CLABBY ANALYTICS

Research Report

IBM System z – When Failures and Breaches Are NOT Options

Introduction

Where do you deploy workloads that must be secured and just can't afford to fail? If you haven't considered the mainframe, you might want to. Over the past several decades, IBM's System z has established a widespread reputation for its *trustworthiness*. Information technology (IT) executives around the world turn to this architecture when they require the utmost in reliability and availability, and the utmost in security. This trustworthiness is why so most of the world's largest financial, government and retail institutions use System z mainframes to run their most mission critical workloads and to protect their most sensitive data.

> ***Executives who run these enterprises know that mainframe architecture offers the highest meantime between failure (measured in decades) – and they know that the mainframe offers the strongest security in the commercial server industry (rated by the Common Criteria organization at EAL level 5+ – no other commercial server has attained this ranking).***

This *Research Report* has been written for new generation IT executives, managers and administrators who have had little exposure to mainframe technology. It describes how and why mainframes are different from other server architectures in the areas of micro-processor characteristics, systems design and related software – and it shows how these differences help make the mainframe the "go-to" architecture when it comes to securing data and avoiding breaches.

The Server Selection Process

As we travel around the world, we constantly meet information IT executives, managers and administrators who have little understanding of System z (mainframe) technology. And this is fully understandable – many of these individuals learned how to write programs and/or how to manage systems using x86-based desktop and server architectures – and have had little-to-no exposure to high-end advanced architectures such as the IBM System z mainframe.

> ***When working with these IT executives, we like to make these important points about server selection:***
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> ***1) Your main goal should be to match your applications with the servers best suited to execute those applications in order to maximize processing efficiency and lower computational costs. This means picking a processor best suited to process batch, interactive, transactional or web workloads – and it means picking a systems design that can best support the Quality-of-Service (QoS) service level requirements of users;***
>
> ***2) General purpose processors such as x86 processors, reduced instruction set (RISC) processors, and System z processors can <u>all</u> process serial, parallel and compute-intensive workloads. So how do***

> ***you choose the right microprocessor for your workload? Your processor selection should be based on the throughput it can deliver when executing specific applications. Processing power of the microprocessor (how much work it can do), the number of cores, number of threads, and other factors such as cryptography on the chip and cache levels should also play a role in microprocessor selection. (See this report for more information on microprocessor selection criteria);***
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> ***3) There are MAJOR DIFFERENCES in the ways that x86, RISC and mainframe systems are designed. These differences have a huge impact on the Quality-of-Service (QoS) that a given system can deliver – particularly reliability, availability, and security. (For more on this topic, see this report for a more in-depth discussion of server design selection criteria); and,***
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> ***4) Systems software should also be examined for availability, security and management extensions.***
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> ***We urge all IT executives to take the time to understand these design differences in order to select the right processors and systems designs to meet user/application service level requirements. Failure to choose the right processor can result in inefficient performance (low return-on-investment); failure to choose the right system design can result in an inability to satisfactorily meet required reliability, availability, and security service levels.***

Why Choose the Mainframe? For Optimized Performance – and to Manage and Secure Client Record Data

So far, we've discussed why the goal in server selection should be to find the best server to most efficiently execute enterprise workloads – while also ensuring that the server chosen can meet end-user service level requirements. Enterprises that make their server selections on this basis can achieve superior economics by running their workloads on systems that can most optimally execute those workloads.

> ***But there is more to IBM's System z than high performance and high reliability/availability/security service levels. Mainframe customers also embrace System z because it provides an environment that can store large volumes of client records, it can secure and manage those records (so mainframe customers are assured "one-version-of-the-truth") – and because these secure records can also be made available to serve multiple types of applications and multiple lines-of-business. System z customers know that they can trust mainframe architecture to perform at high utilization rates (mainframes can operate at 100% utilization for sustained periods of time); and these customers also know that they can trust System z to protect client record data and serve that data in a secure fashion to a variety of enterprise applications.***

A Closer Look: The Three Factors that Make the Mainframe so Trustworthy

The way we see it, there are three factors that make the mainframe an exceptional trustworthy computing environment:

1. Cryptography functions on the microprocessor off-load the CPU from having to burn cycles encrypting/decrypting data, thus speeding secure workload processing;
2. Advantages in mainframe system design that enable the mainframe to offer higher reliability, availability and security levels as compared with other systems; and,
3. Systems software extensions that improve security (such as the EKMF encryption key environment that serves both mainframe and distributed environments) as well as resiliencyfeatures.

The Microprocessor Discussion
When evaluating microprocessor characteristics, IT executives need to consider "how efficiently can specific workloads be executed on a given microprocessor", and "does the microprocessor offer any extensions that improve QoS such that service level requirements can be better served."

From an efficiency perspective, it is important to note that IBM's System z processors:

- Are the fastest processors in the industry (5.5 Ghz);
- Handle 1 thread per processor (in comparison, IBM's POWER architecture handles 4 threads per cycle and Intel x86 processors handle 2 threads per cycle); and,
- Offer plenty of on-chip cache (4 levels including a 48MB level three cache and 384 MB of level 4 cache off die).

So, in essence, the z processor is a very fast processor that is rich in cache and that has a single thread orientation. Workloads that can best exploit this chip are those that can be "*stacked*" on top of each other and executed in serial or parallel fashion. This stacking behavior is why there is no better transaction/batch processor in the industry than an IBM System z mainframe. And this stacking behavior is also why System z makes such an excellent Linux consolidation machine (an average of 20 virtual machines can be stacked per core).

From a security perspective, cryptographic acceleration functions are built on the micro-processor chip (these are known as CP Assist for Cryptographic Function [CPACF]). These functions are designed to accelerate the encryption and decryption of data and support a wide range of algorithms including DES, TDES and AES, as well as hashing algorithms including SHA-1 and SHA-2 (SHA-224, SHA-256, SHA-384 and SHA-512). It is important to note that virtual machines can easily access these cryptographic services – no explicit virtual machine authorization or configuration is needed.

In addition to on-chip cryptography, IBM also offers PCIe Gen 2-based cards known as Crypto Express 4S cards as add-ins to System z. These cards are tamper-sensing/tamper-responding, they are programmable – and they can be configured as a coprocessor (to handle more encryption/decryption work), or as an accelerator (to speed security work).

> ***Chip level mainframe cryptography combined with the fast z processor gives the mainframe distinct advantages in encryption and decryption speed. And the availability of crypto cards gives the mainframes advantages in availability (because these cards are hot pluggable so the machine does not have to come down); scalability (because up-to 16 cards can be added to a mainframe chassis); and cost (because the cards can be updated easily and regularly – as compared with microprocessor microcode modification – helping IBM better manage development costs and reduce ultimate costs to its customers).***

The System Design Discussion
There are HUGE differences in mainframe system design as compared with traditional "distributed" or "mini-computer" designs. IBM's mainframe was designed from the outset as a "shared everything" architecture" – which means it was designed from the very beginning for resource virtualization (which delivers high utilization and that also allows

for transparent fail-over should a virtualized resource fail). This ability to transparently fail-over has long contributed to mainframe application availability advantages because virtualized resources have long been able to transfer work to other virtualized resources in case of a failure.

As for reliability, mainframe architects have always used high quality components to ensure up-time, and have also used redundant components to ensure system reliability (transparently failing-over to other fans, power supplies, network interfaces, etc. should an original component fail).

Other major design differences when compared to RISC and x86 systems designs include:

- An expansive communications subsystem that offloads the central processing units (CPUs) from the lion's share of communications tasks (this huge communications subsystem supports up to 288 input/output processors to handle large volumes of communications traffic);
- System assist processors (SAPs) that offload systems processing to dedicated CPUs (up to 11 SAPs);
- Specialized Crypto Express processors (described in the previous section) for handling security encryption/decryption;
- Highly reliable hardware that is backed up by redundant highly reliable components;
- High-availability software extensions; and,
- Specially designed processors that can accelerate DB2 and Java processing – and that can simplify and deployment and tuning of Linux workloads.

The system design of the IBM System z is distinctly different from the design of POWER- and x86-based servers:

1) ***The huge communications subsystem makes System z ideal for high-volume communications environments (including today's communications-intensive transaction processing environments as well as tomorrow's cloud and mobile service environments).***
2) ***On chip security as well as an extremely strong security subsystem (using Crypto Express cards with the latest/greatest security algorithms) make the mainframe the industry leader in secure communications.***
3) ***Built-in redundancy combined with high availability software extensions make the mainframe extremely reliable and available.***

IT executives can continue to buy x86 servers and try to front-end these servers with expensive communications switches – and they can attempt to design a reliable and available distributed computing environment that allows for failover, backup and recovery using a variety of hardware and software components – or they can turn to highly-integrated, highly-scalable mainframe architecture and reap the rewards of decades of integration to more easily implement a highly reliable, highly available, highly secure information systems environment.

The Systems Software and Ancillary Software Discussion

From a systems software perspective, advanced mainframe systems software supports transparent failover as well as protects information and data – contributing to mainframe availability and to overall system resiliency. Ancillary security software provides strong authentication/authorization and other important security services.

At the operating system level, IBM's z/OS operating environment includes recovery code known as "Functional Recovery Routines" that support every major routine in the system. This code has the ability to refresh the routines that have failed – ensuring that the system is constantly available. Further, the z/OS automated restart manager has the ability to restart failing software components. Finally, the operating system can also perform predictive failure analysis and learn, anticipate and report on problems.

Ancillary software beyond systems-level software includes products such as IBM's Security zSecure Suite and as well as the company's InfoSphere Guardium product offering. These products help customers save time in audit/compliance activities as well as in administering security. Additionally, IBM offers products such as Resource Access Control Facility (RACF) that help IT managers and administrators authenticate users and provide them with the proper levels of authorization to protected data.

How IBM's Focus on Reliability, Availability and Security Is Paying-Off

As described in the previous sections, IBM's System z has many processor/system design/software advantages as compared with other server designs. These advantages give the mainframe significant advantages when it comes to reliability, availability and security (trustworthy computing). With these advantages, IBM System z designers can now boast that:

- System z offers the ***highest level of security certification*** (the mainframe is the only server to have achieved the Common Criteria's EAL level 5+ rating – the highest commercial server security rating in the industry);
- There have been ***no known security breaches*** of the mainframe architecture (as long as it is configured per IBM's recommendations);
- The mainframe has ***the highest meantime-between-failure*** (MTBF) rating measured in decades (@ 30 years – far ahead of other competing architectures);
- Most mainframes experience ***less than 5min of downtime a year***;
- Mainframe systems ***recovery can take place in real time*** (Active Active);
- ***High Availability economic advantages*** compared to distributed systems in terms of the cost of implementing high-availability solutions (due to integrated high availability hardware/software features built into mainframe design);
- Mainframes can scale to large configurations using Parallel Sysplex (an advanced clustering technology);
- Mainframes support Active/Active recovery – enabling transaction recovery over large distances in event of a disaster; and,
- ***Security economic advantages*** (due to security integration on the mainframe).

Case Studies: What Are Customers Saying About System z Trustworthy Computing

Thousands of IBM customers have deployed mainframes across a multitude of industries – due in large part to the mainframe's reputation as the most reliable, available and secure server in the industry (see this link for a long list of references in finance, healthcare, government and insurance). Some of the case studies from this link that best illustrate how customers are using the mainframe to build highly available/highly secure computing environments include:

- *Rizal Commercial Banking Corp*. – "the combination of Finacle and IBM gives us the functionality we want on a high-performance platform that is robust and resilient enough to handle the bank's requirements moving forward," claims Dennis Bancod, senior executive vice president and head for IT and operations, Rizal Commercial Banking Corp. "I don't think there's anything in the market, other than IBM System z and DB2, that's robust and scalable enough to handle this kind of exponential growth in volume."
- *Sicoob* (Brazilian credit union) – Sicoob needed a more flexible, secure and scalable IT infrastructure to support reliable 24/7 service and mobile access. "The System z solution has effectively met all of the criteria evaluated with respect to availability, performance, security, scalability, processing and storage capacity. This has enabled the growth of our business products and our network in general. Over the past year, through our self-service channels, we grew by nearly 600 percent; Internet banking grew by 200 percent; for mobile solutions, growth was 600 percent. It would not have been possible to support this growth without IBM System z" stated Denio Rodrigues, and Information Technology Executive at Sicoob.
- *Garanti Bank* – Instanbul-based Garanti bank is shifting more and more of its banking activity online, and is strongly focused on improving system availability while lowering its transaction costs. The bank sees System z, with its solid infrastructure (reliability, availability, security) as the cornerstone of its future profitability.
- *Kela* – Finland's primary social insurance institution, Kela needs to provide high levels of services to its constituents (this includes on-line service delivery). Kela has used an IBM mainframe with DB2 to expand reliable, available and secure services to users.
- *Haddon Hill Group (for a major healthcare client)* – Haddon Hill's heathcare client needed an improved claim's processing system. Haddon Hill assisted by helping the client deploy a Haddon Hill solution based on IBM's WebSphere Process Server. According to Haddon Hill's chief technical officer Phil Schaadt, one of the big reasons this solution was deployed on a mainframe is that "availability for a healthcare provider is a life or death matter. The system can never, ever go down," said Schaadt. "There was never any question of any other type of server other than System z for our customer."
- *Itaú Unibanco* – Itaú, a very large Brazilian bank, needed a new security solution to cover a variety of management, auditing, compliance, and monitoring security elements in its banking environment. The company had deployed and integrated

a variety of security products on IBM's industry leading security platform – the System z.

- *FIDUCIA IT AG* – German IT service provider FIDUCIA IT AG deployed a new secure and stable infrastructure on a System z mainframe in order to allow its customer to better protect its data. This solution also improved availability as well as security.

As can be seen in these examples, the themes of reliability, availability and security are major drivers for the adoption of mainframe solutions. And, in some cases, mainframes are replacing x86 architecture due to the mainframe's more integrated availability and security features.

The Mainframe of the Future: Cloud, Mobile, Social and Big Data – All Based on a Reliable/Available/Secure Mainframe Platform

Revist this link and you'll note that a lot of IBM's mainframe case studies show the mainframe in the forefront of technological initiatives such as cloud computing, mobile and Big Data. For instance, notice how Nationwide is deploying cloud architecture using System z (expect a *Clabby Analytics* in depth case study on the Nationwide cloud next month); observe how Banca Carige and First Tenessee Bank are using the mainframe for Big Data processing; notice how Sicoob is using the mainframe to address its mobile computing need (see this YouTube link for more details).

Over the past year *Clabby Analytics* has seen a marked upward spike in the use of mainframes in cloud computing and in Big Data. In cloud, we first noticed mainframe clouds when visiting a government organization known as Elcot in Chennai, India. We also spoke with a professor from the University of Bari (in Italy) regarding his use of a mainframe cloud to server as an intermediary system that removes the middleman between the supplier and the buyer (for seafood and other goods). Further, we visited Marist College, the home of one of the most advanced and multi-faceted mainframe environments that we have yet seen to date (see this report for more on the Marist cloud).

Likewise, we've seen steady growth in the use of Big Data analytics on mainframe systems. Two years ago we wrote a profile on Switzerland's Swiss Re reinsurance company, and have since learned that the company had adopted IBM's IDAA (IBM DB2 Analytics Accelerator) technology – a systems configuration that integrates the mainframe with a specialized PureData System for Analytics appliance for greatly accelerated complex query processing. Using the IDAA configuration, the mainframe allows secure access to back-end data – and the PureData appliance uses fast, specialized processors that include field programmable gate arrays to process that data at speed that is much faster than general purpose processors. The mainframe is an excellent analytics processor – and the IDAA configuration expands the types of analytics workloads that should now be deployed on the mainframe.

The bottom line when it comes to mainframe system design and future major initiatives such as cloud computing, mobile, social, and Big Data environments is that the mainframe platform is well positioned for the very demanding, communications-intensive, reliability/availability/security workloads of the future.

With advanced virtualization, provisioning and workload management, the mainframe is already the most secure and reliable cloud environment on the planet (see this Marist cloud report for an example of a mainframe cloud environment). With a rapid mobile applications development environment as well as a complete, highly integrated mobile backend infrastructure, the mainframe is primed to provide backend mobile computing services. And with the ability to speedily cull through very large databases, the mainframe is ready to support the move into social media analysis.

Summary Observations

There is a huge gulf that exists in the field of information systems when it comes to systems platform selection. In this *Research Report* we have endeavored to demonstrate why current generation IT executives, managers and administrators should consider IBM's System z when it comes to processing workloads that demand super-strong security and high degrees of system reliability, availability and resiliency. The System z processor design has enterprise-strength hardware extensions that speed security encryption and decryption – and these extensions are complimented by PCIe-based crypto cards that add support for new security algorithms while either accelerating security processing speed or enabling more security volume to be handled. The System z systems design is distinctly different from the designs of RISC-and x86-based servers – especially in the areas of communications handling (with a very large communications subsystem); in its "shared everything" design (that contributes to performance as well as availability); and in the reliability of its components. And finally, System z is distinctly different from its competitors in systems software (especially the strength of its operating environments when it comes to availability features) – and in ancillary software that supports strong authentication, authorization, audit, security management and other functions.

As stated at the outset, we believe that enterprises that look more closely at their server designs (the microprocessor, the system design and related software) will find that they can run their operations more efficiently, while also achieving higher service levels. We recommend that enterprises that have requirements for super-strong security combined with high reliability and availability – and that also have heavy input/output (I/O) requirements – should look very closely at mainframe architecture.

The bottom line: Enterprises that make systems selections based on the ability to execute workloads most optimally – and on the ability to meet service level requirements for reliability, security, and performance – will always see a better return-on-investment in information systems due to higher utilization rates and lower management costs. Further, enterprises that invest in integrated systems environments (such as mainframes with integrated availability and security features) often see the QoS delivered to users improve significantly, while lowering the risk of systems failure or data breach for the enterprise. In situations where high ROI, strong security, and high-availability/reliability are desired – and where failure and information breaches are not an option – IBM's System z mainframe should be adopted as the go-to architecture for trustworthy computing.

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