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- **Energizing the Mainframe Mainstream – The Complementary Benefits of IBM's Software and Linux on System z**

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Energizing the Mainframe Mainstream – The Complementary Benefits of IBM's Software and Linux on System z

Introduction
Since the creation of the Linux kernel by Linus Torvalds in 1991, Linux has matured from a simplistic, UNIX-like operating environment to an enterprise-class technology supporting millions of individuals and businesses. While the evolution of Linux was not particularly smooth it has been steady. Initial benefits including low acquisition costs and significantly reduced software licensing fees were succeeded by next stage benefits such as leveraging Linux for server and workload consolidation efforts, simplifying datacenter management tasks and improving IT staff efficiency.

All of these signaled the growing maturity of Linux technologies and the vendor, developer and user communities and today, those benefits have become common wisdom for many or even most Linux customers. Why? Because rather than the simplistic alternative operating system (OS) it was then, Linux distributions from vendors including Red Hat and Novell/SuSE are now very much a part of the IT mainstream for owners of virtually every major hardware platform and enterprise application. Moreover, Linux continues to influence or impact a range of new and emerging business technologies.

There are, however, some Linux solutions that stand well above the crowd, including those developed by IBM for its System z mainframe platform. In a way, this is an entirely predictable situation. IBM was the first major vendor to publicly support the fledgling OS, and the Integrated Facility for Linux (IFL) on System z represented the company's and the IT industry's first truly enterprise-class Linux solution. Today, Linux on System z offers mainframe owners a fully managed and manageable environment for critical business computing. More importantly, IBM mainframe customers are reaping additional benefits from the notable synergies between Linux and the company's Information Management, Lotus, Rational Tivoli and WebSphere software solutions.

IBM's System z – the Once and Future Enterprise Platform
"Legacy" can be an odd term in the IT industry, denoting both the value and sophistication of proven technologies and the burdens which can ensue when they lose their shine or drift out of date. But like people, the age of a technology does not automatically define its quality or relevance. That is certainly the case for IBM's System z solutions. For 45 years, an almost incomprehensible time in an industry that tends to equate newness with goodness, IBM mainframe systems have stood out from the crowd in both technical innovation and excellence.

During that time, mainframe solutions have steadily defined the qualities of enterprise computing and notions of IT best practices for IBM customers. But System z also has a subtle if significant effect on competing vendors who proudly define their own enterprise solutions as "mainframe-like." How did IBM manage this? By recognizing that new opportunities tend to result from continuous evolution – System z has been anything but a static platform. In fact, IBM has constantly reinvented the concept and processes of mainframe computing while ratcheting-up overall system performance. Some of these benefits are directly due to developments in processing engines and other hardware components.

Among the solutions from which mainframe clients have benefitted particularly are IBM's System z specialty co-processors which the company designed to enhance specific applications and workloads. These include the Integrated Facility for Linux (IFL), the zAAP (z Application Assist Processor – for new generation JAVA and XML workloads) and the zIIP (z Integrated Information Processor – for data serving applications including ERP and CRM, and data warehousing and business intelligence processes). The first of these, the IFL, was formally introduced in 2000 and is dedicated to Linux workloads. The IFL is supported by IBM's robust z/VM virtualization technologies, Novell SuSE and Red Hat Linux distributions, and a wide range of Linux applications.

It is hardly an overstatement to say that Linux altered the course of System z. IBM's decision to deploy the fledgling OS on its flagship mainframe systems was a bold stroke by any measure but the embrace of Linux on System z also indicated a subtler strategic shift. Prior to this, the company was a recognized leader in enterprise computing systems whose "Big Iron" sobriquet described their size and heft. After IBM introduced the IFL, the value and performance of IBM's mainframe and other systems began to be defined as much by innovative software assets, including Linux, as they did on hardware development.

This shift was also strengthened by the evolution of the company's software portfolio, sparked by a steady build-out of solutions surrounding IBM's core Information Management (DB2 database, business intelligence and performance and enterprise content management) Lotus (access and collaboration), Tivoli (infrastructure and service management) and WebSphere (application and business process management) software assets, all of which have particular affinities for the System z platform. This was accomplished through both internal development efforts and through a proactive acquisition strategy which saw the company purchase key vendors including Informix, Rational, FileNet, Princeton Softec, Cognos, Exeros and SPSS.

IBM also continued enhancing key mainframe software technologies including z/VM and System z's robust data security and encryption capabilities. As a result, System z continues to represent the pinnacle of virtualization performance and has long enjoyed the coveted EAL5 security certification – the highest rating bestowed by the U.S. government. In fact, in 2003 IBM's System z900 became the first server to be awarded EAL5 certification. During the time it was instituting these technical advances, the company also significantly reduced mainframe hardware and software costs, particularly related to Linux workloads, helping System z to remain the platform of choice for business-critical enterprise computing

Penguin's Progress – IBM and Linux Today

Pragmatism and performance have driven Linux adoption. Businesses initially flocked to the OS due to low acquisition and software costs, and its flexible deployment capabilities. As Linux and the open source development community matured, growing numbers of enterprise ISVs recognized the platform's benefits and significantly expanded Linux support for a widening range of applications. Organizations can leverage Linux for a variety of leading edge IT solutions, including virtualization and high-performance computing. But perhaps most importantly, along with its enterprise chops and Swiss Army Knife-style flexibility Linux continues to deliver the enhanced ROI and reduced TCO that originally attracted businesses to the platform.

IBM clearly understood these fundamental benefits and leveraged them for its own use. Though Linux was first supported on System z, it soon found a home on IBM's Power (RISC) and System x (Intel and AMD x86) server platforms, along with the company's core software portfolio. Why was the company so proactive in driving Linux across these assets? Because IBM saw that Linux could serve as a lingua franca which ensured a commonality of experience and use across all its heterogeneous computing platforms. In turn, that portability of applications informs IBM's "fit for purpose" strategy which enables customers to easily leverage the computing platforms best suited for specific workloads or business processes. Finally, Linux's popularity among young developers and IT professionals has for years helped to provide the Linux community a steady stream of energetic new members, partners and potential employees.

During the decade of IBM commercial Linux on System z solutions, a steady stream of developments helped prove that increasing innovation can yield a bigger payback. IBM fully supports Red Hat and Novell/SuSE Linux distributions on System z, and other Linux on mainframe distributions are available from Debian, Gentoo, Slackware, and CentOS. But strategically, IBM's support of Linux maximizes customers' freedom of choice in matching applications and workloads with the most appropriate OS. The fact that IBM software offerings virtually all support Linux, as do the vast majority of major and minor enterprise applications, emphasizes the value of this point.

IBM also leverages Linux to enhance highly-prized mainframe capabilities and features. For example, while server virtualization has become hugely popular as a means for consolidating poorly-utilized scale-out environments, industry standard x86 systems are not able to deliver mainframe RAS performance. IBM's z/VM technology continues to represent the leading edge in enterprise-class virtualization, and Linux provides the means to consolidate hundreds or even thousands of x86 or UNIX workloads in a single System z enclosure.

Linux on System z also provides a foundation for new IBM products and initiatives, such as the recently announced Enterprise Linux Server (a dedicated System z server for large Linux workloads) and the Solution Edition for Enterprise Linux (which adds capacity on installed System z servers for large Linux workloads). Most impressive, while these solutions' total cost of acquisition is competitive with x86 and UNIX alternatives, their TCO and quality of service (QoS) simply blow away the competition. This is particularly the case in facilities, staffing and management expenses)

Bottom line: Linux on the IBM mainframe is a mature, mainstream, fully realized and manageable business platform with a TCO that makes it competitive with even aggressively priced scale-out x86 and UNIX products. Moreover, IBM's continuing investments in System z make it appropriate for traditional and new business processes and applications of every sort. Linux is certainly worthy of current System z owners who wish to better leverage their mainframe investments with proven open source benefits but the new Solution Edition for Enterprise Linux also allows non-mainframe clients to take advantage of the integral value and TCO of Linux on System z. At the same time, the inherent capabilities of IBM's System z make it a valuable option for companies that wish to enhance the performance and value of their Linux investments.

IBM's Mainframe/Linux/Software Connection

Linux's path to enterprise-class status did not follow a straight line, even with IBM. Testing and certifying the OS on System z took months of development before commercial release, and early iterations of mainframe Linux did not inspire broad ISV enthusiasm. However, IBM's decision to support Linux did not end with its public declaration. Instead, the company enables the use of Linux, supports distributions including Red Hat and Novell SuSE on its products and IBM significantly enhances the effectiveness of Linux via contributions to the open development community. Linux is also optimized across numerous IBM Information Management, Lotus, Rational, Tivoli and WebSphere software solutions. Since those technologies have themselves evolved considerably during the past decade, it is wise to consider the current state of IBM software solutions for Linux:

Information Management

The head of this IBM software family is the company's DB2 database solution, a key foundational technology for virtually every transaction-focused application on System z and other company server platforms. But some $12 billion in development and acquisition investments over the past five years have broadened these solutions to include information integration and master data management (InfoSphere), enterprise content management (ECM – FileNet) and business intelligence and performance management (Cognos). IBM's System z systems play key roles in processes and applications which leverage enterprise information repositories, and the company offers versions of or support for Linux across its Information Management portfolio. In addition, the company recently announced the formation of a new Information Management business unit focusing exclusively on business analytics, an area of particular interest for its enterprise/mainframe customer base.

Lotus

IBM's Lotus software portfolio has supported Linux for over five years on solutions including Lotus Domino (email, calendar, and employee collaboration), Lotus Notes (integrated desktop clients/applications), Lotus Sametime (realtime communications), WebSphere Portal, and Lotus Symphony (productivity tools). While all these solutions can all run individually on Linux on System z, their true value is in consolidating enterprise mail and collaboration processes, as well as Portal and Social (networking) software infrastructures. This provides a range of benefits, including reduced software costs and overall TCO through maximizing System z capacity and efficiency. That has certainly been the case for numerous IBM customers but is also true for the company itself. As part of its 2007 "Project Big Green" initiative, IBM consolidated parts of its cross-company Lotus Notes infrastructure (called Global Notes Architecture or GNA), to Linux on System z, leveraging the platform to provide/support business applications for its nearly 400,000 employees.

Rational

IBM Rational provides governance of the software delivery process, for software assets including those deployed on or consolidated to Linux on System z. The Rational portfolio spans the complete set of software delivery disciplines across Application Lifecycle Management (ALM), including architecture management, change and release management, enterprise architecture management, requirements management, quality management and security governance, and portfolio management solutions – and supports development and maintenance of applications deployed to Linux on System z. Rational Developer for System z (RDz) offers a modern integrated development environment for System z application developers and common tooling for developing and maintaining applications for both tradi-

tional z/OS and Linux on System z applications. Rational also supports Linux on System z via its Jazz strategy and the Rational Team Concert product by providing a consolidation platform for an Enterprise's ALM infrastructure. These solutions offer multi-platform and cross-site collaboration support for software development, and should be considered when consolidating x86 server environments.

Tivoli

In essence, IBM's Tivoli solutions are all about ensuring the health, performance and security of clients' IT infrastructures. They accomplish this through a variety of automated processes, including application management, business service management, availability, orchestration and provisioning, security and storage and optimization. All of these support Red Hat and SuSE Linux distributions on System z, but IBM also offers Tivoli OMEGAMON for zVM and Linux on z, which can be used to monitor Linux system characteristics, such as CPU workload and resource activity, identify issues that might cause outages or affect system performance and generate alerts and reports. Effective automation and workload management solutions like Tivoli's are critical in mainframe environments due to their sheer size and breadth. This is especially true in sectors including banking and finance, insurance, healthcare and public sector organizations which depend heavily on IBM System z and Linux.

WebSphere

IBM's WebSphere is designed to help clients save money by increasing the efficiency of applications, development and business processes across numerous hardware platforms and their operating systems. WebSphere solutions span numerous business integration and application infrastructure issues and processes, including application integration, infrastructure and connectivity, business process management, commerce, mobile computing and speech and portals. WebSphere's support for Linux distributions reflects IBM's broader "fit for purpose" strategy which provides clients the specific capabilities they need to solve critical business requirements. WebSphere solutions for Linux on System z leverage many classic mainframe strengths, making them appropriate for everything from consolidating datacenter assets to enabling service oriented architecture (SOA) strategies. As a result, Linux is a key component of WebSphere's Right Fit evaluation service, which aims to ensure that IBM clients deploy the most appropriate platforms for their computing needs.

IBM Software and Linux on System z – Complementary Synergies and Use Cases

The combination of IBM software and Linux on System z supports powerful solutions for numerous traditional, transaction-focused business applications and processes. But the highly synergistic combination is also an intriguing choice for new and emerging use cases, such as:

- **IT consolidation** – While virtualization has become hugely popularity over the past 5 years, particularly in x86 server environments, a large majority of these deployments have been performed to consolidate x86 servers and workloads. This is not especially surprising, given the low (5%-15%) utilization these systems typically offer. Along with streamlining IT infrastructures, consolidation allows companies to enjoy significant reductions in datacenter power costs and improved IT management efficiency. But despite the increasingly robust performance of Intel Xeon and AMD Opteron technologies, are

new x86 servers the best architectural choice for consolidating older x86 servers?

IBM's System z organization would argue that Linux and the company's IFL and z/VM technologies offer a powerful, valuable alternative for consolidating x86 Windows and Linux, and UNIX applications and workloads onto mainframe systems. The various consolidation capabilities of these solutions are robust enough for virtually any enterprise. IBM leveraged Linux on System z for its own datacenter consolidation effort, in which over 3900 x86 and UNIX servers were consolidated onto ten z10 mainframe systems. Additionally, a recent company project designed to test maximum mainframe virtual machine capacity found that a fully configured System z10 was capable of supporting 97,943 VMs. Finally, developers are leveraging IBM's Open Virtual Client technology on System z for virtual desktop infrastructure (VDI) solutions, including Virtual Bridges, which claims that its Verde 2.0 can scale to one million users.

- **Enterprise Content Management** – Enterprise content management (ECM) resides at the intersection of two critical issues: 1) the continuing, massive growth of structured data residing in traditional databases and unstructured information including email, reports and other documents, and 2) enabling organizations to maximize the benefits of their information assets, wherever they reside. IBM's ECM solutions are derived from its established ECM business combined with the 2006 acquisition of FileNet, a longtime leader in both content and business process management. Prior to the deal, FileNet supported Linux but not System z. In 2007, IBM moved most FileNet technologies to mainframe platform, in addition to Content Manager and Content Manager on Demand which have been mainframe options for many years. The exception was FileNet's complex business process features. When they finally transition to System z (planned for 2010), they will leverage the mainframe's formidable transaction processing capabilities end-to-end.

  IBM's ECM solutions for System z can blend established mainframe reliability and performance benefits with scalability across 100s of terabytes of structured and unstructured data. These are critical points for System z customers in banking, finance, insurance and other sectors whose services depend on efficiently managing high volumes of data. But since IBM's ECM solutions can be deployed on existing mainframe systems without buying additional hardware, the company is working to spread the ECM gospel beyond its traditional congregation. The cross-platform capabilities of IBM's ECM solutions are broader than most competing products. Plus, their ability to drive economies of scale and utilize existing IT staff skills make them particularly attractive to existing System z customers, including those leveraging Linux.

- **Cloud Computing** – The myriad benefits of IBM's software and Linux on System z come into clear focus in cloud computing environments. It could be argued that the mainframe was made for the cloud – and vice versa – since cloud computing solutions of every sort aim to leverage technologies including virtualization, automation, and self-managing/healing which have been available for decades on the mainframe. Cloud computing is in an evolutionary state which will continue as users such as corporations, service providers and consumers figure out the intricacies of the cloud. But at the same time, public and private sector IBM clients are already leveraging System z and Linux to consolidate, support, manage and deliver cloud-based services and other offerings

Additionally, IBM's new Solution Edition for Cloud Computing is an aggressively priced package that aims to help clients utilize existing IBM System, software and Linux investments for cloud service delivery. In essence, the Solution Edition is designed for companies that want the benefits of cloud computing but wish to avoid risks associated with public clouds. It does this by creating private cloud service automation and management capabilities on mainframe hardware and software infrastructures, enabling owners to leverage mainframe virtualization and other capabilities to gain the cost and operational efficiencies of the cloud

Summary Analysis

The myriad benefits of Linux have become common wisdom for businesses but some Linux solutions stand well above the crowd, including those developed by IBM for its System z mainframe platform.
IBM was the first major vendor to publicly support the fledgling OS, and the company's Integrated Facility for Linux (IFL) on System z was the first truly enterprise-class Linux solution. Along with well-established cost and management benefits, modern Linux-on-System z solutions offer organizations notable flexibility and freedom of choice, full support for Red Hat and Novell/SuSE distributions, leading edge virtualization and unmatched server and workload consolidation capabilities. IBM also recently announced new Enterprise Linux Server and Linux Solution Edition which are designed to significantly enhance TCO and QoS on large Linux workloads.

If Linux represents one aspect of IBM's continuing evolution of the mainframe, the notable synergies between Linux on System z and the company's Information Management, Lotus, Rational Tivoli and WebSphere software solutions qualify as another. This has resulted in notable benefits for both IBM clients and the company's partner community, and led to the development of successful solutions for established and emerging business challenges, including IT consolidation, Enterprise Content Management and cloud computing. Overall, the combination of IBM's software, Linux and System z technologies provides mature, tried and true, mainstream IT solutions for business processes and applications of every sort. We believe that new and existing users of mainframe platforms, and companies already using or contemplating the use of Linux would do well to consider the myriad benefits offered by IBM's software and Linux on System z solutions.