White Paper

Ladies and Gentlemen — Start Your Linux on z Engines!

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IDC OPINION

Enterprise-class servers are converging with the massive open source-driven digital transformation that is under way everywhere. These systems, which have traditionally run an organization's systems of record (e.g., the database, the transactions, and the analytics), are starting to not only open up to digital transformation but also offer unique capabilities to escalate the advantageous innovation opportunities that digital transformation brings forth.

An enterprise-class scale-up system that is extended to connect to an organization's distributed infrastructure or, even better, on which the distributed infrastructure is consolidated offers a powerful platform for innovation, operational efficiency, and cost reductions.

What's more, when open source and next-generation (next-gen) apps that run on Linux are hosted in the same scale-up footprint as the enterprise's core business applications, the former benefits from the processing power, scalability, security, and reliability of the enterprise-class hardware. At the same time, integration between the two workloads presents new possibilities for efficiencies as well as for critical insights from shared data.

This white paper takes a look at the drivers that are providing new opportunities for IT to leverage larger enterprise-class scale-up systems for digital transformation. It also specifically looks at IBM z Systems, which is uniquely capable of running multiple workloads in parallel, on both z/OS and Linux, and as such offers a powerful on-premises cloud services platform for the integration of systems of record and engagement as well as for deployment of Linux servers in one z Systems footprint.

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SITUATION OVERVIEW

Linux and Other Open Source Software Have Gone Mainstream

Growth of open source software has been one of the most profound IT changes of the past 20 years. Open source software goes back to the 1980s but didn't become mainstream until the early 2000s when Linux legitimized the concept. Linux allowed organizations to avoid vendor lock-in with multiple distributions and a rich ecosystem of third-party solutions. The OS proved that open source software can be reliable and enterprise capable. Today, Linux is a mainstream OS – 31% of worldwide server revenue is generated with servers that ship with Linux installed. IDC estimates shipments of commercial Linux distributions (in other words, paid for) will grow at a CAGR of 12.7% (2014-2019) to a total of 6 million in 2019.

Furthermore, open source now enjoys broad industry support, and hundreds of projects are under way, with individual contributors, professional developers, and commercial vendors completely changing the software landscape along the way. Open source software products range from databases, cloud infrastructure software, and virtualization software to container packaging and developer tools. Service providers are using open source to provide commercial services, and enterprises worldwide are deploying open source in their organizations. New applications are built on top of open source and, ultimately, this means that hardware platforms need to provide more scale, flexibility, and price/performance.

What's more, these shifts have contributed to the dawn of digital transformation.

Digital Transformation Is Not Optional, Not Even for Enterprise-Class Hardware

IT has moved from the back office to the front office in nearly every aspect of business operations, driven by what IDC calls the 3rd Platform of compute, with mobile, social business, cloud, and big data and analytics as the pillars. In this new environment, business leaders are facing the challenge of lifting their organizations to new levels of competitive capability leveraging digital technologies together with organizational, operational, and business model innovations to develop new growth strategies.

IDC identifies five stages of maturity with regard to the progress businesses have made toward digital transformation (the percentages represent data from IDC's *Digital Transformation MaturityScape Benchmark Survey,* February 2015).

Resisters (14.2%) make up the rear guard, and they provide weak customer experiences and have a defensive posture toward digital. The next category is that of the digital explorers (31.8%) that offer digitally enabled products, services, and experiences, albeit inconsistently and not well integrated. The third group is that of the digital players (32.4%) that provide consistent but not truly innovative products, services, and experiences. The fourth segment comprises the digital transformers (13.6%) that are leaders in their markets, providing innovative products, services, and experiences. And at the front lines are the digital disruptors (9%) that are remaking existing markets and creating new markets to their own advantage. As the data indicates, more than 50% of businesses now fall in the player, transformer, or disruptor categories. The other half of the businesses are at risk of losing their competitive edge.

Digital transformation means that new applications need to be created to support the automation and the data generated by digital operations. Traditional applications were not designed to process live data in a highly digital organization. IDC expects to see the development of a host of new applications that will connect to traditional applications at the data layer. As a result, traditional hardware is converging with the massive open source–driven digital transformation that is now under way.

Enterprise-class systems that run an organization's systems of record (e.g., the database, the transactions, and the analytics) offer unique capabilities to escalate these changes. The innovation opportunities are legion with an enterprise-class scale-up system that is extended to connect to an organization's distributed infrastructure or on which the distributed infrastructure is consolidated as an on-premises cloud service. When open source and next-gen apps that run on Linux are hosted in the same scale-up footprint as the organization's core applications, the former benefits from the processing power, scalability, security, and reliability of the enterprise-class hardware. At the same time, integration between the two application sets opens up new possibilities for not only efficiencies but also insights from combined data.

Most enterprise-class systems today support Linux in one way or another as well as, increasingly, the myriad of enterprise-grade open source applications that are available. Enterprise-class systems are also very suitable for private and hybrid cloud deployments. If IT in businesses around the world has extended the enterprise-class system to the cloud as well as enriched it with open source software, used it to run systems of record and engagement, and enabled it to connect next-gen applications to the core business data, new innovation opportunities with competitive characteristics present themselves continuously.

Next-Generation Applications Drive DevOps-Led Infrastructure Changes

Developers in enterprise IT or developers working for ISVs prefer new techniques for application development, packaging, and life-cycle deployment. The applications the developers create are often referred to as web native, next generation, or modern. Mostly, the applications are written with open source tools and use open source frameworks and runtime environments. Often the applications run as PaaS, making it easier to stand them up and manage them. These applications use reusable code segments, also called microservices, with APIs that connect them to other applications, and they scale horizontally with built-in resilience. Increasingly, developers stand up new applications using DevOps, which means that they are also responsible for the deployments and that modern application code has a short life span, is often updated, and is rarely maintained in the traditional sense.

Thanks to this new wave of modern application development, the majority of IT spending today has become heavily influenced by LOB and developer demands, even as businesses are struggling with adjusting to these new realities. Many organizations do not have the capabilities, for example, to work with various development groups (both inside and outside the organization), manage apps across multiple platforms, and integrate data from different computing environments. On top of that, the organizations are dealing with a variety of skill sets while trying to develop agile DevOps processes. The goal is to deliver maximum application performance and, subsequently, an optimal end-user experience. This means that advanced data analytics are critical to continue generating predictive customer insights. In the end, businesses will find that DevOps needs near-real-time control to manage this intensely dynamic environment.

The changes caused by the growing mandate of DevOps have led to increased operational complexity. Automation and orchestration are becoming critical for managing enterprise computing and modern applications at scale. Modern applications tend to be cloud native, but at the same time, they must integrate with the traditional applications and infrastructure.

Businesses' priorities in this fast-evolving environment are clear. IT seeks to simplify management and reduce cost of operations; transform IT teams into strategic service delivery organizations; deliver critical services to end users and customers faster with higher SLAs; ensure mission-critical availability, business continuity, and security; and create a more flexible and cost-effective service delivery environment. IDC's research shows that in 2015, the top 5 IT initiatives were security (>50% of survey respondents), cloud computing (>50% of survey respondents), IT consolidation and virtualization (>40% of survey respondents), IT automation and process automation (>35% of survey respondents), and data analytics (>30% of survey respondents).

The Benefits of Combining Systems of Record and Engagement

Systems of record are the operational ERP and transaction processing systems that include a database related to fundamental business tasks such as payments. Systems of record also execute the online transaction processing (OLTP) tasks and the batch transaction processing, and they run transactional applications as well as commercial and custom-developed software. They include the data warehouse and perform the business' online analytical processing (OLAP), data mining, and other business intelligence techniques. The data that systems of record process is structured, well formatted, and quantitative (e.g., transaction data or ERP data).

Systems of engagement are customer-focused and front-office applications. They include customer relationship management (CRM) systems, marketing systems, service and support systems (e.g., call centers), and commercial and custom-developed software. They produce the bulk of today's data, most of which is unstructured, qualitative, and language based – images, sensor data, social data, video, and documents. Systems-of-engagement workloads are more likely to run on Linux, and they often run on a distributed infrastructure.

Colocation of these two groups of applications on the systems-of-record hardware can have a range of benefits for an organization. It allows companies to extend their core business systems rather than proliferate data to other servers, which would result in a more complex infrastructure. It enables cloud services; is cost effective; makes management easier; protects more workloads with the same security and reliability, availability, and serviceability (RAS) features; and keeps interacting applications closer together. In addition, colocation makes it possible to perform analytical processing on the same data sets rather than on copies, which is increasingly demanded by businesses that want real-time analytics on transactional data for competitive advantage.

LINUX ON IBM Z SYSTEMS FOR INTEGRATION AND IT EFFICIENCY

IDC believes that organizations that deploy IBM z Systems should, if they don't already, take advantage of the application colocation benefits that the System z Linux processors, named Integrated Facility for Linux (IFL), offer. These IFLs may be present in an organization's mainframe but remain underused or dormant. If organizations do not yet have IFLs, IDC believes they should bring them into their z Systems environment. The section that follows explains why.

z Systems Have Embraced Digital Transformation

As digital transformation is changing the business, mainframes have changed as well. Unit sales of z Systems have consistently increased since 2009, showing a solid mainframe recovery after the 2008–2009 dip, with a very strong 2015 after IBM launched the z13 in January 2015 and the z13s in February 2016. IDC estimates the total number of mainframes currently in operation to be somewhere in the range of 30,000–40,000 units worldwide.

The z13 delivers on hardcore mainframe attributes such as performance, SLAs, scale, reliability, and security, but the platform also fully embraces digital transformation. The z13 has been enabled for cloud computing, DevOps, next-generation app development using open source frameworks and runtime environments, PaaS, and the APIs and microservices that open up its core capabilities as a system of record to mobile apps and hybrid cloud.

Apache Spark is available on the platform, enabling high-speed analytics on large data volumes from a wide and diverse range of sources, as is IBM API Connect (formerly called StrongLoop), application development software that uses Node.js to enable businesses to build mobile and cloud-based apps with APIs that allow the apps to easily interact with each other as they process large data volumes. These capabilities are delivered on top of IBM's most powerful mainframe to date.

The dominant OS on z Systems continues to be z/OS, but at SUSECON in November 2015, IBM said that 35% of all z Systems servers have Linux processors (IFLs) that are identical to general z processors except that they run only Linux and are more affordable. IFLs represent a unique opportunity for businesses to colocate their systems of record and systems of engagement in one mainframe footprint, and many IBM customers have done just that. IBM customers bring Linux workloads to the mainframe or extend existing workloads by integrating them with modern applications that leverage systems of record such as IBM's online transaction processing program Customer Information Control System (CICS).

At the same time, many more organizations have not (yet) used their IFLs, leaving them dormant or barely used, which IDC believes is a missed opportunity in terms of optimizing the IT environment for operational efficiency and cost as well as for digital transformation.

Reasons That IFLs Remain Unused

Among the reasons why organizations are not leveraging IFLs on their z Systems may be unfamiliarity with Linux given that z Systems teams tend be long-time z/OS experts; confusion about whether Linux for z is a different kind of Linux than Linux on other platforms (it is not); misconceptions about the availability of commercial and open source software for Linux that could improve operations and benefit the organizations; unawareness that IFLs can provide cost savings compared with distributed processors; and a general lack of insight as to how a business can benefit from Linux on z. Also, there's a concern that firing up IFLs and doing POCs on them will require freeing up already overextended staff for this purpose.

Another reason why IFLs sometimes remain unused is that mainframe teams have been delivering on a very specific mandate — managing the systems of record — for years, if not decades, and they have become very effective and efficient at it. At the same time, in another part of the datacenter, teams that manage the distributed environment have sprung up. The distributed teams have been focused primarily on the systems of engagement, including next-gen app development, and they are using or experimenting with Linux and open source software. These two teams, the mainframe team and the distributed team, have different skill sets, different backgrounds, and different mandates, and they may not communicate much. As a result, some mainframe teams believe that deploying Linux workloads on IFLs in the mainframe is either not necessary or "politically" not desirable. These are circumstances in which organizational behavior may be impeding deployment of the most beneficial infrastructure.

Examples of How Some IBM Customers Leverage Their IFLs

It is instructive to look at how some organizations have colocated their systems of record with their systems of engagement on the mainframe by deploying the former on z/OS and the latter on IFLs with Linux side by side. The following are brief case studies from companies around the world:

- For many years, Banca Carige in Italy has run its core banking systems, including accounts, payments, and loans, on IBM CICS Transaction Server with the IBM DB2 database running on z Systems with z/OS. The bank recently supplemented this core functionality with branch applications, ATM systems, and internet banking running on IBM WebSphere Application Server Network Deployment and IBM WebSphere Portal. The WebSphere applications run on Red Hat Enterprise Linux on IFL engines within the same mainframe servers. Also, while the front end of Banca Carige's new mobile application currently runs in the cloud, it hooks back into web services running on WebSphere on Linux on z Systems. Transactions and queries initiated on the mobile channel are ultimately processed through CICS and DB2 on the mainframe.
- A European railway operator manages all transactions for ticket sales — from online and mobile to sales points at stations and travel agencies — on z Systems using IBM WebSphere Application Server for z/OS. Once the tickets have been booked and created within the z/OS environment, payment transactions are pushed to WebSphere Application Server on Linux on the same physical z Systems mainframe that handles security checks and brokers the transactions with external payment processor companies.

- The Turkish bank Halkbank runs its core banking systems on CICS on z Systems while centralizing risk analytics and newer Linux-based services on the mainframe. This way, the bank benefits from reduced infrastructure complexity and consolidated processes for systems management and security. By running other important workloads alongside its core banking systems on the mainframe, the bank can ensure that it shares the same quality of service and the same arrangements for administration, security, backup, and disaster recovery. A small team of mainframe specialists can provide support for a wide range of systems, keeping service levels high while minimizing operational costs.
- Sparda-Datenverarbeitung eG in Germany consolidates application servers from distributed environments to Linux on z Systems and uses Geographically Dispersed Parallel Sysplex (GDPS) for continuous availability. The company says that for high-performance applications where short network latency is essential, z Systems is the ideal platform to run both database and application server in the same environment. The company leverages z Systems' HiperSockets integrated in-memory networking technology to effectively eliminate any delays in network connectivity. The bank also selected z Systems with SUSE Linux Enterprise Server as its Oracle Database platform because, the bank says, it combines the reliability and security features of z Systems with the ease of use, stability, and economics of Linux. The usage of GDPS enables the bank to move Linux services from one physical z Systems server to another within seconds, helping minimize failover and recovery time.
- A manufacturing company runs its SAP application servers in virtual Linux environments on the z13, using z/VM virtualization technology, while supporting IBM DB2 for z/OS databases in z/OS partitions. The company says that the combination of SAP and z Systems allows it to operate a very streamlined manufacturing process. The company believes that if it relied on a different mix of systems, it would have many more moving parts to keep track of at a higher cost. With z Systems and SAP, the company has achieved a single platform that, the company states, gives it deep insight into and tight control over the end-to-end manufacturing process.
- The California DMV opted to migrate its website to Linux on z Systems. The migration also involved replacing TIBCO enterprise service bus with IBM Integration Bus and Oracle Portal with IBM WebSphere Portal Server. The Linux virtual servers running the DMV website are guests of z/VM and IBM's mainframe virtualization platform and run on IFLs, enabling tens to hundreds of guest images to run on a single z Systems server. The DMV considers Linux on z Systems to be an extremely stable and cost-effective platform that, the company says, maximizes its development options while benefiting from z Systems' reliability, security, and scalability.

These case studies demonstrate not only how IT infrastructure can be more effective and efficient but also how these businesses made a move forward in their digital transformation and started serving their customers better. The solutions that these businesses have implemented would also make sense for organizations with z Systems that are currently not using their IFLs to colocate applications. Activating an IFL is cost effective, and testing applications on IFLs in a separate LPAR is straightforward. There are many colocation solutions that businesses are designing today, mostly as cloud services, in the form of either a Linux integration with z/OS or a side-by-side deployment of a Linux environment that is independent from z/OS.

Examples of Workloads for Integration or IT Efficiency

Some example of extending or integrating with existing workloads are:

- Connecting existing z Systems applications and queries to mobile and cloud environments with IBM Integration Bus to create a hybrid integration platform (IBM Integration Bus is software that enables the flow of business data between various applications across different hardware and software platforms.)
- Mobilizing existing apps with IBM MobileFirst, an environment for developing apps and enabling secure, personalized interactions for mobile users
- Combining analysis and mining on DB2 for z/OS with IBM Cognos (IBM's business intelligence software that allows business users to extract data, perform analyses, and create reports), IBM SPSS (a family of products for analytics, such as planning, data collection, analysis, reporting, and deployment), or Apache Spark running on Linux
- Leveraging IBM InfoSphere for information integration and delivering trusted information across the enterprise
- Using open source technologies such as Node.js or Java application serving in IBM WebSphere to add branch applications, ATM systems, or internet banking to core software such as CICS

In addition, there are many examples of extending or integrating with existing workloads (too many to list) for deploying new IBM, ISV, or open source workloads on Linux on z Systems. From IBM, examples include IBM Blockchain, IBM Financial Transaction Manager, IBM DB2 with BLU Acceleration for in-memory technology, IBM Spectrum Scale, and IBM GDPS. From ISVs, examples include Finacle, SAP, and Oracle. And the list of open source apps covers an alphabet-spanning range from Apache CouchDB to WordPress. Finally, deploying or consolidating from a distributed environment onto z Systems can be lucrative for Oracle databases and SAP landscapes.

Colocation of Systems of Record and Engagement on z Systems

As mentioned previously, the benefits of colocation of systems of record and engagement in the same footprint are first and foremost performance and efficiency. With z Systems, less memory is required due to the larger caches that are used to optimize data serving environments. Higher I/O bandwidth throughput is achieved thanks to dedicated specialty engines or HiperSockets, which execute the exchange of data entirely inside the system and without the need for a network, allowing for minimal latency.

Centralized management of colocated workloads is achieved with end-to-end workload monitoring, monitoring not only the database on one side and the application server on the other but also the entire business process. With a mission-critical server that connects to the outside world, this can be extremely advantageous because it enables IT to see the complete flow from the database to the application server from a centralized point of view covering the z/OS and Linux portions. And from the perspective of security, nothing beats not needing routers, switches, and firewalls (which are all vulnerabilities in a distributed environment) because everything runs in one system with a virtual internal network.

Datacenter in a Box

IBM z Systems is generally considered to be the strongest system on the market for running multiple different workloads in parallel. Comparing a single application running on a distributed server with a single application running on a z Systems is a fairly pointless exercise; z Systems would be viewed more accurately as a datacenter in a box that operates as an on-premises cloud service. Thanks to this on-premises cloud capability, enterprises can maintain full control over both new cloud services and existing applications while meeting their security and privacy needs, SLAs, and compliance and regulatory requirements. Furthermore, IT can achieve high efficiencies and realize significant cost savings because of the large number of distributed servers that can be consolidated on a single z Systems.

For example, one such cost-saving efficiency is GDPS, IBM's disaster recovery solution that is part of z/OS and that has been expanded to cover long-distance recovery. GDPS can easily be extended to cover every workload, whether on z/OS, z/VM, or Linux, by adding z/VM and the virtual guests to the GDPS environment. This means that IT can install disaster recovery in minutes, if not seconds, versus having to think about a solution to bring back hundreds of physical, networked servers.

The GDPS' example also shows that the ability of z Systems to serve as an umbrella for all workloads delivers not only cost savings to the deployed workloads but also the performance, reliability, availability, serviceability, security, and scalability that z Systems are known for. Scalability, for example, is nondisruptive. IT can grow up to 8,000 virtual servers without lifting a finger (or perhaps lifting one finger). Compared with a distributed environment, where horizontal scalability means adding boxes as well as networking and provisioning them, z Systems offer indisputable advantages. Also, from an IT management point of view, managing the environment requires less equipment and therefore less operational effort.

Scalability on z Systems is essentially multidimensional. IT can dynamically add resources such as cores, memory, I/O adapters, devices, and network cards, which can be either shared or dedicated. Scaling can be done horizontally (added to Linux guests) or vertically (added to existing Linux systems) without disrupting the operational environment. For example, when peaks are expected because of a special offer to customers or an anticipated seasonal spike, resources are easy to provision, and they are automatically reallocated after the peak. Workload management has been designed to facilitate maximum utilization of the system resources.

Capacity provisioning for mixed workloads with different priorities is very effective on z Systems. The peaks of high-priority workloads get nearly 100% of the available capacity, while the low-priority workloads fill the valleys between the peaks of high-priority workloads. On distributed systems, low-priority workloads ride on top of the high-priority workloads, suppressing the capacity that is available for the high-priority workloads, thereby slowing the workload down unless IT adds more processor cores, which means greater software licensing costs and added IT management responsibilities.

Finally, IBM's Capacity on Demand allows organizations to purchase the desired number of active cores plus optionally purchase "on demand" inactive cores that can be activated as needed without operational disruption. Organizations can activate these on-demand cores either manually or automatically, either permanently or temporarily on a per-day, per-core basis. Once activated the added cores have the ability to manage themselves.

CHALLENGES/OPPORTUNITIES

For Businesses

- **Challenges:** For organizations with enterprise-class server hardware that has reliably run their most critical workloads, the systems of record, it has been convenient to insulate these environments from the new wave of next-gen applications and open source solutions that are kept either on distributed environments or in a cloud. This is no longer a feasible strategy as colocation of systems of record and engagement can offer distinct advantages in terms of efficiencies and innovation opportunities depending on the hardware's capabilities.
- **Opportunities:** Businesses should start experimenting with bringing both workloads (systems of record and systems of engagement) inside the same enterprise-class server footprint and then increasingly integrate them. POCs will be required, skill sets will have to be evaluated, and resources will have to be allocated. What's more, the teams that run the enterprise-class platform and the teams that run the distributed environment will need to communicate about which applications would benefit from being migrated to the enterprise-class system because this will either yield efficiencies or present new competitive opportunities. Despite the logistical and cultural hurdles, tangible benefits can be achieved.

For IBM

- **Challenges:** IBM's z Systems is arguably the most potent system for use as a cloud infrastructure platform and for colocating workloads. Its ability to run systems of record on z/OS and systems of engagement on IFLs with Linux in parallel, either side by side or in a more integrated fashion for new capabilities, is unmatched. However, IBM's customers are still discovering the colocation opportunities that the platform offers, and the cultural barriers discussed previously for organizations are an impediment that affects IBM as a vendor too. It is very important for IBM to help business overcome the old concept of different teams for different types of workloads. In the modern enterprise, IT needs to function as a single team, delivering on SLAs as effectively and efficiently as possible. IBM can play a role here by helping these teams come together.
- **Opportunities:** The advantages of a datacenter in a box for IT efficiency and integration for customers on a digital transformation journey, combined with the performance, RAS, scalability, and security that the mainframe offers, can be distinct. It is interesting to witness how businesses are increasingly interested in dense compute and software-defined networking on this journey but do not look at z Systems as perhaps the most dense compute environment available on the market. IBM has an intriguing opportunity to drive this home, starting with demonstrating z Systems' IT efficiency and integration capabilities for competitive innovation.

CONCLUSION

IDC believes that an enterprise-class system that is extended to connect to an organization's distributed infrastructure or on which the distributed infrastructure is consolidated offers a powerful platform for innovation, operational efficiency, and cost reductions. For businesses that operate z Systems, a unique opportunity exists to realize these advantages in the form of IFLs. Activating an IFL is cost effective, and testing applications on IFLs in a separate LPAR is straightforward. There are many colocation solutions that businesses are designing today, often as cloud services, in the form of either a Linux integration with z/OS or a side-by-side deployment of a Linux environment that is

independent from z/OS. This approach allows IT infrastructure to be more effective and efficient and provides opportunities for businesses to move forward with digital transformation and start serving their customers better. IDC believes that organizations with z Systems that are currently not using their IFLs to colocate applications will benefit from activating them, experimenting with them, and then including them in the operational environment.

About IDC

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