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White Paper

Oracle's Maximum Availability Architecture on the IBM System z

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Executive Summary

The IBM DB2 data server platform running on IBM System z is well established as a powerful and highly reliable workhorse with a long established track record in many enterprise organizations. However, innovations in technology — particularly in the areas of open standards, server virtualization, and high-availability grid computing — have changed the landscape of enterprise computing. New software options have emerged that can harness the full power and dependability of the System z server platform.

Driven by factors such as advances in web technology, middleware, and object-oriented programming, current IT trends have moved sharply in favor of virtualization and merging of distributed resources in more loosely coupled, standards-based Service Oriented Architectures, where sharing and re-use of those resources can be easily achieved. These trends go well beyond saving money through consolidation and streamlined management. A major benefit is that organizations are able to more closely align business purposes, strategies, and plans with the technology underpinning them, *and to rapidly re-align that technology when business requirements change.*

Conventional mainframe technology — exemplified by proprietary centralized environments that tightly couple IBM z series hardware exclusively with IBM z/OS, the DB2 data server platform, and Sysplex — was never designed to participate in open-standards multi-platform environments. Yet, these systems ordinarily represent tremendous investments in terms of development and training, and have proven and well-established utility in their specified functions. Indeed, they often host an organization's core business activities. It is easy to understand how even businesses using modern distributed platforms and open technology to build all their new applications are highly resistant to the idea of replacing their mainframe platforms.

Thus, the central challenge for most mainframe-based enterprises is how best to leverage their often considerable investment in the System z platform for deploying highly available, loosely coupled SOA-based strategic architectures.

One of the most notable developments in the System z market is its evolution into a platform for running Linux virtual servers – a market that has seen growth in the triple digits. As the market leader in applications for Linux, Oracle has evolved architectural approaches that align the inherent strengths of the System z hardware platform with the bullet-proof, ultra-high availability of Oracle's software platform incorporating the Oracle's Maximum Availability Architecture (MAA). These approaches involve integrating virtual Linux servers running on z LPARs and z/VM into an on-demand grid

computing environment tailored to meet an organization's specific goals of modernization, greater agility, and lower operating costs — all while preserving and leveraging that organization's investment in legacy systems and protecting the organization's ongoing operations from the risks involved in evolution and growth.

Thus Oracle offers businesses an approach to innovation that not only matches but exceeds the mandatory business values of availability, performance, security, manageability, and scalability that have long been assumed to be dependent on proprietary software technology, and have limited them in their ability to reach for new business and react quickly to the pressures of competition.

Introduction

Many of the most demanding and risk-adverse enterprise organizations have chosen IBM z/OS and IBM DB2 data server platform running on IBM System z servers. Even as innovations in clustering and virtualization within the distributed and open systems arena offer the bright promise of lower costs and modern standards, yielding superior business flexibility and agility, such organizations have kept many of their core business applications on the IBM proprietary platform.

However, for some time now Oracle has been integrating System z into Oracle's Grid architecture resulting in solutions that more than match all the rock-solid attributes of DB2 on System z while providing the advantages of modern, standards-based open system architecture. This paper describes how, by leveraging advances in both IBM's System z and in Oracle's highly available grid computing software, Oracle builds systems that deliver application availability across the entire application life cycle — design, build, run, maintain, upgrade, patch extend, and change. Moreover, it accomplishes this while reducing operational costs and overcoming many of the limitations and challenges facing traditional mainframe shops as they struggle to remain competitive and strive to create new opportunities for increased revenues.

What This Paper Contains

This paper contains the following sections:

- **The Traditional Mainframe Environment** — Discusses the firm place that mainframes have established in the enterprise and the business value they impart to an organization, as well as the challenges facing mainframe shops today.
- **The New Positioning of System z for the Linux Server Market** — Discusses advances made by IBM in making System z more accommodating to modern computing models and open systems.
- **Enterprise-Grade Linux** — Describes how running System z on an Oracle grid incorporating virtual Linux servers can meet and exceed the business value traditionally obtained using DB2 on the **System z** operating system.
- **The Trick is in the Approach** — Explains how the Oracle team of MAA experts implements modernization methodologies developed by Oracle, IBM, and their partners to address the need for preserving and leveraging the business value in legacy systems.
- **Conclusion** — Draws concisely presented conclusions from the propositions contained in the body of the paper.

Bringing Together the Best of Two Worlds

Through a long association with IBM as a strategic business partner, Oracle has evolved architectural approaches that align the inherent strengths of the System z hardware platform — including a massive degree of redundancy and fault tolerance and a 35-year Mean Time Between Failure (MTBF) rate — with the bullet-proof, ultra-high availability of Oracle's software platform incorporating the Oracle's Maximum Availability Architecture (MAA). Generally speaking, these approaches involve applying MAA to virtual Linux servers on System z in an on-demand Oracle Grid computing environment. This environment is tailored to meet an organization's specific goals of modernization, greater agility, and lower operating costs. At the same time, it is designed to leverage that organization's investment in legacy systems and protect the organization's ongoing operations from the risks involved in evolution and growth.

In short, the many years that Oracle has devoted to developing the expertise, knowledge, and technology embodied in its Maximum Availability Architecture today gives System z-based enterprises exciting new options. Oracle MAA offers them an approach to innovation that not only matches but exceeds the mandatory business values of simplified infrastructure, availability, performance, flexibility, security, manageability, and scalability that have long kept enterprises dependent on yesterday's technology, and have limited them in their ability to reach for new business and react quickly to the pressures of competition.

The Traditional Mainframe Environment

Because of their longevity and several highly valued attributes, IBM mainframes have become firmly ensconced in the enterprise today. More commercial transactions are processed on mainframes than on any other platform, and more than 450 of Fortune 500 companies rely on them. In fact, more transactions are currently processed by IBM CICS and IMS systems than by the Internet in its entirety. [1]

The IBM System z range has evolved as IBM's mainframe offering over a 40-year span of time. With unsurpassable horsepower for processing high-volume transactions, today these systems can support up to 64 processors and 1.5 TB of memory and yet are so extraordinarily scalable that they can be cost-effectively deployed to support small enterprise requirements where only one processor may be required.

Within traditionally proprietary centralized environments that tightly couple IBM z Series hardware exclusively with IBM z/OS, the DB2 data server platform, and Sysplex architecture, today's System z mainframes are running many applications that have been delivering mission-critical business value to their host organizations over the course of decades, and delivering it well.

Aside from the top-notch performance and amazing scalability already mentioned, other factors keeping System z mainframes at the heart of the enterprise include:

- **High Availability** — The 35-year MTBF rate attributable to the superb quality of the IBM mainframe hardware has been cited above. In addition, the high availability demanded by the enterprise is provided by features such as the Sysplex and Parallel Sysplex architectures, along with Coupling Facility and Server Time Protocol technology, that together allow for the configuration of systems having an enormous degree of redundancy and fault-tolerance.
- **Security** — The security system that System z uses to provide access control and auditing functionality, the Resource Access Control Facility (RACF), is one of the most scalable and mature security monitors known in IT. Able to support extremely granular policy-based permissions, RACF works closely with the underlying System z hardware — for example, protecting digital certificates within tamper-proof cryptographic processors.
- **Manageability** — IBM System z servers have evolved to provide an extremely rich set of features that include world-class workload management technology, dynamic

[1] "*Modernizing the Mainframe for SOA*," Dan Finerty, *The SOA Magazine*, April 2007 http://www.soamag.com/I6/0407-1.asp

logical partitioning, and an array of self-managing, self-optimizing, and self-healing tools in both the hardware and the z/OS software.

Challenges Facing the Mainframe Platform in the Modern IT Environment

For all the solid reliability and high availability they deliver, proprietary mainframe environments as they exist today in the typical enterprise present certain serious challenges — particularly when it comes to legacy application platforms.

Driven by factors such as advances in web technology, middleware, and object-oriented programming, current IT trends have moved sharply in favor of virtualization and merging of distributed resources in more loosely coupled, standards-based Service Oriented Architectures (SOAs) , where sharing and re-use of those resources can be easily achieved. These trends go well beyond saving money through commodity hardware, consolidation, and streamlined management. A major benefit is that organizations are able to more closely align business purposes, strategies, and plans with the technology underpinning them, *and to rapidly re-align that technology when business requirements change.*

Legacy technology is typically poorly suited to such agile and flexible approaches. The traditional mainframe computing model tends to take a one-size-fits-all platform and process approach designed to exploit economy of scale in order to increase asset productivity and lower unit costs. However, this approach too often has the effect of constraining rather than enabling business innovation.

Often initially developed decades before distributed platforms, web technology, and open technology standards came into existence, such applications commonly exist in technology "silos" designed to address specific business purposes. While often modified over the years to address additional and/or changing business and technology requirements, such development has resulted in complex, tightly coupled environments that greatly impede change.

Organizations with sizeable investments in legacy mainframe technology are finding themselves facing the following circumstances:

- Current and planned strategic business objectives are increasingly misaligned with systems initially designed to address past conditions.
- Dedicated software and/or hardware technology platforms with restrictive uses are becoming unacceptably expensive to maintain in open, standards-based IT infrastructure.

- Adding critical new business functionality in a timely manner is difficult and risks "breaking" existing processes and interrupting operations.
- Developers with expertise in legacy technology and programming languages are becoming less available and are charging more.
- Even routine software maintenance such as patches and upgrades is extremely onerous and time-consuming.
- Monthly License Charges (MLCs) are expensive — at times excessively so.
- Performance of key operational applications is either falling short of burgeoning demand or inadequate to handle the demand expected in the future.

It is easy to see how organizations seeking to modernize are loathe to replace their legacy systems — even organizations that are using modern distributed platforms and open technology in building all their new applications. The process of replacing the mainframe platform and moving its functionality to a different platform entails considerable time and expense. And that is if it is an unqualified success. The probability of disruption and intermittent, partial, or even system-wide failure is also high. Considering the mission-critical nature of many mainframe-based applications, that can have seriously adverse impact on productivity and revenue, as well.

Thus, the central challenge for most established mainframe-based enterprises is to *preserve the business logic that has been embedded in the mainframe environment while modernizing the technology.*

Outmoded Thinking Impedes the Solution

Mainframe technicians and architects are accustomed to viewing distributed platforms and open technology standards as inadequate for delivering the caliber of business value delivered by DB2 on the System z/OS. However, this perception is based on outdated maxims that are no longer valid. A mainstream shift to virtualization and clustering technology has transformed the System z environment and has opened the door to attractive new options that any enterprise organization ought to consider.

The New Positioning of System z for the Linux Server Market

The perceived drawbacks of the mainframe platform have hardly gone unnoticed by IBM. The vendor is now about two years into a five-year development effort and $1 billion technology and marketing investment specifically aimed at simplifying and modernizing its System z offering. The combined attributes of System z10's hardware design and advanced virtualization stack, along with the low-cost specialty engines embodied by the Integrated Facility for Linux (IFL), constitute the energy-efficient platform on which IBM will run the widest array of application workloads.

A key factor behind the rethinking of the enterprise data center architecture is the advances that IBM has made in accommodating open systems. Linux on System z offers a new paradigm where the operating system and the supporting hardware are no longer a single proprietary platform. Linux running on System z is the same as Linux running on any other platform. Business organizations are increasingly choosing to harness the advantages of the System z hardware at lower costs while benefiting from the use of contemporary IT skill sets and architectures.

Linux a Growth Strategy for System z

Running Linux on the System z platform is rapidly emerging as a successful growth strategy for the IBM offering. While industry use of applications running on the z/OS has been in gradual decline, use of Linux applications running on the System z platform has seen growth in the triple digits. IBM recently announced that more than 390 IBM business partners were offering nearly 1,000 applications for System z customers running Linux, a 100 percent increase over the previous year. The number of organizations running Linux on System z has grown 40 percent YTY; it is unusual to find a System z customer today who has not adopted or is not planning to incorporate this approach. IBM also aggressively positions Linux on System z as a cornerstone of its heavily promoted "Green Datacenter" strategies, designed to reduce the physical IT footprint and energy consumption as well as reduce operating costs through consolidation of resources.

What Value Does System z Bring to Linux Environments on System z?

The use of System z's virtualization technologies such as Logical Partitions and System z/VM is being leveraged to efficiently deploy Linux servers. This platform allows organizations to easily create many virtual Linux machines as "guests," consisting of virtualized processor, storage, networking, and I/O resources. It helps those

organizations extend the business value of System z technology by providing exceptional levels of availability, security, and operational ease. z/VM virtualization technology is designed to allow clients to run hundreds to thousands of Linux servers on a single System z unit, reducing server machine sprawl and greatly increasing the efficiency of data center management.

Linux on System z in a Strategic Grid Infrastructure

Because large enterprises commonly have thousands of standalone distributed Linux boxes running all kinds of applications, this strategy of consolidating on a high-performance, highly available System z platform makes good sense. However, as the leader in the Linux application market, Oracle sees the true value of Linux on z LPARs and z/VM in terms of sweeping and sophisticated IT strategies that provide breakthrough solutions for risk-adverse enterprise organizations which are struggling with the limitations of their traditional mainframe platforms and legacy applications.

Oracle has developed well-established strategies for incorporating discrete distributed Linux systems into an overarching grid proven to provide superior performance, availability, scalability, and management. Bringing System z running Linux virtual machines onto the Oracle grid as additional Linux servers combines the benefits traditionally conferred by the proprietary mainframe platform with the full benefits of modern open systems architecture.

Whether or not System z is part of the environment, Oracle's approach is to virtualize the data center in a four-step process:

1. *Standardize* the IT environment to enable simplification and agility.
2. *Virtualize* everything in the IT environment to enable high availability and scalability.
3. *Consolidate* fragmented data systems (e.g., Sybase, SQL Server, Teradata, and/or homegrown applications) for greater operational efficiency.
4. *Automate* systems management including recovery.

Seen in this light, consolidation becomes far more than just a means to conserve resources and make better use of underutilized systems. It is instead a means of moving from a fragmented, proprietary IT environment to a SOA-based environment using standardized off-the-shelf applications, all managed from a single point of administration above the entire grid infrastructure that may include System z, Linux, or any other server platform.

For an organization facing the challenges of maintaining legacy systems, these strategies can confer considerable benefits that include:

- Better alignment of underlying enabling technologies with current and planned strategic business objectives.
- Reduced need to maintain dedicated software/hardware platforms with restricted and narrowly-focused purposes.
- Greatly improved efficiency in routine software maintenance as well as in expanding capacity and developing new business functionality, along with reduced risk of disrupting ongoing operations.
- Abundantly available and competitively-priced Linux and Oracle skill sets, reducing reliance on expensive and increasingly unavailable legacy expertise.
- Reduced TCO over proprietary systems, providing more business functionality and more business value that does a better job of meeting business needs for lower cost.

Enterprise-Grade Linux

The Linux operating system is extremely portable and lends itself to flexible and agile environments. However, for typical mainframe technicians accustomed to the full panoply of utilities and capacity of the z/OS, Linux appears unable to meet the demands of enterprise computing. System z technicians must assess Linux as part of a complete and integrated architecture strategy just as z/OS, DB2, and Sysplex are packaged for mainframe applications today. To deliver "mainframe quality of service" in Linux Oracle environments, that architecture is the Oracle Grid.

Oracle grasped the true potential of the Linux open source operating system very early on, throwing its support behind Red Hat and SUSE Linux. As a leader in software for the enterprise, Oracle approached Linux fully aware of the requirements and challenges in enterprise-scale computing. Oracle has invested heavily in building its Linux development and testing resources, making numerous contributions to the mainstream Linux kernel, and formulated a roadmap for enhancing Linux to make it suitable for mission-critical use. One of the means by which Oracle delivers enterprise-grade Linux-based systems is through the implementation of Maximum Availability Architecture.

Oracle MAA: Technology Alone is Not Enough

Evolved from decades of experience with Oracle customers, Oracle Maximum Availability Architecture (MAA) is a set of proven best practices for developing a high availability architecture utilizing the full complement of Oracle high availability and disaster technologies. The goal of MAA is to deliver unparalleled levels of service from an organization's IT infrastructure while removing complexity in designing the underlying optimal high-availability architecture. MAA is designed to provide data protection and availability by minimizing or eliminating planned and unplanned downtime at all technology layers, including hardware and software components. It delivers protection and high availability regardless of the type of failure — whether from hardware failures that cause data corruption, or anything ranging from human error or software malfunctions to catastrophic acts of nature that impact a broad geographic area.

Oracle MAA encompasses the following main components:

- Redundancy at all levels: hardware, network, and storage infrastructure.
- Oracle Real Application Clusters (RAC) to deliver scalability and to protect from host and instance failures.

- Oracle Data Guard to protect from human errors and data failure and to recover from site failures.
- Oracle Automatic Storage Management, a vertically integrated file system and volume manager that is purpose-built for Oracle database files, to provide the performance of asynchronous I/O with the easy management of a file system.

Depending upon an organization's infrastructure — which may include running virtualized Linux servers on System z within an Oracle grid — and the organization's specific business requirements and goals, MAA supplies a custom-tailored blueprint for providing high availability and disaster recovery incorporating technologies and products best suited to the environment.

This point deserves emphasis; MAA is not a one-shoe-fits-all solution based on a fixed specific product or set of products. It represents a 20-person-year effort in formulating tested, validated, and documented best practices spanning Oracle Database, Oracle Application Server, Oracle Applications, and Grid Control. MAA considers a range of business requirements to make these best practices as widely applicable as possible. Hardware and OS independent, MAA is a dynamic architecture that evolves to accommodate new Oracle versions and features. As the architecture is validated under load in Oracle's MAA test labs, Oracle product deficiencies are fixed and improvements are rolled back into the development cycle, leading to a simpler and more easily managed system.

Whatever the particular MAA specifications entail for a given organization, that organization gains the following benefits:

- Reduced implementation costs via MAA's detailed configuration guidelines.
- Reduced risk and costs of downtime that would otherwise occur due to scheduled and unscheduled outages such as human errors, system faults and crashes, maintenance, data failures, corruption, and disasters.
- The ability to tailor the length of time needed to recover from an outage based on the organization's specific business requirements, up to and including real-time operations, without application failure.

Aside from providing very detailed recommendations for deploying and configuring Oracle software, MAA offers guidelines and directions to apply in assessing and comparing non-Oracle products to be incorporated into the MAA environment, as well as best practices for using the architecture once it has been built. This approach eliminates guesswork and uncertainty when a high availability architecture utilizing the full complement of Oracle MAA technologies is implemented in real-world

heterogeneous enterprise data centers. Regardless of the particulars, any MAA environment entails the following:

- Redundant, secure system stacks to prevent downtime resulting from single points of failure or malicious acts.
- A monitoring infrastructure to quickly detect, prevent, notify, and possibly resolve problems.
- An automated recovery infrastructure to resolve the most common outages.

Linux on the Grid: Architectural Approach is the Key

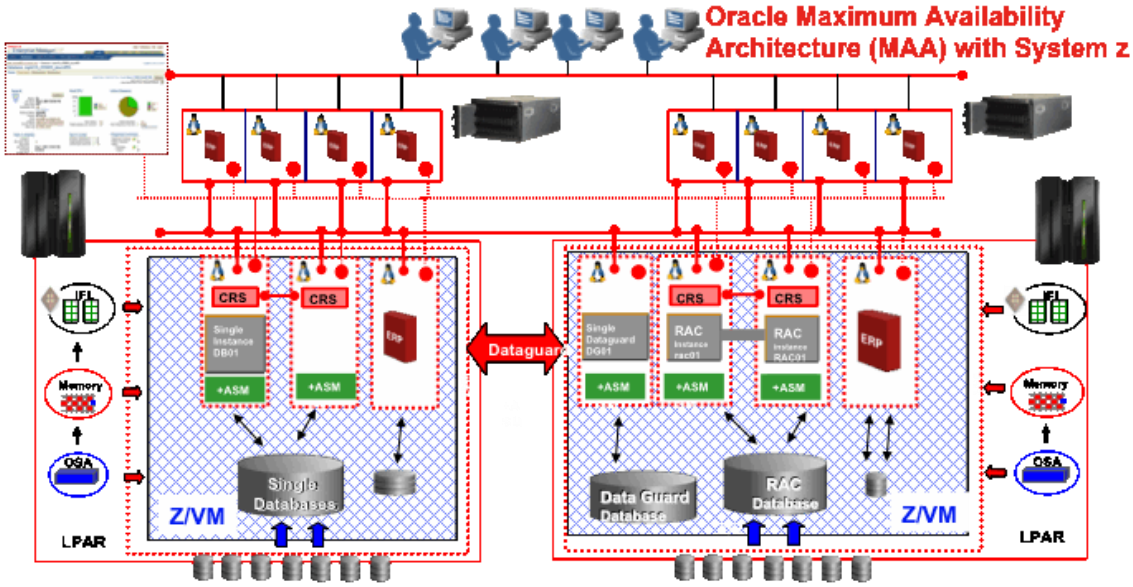
Long a champion of distributed computing platforms and open systems, Oracle has pioneered the use of low-cost, open source Linux clusters in powerful grid environments that provide on-demand capacity with superior scalability and enterprise-class availability.

Grid computing technologies developed by Oracle — such as Oracle Database and Oracle Fusion Middleware Clustering, Automatic Storage Management, and Enterprise Manager Grid Control with Linux provide the high availability business value for which the System z platform is known. The Oracle grid strategy is to virtualize the data center — storage, database and middleware, and systems management — to simplify management, facilitate agility and scalability, and maintain dependable load balancing and failover for extremely high-availability.

By incorporating virtualized Linux servers on System z as a platform on the Oracle grid designed in accordance with Oracle MAA, an organization benefits from an integrated solution that combines both the inherent strengths of both IBM's System z platform and Oracle's highly available solutions, as well as the low cost, flexibility, and agility of open systems.

The rich set of Oracle High Availability features provide customers with the flexibility to implement an MAA architecture optimized for specific business requirements; it can differ depending on considerations such as how critical uninterrupted uptime is to the organization and/or related applications.

The architecture presented in the graphic on the following page is only one example of an MAA implementation for a System z virtual Linux machine environment.



This architecture involves identically configured primary and secondary sites. The primary site contains multiple application servers and a production database using Oracle Real Application Clusters (RAC) to protect from host and instance failures. The secondary site also contains similarly configured application servers, and a physical standby database kept synchronized with the primary database by Oracle Data Guard.

Clients are initially routed to the primary site. If a severe outage affects the primary site, Data Guard quickly fails over the production database role to the standby database, after which clients are directed to the new primary database to resume processing. The Active Data Guard Option with Real-Time Query (Oracle Database 11g) enables the physical standby database to be open-read only while apply is active; this enhances primary database performance by offloading overhead from ad-hoc queries and reporting to the synchronized standby database at the secondary site. Data Guard 11g Snapshot Standby also makes standby databases an ideal QA system without compromising data protection. Thus all computing resources are actively utilized, even those that are in a "standby" role — providing maximum return on investment along with enterprise-class data protection and availability.

How Oracle MAA with System z Delivers Superior Business Value

Several technologies from both Oracle and IBM are recommended for implementing MAA in a System z virtual Linux environment in order to surpass even the business values that can be delivered by DB2 on the System z OS. The MAA for this Grid environment calls for the Oracle database with high availability and disaster recovery features running on System z virtual Linux servers The application tier may reside on System z where available or on distributed server platforms.

This approach can allow an enterprise to benefit both from the flexibility and cost savings associated with the use of distributed platforms as well as security and reliability associated with System z technology. It allows an enterprise to reap all of the benefits of standardization, virtualization, consolidation, and automation in an extremely cost-effective and flexible way. MAA delivers this degree of business value across all platforms supported by Oracle, including SMP, UNIX, and Linux running on both Intel-based servers and System z. It also supports a modern, open technology, standards-based infrastructure for application platforms in J2EE and SOA environments.

The following table presents a side-by-side arrangement that illustrates how an Oracle MAA system implemented with System z and Linux provides specific business value propositions as compared to the DB2 on z/OS. [2]

System z w/ DB2	System z w/ Oracle MAA and Linux
Performance & Scalability	
Database Partitioning Feature (DPF) is an add-on to the DB2 Enterprise product, which establishes a shared-nothing environment in which a single large database is partitioned across multiple DB2 servers that communicate over a high-speed interconnect. A data center with a well-designed DPF system can achieve near-linear scalability.	Real Application Clusters (RAC) is a cluster DBS with a shared cache architecture that overcomes the scalability and access limitations of traditional shared-nothing and shared-disk approaches to provide highly scalable database solutions for all business applications.
Availability	
Parallel Sysplex provides fault-tolerant storage by duplicate storage units synchronized in real time. System z has been certified at the LPAR level EAL5 (Evaluation Assurance Level 5), meaning that if provable separation of function is required, this can be handled by deploying a new z/VM within a dedicated LPAR. This in turn can be used to meet legal regulatory requirements. System z also includes full support for hardware encryption.	RAC delivers highly available database solutions for all business applications, delivering fault tolerance from hardware failures or planned outages. Automatic Storage Manager (ASM) provides a simple storage management interface consistent across all server and storage platforms. ASM virtualizes the DBS storage into disk groups, spreads data evenly across all available storage resources to optimize performance and utilization with no need for manual I/O

[2] This table maps the roles equivalent features perform. It does not purport to compare the features being mapped.

System z w/ DB2	System z w/ Oracle MAA and Linux
	performance tuning, and enables the DBA to change the storage configuration without having to take the DBS offline and automatically rebalances files across the disk group after disks have been added or dropped. Flashback provides a set of features to view and rewind data back and forth in time. The Flashback features offer the capability to query historical data, perform change analysis, and perform self-service repair to recover from logical corruptions while the database is online. Active Data Guard ensures business continuity by minimizing the various kinds of planned and unplanned downtime. A Data Guard configuration consists of a production database, also known as the primary database, and up to nine standby database(s), which are transactionally consistent copies of the primary database. Data Guard guarantees an efficient and comprehensive disaster recovery and high availability solution. Automatic failover and easy-to-manage switchover capabilities safeguard against data corruptions and user errors.
Security	
The Resource Access Control Facility (RACF) supports extremely granular policy-based permissions. RACF works closely with the underlying System z hardware — for example, protecting digital certificates within tamper-proof cryptographic processors. Multilevel security addresses government requirements for highly secure data	Oracle is the undisputed market leader in formal security evaluations, with an impressive list of major certifications. Oracle Database Vault helps protect against insider threats and to meet the needs of regulatory compliance. It can prevent highly privileged users, including highly skilled application DBAs and others, from accessing

System z w/ DB2	System z w/ Oracle MAA and Linux
which can be shared between agencies on demand. Security features in DB2 V8 and z/OS 1.5 and later let customers maintain a secure single repository of data that can be accessed by different agencies, by people with different need-to-know authority. This secure access is managed at the row level in DB2 to provide the required granularity.	sensitive applications and data in Oracle databases outside their authorized responsibilities. Data Vault can protect existing applications quickly and easily and requires no changes to existing applications. Oracle Audit Vault reduces the cost and complexity of compliance and the risk of insider threats by automating the collection and consolidation of audit data. It provides a secure and highly scalable audit warehouse, enabling simplified reporting, analysis, and threat detection on audit data. Oracle ID Manager provisioning and administration solution automates the process of adding, updating, and deleting user accounts from applications and directories and improves regulatory compliance by providing granular reports that attest to who has access to what.
Manageability	
Oracle Enterprise Manager helps an organization achieve the highest quality of service and lowest IT operations costs with a unique top-down approach providing management across all systems from a single point of administration. This approach employs an unrivaled blend of broad application management and quality assurance solutions with deep management solutions for Oracle technologies, including Oracle packaged applications, Oracle Fusion Middleware, and Oracle Database.	

Why Traditional z Customers Should Consider Oracle

With a history of innovation that dates back to the 1970s and a solidly established working business partnership with IBM that extends back at least 25 years, Oracle's portfolio and technology strengths exceed even those offered by DB2 on the System z operating system. The world's largest enterprise software vendor, Oracle has a support organization that consists of more than 7,000 support professionals using more than 200 advanced support tools. Thanks to a global reach spanning nearly 150 countries and

including nearly 30 languages, a technical issue opened with Oracle's support team can literally "follow the sun" until it is resolved, if necessary. Only Oracle support has received the coveted JD Power and Associates certification for outstanding service and support, and has received awards from the Service & Support Professionals Association (SSPA) for four consecutive years.

Oracle also has a long history of involvement in Linux; the Oracle database was the first commercial database to run on Linux, and today Oracle is a prominent market leader in Linux. The Oracle relational database is the number one database on Linux, with 82.6 percent market share, and more than $1.95 billion in Linux database revenues, according to Gartner. Linux is also a very popular platform for deploying Oracle middleware and Oracle applications. Oracle contributed the Oracle Cluster File System (OCFS) to Linux, which proved an important technology for realizing Oracle's vision of high-performance Linux grids. Oracle began development for Linux for System z in 1999 and brought it to production in August of 2002.

The Trick is in the Approach

To help customers assess their MAA strategy for Oracle on Linux for System z, Oracle and IBM have invested in a dedicated team of architects who work in one lab to develop MAA best practices on all IBM server platforms. They offer design workshops, proof-of-concepts, and benchmark services to customers who qualify. In addition, they have also created a virtual sandbox services called Oracle zLite that gives customers free remote access to a fully-supported System z environment that is pre-configured with Oracle MAA components and Oracle Fusion Middleware. Once customers have decided on standards and determined their MAA infrastructure strategy with Linux on System z, they can plan their strategy for moving toward this environment.

Legacy data, applications, and processing resources residing on enterprise mainframe platforms have traditionally been notoriously tricky and costly to change and adapt to new, typically web-centric purposes. On the other hand, they often excel at the critical functions they have provided, typically for many years, and are highly reliable. Replacing them outright would be extremely costly as well as dangerously disruptive to operations that are commonly mission-critical to an organization.

The advancement of Linux and SOA in business organizations has radically changed this picture and has opened the door to almost unlimited ways of mining the riches of legacy assets contained in those organizations' mainframes. It makes the System z platform more capable of participation in loosely coupled, standards-based, cross-platform environments, and makes the evolution to such modern platforms considerably less disruptive. To be more agile and competitive, organizations with tremendous investments in legacy mainframe hardware and software assets are turning to Linux and SOA to provide more infrastructure flexibility with reduced development cycles and lower costs while dramatically reducing the risks involved in change.

Oracle is well aware that systems with long histories of running an organization's business processes are not candidates for an all-out rip-and-replace approach to modernization. Oracle's team of MAA experts implement modernization methodologies developed by Oracle and its partners to address the need for preserving and leveraging the business value in legacy systems.

The first step taken by Oracle is an in-depth assessment of an organization's particular technical environment and business requirements, both current and planned. This team develops a blueprint tailored to these individual circumstances, incorporating the best methodologies and experience to prevent unplanned downtime. Oracle's vast partner network that includes nearly all the large ISVs gives Oracle knowledge in formulating

the best approach to phased application migrations wherever such an approach makes sense.

How Some Businesses Have Gone About it

Large Financial Institution

One of Brazil's Big Four banks, with more than 2,000 branches that included international operations and affiliates in New York, Luxembourg, and Tokyo, needed to upgrade its stock option application to deliver a greater level of availability without any trade-off in terms of security. The solution in place — a Windows-based platform running 54 processors — lacked the extremely high level of availability required. The bank's IT environment included IBM's System z platform running DB2; however, a recently mandated requirement stipulates that all financial services in Brazil be able to work with a particular front-end stock brokerage software. The Internet component of that software was built to run only on the Oracle version 10g platform.

"The president called Oracle LAD in to see if Oracle couldn't provide an overall solution rather than just for the one necessary component," says Wellington Pinto, a senior solutions specialist with Oracle LAD Architecture team. "We applied a team to understand the customer's requirements and came up with a Maximum Availability Architecture solution using an Oracle grid running Linux on their System z platform."

After approximately five months Oracle had a proof of concept system in place, encompassing both a production site and a second one (employing a separate z/VM) as a disaster recovery standby site. The solution uses but a small partition to deliver performance and throughput equivalent to that provided by the Windows system running 54 processors and using 34 GB of memory. Most importantly, it meets the main criteria of the organization — very high availability and superior stability — while also being easier to manage. Additionally, Oracle's Data Vault delivers the high degree of security the organization had come to expect of its mainframe platform (which typically employed CA's Top Secret solution).

"Our solution is lower priced than DB2 on System z, provides superior manageability, and delivers security that is 100 percent compliant with Sar-Ox," says Pinto, referring to the U.S. federal Sarbanes & Oxley Act of 2002 that significantly tightened accountability standards for directors and officers, auditors, securities analysts, and legal counsel.

Pinto explains that the high level of manageability of the organization's new MAA solution is provided by consolidation using Oracle's Grid Control software, in conjunction with Tivoli Enterprise Manager running on distributed systems. Grid Control has the ability to trap events and notifications and supply them to the Tivoli

center of operations, enabling a single point of administration to manage all of the Oracle solution whether residing on the System z platform or not.

Pinto reports as well that a MAA solution will solve another challenge faced by the bank as well as the entire finance industry in South America and Mexico: the need to migrate ADABAS / Natural workloads onto other platforms, due to today's extreme shortage of ADABAS professionals.

"Many ADABAS solutions have been moving to DB2," he says. "Now we are positioned to offer the option saving costs and increasing manageability and agility by moving those solutions to System z on the Oracle grid."

Education Enterprise

As one of the leading private research and teaching institutions in the world today, with primary campuses in the heart of Boston and programs around the world, Boston University ranks as an enterprise of enormous scale. Its Information Technology Group is heavily tasked to provide always-on technical services and continuous data availability when and where they're needed throughout the organization.

"We tend to exploit technology to its fullest," says Gerard C. Shockley, Assistant Director of Technical Services in the IT Group. "Now we've done exactly that with System z running on the Oracle grid."

Shockley reports that his team saw the value in the Oracle Maximum Availability Architecture to reduce complexity and server sprawl, as well as to simplify manual tasks by cloning, so that environments being run are actually clones of other environments that have been customized.

"A very strong component of virtualization is the availability of resources across the organization," Shockley says. "That's one of the things we focus on in our use of the Oracle grid and MAA. We're also very involved in open source and open standards, so our deployment of Linux virtual machines on System z fits well into our technology culture."

Shockley is quick to emphasize that their approach to standardization and virtualization is nothing new. In this regard, Boston University has been exploiting a wide variety of features and functions built into System z for years. But Oracle's MAA offered a good fit for their planned strategic direction, and also addressed some challenges that had arisen over time.

"Some of the database platforms we'd been using were undergoing a declining install base," Shockley reports. "That meant we were facing a declining pool of available expertise, as well as a shrinking community of users."

Adopting Oracle's MAA also enabled Boston University's IT Services to realize another component of their solution strategy besides standardization and virtualization: consolidation. Several existing Oracle workloads previously running on Windows and Intel boxes have been consolidated onto Linux running on System z. More importantly, however, fragmented databases systems have now been consolidated onto the Oracle database platform.

Two completely new applications – a Business Intelligence based on a data warehouse established by Oracle Warehouse Builder and an enterprise-wide university document imaging system – have also been successfully deployed from scratch entirely on the new platform.

"We've been particularly pleased with Oracle Grid Control management of multiple virtual Linux instances," Shockley says in conclusion. "Having the ability to drill into an individual running instance and assess its health in real time is extremely useful to us."

Conclusion

Risk-adverse enterprise organizations running mission-critical, mainframe-based applications have traditionally been limited to IBM's proprietary platform running the DB2 data server on the System z platform. However, such organizations are building all their newest systems using open standards and technologies such as Linux and Service Oriented Architectures in order to share and reuse resources and to more closely align business purposes, strategies, and plans with the underlying technology. The breach between this model and proprietary mainframe systems (along with the legacy applications that run on them) costs the businesses struggling to operate these two disparate environments in terms of maintenance, development, expertise and training, and monthly license charges.

Thanks to considerable advances in technologies such as virtualization, clustering, and middleware, combined with the cooperative establishment of industrywide open systems standards, these organizations now have compelling new options to consider.

A longtime partnership with IBM has allowed Oracle to evolve architectural approaches that bring together the strengths of the System z hardware platform with the highly reliable and highly available Oracle software platform incorporating Oracle's Maximum Availability Architecture. By running virtualized Linux servers on the System z platform in an on-demand grid computing environment, Oracle offers agile and flexible systems that not only match but exceed the indispensable business values of availability, performance, security, manageability, and scalability demanded by the most exacting organizations operating mission-critical systems around the clock.