Server Virtualization with SUSE® Linux Enterprise Server for System z

Many of today’s leading enterprises are turning to SUSE® Linux Enterprise Server for System z on IBM mainframes to consolidate their workloads. 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.

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Reduce Costs Through Server Virtualization

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.


“Running SUSE Linux Enterprise Server on IBM System z really gives us peace of mind. We get the benefits of open systems technology with all its flexibility combined with high availability and high performance—specifically the large I/O-bandwidth—of the mainframe platform.”

BERND BOHNE
Department Head, Central Systems Technology
Sparda-Datenverarbeitung eG

Figure 1. Customer satisfaction summary—utilization over 80 percent1
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 on 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. 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), you will still find it easy to migrate to System z, since all models are based on an evolution of the same architecture.

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):

- 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. 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.

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.

**Scenario 1:**
**Traditional System z environment**
- Typical z/OS, z/VM, z/VSE environment on general-purpose processors

“Looking at where SUSE is heading in terms of its product set and the alliances it’s creating, I think not being on the SUSE track is detrimental to any IT business at the moment!”

FRANS LABUSCHAGNE
Senior Manager for Open Systems Support Services
Business Connexion

**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

The illustration shows that the addition of IFLs does not impact the System z model designation. This means that 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.
**Highlights of the IFL**

- 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—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.

**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.

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 3 on the following page).

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.

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3  [www-03.ibm.com/systems/z/os/linux/solutions/ifl.html](http://www-03.ibm.com/systems/z/os/linux/solutions/ifl.html)

“**The high performance of SUSE Linux Enterprise Server makes it an effective alternative to UNIX for our SAP application servers and data warehousing solutions. For mission-critical applications, SUSE Linux Enterprise Server for System z is an excellent platform, combining openness and stability.**”

**Gaetano Scebba**

CTO

Gruppo API
HOW zVM WORKS

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 tasks:

1. 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.

2. Do a Live Guest Relocation. With IBM z/VM Single System Image Feature (VMSSI), a running Linux virtual machine can be relocated from one member system to any other, a process known as Live Guest Relocation. Live Guest Relocation occurs without disruption to the business. It provides application continuity across planned z/VM and hardware outages and flexible workload balancing that allows work to be moved to available system resources.

3. 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.

4. 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.

5. 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.

6. 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

“SUSE Linux Enterprise is the de facto standard for Linux on System z, as a very large proportion of mainframe customers run it. Moreover, we were impressed with the management tools such as YaST, which makes configuration simple.”

GENNARO DEL CAMPO
Team Leader for the Cloud Project
DAISY-Net

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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.

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.5

**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 current version of SUSE Linux Enterprise Server includes the Linux 3 kernel, which enhances the overall performance by 20 percent. The performance of memory and compute intensive workloads is increased through support for transparent huge pages. Support for transparent per-CPU load balancing on multi-queue devices and faster packet filtering improve network performance. Enhanced control groups (I/O throttling and memory cgroup controller optimization) help you get the most out of your systems. The 3.x Linux kernel enables for greater RAS and security, as and example, it adds roll based access controls to the AppArmor security framework. With btrfs, a more resilient file system, customers get improved scalability and data integrity, and new snapshot and rollback capabilities increase service availability.

**Advantages of Running SUSE Linux Enterprise Server for System z**

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.”6

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. And you can opt to physically replace a “book” which comprises the processors (the number of processors of one book depends on the machine type).

5 z/VM provides services that permit recovery of incomplete interactions with resource managers
6 “IBM System z10 design for RAS,” IBM Journal of Research and Development, Volume 53 Issue 1, Jan 2009
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 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 good TCO savings with Linux—sometimes huge savings. But variables in every organization determine exactly what that monthly, quarterly or yearly savings will be.

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

- Aiming to extend its internal helpdesk management solution and make it available as a hosted service to clients, Business Connexion Ltd., South Africa, determined that the existing platform was not a viable long-term option. The company was running BMC Remedy IT Service Management Suite on Solaris, and determined that the cost of licensing the underlying Oracle database across numerous processors would make it difficult to offer solutions to clients at a competitive price. From the Business Connexion point of view, the key benefit of using SUSE Linux Enterprise Server for System z is the cost advantage it offers. Frans Labuschagne, Senior Manager for Open Systems Support Services at Business Connexion, says: “Based on the utilisation of database servers on the mainframe, we calculated that the production environment equates to about 36 Intel-based servers. “Running in a distributed landscape would have pushed the Oracle licensing costs way beyond the point where we could offer a competitively priced solution to our clients. SUSE Linux Enterprise Server on the mainframe is a real strategic enabler for this whole service offering.”

- By running SUSE Linux Enterprise Server on IBM System z, Baldor Electric Company, headquartered in Fort Smith, Arkansas, greatly increased uptime and, with virtualization, consolidated its data center from 6,000 down to 900 square feet. Baldor also purchased SUSE Linux Enterprise Server with Priority Support for SAP for a single point of support—SUSE—for all servers, simplifying service. The experience of working with SUSE and IBM in deploying the entire IBM System z environment running SUSE Linux Enterprise Server for System z has been excellent, with migrations and upgrades going smoothly, and timely call backs and resolutions for all support calls. Quantifiable results include 30 percent lower

“With SUSE Linux Enterprise Server for System z, we are confident that our crucial business operations are supported in a highly trusted, available and scalable way. With only one license needed to cover all of the virtual servers we run, we can hugely decrease software licensing and support costs, and re-invest the money saved.”

ANDREA COCCIA
IT Director
Colacem
hardware and software costs, 50 percent lower administrative costs, 90 percent consolidation of servers (resulting in lower space, cooling and power costs), 90 percent improvement in up-time (reducing disaster recovery losses), and 34 percent improvement in employee productivity. All in all, Baldor Electric Company reduced IT costs from two percent of sales to less than one percent—while improving response time, up-time and productivity.

As an additional benefit, the cost of labor per transaction on System z has been decreasing continuously. 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. Consolidating the SAP application servers on SUSE Linux Enterprise Server for System z has enabled Endress+Hauser to create a simple, manageable and highly flexible platform. The combination of SUSE Linux Enterprise Server for System z and IBM z/VM enables the creation of new Linux virtual instances in a matter of minutes, making it easy to deploy new SAP systems whenever the business requires. The infrastructure is so simple to manage that the staffing level has remained constant for several years, while the environment grew massively.

**Support**

Many companies, including SUSE, make Linux support a top priority. The 20+-year history of SUSE in Linux and support services has yielded a well-developed set of offerings and support operations infrastructure.

The structure of its support 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. In addition to the vast free resources that are in place for Linux developers worldwide, SUSE and other companies are bringing an additional level of professional support to Linux. The experienced SUSE Technical Services team provides industry-leading 24x7x365 Linux support for businesses around the world via a team committed to quick, accurate problem resolution and guaranteed response times.

This broad infrastructure provides true peace of mind—SUSE 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.

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“The total cost of ownership of the IBM and SUSE solution is very low. We only need two employees to support our System z environment of more than 800 virtual servers. We would need three times the staff if we were using any other platform.”

**MARTHA McCONAGHY**

*Strategic Project Manager*

*Marist College*
Manager, Large Systems

“We believe SUSE has the best Linux distribution with the best support.”

ERIC BREUER
Manager, Large Systems
Baldor Electric

Enterprise-class Linux from SUSE

SUSE 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. SUSE and IBM have been close partners for about 15 years and are still going strong today.

During this time, SUSE has added hundreds of features requested by IBM to enhance the capabilities of SUSE Linux Enterprise Server for System z. There are currently more than 1,300 Linux customers on System z and more than 3,000 applications certified 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, SUSE together with IBM and Marist College ported Linux to the mainframe, and was first to implement an enterprise-ready and fully supported Linux operating system for mainframes back in the year 2000. Today, SUSE is the most experienced Linux vendor in the mainframe space.

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
- Verticalization
- 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 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 workload capacity at a lower cost while enjoying the RAS benefits of an IBM mainframe.

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.suse.com/products/systemz/