IDC
Analyze the Future

WHITE PAPER

Enterprise Linux Consolidation and Optimization on IBM System z

Sponsored by: IBM

Jean S. Bozman
April 2012

EXECUTIVE SUMMARY

That Linux has come a long way in the past 15 years is undeniable. It began as a system for small Web servers, and now it spans multiple hardware platforms to run enterprise workloads and technical workloads and to support a wide range of new workloads in social media, Web serving, and cloud computing.

Indeed, Linux is running on millions of server units worldwide and generating more than $4 billion in factory revenue in annual server sales. The opportunity exists to consolidate workloads onto more powerful systems, to reduce operational costs, and to improve scalability, availability, and reliability.

Several qualitative changes are happening as well:

- Enterprise Linux is running demanding enterprise applications, along with IT and Web infrastructure and application development workloads.
- Linux is finding its way onto the most scalable and reliable systems — starting with scale-out configurations in clusters and reaching into midrange and high-end server systems.
- Linux is a platform for workload consolidation, supporting workloads on central-site computers that are migrating from other hardware platforms distributed throughout the corporate network.
- Linux shares many of the programming profiles and characteristics of Unix running on scalable SMP servers, allowing IT skill sets to be shared across multiple hardware server deployments.

This paper describes the Linux environment on the IBM System z mainframe — and the Integrated Facility for Linux (IFL) specialty engines that support Linux — which is deployed in more than 30% of newly shipping System z servers.

This combination of Linux running on System z includes the hardware and software aspects of the platform and its support for virtualization, IT optimization, cloud computing, and Big Data. Taken together, these components of the Linux environment on System z address a wide array of customer requirements. From a business perspective, they provide a new way to do workload consolidation that addresses operational costs associated with supporting large numbers of Linux systems that have been deployed across the corporate network.

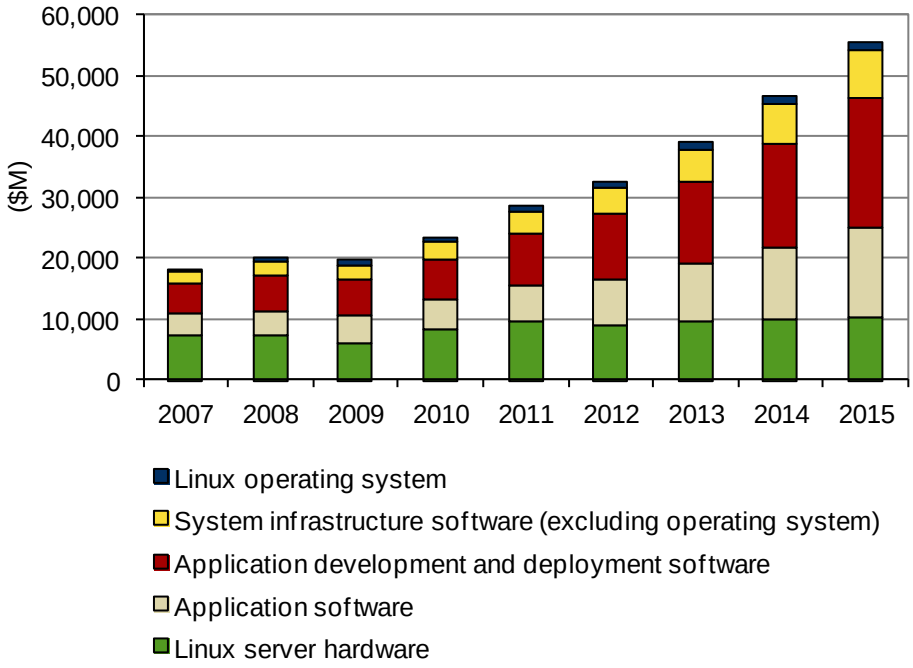
Global Headquarters: 5 Speen Street Framingham, MA 01701 USA P.508.872.8200 F.508.935.4015 www.idc.com

SITUATION OVERVIEW

The Linux ecosystem has grown and expanded since it made its first impact on traditional enterprise datacenters back in the late 1990s. The "ecosystem" of Linux workloads has broadened over that time as well, spanning high-performance computing (HPC), Web serving, online transaction processing (OLTP), ERP, CRM, database products, decision support products, and analytics software including business intelligence (BI). Figure 1 shows that spectrum of software products and how IDC expects it to grow through 2015.

FIGURE 1

Growth of the Linux Server Ecosystem, 2007–2015



Note: Linux server hardware excludes operating system revenue.

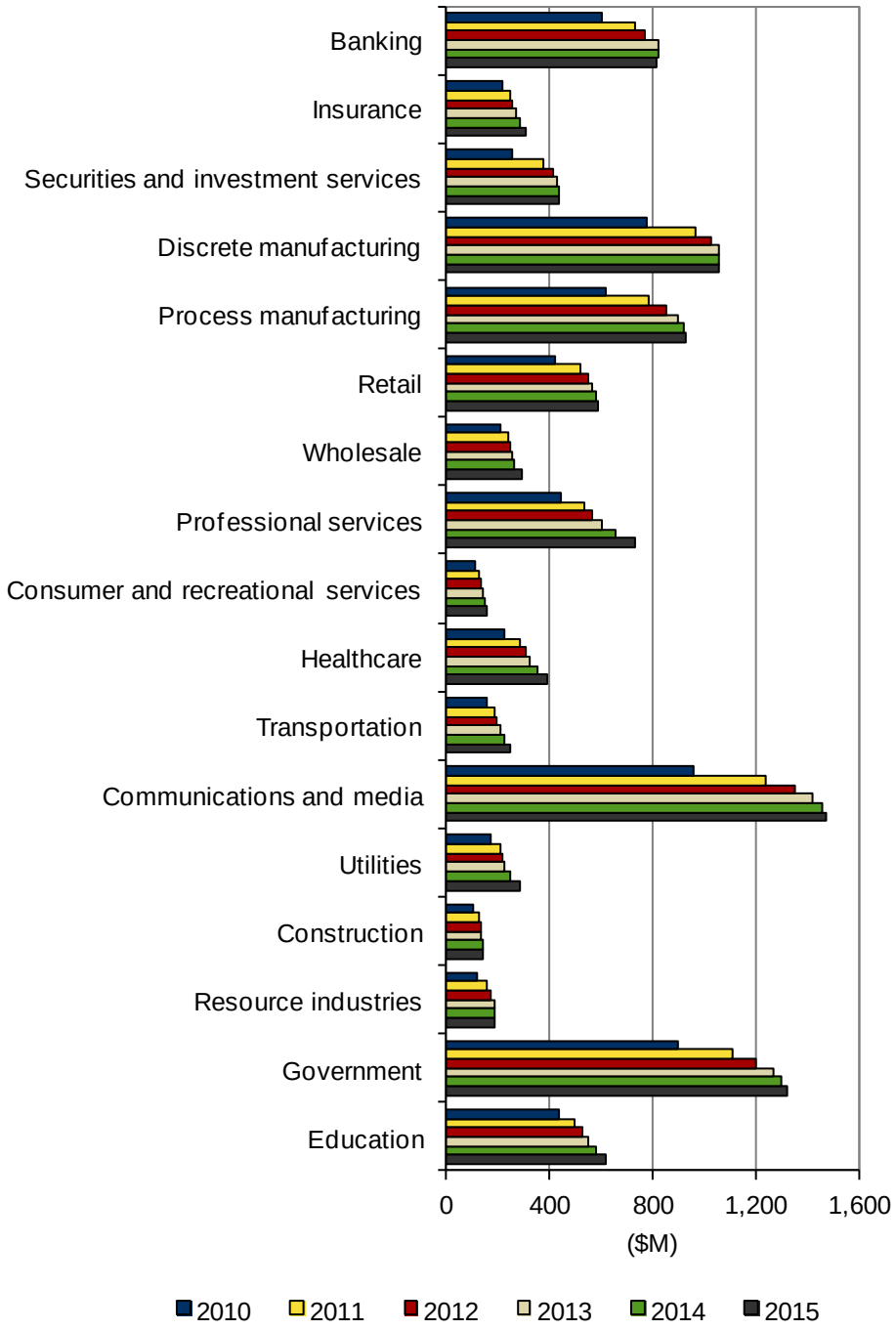
Source: IDC, 2012

The Wide Reach of Linux

As Figure 2 shows, Linux has touched more than two dozen vertical markets, including financial services, government, insurance, healthcare, manufacturing, retail, telecommunications, and transportation, among others. Whether running Monte Carlo simulations of financial market dynamics or supporting enterprise database images on commercial systems, Linux has given rise to a wide range of customer applications and has contributed to a portfolio of independent software vendor (ISV) applications sold into the enterprise computing space.

FIGURE 2

Worldwide Linux Server Revenue Forecast by Vertical, 2010–2015



Source: IDC, 2012

Linux has also become an enabler of workload optimization: It can host thousands of custom applications that have been developed across many individual vertical markets in recent years and more than 3,000 ISV applications that are certified to run on Linux on System z's IFL specialty processors. The ISV products include a variety of commercial applications and databases as well as technical and scientific applications for high-performance computing and analytics applications for decision support and BI. By running Linux on the IFL, customers can reduce their software license costs, compared with running the same applications and databases on the other processors within the System z — and this has been a driver of Linux workload consolidation on System z.

Today, end-to-end workloads tap multiple computing tiers, with Web-serving tiers sending requests to application-serving tiers and application servers accessing database-serving tiers that are typically more scalable and have higher reliability characteristics than most workloads. The central-site systems, then, take on renewed importance in these end-to-end workloads because any disruption in the overall application creates a ripple effect throughout the entire organization, resulting in the disruption of business continuity for many end users.

Linux on the IBM System z

The IBM System z computing environment has been a mainstay of the datacenter for more than 40 years, known for its availability, reliability, scalability, and security and its early support of virtualization throughout the system. But when it comes to programming and operating in this IT environment, today's new generation of programmers and system administrators are not as familiar with the specifics of its software as they are with newer technologies such as Linux and Java.

IBM, which ships the most mainframe systems worldwide, has addressed these challenges in two ways: by providing education regarding the mainframe, its operating systems, its software tools, and its application software and by hosting workloads and a new portfolio of applications in a Linux environment, with the same Linux distributions that are available for other platforms, allowing customer sites to leverage the widely available Linux skills.

Linux has become one of the top software systems for IBM System z, along with z/OS and z/VM virtualization software, which hosts multiple copies, or images, of Linux simultaneously. The number of Linux images running side by side can climb to hundreds of separate Linux instances. This allows for a large-scale consolidation, helping improve IT economics for companies that would otherwise have run the same aggregate workloads on dozens, or even hundreds, of small Linux servers. Today, Linux use is so widespread on System z that about 30% of all new System z units ship with Linux — and more than 60% of the top System z customers have Linux running on their System z servers.

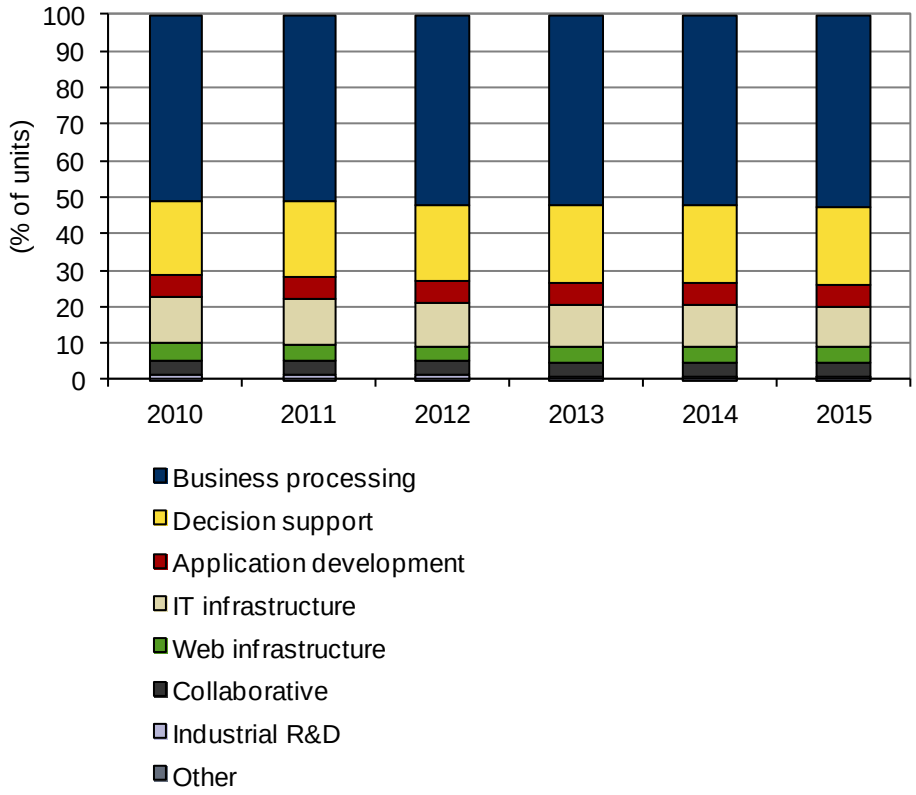
Linux Workloads on Enterprise Servers

While most Linux instances are running on x86 servers, as measured by the number of Linux server units shipped each year worldwide, it is also clear that many of the most demanding Linux workloads run on midrange and high-end servers (including the scalable RISC and EPIC servers and the IBM System z servers).

As Figure 3 shows, the workload types running on these high-end servers include (as identified by IDC's workloads taxonomy) business processing (e.g., enterprise applications such as ERP and CRM, and OLTP); decision support (business analysis and BI); and collaborative workloads (enterprisewide email and groupware). IDC notes that databases are also running on these production systems — and that these databases are associated with multiple workloads listed in the figure.

FIGURE 3

Worldwide High-End Server Shipments by Workload, 2010–2015



Source: IDC, 2012

High-end servers, defined by IDC as servers priced at $500,000 or more, will continue to host workload consolidation, which brings applications from other servers to rehost them on the scalable server. As a logical consequence, new workloads are deployed further on these servers as well. For business processing and decision support, the reason for running on high-end servers is clear — the sheer demand from hundreds of end users combined with a requirement for stability and reliability. Typically, these high-end systems have built-in reliability, availability, and serviceability (RAS) features and strong security software that prevent outages due to security lapses. Although these high-end systems can run many other types of workloads, the "mix" of workloads is weighted toward those that need scalability, reliability, availability, and security to ensure business continuity for mission-critical workloads.

IBM SYSTEM Z FEATURES

Characteristics that customers are seeking for their enterprise workloads running under Linux include performance, virtualization, and partitioning on System z (via logical partitions [LPARs]) and high levels of security and availability.

All workloads that run on System z, including Linux workloads, benefit from this underlying security, availability, scalability, and manageability — four attributes of the System z platform that would be "inherited" by any Linux workloads that run on it and that would be a differentiator from running Linux on x86 servers. Another decisive factor driving Linux on System z deployments, as noted by customers doing so, is the optimization of Linux to run with System z's z/VM virtualization software environment, which makes highly efficient use of the hardware resources available to it.

This means that Linux workloads that are deployed directly onto System z servers or migrated to System z from other platforms support these features, which are important for mission-critical workloads that cannot be interrupted without impacting business continuity. Therefore, gathering up the most "critical" Linux workloads from a datacenter can result in placement on a platform known for its RAS features and stability in supporting enterprise data processing and thousands of end users.

Customers continue to invest in the System z platform, given its value to the business and given the history of previous investments in their mainframe technology. These investments continue to pay dividends to the business because business services are delivered with high availability, reliability, scalability, and security. Today, pricing for System z servers starts at $50,000 to $100,000, with the arrival of the IBM z114 in July 2011, but can range up to $500,000 or more in high-end deployments and Parallel Sysplex configurations of System z.

System z customers have told IDC that the largest portion of projected increases in spending will target adding capacity for growth in usage of existing applications, such as supporting larger numbers of users accessing the system. Growth is also expected from workloads that are now coming onto the System z platform — many of them based on Linux, Java, and other highly abstract languages.

These growth factors ensure that the current System z platform will have more "runway" in front of it, and the importance of this platform and its workloads to large businesses ensures its longevity over IDC's current forecast period (2010–2015), although pricing can be expected to be more intense, over time, due to competition from midrange and high-end Unix servers.

Security

Mainframe security is a characteristic that is inherited by the workloads running on System z. That means that the IBM RACF security, or other security software provided by a third-party ISV, will apply to the Linux workloads running on top of the System z hardware platform. High levels of encryption (256-bit security) are supported, conferring the high levels of security specified by federal governments and international standards for encryption.

Regarding security support, the z/VM computing environment extends the security capabilities of the System z environment. For example, z/VM not only makes the Crypto Express2 and Crypto Express3 features available to Linux systems but also virtualizes the System z cryptographic devices so they can be shared by many Linux systems running under z/VM. That means that z/VM provides secure interactive facilities for maintaining the z/VM system directory, even as it maintains tight integration with the IBM RACF security server on System z.

Scalability

Scalability is an important attribute of System z servers, which can add capacity on demand, as demand for processing increases. System z supports high levels of granularity and control of system resources with LPARs that can be sized to fit the requirements of the workloads running on the system. Multiple LPARs can be deployed, side by side, with isolation of the workloads running inside them. This means that workloads running inside one LPAR would not interfere with others, enhancing overall uptime for the system.

With many types of servers, there is a challenge when working to "balance" system resources — providing the appropriate amount of memory and I/O to match the processing power. These levels must be adjusted, time and again, as workload demands change over time. With IBM System z, the fine-grained management controls and integrated workload management (WLM) allow resources to be automatically readjusted, based on business-oriented goals, enabling workloads to scale up when applications and databases need more system resources or to support larger groups of end users as demand spikes due to seasonality or end-of-quarter close.

The z/VM virtualization software is extending the scalability of the System z environment through several data-in-memory techniques, support for highly granular virtualization, and very high levels of resource sharing (e.g., processor, memory, communications, I/O, networking). This technology includes the sharing of Linux program executables, nondisruptive dynamic configuration, overcommitment capabilities for processors and memory, as well as cooperative memory management between Linux and z/VM, with virtually no system overhead.

Availability

IBM System z supports the highest levels of availability, Availability Level 4 (AL4) in the IDC Availability Spectrum, when IBM Parallel Sysplex configurations are shipped. This level of availability supports up to 5-9s of uptime (99.999% uptime, which is 5 minutes of downtime per year). These configurations of multiple System z servers support processing, without interruption, even when a request is sent to an alternate server in the Parallel Sysplex cluster. In standalone servers, availability is very high due to many built-in design features that ensure that processing can continue, even if a specific hardware component were to fail.

These high availability levels apply to the Linux workloads running on the System z so that Linux workloads that are transferred to or installed on the System z gain the availability characteristics of the mainframe platform itself, which is known for having extremely high levels of security. Workload consolidation onto IFLs, which leverage the z/VM computing environment, support applications and databases that migrated from other types of server platforms and support new workload deployments. The z/VM virtualization software supports many virtual servers simultaneously, providing flexibility and scalability in deployment and security through workload isolation. The latest version of z/VM, 6.2, supports live guest relocation (LGR), enhancing high availability for Linux workloads and supporting business continuity.

Manageability

IBM offers support for z/VM, IBM Systems Director systems management software, and the IBM Tivoli enterprise system management framework on the IBM System z, providing visibility into all of the physical and logical objects running on the platform. The ability to manage all of these objects in a comprehensive and holistic way allows IT organizations to correctly "map" business services, as delivered by IT systems, to the underlying IT infrastructure platforms. IDC research has shown that without effective management tools, operational costs rise dramatically. Because of its design, z/VM 6.2 allows customers to cluster up to four instances of z/VM within a single system image (SSI), which can be serviced and administered as one system, resulting in simplified systems management. This also simplifies everyday systems management tasks for system administrators, reducing IT staff costs.

With the IBM zEnterprise 196 and 114 server platforms, IBM introduced the IBM zEnterprise BladeCenter Extension (zBX) and the zBX blade chassis, which houses dozens of IBM POWER blades and x86 blades and manages them alongside the IBM System z platform. The blades can run Linux or Microsoft Windows on x86 blades or IBM AIX Unix on POWER blades.

The IBM Unified Resource Manager manages cross-tier, end-to-end resources that combine System z workloads with those running on POWER and x86 blades on the zBX chassis to address performance, controllability, and manageability. This approach reduces the total number of "hops" of any given request to the System z, when that request comes from one of the blades housed in the zBX chassis. The zBX firmware and new software have been optimized to speed performance of the overall workload, which "taps" multiple servers within that configuration.

IBM System z Support for the Cloud

Cloud computing provides new levels of access to System z applications and data for large numbers of end users — whether they are working at remote sites or using business services hosted on cloud-enabled server systems. IBM System z is fully enabled for cloud computing, although its use in private clouds partially masks its importance as a hosting system for all types of clouds. The System z's strong support for virtualization means that it is well-positioned to deliver software stacks, on demand, to end users who are authorized to request them.

Even so, the perception about mainframes is that they play a marginal role in cloud computing. Instead, many industry participants focus on x86 servers nearly exclusively. And yet, as demand for cloud computing accelerates and as the workloads for cloud mature, System z servers could easily be put to work as sturdy sources for application delivery and data archiving services. Both areas would benefit from System z's high-availability, deep encryption capabilities for security and extreme scalability for supporting hundreds or even thousands of end users.

Today, customers are able to host cloud services that are running on virtualized Linux systems on System z. They are able to add and to adjust the amount of system resources supporting those workloads, as needed. Importantly, customers have reported that as their site's capacity needs grow, they can add IFL specialty processors (for more details, see the Customer Snapshots section). Because Linux is the operating environment, the System z can be accessed and used by larger populations of programmers, system administrators, and end users than would have been possible before. This allows new business unit groups to access System z resources and provides a larger pool of IT staff to work on System z.

Another potential use for cloud computing hosted on System z includes the archiving of enterprise data, via the cloud, for the sake of protecting vital data and disaster recovery (DR) and business continuity. System z's support for RAS features and the highest levels of availability (conforming with IDC's Availability Level 4 designation, which provides 999.999% uptime, or better, per year) and security bring a new level of enterprise support to Linux applications and databases than would be possible on most other types of server platforms.

SYSTEM Z AND ITS SUPPORT FOR LINUX

The next sections examine IBM System z servers and specific onboard features that support Linux workloads as they run on the System z. The IFL specialty engines, the z/VM virtualized computing environment, and support for Linux applications and databases enable the hosting of Linux workloads on System z for new approaches to enterprise computing.

IBM Integrated Facility for Linux

The specialty engine strategy for System z is based on providing specialized hardware processors such as IFL.

Specialty engines are System z processors that are optimized to do a specific job — and the workloads that run on them can be deployed and maintained at lower price levels than on the other processors on the System z. This attribute of System z IFLs has been discovered by longtime mainframe customers that have chosen to "mix" IFLs with other System z processors, thereby reducing their overall software costs for licensing and ongoing operational costs.

According to IDC research, each type of System z specialty engine is designed to optimize performance for specific computing environments. In this paper, reference is made to the IFL specialty engine. The other types of specialty engines were developed for other purposes, including the zIIPs (Integrated Information Processors), and the zAAPs (Application Assist Processors). However, this paper focuses on the use of IFLs for supporting Linux deployments on System z.

The IFLs are dedicated to Linux and z/VM (which provides a hypervisor that hosts many Linux system images). The IFLs are dedicated to Linux and z/VM workloads, but otherwise they function in the same way as the other System z processors. IBM supports two Linux distributions: SuSE Enterprise Linux (SLES) and Red Hat Enterprise Linux (RHEL). Some customers have run other distributions on the IFLs, but they are deployed in custom solutions.

Mostly, Linux is running in the IBM z/VM virtualization environment. Importantly, customers may "mix" IFLs with standard System z processors, dedicating as many IFLs as they would like to Linux workloads.

z/VM as a Host Environment for Linux

IBM's z/VM virtualization software provides a highly virtualized computing environment in which virtual servers are hosted, potentially numbering into the hundreds of individual "images" of Linux. Originally developed in IBM's Boeblingen, Germany, labs, the combination of z/VM and Linux is now widely deployed within the IBM System z installed base. By using z/VM, each Linux image is isolated and dedicated to running its specific application, database, or other workloads. For example, dozens of programmers could work on separate Linux images, each of which would run without interfering with other instances running under z/VM. In effect, z/VM is hosting all of the images — each of which runs as a guest operating system.

In the same way, multiple production workloads can be hosted under z/VM, and each workload can also run separately without interfering with the other workloads. The business value of this approach is clear: The work of many business units can be hosted side by side while sharing hardware resources in a virtualized environment.

More than 3,000 software products are certified to run on Linux/System z environments. These products are from IBM and also from ISVs, and each product has been tested before its certification. The range of products is broadening over

time, including relational databases (IBM DB2, Oracle 10g and 11g); IBM Business Analytics and IBM Cognos Business Intelligence; IBM WebSphere; IBM Lotus collaboration; IBM Rational development tools; IBM Tivoli system management software; and many other applications and databases.

Enterprise Linux Server

Some System z servers are dedicated to run only Linux workloads. This type of shipment, called an Enterprise Linux Server (ELS), started with just a handful of systems a few years ago. This all-Linux System z is emblematic of an emerging deployment style, especially in fast-growing economies with infrastructure buildouts — and plenty of Linux skills in programming and system administration. This means that it will be easy for new customers to adopt the ELS — without special training — and that Linux workloads will have a way to scale up as demand grows, even as they "inherit" security and availability from System z.

Now, there is increasing adoption of this style of deployment globally, based on recent customer installations in 2011. Examples of ELS deployments include System z servers that support data serving and data analytics; technical workloads; financial modeling; and those servers that are deployed in places where Linux skill sets are predominant.

CUSTOMER SNAPSHOTS

Shelter Insurance Companies

Shelter Insurance Companies of Columbia, Missouri, has embarked on an enterprisewide program of consolidating Linux workloads on the IBM System z114 server. As part of a technology refresh plan, the new z114, installed in January 2012, replaced an older IBM System z10 Business Class (BC) model, which in turn had replaced a z9 Business Class system several years ago.

The insurance company, which operates in 14 U.S. states and in 46 countries worldwide, supports a total of three IFL specialty processors running on the IBM z114.

Many of the Linux workloads at Shelter Insurance run on IBM WebSphere middleware, which includes a store-and-forward engine, an Enterprise System Bus (ESB), and portal software. This means that the company's WebSphere skills can now be applied to work in the Linux on System z computing environment, without any additional retraining efforts. All of the IFL engines run the SLES 11 Linux distribution, as hosted by IBM z/VM 6.1.

By using z/VM, the company has achieved a greater degree of IT flexibility, pulling in applications that had been running throughout the business units on Microsoft Windows x86 servers. This results in consolidation of specific Linux applications to run on the central-site System z, where a small group of IT system administrators can run them efficiently. A targeted team of programming and system administration experts focuses on each individual workload to be moved over from the x86 server where it originated — and onto the z114. The new deployment is saving the company on licensing fees because the applications are now running on fewer cores than they were before.

A first "test case" for this approach to workload consolidation on the Linux on System z was moving a custom-built internal "phone directory" — porting it from Windows to Linux — to run on the central-site System z. Now, other workloads are planned for a similar migration to Linux on System z. Driving the migration process is a plan to reduce overall software license costs for Windows and to be able to move workloads among the IFLs to share resources. The database tier for these applications is running on the IBM DB2 relational database on the IBM z/OS operating system.

"We plan to move a few more of our existing IT applications, moving them over to the System z," said Terry Cavin, director of information services at Shelter Insurance. "We're also looking at building our entire SOA infrastructure to run on the System z." The IBM WebSphere ESB will then "map" business services to underlying IT infrastructure capabilities, he said, redeploying them among the IFLs, as needed.

Because Shelter Insurance is a data-intensive company, it has a total of 300 personnel working in IT services — one-tenth of the company's 3,000 employees. However, there is an effort to contain IT budgets so that IT costs will stay within the target range of 3–4% of annual revenue. The focus is on building business services that support the overall business. "We're an information-intensive company, and a lot of our applications are homegrown," said Cavin. To do so, custom applications are developed in higher-level languages, abstracted away from the physical hardware via virtualization layers (e.g., VMware on the x86 servers and z/VM on the z114).

"We're looking at the ability to deploy and manage services for reuse. We have a list of applications we're going to move over from Windows to Linux over the next few months. At some point, after bringing many applications over to run on Linux, you're saving a lot on license costs," noted Cavin. Those savings are estimated to amount to thousands of dollars per year.

The process of application migration is far from over; there are still hundreds of x86 servers throughout the organization. That means that new applications must be multiplatform — and designed to run on top of WebSphere's ESB. "We want to be able to run our applications on multiple platforms, if necessary," said Cavin. "It gives us a lot of flexibility in terms of moving workloads around."

For each application, Shelter selects a "task force" or team — including system administrators for IBM WebSphere and for Linux and the key developers to support the application — to verify its performance in a Linux production environment. "That gives us an opportunity to verify that the application functions well there [on the IFLs]." The new zBX blade chassis is also attractive, with the option to run Linux and Windows on x86 server blades. "We're certainly interested in that," he said.

According to Cavin, the pattern for the migrations is taking shape: "We're there now with a reliable, performance environment on Linux for System z. We're enjoying the enhanced stability of the mainframe platform. That's where we want to go."

Miami-Dade County

Miami-Dade County has two IBM System z10 Business Class servers — each of which has two IFL engines supporting production applications. The county already had two machines in 2009, when it decided to bring new IBM Cognos 8 workloads online — to extract data from the online databases and make it available for analysis by all the departments serviced across the network.

Cognos 8 was installed on Linux, and this spring, the number of IFLs will be increased from two to five on each System z to meet anticipated capacity demands from the more than 1,500 end users who access the Cognos data. The county is also testing an Oracle on Linux system in anticipation that it will move some Oracle databases from a Unix server to run on Linux on the central-site System z.

The z/VM virtualization software allows virtual servers to be spun up quickly, and it supports the addition of memory or I/O cards as needed. This enhances IT because of the rapid deployment capability. High availability is also a consideration because the System z's workloads are mission critical to county operations. Importantly, the presence of two System z machines allows the county to schedule planned downtime so that production applications can be moved to the other machine, avoiding downtime for the application and preserving business continuity.

The county started to think about using Linux on its mainframe systems in 2002–2003, but it didn't start working on Linux/mainframe projects until 2007. When SLES 8 was available, the county felt comfortable with the enterprise Linux solution being offered for z/VM 4.2 at that time and has since moved to SLES 9, 10, and 11 on z/VM 6.1. Today, 40 Linux virtual machines (VMs) are running on z/VM on the county's System z Business Class servers.

The Linux systems running on System z serve multiple purposes — and they provide a gateway to the county's online business services, as accessed by up to 1,500 end users, such as county employees, lawyers, and people accessing court information. "Three of our Linux [virtual] machines sit on the DMZ [a term for a section of the infrastructure that has high-speed interfaces to the Internet], and they serve public access customers," said Anita Nolan, a senior operating systems specialist at Miami-Dade. "It's like a cloud computing system, with access to our public information and court records." End users accessing the System z can also view images of checks they have written to pay county fees and taxes.

Initially, the county considered the expense of running Linux applications on the mainframe — and some were concerned that costs would rapidly grow. "At first, it was a hard sell to bring z/VM and Linux into the mainframe environment," said Jose Eskert, a senior operating systems specialist. "But with time it has proven to be a trusted system. The TCO [total cost of ownership] is good, and management is supportive of the platform because they're seeing the business benefits."

HeiTech Padu Berhad

HeiTech Padu Berhad, a systems integrator and managed services IT company in Kuala Lumpur, Malaysia, is running Linux on System z to consolidate Linux workloads for scalability and reliability — and to form a new platform for its end-customer deployments. The company has two System z machines running Linux — both of which are installed in Kuala Lumpur datacenters. One is a System z Business Class system with two IFL specialty processors, and the other is a new IBM zEnterprise 196 (z196) machine with nine IFLs. In the future, the same approach may be applied to several computing centers the company operates in Indonesia, Sri Lanka, and the Middle East to serve end customers in those countries,

HeiTech Padu started deploying Linux on System z three years ago, said Wan Zailani Wan Ismail, who is director of pre-sales and marketing of HeiTech Managed Services (a business unit of HeiTech Padu). For a company with hundreds of professionals programming custom applications for its clients, the skill-set transfer associated with Linux is an important element of the deployment. "The benefits will be coming to our people," he said. "Now, people who have System z skills can learn and understand Linux, and people who run Linux on x86 can start understanding System z."

Beyond that, HeiTech Padu is beginning to host more cloud computing capabilities with its System z servers. The company will be using the IBM middleware "software stack" and management software to host some cloud services to be accessed by its customers throughout Asia. Separate services (e.g., SaaS and IaaS) will be coming from the Malaysia, Indonesia, Sri Lanka, and Middle East datacenters because of governmental regulations regarding data security and because different services will be hosted on different systems. Wan noted that traditional System z and z/OS workloads will continue to run on the IBM z196 system, including the IBM DB2 database on z/OS and the IBM CICS transactional computing software.

Training of future generations of programmers and system administrators is very important to the company, which is building custom applications that are mission critical for its end customers. Some of these customers are governmental agencies, while others are in transportation, banking, and finance. The scalability, reliability, availability, and security (IBM RACF security software) inherent in the System z architecture will then be supporting the Linux workloads that run on the IFLs. All of that will enhance the operational characteristics of Linux enterprise workloads.

Overall, HeiTech Padu has about 1,200 employees — and several hundreds of them work in IT; about 50 of the IT staffers operate and manage the System z servers. Besides its System z servers, the company has hundreds of x86 servers, several IBM pSeries and System p Unix servers, and several HP and Sun Microsystems servers using the Oracle database. Platform migration will aid in workload consolidation — already the Oracle database workload is moving from the IBM AIX system to Linux on System z — and more IBM WebSphere applications will bring a number of Linux x86 server workloads to the System z platform for central-site operations.

The company is also considering the installation of an IBM zBX blade chassis alongside the z196 system. That chassis would hold x86 server blades running Linux and Microsoft Windows, an approach that is intended to improve end-to-end workload performance for applications accessing z/OS on the System z.

HeiTech Padu has partnered with IBM on its IBM Academic Initiative, which is training university students in System z technologies and skills — and adding Linux on System z skills to the curriculum. Wan said that HeiTech Padu is already seeing the benefits of that partnership, with five university students who recently graduated from the program working at HeiTech Padu.

CHALLENGES/OPPORTUNITIES

Changing demographics for IT staff is bringing a new mix of programming and system administration skills to datacenter deployments. Enterprises have made deep investments in System z servers, but they must make the servers more accessible to IT staff who work with them on a daily basis. One way to do that is to leverage Linux operating systems, Linux software tools, and Linux workloads — all running on top of the IBM System z hardware platform. This combination preserves the security, scalability, reliability, and availability of the mainframe platform while leveraging the widely familiar Linux software environment.

By growing the Linux environment on System z, IBM is carrying forward the value proposition of the mainframe for workloads such as Web-enabled end-to-end workloads or business analytics and BI workloads that take the pulse of the business by finding the patterns in the data throughout the organization.

The ability to run Linux on System z promotes interoperability with the other computing platforms in the organization's infrastructure, including x86 servers and systems based on IBM POWER processors. This enables improved end-to-end workload deployment with components of Linux end-to-end applications running on x86 servers in the business units and on x86 or POWER server blades in the datacenter. But key to all of this activity is ensuring that a wider group of potential customers know that the pricing models for System z have been — and are — changing, allowing a larger number of businesses to evaluate and test new IBM System z hardware — including eventual deployments at lower cost than would have been possible just a few years ago.

CONCLUSION

The use of Linux on the System z platform is a way to leverage Linux IT skill sets that are already present on the IT staff and to attract new talent from universities and other companies to work on the System z platform's production applications and databases. Customers have said that they were quickly able to adapt when long-used custom applications and ISV applications were ported to run on Linux on a z/VM virtual server. In these cases, Linux on System z provides many opportunities for IT optimization, which, these customers report, results in dramatic cost savings. The ability to support many workloads at once — and to use workload consolidation to

gather applications for central-site processing — makes the use of Linux on System z a forward-looking approach for the future of the IBM System z server platform and for the types of workloads that will be carried forward on it.

For more information regarding Linux on IBM System z, visit **www.ibm.com/systems/z/os/linux**.