example, in the diagrams below, Scenario 1 shows a traditional mainframe environment consisting of only CPs, while Scenario 2 shows the same traditional mainframe environment but with the addition of IFLs to extend the mainframe workload.

⁵ ibm.com, *Integrated Facility for Linux (IFL)*, 2006

⁶ *IBM Redbooks, Capacity Test of IFL vs CP*, www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/tips0479.html, 2004.

CICS	CICS	DB2	CICS	CICS	DB2	DB2 Connect	WebSphere	Apache
z/VSE	z/OS	z/OS	z/VSE	z/OS	z/OS	Linux	Linux	Samba
z/VM		z/OS	z/VM		z/OS	z/VM		
General Processors (CPs)						IFL Processors		

- 7 *ibm.com, Integrated Facility for Linux (IFL), 2006*
- 8 *Elliott, J. IBM System and Linux: Enhancing the value of mainframe investments, IBM Corporation, 2006*

Scenario 1: Traditional System z environment

- Typical z/OS, z/VM, z/VSE environment on general-purpose processors

Scenario 2: Multiple IFLs and IBM software added

- Cost remains the same for a traditional System z environment
- Cost for multiple IFLs
- Cost for a Linux distribution
- Open source applications such as Apache and Samba are included in the cost of the Linux distribution
- Cost for z/VM, DB2 Connect and WebSphere, processor-based pricing

Table 2. Before and after adding IFLs to a traditional System z environment⁷

The above illustration shows that the addition of IFLs does not impact the System z model designation. (Adding IFLs to the current configuration does not result in any increase in licensing charges for IBM operating systems or other IBM software running on the CPs.)

Virtualization and z/VM

Today’s IT environments are increasing in complexity, which leads to additional hidden costs and higher probabilities of human error. Consequently, your business might be facing server sprawl, underutilized assets, hundreds of applications, thousands of software licenses and ineffective cost-control measures. On the bottom line, these issues translate to skyrocketing staff costs, downtime, security breach costs and potentially suboptimal IT investments.⁸

You can address most of these issues and costs through virtualization, a solution that enables you to run several virtual machines on a single processor without adding physical hardware. Using virtualization, your organization can add more power to its IT environment and quickly improve server utilization.

Simple server virtualization is a proven way to better utilize network resources—improving

scalability, manageability, and availability, which can help lower total cost of ownership (TCO).” When workloads increase, you can quickly create additional virtual machines at no extra cost. This will guarantee you an agile response to changing business conditions without requiring you to purchase additional physical servers.

Virtualization offers a number of tangible advantages, including improved server utilization, increased reliability and simplified server expansion. By running multiple applications on a single server, you will increase server efficiency and reduce the number of servers you have to manage and maintain. You can also count on enhanced security, lower data center cooling costs and remote management capabilities—all of which contribute to a lower total cost of ownership (TCO) and a higher return on investment (ROI).

The virtualization technology in System z is z/VM, an operating system hypervisor

designed for System z (or any equivalent server designed to the z/Architecture). Using z/VM, you can run other operating systems such as z/OS and SUSE Linux Enterprise Server for System z (see Figure 2). z/VM supports z/Architecture (64-bit) guest operating systems as well as Enterprise Systems Architecture/390 (31-bit) operating systems. These operating systems and application

programs often run in virtual machines on the host mainframe. Additionally, z/VM enables you to remap and share existing system resources, so the virtual environment can be fine-tuned (even dynamically) to adapt to existing and changing needs. Capacity (in the CPU, IO and network) can be added on the fly and redirected if it's needed elsewhere.

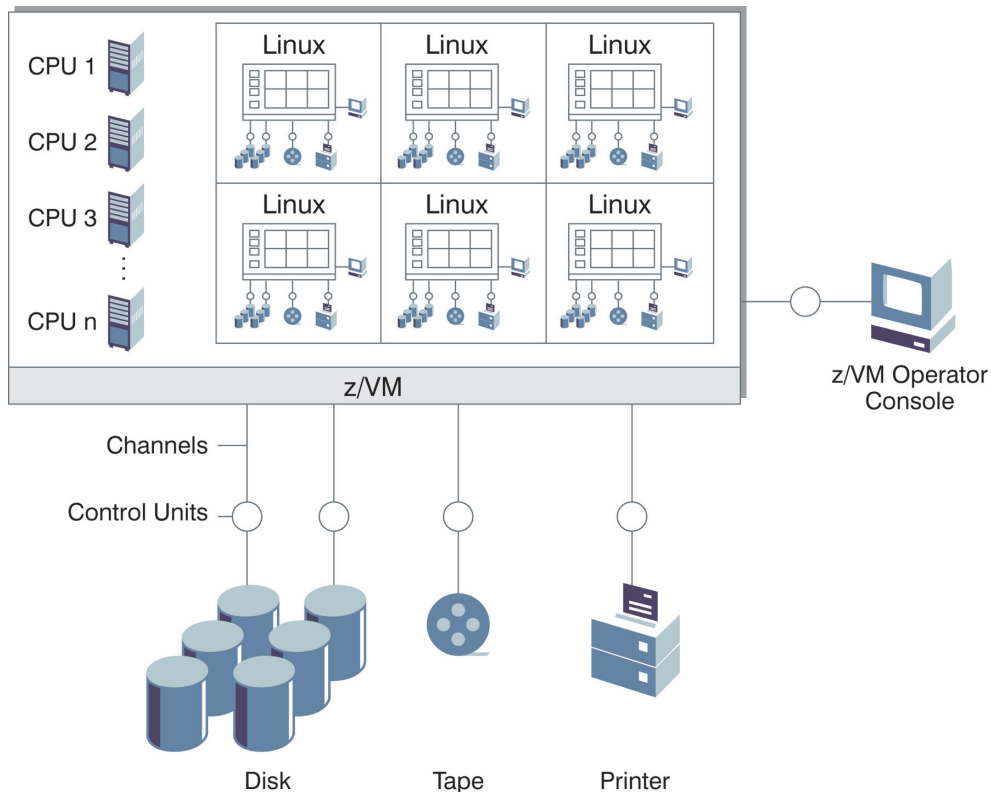


Figure 2. z-VM OperatorConsole

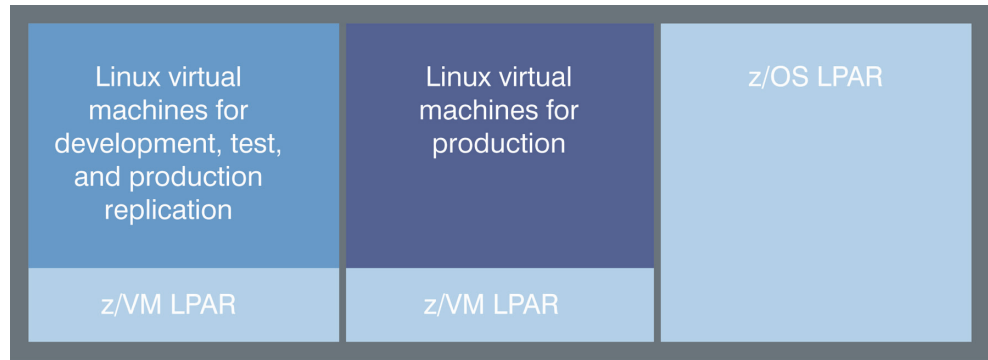
Through virtualization, you can run your development, testing and production systems on a single shared machine. You can also use z/VM in a variety of other ways. For example, you can reduce costs via server virtualization or reduce risk by safely using production hardware to perform various types of testing. Specifically, you can use z/VM to perform the following tasks⁹:

- **Move select Linux and Windows workloads to a single physical server while maintaining distinct server images and current LAN topology.** *This ability can help reduce systems management complexity. Because the number of real hardware servers and associated physical LANs is reduced, you can manage large server farms deployed on virtual servers instead of using multiple hardware servers. This ultimately drives down your costs.*
- **Test programs that could cause abnormal termination of real machine operations and, at the same time, process production work.** *You can test system-oriented programs on your virtual machine even while production work is in progress. Virtual machines enable you to isolate the separate processes so that testing cannot cause abnormal termination of the real machine.*
- **Test a new operating system release.** *You can generate and test a new release of an operating system while the existing release is performing production work. This enables the new release to be installed and put into production more quickly and without disruption. Your staff can gain experience with the new system before it is used on a production basis—and without dedicating the real machine to this function. With z/VM, you can run multiple operating systems concurrently, even different releases of the same program. This could be a critical feature if you need to concurrently run programs that operate only under a back-level release—for example, programs that are release-sensitive or uneconomical to convert—with the most current release.*
- **Perform operating system maintenance concurrently with production work.** *You can install and test program temporary fixes (PTFs) for an operating system while normal production operations are in progress.*

Through virtualization, you can run your development, testing and production systems on a single shared machine, and reduce costs or reduce risk by safely using production hardware to perform various types of testing.

- **Provide backup facilities for the primary operating system.** *A generated z/VM system is not model-dependent and can operate on various server models as long as the minimum hardware requirements are present. This flexibility enables you to deploy a smaller server model to provide backup for a larger model. (Note: the smaller model typically features less real storage, fewer channels, fewer direct access devices, and fewer unit record devices than a larger server—and it generally operates at a reduced level of performance.)*
- **Perform operator training concurrently with production work processing.** *You can train operators on the virtual machine(s) without disrupting the live production work of the real machine. Operator errors on the virtual machine cannot cause termination of real machine operations.*
- **Simulate new system configurations before the installation of additional channels and I/O devices.** *You can determine the relative load on channels and I/O devices using the simulated I/O configuration rather than the real I/O configuration. Using one real machine, your IT personnel can gain experience generating and operating an I/O configuration for multiple guest operating systems.*

10 z/VM provides services that permit recovery of incomplete interactions with resource managers.



Mainframe

Figure 3. Example mainframe configuration

z/VM is built on a foundation of system integrity and security, and it incorporates additional availability and reliability features. To deliver security and integrity, z/VM supports Kerberos authentication and Secure Sockets Layer (SSL) and it also supports guest use of the cryptographic facilities provided by IBM System z servers. In the areas of availability and reliability, z/VM enables fast restarts, improving application recovery and reducing end-user impact if an outage occurs.¹⁰

SUSE Linux Enterprise Server for System z: Reliable, Flexible, Open

Given the possibilities of virtualization and the proven record of z/VM, running SUSE Linux Enterprise Server for System z is a logical way for your business to achieve flexible performance at a lower cost. Combined with the RAS design features of a System z mainframe, SUSE Linux Enterprise Server for System z delivers high performance and best-of-breed security time after time.

Kernel Enhancements

The Linux 2.6 kernel has undergone substantial testing in 64-bit mode and is intended for large-scale, highly available systems. The 64-bit kernel offers greater memory addressability than a 31-bit kernel and provides greater flexibility for running SUSE Linux Enterprise Server for System z. With the 64-bit kernel, you can run many small Linux images or fewer—but larger—Linux images in any given z/VM partition. Whenever possible, we recommend you use the 64-bit SUSE Linux Enterprise Server distribution.

Some of the major enhancements made to the Linux 2.x kernel include:

- **Reduction in the number of global locks.** *This change enhances the performance of processes running on the 2.6 kernel due to the design of the fine-grained locks.*
- **Increase in the number of simultaneously attached devices.** *Prior to the 2.6 kernel, a Linux system was limited to 255 different types of devices, with each type supporting up to 255 connected instances. The current 2.x kernel supports up to 4,096 connected device types with each device type supporting up to 1 million connected instances.*

Advantages

Running SUSE Linux Enterprise Server for System z gives your business the ability to consolidate many smaller Linux servers onto a single piece of hardware. This consolidation—combined with the isolation features of virtualization—helps you maintain each server’s specialization even as you reduce costs. These could be servers that specialize in any number of areas, including Web services, database hosting, or Java* application hosting, to name a few.

Another advantage of running SUSE Linux Enterprise Server for System z has to do with the RAS design of IBM mainframe technology. For example, many industries, especially the financial services industry, choose mainframes because they ensure accurate calculations. This accuracy is provided by the concept of CRO (continuous reliable operation)—the ability of the server to run without interruption, ensuring “error-free execution and data integrity.”¹¹ Another example of RAS is the mainframe’s ability to support changes to processor hardware without any impact to end-users or downtime; SUSE Linux Enterprise Server for System z and its applications can continue to run, even while you add or replace processors. You can easily perform processor replacements with a standby processor, so no processor has to be physically replaced. You can opt to physically replace a book (which comprises eight to 14 processors, depending on the machine). This process can be completed online for the newest System z generation, but not for zSeries* machines.

Total Cost of Ownership (TCO)

The mainframe has always had a compelling TCO story, particularly for the consolidation of large application workloads that include ERP, CRM and collaboration systems. The mainframe delivers TCO benefits through the following features:

- *The ability to divide a single server into multiple partitions or virtual servers, each one running multiple applications simultaneously and securely.*
- *The ability to self-manage the allocation of system resources among multiple workloads and virtual servers based on business priorities. This allows the mainframe to sustain very high utilization rates (90+ percent) while meeting IT service level objectives. This approach dominates average utilization rates of 15–20 percent for UNIX and 5 percent for Microsoft Windows NT environments.*
- *Industry leadership availability and scalability characteristics that allow for consolidation of large applications.*
- *A high degree of systems management software and automation coupled with mature IT management processes, which allows increased staff productivity.*

By using System z servers in the data center, you’ll be able to more efficiently utilize server capacity, improve IT staff productivity and trim environmental costs—all of which will reduce total cost of ownership and IT complexity.

Combining the benefits of System z servers with those of SUSE Linux Enterprise Server for System z creates an entirely new TCO value proposition, especially with the Integrated Facility for Linux, which costs significantly less than a typical Central Processor. This combination gives your business the opportunity to add more power to its existing mainframe infrastructure at a fraction of the cost of a non-Linux deployment.

Many independent analysts, developers and IT executives agree: yes, generally there are fair to good TCO savings with Linux—sometimes huge savings. But variables in every organization determine exactly what that monthly, quarterly or yearly savings will be.

¹¹ Alves, C et al. RAS Design for the IBM eServer z900, *IBM Journal of Research and Development*, 2002

The cost of labor per transaction on System z has been decreasing at a rate of 16.9 percent per year.

12 Gartner, G00148213, June 2007

Consider the following cases in which companies have saved money by running SUSE Linux Enterprise Server for System z:

- Gartner¹² released a case study detailing how Nationwide Insurance significantly reduced its costs by consolidating non-mainframe server workloads on two Linux-only System z mainframes. The solution also increased growth and improved quality of service with significant reductions in floor space, power and cooling. Nationwide chose SUSE Linux Enterprise Server for System z to run multiple Linux virtual machines under z/VM.
- Deutsche Bahn, the largest rail transportation company in Germany, using SUSE Linux Enterprise Server for System z reduced its software licensing and hardware costs by 50 percent. And it reduced maintenance costs by 25 percent.

An initial deployment of 150 virtual Linux servers has grown to 450 virtual Linux servers, and the two System z servers now have an average utilization of 70 percent. Nationwide also has the potential to more than triple its capacity in the same footprint, and its server provisioning times have dropped significantly. Best of all, TCO has been reduced. The insurance giant has forecast an estimated savings of US\$15 million over three years, seen a 50-percent reduction in hardware and operating system costs, realized significant savings on middleware costs, and enjoyed an 80-percent reduction in floor space and power consumption.

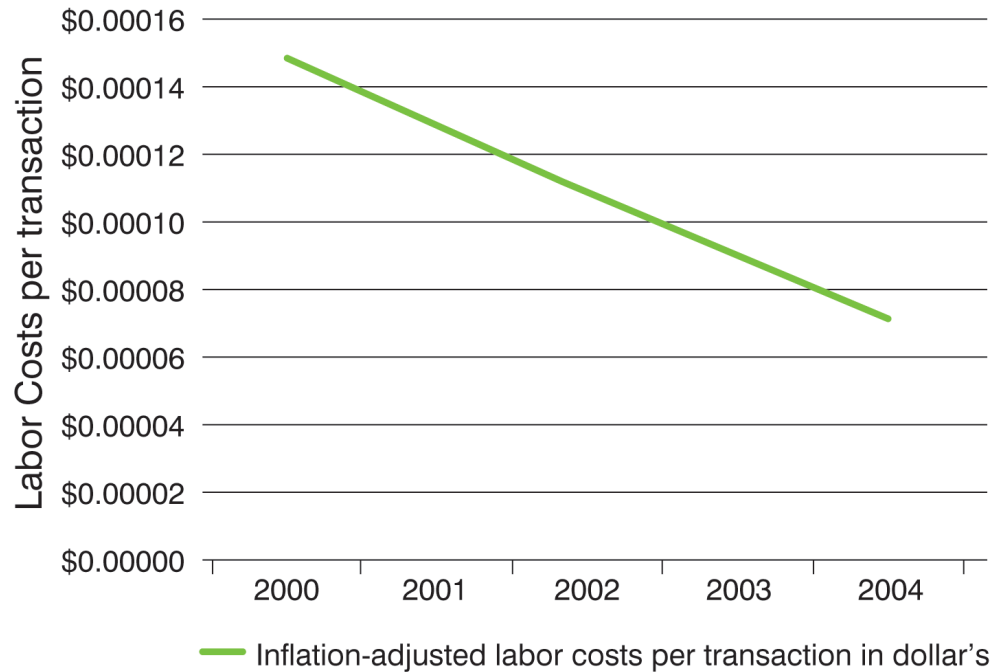


Figure 4. Labor costs

As an additional benefit, the cost of labor per transaction on System z has been decreasing at a rate of 16.9 percent per year.¹³ This reduction is due to several factors:

- *Increasing workloads on the mainframe—requires less administration because there are fewer boxes to manage*
- *The data-center-in-a-box design—reduces the need for more skilled administration and more out-of-the-box functionality*
- *Scalability of the mainframe—improves the ease of incremental upgrades*
- *The RAS design—provides constant uptime and fewer repairs and patches*
- *Intelligent workload management—improves efficiency*
- *Minimal security risks and breaches—safeguards critical data and ensures uptime*

Staffing and Training

By consolidating servers with SUSE Linux Enterprise Server for System z, your organization can realize significant cost savings from a staffing perspective. You will need fewer support staffers to manage a single mainframe than you would to manage multiple x86 servers. When Boscov's Department Stores chose SUSE Linux Enterprise Server for System z, 37–40 percent of its TCO reduction came from staffing savings.

Support

Many companies, including Novell, make Linux support a top priority. According to Gartner¹⁴, "Novell's 20-year history in support services has yielded a well-developed set of offerings and support operations infrastructure. The structure of its support Premium Service™ offerings portfolio is a comprehensive six-tier model that provides the widest-scaled set of support options in the industry. The tiers scale according to factors such as tools and training, response time, number of incidents, access to support resource expertise, account management and dedicated resources.

Linux evolved from the UNIX family, and your administrators will find that their UNIX skills transfer quite readily to Linux.

In addition to the vast free resources that are in place for Linux developers worldwide, Novell and other companies are bringing an additional level of professional support to Linux. The experienced Novell Technical Services team provides industry-leading 24x7x365 Linux support for businesses around the world. They employ more than 800 Linux support personnel, who are all committed to quick, accurate problem resolution and guaranteed response times. This broad infrastructure provides true peace of mind—Novell will be there to support you, whenever and wherever you need them.

TCO Considerations

IBM notes some interesting differences you might experience when consolidating your servers on System z instead of on distributed systems such as x86-64 machines. These differences—outlined below—can greatly affect TCO:

- *Customers who use System z servers are more likely to lower TCO in the areas of annual system maintenance, network connectivity and software support.*
- *Provisioning new Linux virtual machines using z/VM can be done in minutes, while a similar solution often takes weeks on an x86-64 system.*
- *System z workload managers can schedule multiple and varied workloads with no operator intervention.*
- *The cost of running incremental workloads on the mainframe goes down as the total workload grows; however, the cost goes up linearly for distributed systems with added workloads.*

¹³ IBM, *op. cit.*, p. 35

¹⁴ For more information about the courses (Certified Linux Engineer 10 or 9, Certified Linux Professional 10, Novell Certified Linux Professional and others), please visit: www.novell.com/training/courseware/index.jsp

15 Interested parties should contact IBM for an ROI evaluation by IBM.

- *Disaster recovery, a large issue for many IT organizations, is generally a big win for System z users.*

There is more evidence than ever before that you can lower TCO by using SUSE Linux Enterprise Server for System z. It's as simple as consolidating your non-mainframe workloads (Linux, Solaris and Windows) onto virtual Linux servers that run on one or more System z servers.

Before you can quantify the potential cost savings of server virtualization with SUSE Linux Enterprise Server for System z, you need to understand the characteristics of the workloads to be consolidated. Specifically, you'll need to know more about your I/O, memory and CPU usage, unused processing power and other considerations before you can calculate possible TCO. Fortunately, IBM has developed a ROI calculator, referred to as RACEv (Rehosting Applications from Competing Environments)¹⁵ that can help you determine whether it makes sense to consolidate your servers to SUSE Linux Enterprise Server for System z.

Enterprise-class Linux from Novell

Novell is a world leader in enterprise infrastructure software and a driving force in the growth of the Linux market. This accelerated growth can be attributed to many factors, one of which is innovation in the enterprise Linux and mainframe spaces. Novell and IBM have been close partners for more than 10 years and are still going strong today. During this time, Novell has added over 180 features requested by IBM to enhance the capabilities of SUSE Linux Enterprise Server for System z. There are currently over 1,300 Linux customers on System z and more than 1,000 applications for SUSE Linux Enterprise Server for System z. These applications include hundreds of IBM middleware products such

as IBM DB2 and WebSphere Application Server and many open source applications such as Apache, Samba, MySQL, Sendmail, and so on. In fact, Novell co-developed SUSE Linux Enterprise Server for the mainframe, making Novell the most experienced Linux vendor in the mainframe space as well as the first to implement mainframe Linux.

Benefits and Value Proposition

Today's IT organizations are increasing in complexity, often experiencing server sprawl as more servers are added to handle increased business demands. Unfortunately, many of these servers host just one application apiece and typically have utilization rates of around 10–15 percent. This extra hardware and wasted processing power will affect your bottom line unless you use virtualization to consolidate your servers and lower costs.

Linux on a System z machine running z/VM is an enterprise virtualization platform. SUSE Linux Enterprise Server for System z is the leading example of this platform, delivering everything you need in one box and providing faster, more secure communication among servers. In addition to lowering your TCO, this solution also features the benefits of System z, including:

- *Resource sharing*
- *Server virtualization*
- *Co-location of applications and data*
- *Virtualization*
- *Horizontal growth*
- *Decreasing price curve for Linux*

Server virtualization is one of the main benefits of using SUSE Linux Enterprise Server for System z. In fact, many organizations are moving their Web server applications off of individual servers, now consolidating them on multiple virtual Linux servers running on one System z server.

Conclusion

As a CIO or IT manager, you face the constant, growing demand for services and applications. You need a way to increase your service levels and maintain high quality, while still reducing costs and minimizing risk. This is a difficult balancing act because increasing levels of service typically requires you to add more applications, which correspondingly increases your system complexity and costs.

One way to achieve these goals is to purchase more hardware. Unfortunately, you would incur not only the actual cost of the hardware, but also the cost to support and maintain your new servers. You can avoid this scenario—while reducing costs and minimizing risk—by consolidating your servers with SUSE Linux Enterprise Server for System z servers. Web services, databases and Java applications are ideal candidates for such consolidation. Using the IFL technology of System z, which is specifically designed for Linux workloads—and is substantially less expensive than the traditional CP—your administrators can add

You need a way to increase your service levels and maintain high quality, while still reducing costs and minimizing risk.

workload capacity at a lower cost while enjoying the RAS benefits of an IBM mainframe. Your lower costs come from two sources: the pricing model that IBM offers on IFLs and the inclusive SUSE Linux Enterprise Server for System z operating system, which bundles open source software free of charge, including Apache, MySQL and PHP.

You take your technology seriously, scrutinizing potential purchases after thoroughly assessing your organization's needs, requirements and budget. And you now know the benefits—both from a cost and technical perspective—that your organization will realize by deploying SUSE Linux Enterprise Server for System z. So, why increase complexity when you can get better service at a lower cost? Learn more about this powerful solution, visit: www.novell.com/mainframe

www.novell.com



Contact your local Novell
Solutions Provider, or call
Novell at:

1 800 714 3400 U.S./Canada
1 801 861 1349 Worldwide
1 801 861 8473 Facsimile

Novell, Inc.
404 Wyman Street
Waltham, MA 02451 USA