One Architecture Fits All – IBM Mainframe

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Abstract

IBM running the z/OS workhorse with the huge majority of financial, insurance, health care, government, retail and utility companies today to run their enterprises solution. Today, main-frame computers play a central role in the daily operations of most of the world's largest corporations, including many Fortune 1000 companies. While other forms of computing are used extensively in various business capacities, the mainframe occupies a coveted place in today's e-business environment. In banking, finance, health care, insurance, public utilities, government, and a multitude of other public and private enterprises, the mainframe computer continues to form the foundation of modern business. Today's mainframe has taken on an additional critical role as an energy efficient system. As energy costs are increasing at a rate of 2.8% per year, energy costs to power equipment often exceed the purchase cost of the hardware itself.

– Why has this one form of computing taken hold so strongly among so many of the world's corporations?
– How can a technology change so much yet remain so stable?

To answer these questions, we will study the position of Main-frames in enterprises world, as well as their legitimacy in big infrastructures. To better understand their importance, we will present several aspects of this platform, theoretical as well as technical. First, after having defined the context, this study will graph the current position of Mainframes in the world, especially in fortune listed companies. We will try to understand what they really are and to have a new look on them. We will then briefly present their evolution and study why they are still used despite criticisms that are often made about their age. We will showcase No single point of failure. We will identify factors of their continued existence, such as the need to capitalize on the existing structure, notably in big banks. Therefore, we will see that billions of dollars has been invested in them and the most important consulting group such as Gartner still believe in them. Then, we will present an overview of their qualities not present on distributed servers, or not enough efficient for big infrastructures. After having study its overall strength, its place in IT environments will be presented, as well as its market. In a second step, we will present technologies used under these environments, their efficiency and their legitimacy in a modern world.

Keywords- Distributed System, Enterprise system, Mainframe architecture

I. INTRODUCTION

Mainframe Computers are often seen as old and archaic systems. When someone talks to average people about "Mainframes" and asks them to think about these machines, they will probably ask you if you're talking about these huge "machines" which need so much place that a small room is not enough. Well, maybe that's a caricature. But give it a try and you'll see by yourself! If only there were living during the 60's they would be probably true.

Mainframes were indeed systems hosted in huge room-sized metal box, needed an incredible amount of electricity, space and air-conditioning. It needed about thousand square meters, up to 3000 to take place. But that time is over. It's now like a big refrigerator, nothing more, taking the place of about two frames containing standard x86 servers.

Lot of people will also tell you Mainframe Computers are dead, and that the small ones still being used will be replaced by grid computing technologies [17].

Well... In fact, the truth is while people's mind didn't evolve about Mainframe Computers technologies, these last one did. Another reality is that even if it's been said they were finished, they are still used. People don't really have a concrete idea about what a Mainframe really is, even in most IT Environments.

It thus remains important to precise what are Mainframes, which companies are using them, their real place in the world and why they're still there, despite violent criticisms [3] [4], like

1) The Mainframe is old and lags behind distributed servers in technology innovation.
2) Distributed Servers exceed mainframe in performance.
3) The Mainframe legacy applications are inflexible [3] [4].
4) The mainframe labor pool is disappearing.
5) The number of available applications on mainframe is shrinking.

6) Distributed DB servers are sufficient as DB2 on mainframe.
7) Distributed Servers use less power than the mainframe.
8) UNIX and Windows-based systems deliver same qualities of service as the Mainframe.
9) Mainframe Application migration makes sense
10) Distributed platforms significantly improve operating costs [6].

II. MOTIVATION, OBJECTIVE AND SCOPE

The main focus of this paper is to understand the value of the Mainframe in today's Industry. In order to excel in today's competitive environment, businesses need to support these processes, and efficiently manage the massive volumes of data they drive, with minimal risk. The mainframe has always been the IT industry's leading platform for transaction processing, consolidated and secure data serving, and for supporting enterprise-wide applications. IBM provides world-class mainframe technology to help today's enterprises respond quickly to evolving business conditions with extreme flexibility. With automation and advanced virtualization technologies, IBM mainframes deliver competitive advantages that allow businesses to become more successful and contribute to a smarter planet [14].

System z servers and solutions facilitate the integration of operational data with analytics and enable cloud delivery in a secure environment, while generating ongoing savings and value. Data centers around the globe are facing an IT conundrum: how to meet huge new demands on a flat budget. Leaders are addressing this conundrum by transforming infrastructures to deliver enterprise computing that is designed for data and tuned to the task and managed in a cloud. The unique hybrid design of the IBM zEnterprise System is ideally suited to play a leading role in these transformations.

The IBM zEnterprise System is a world class enterprise computing system designed to help address the IT conundrum to deliver the new IT services businesses requirements with a lower cost structure. zEnterprise helps businesses to realize opportunities for cloud, analytics and mobile.

System z platform and systems management capabilities are designed to help businesses take control. They gain an end-to-end picture across the systems and the multiple workloads on those systems that enable informed decisions, improved control optimized use and redeployment of resources for optimal efficiency and effectiveness. This is achieved with lower labor costs due to advanced automation and systems self-management. There are, of course, no specific rules about which platform should be used for any specific application; many applications are available on the majority of platforms. But only zEnterprise System provides the flexibility and choice of deployment platforms along with centralized management and control enabling the optimal deployment scenario for your business.

System z continues a history of Mainframe - zEnterprise is a "one of a kind" multi-architecture platform designed to increase data center operational efficiencies, optimize workload performance and reduce IT infrastructure costs - and all from a platform that delivers the lowest cost per workload. This study will present a variety of strategies for achieving smarter computing with zEnterprise. We will define the concepts of "fit for purpose", virtualization and consolidation, private cloud computing, and data optimization on zEnterprise [14].

III. OUR NEW APPROACH

System z can be uniquely optimized for critical core business solution for growing workload and inclined number of transaction.

1) Extreme scalability coupled with highest I/O capability -
– Optimized for real-world, enterprise-class transaction processing and batch
2) Designed with highest reliability and elasticity -
– Significantly reduced costs of downtime [6].
3) Active workload management drives up utilization -
– Reduces core requirements yielding lower software costs
– Consolidate SAP data bases into DB2 multi-tenancy
– Solution Edition pricing
4) No data movement necessary
– Consolidate back end data marts on System z IDAA is a game changer
5) Better administrator productivity.
6) An evolving architecture- set of defined terms and rules that are used as instructions to build products.
7) Smart and optimized use of buffer via analyzed buffering techniques.

For example: Use of BUFNO for sequential Datasets: When dealing with sequential DASD datasets, MVS does some performance tuning behind your back. Instead of dealing in 1 block chunks it now deals in 5 block chunks. What this means is that for the following blocked datasets you actually deal with larger chunks of data.

BLKSIZE BUFNO=5
22000 110,000 bytes gotten per access
6160 30800 bytes gotten per access

Thus when reading a 22,000 byte blocked dataset, MVS really works with 110,800 bytes chucks by default. The objective being met here is to minimize the amount of requests made to MVS's I/O subsystem, an expensive option.

In the same way DB2 or IMS database can also be wisely used with optimized buffer formulation

8) The current mainframe is built using a modular design that supports a packaging concept. This approach enables many of the high-availability, non-disruptive capabilities that differentiate it from other platforms [15].
9) In software engineering, extensibility is a system design principle where the implementation takes future growth into consideration.
10) Total cost of ownership: In distributed servers, the cost per unit of work never approximates the incremental cost of a mainframe [15].
11) Optimal buffer credit allocation – The optimal number of buffer credits is determined by the distance (frame delivery time), the processing time will be considered at the receiving port, the link signaling rate, and the size of the frames being transmitted. As the link speed increases, the time frame delivery time is reduced and the number of buffer credits must be increased to obtain full link utilization, even in a short-distance environment. You can configure the number of buffers by using the –frameSize [16]. OS calculates the number of buffers from the –frameSize option value according to the following formula:

Buffer_required = (2048/framesize) * data_VC_credit.

Example: The following example calculates the number of buffers required for an 8-Gbps ort on a 100 km link with an average frame size of 512 bytes.

1606 buffers are required for 100km at 8G and framesize of 512 bytes.

12) Ecologically affable: Refurbishing existing data centers can also confirm cost-exorbitant, such as installing new cooling units that require reconfigured floors. The cost of power over time must also be considered in data center planning.

Another objective of this study is to distinguish between centralized and distributed computing efficiency over a period of time, however, is rapidly blurring as smaller machines continue to gain in processing power and mainframes become ever more flexible and multipurpose [15]. Market pressures require that today's businesses continually re-evaluate their IT strategies to find better ways of supporting a changing marketplace. As a result, mainframes are now frequently used in combination with networks of smaller servers in a multitude of configurations. The ability to dynamically reconfigure a mainframe's hardware and software resources (such as processors, memory, and device connections), while applications continue running, further underscores the flexible, evolving nature of the modern mainframe.

Servers are proliferating. A business might have a large server collection that includes transaction servers, database servers, e-mail servers and Web servers. Very large collections of servers are sometimes called server farms (in fact, some data centers cover areas measured in acres). The hardware required to perform a server function can range from little more than a cluster of rack-mounted personal computers to the most powerful mainframes manufactured today.

A mainframe is the central data repository, or hub, in a corporation's data processing center, linked to users through less powerful devices such as workstations or terminals. The presence of a mainframe often implies a centralized form of computing, as opposed to a distributed form of computing. Centralizing the data in a single mainframe repository saves customers from having to manage updates to more than one copy of their business data, which increases the likelihood that the data is current.

To Determine What Modernization Means to the Business, our proposed study will demonstrate the critical place for these old dinosaurs in competitive environment with their continued mainframe tradition of providing the most trusted and resilient platform for large businesses in this competitive world with minimal risk [7]. Strip out the emotionalism or bias toward a particular technology or platform, and determine what the business requires. For example, ascertain whether agility and speed are the most critical business requirements, or whether service or lowest cost is the highest priority. This doesn't suggest a bias toward or away from the mainframe, but can provide the guiding principles about which platform(s) you should be using in three to five years and when we think to span our business for generations then there is no other choice than Mainframes, as we see its track record in last 5 decades already.

Many mainframe installations have modernized their applications/workloads; therefore, organizations should not presume that the only way to modernize is to get off the mainframe. Modernization is sometimes mistakenly conveyed by those who don't use mainframes who think of them as some 50-year-old hardware running in a corner in the data center. Today's IBM System z has sophisticated chip and system design and advanced virtualization, provisioning, availability, security and workload management capabilities.

Migration off the mainframe may or may not be the right decision for any organization. Infrastructure and operations leaders must understand the implications of key factors such as time, cost, workload, business impact, capacity planning, staffing skills and tools.

The situation is very paradoxical, indeed, these machines are seeing as old and creepy, but in reality they’re the most technologically advanced. Here is a definition I found quite ironic and relevant.

“An obsolete device still used by thousands of obsolete companies serving billions of obsolete customers and making huge obsolete profits for their obsolete shareholders.”

- The Devil’s IT Dictionary

IV. ANALYSIS METHODOLOGY

Our methodology is the systematic, theoretical and practical analysis of the methods applied to analyze best infrastructure which can be used for decades without a single shutdown and reap the safe and maximum profits in your business plan.

This research paper will elaborate the facts and figures and propose successful models how the new releases of zEnterprise can provide the most cost effective, flexible, easier-to-manage solution than "One architecture fits all" alternatives with sophisticated virtualization technology, standardization and rapid provisioning of virtual servers and applications [18][19]. Most companies using mainframes have managed to achieve a perfect blend of the two technologies to meet their computing needs. However, smaller organizations, due to the huge cost associated with maintaining mainframes, have migrated to client/server systems. The main focus of this study is to understand the value of the Mainframe in Industry. In order to excel in today's competitive environment, businesses need to support these processes, and efficiently manage the massive volumes of data they drive, with minimal risk. To research how mainframes deliver competitive advantages that allow businesses to become more successful and contribute to a smarter planet.

Here it would be necessary to unleash how mainframe can deliver cost efficient model to Industries in a competent environment:

1) Consolidation of mainframes - There are fewer mainframes in use today than there were 20 years ago because of corporate mergers and data center consolidations. In some cases, applications were moved to other types of systems, because there is no such thing as a "one size fits all" solution [18][19]. However, in most cases the reduced number is due to consolidation, that is, several smaller mainframes have been replaced with fewer but larger systems. Today's mainframe is considerably more powerful than past generations [15].
2) Mainframes require fewer staff when supporting hundreds of applications. Because centralized computing is a major theme when using the mainframe, many of the configuration and support tasks are implemented by writing rules or creating a policy that manages the infrastructure automatically. This is a tremendous savings in time, resources, and cost [15].
3) As an aid to consolidation, the mainframe offers software virtualization, through z/VM. z/VM's extreme virtualization capabilities, which have been perfected since its introduction in 1967, make it possible to virtualize thousands of distributed servers on a single server, resulting in the significant reduction in the use of space and energy.
4) Integrated Facility for Linux (IFL) this is a processor used exclusively by a Linux LPAR or Linux running under z/VM. An IPL of the LPAR performed only to run either operating environment. This processor type is accompanied with special user licensing incentives. Because these incentives reduce cost, they are not counted towards the overall capacity of the machine [8]. This can make a substantial difference in software costs.
5) Each processor in a system (or in an LPAR) has a small private area of memory (8 KB starting at real address 0 and always mapped to virtual address 0) that is unique to that processor.
6) A processor can interrupt other processors by using a special instruction (SIGP, for Signal Processor). Again, this is typically used only for error recovery.
7) A major difference between a sysplex and a conventional large computer system is the improved growth potential and level of availability in a sysplex. A sysplex generally provides for resource sharing between communicating systems (tape, consoles, catalogues, and so on). The sysplex increases the number of processing units and z/OS operating systems that can cooperate, which in turn increases the amount of work that can be processed.
8) Each LPAR can concurrently cache shared data in the CF processor memory through hardware-assisted, cluster-wide serialization and coherency controls. As a result, when applications are "enabled" for this implementation, the complete benefits of the Parallel Sysplex technology are made available.
9) An important design aspect of a Parallel Sysplex is synchronizing the TOD clocks of multiple servers, which allows events occurring on different servers to be properly sequenced in time. As an example, when multiple servers update the same database and database reconstruction is necessary, all updates are required to be time stamped in proper sequence.
10) Today's mainframe processors are real fast processors (clock speed for zEnterprise196 is 5.2 GHz).
11) A special logical partition that provides high-speed caching, list processing, and locking functions in a sysplex.
12) Another unique advantage of using Parallel Sysplex technology is the ability to perform hardware and software maintenance and installation in a non-disruptive manner.
13) Mission-critical applications – where business can't afford failure (System Z stands for zero downtime)
14) More physical memory and greater virtual memory addressing capability (Total Memory is 3 TB in for zEnterprise196).
15) Dynamic capabilities for upgrading Hardware and Software (Total capacity in new zEnterprise196 is 52,286MIPS) [13]
16) Enhanced I/O devices and more and faster paths (channels)
17) Sophisticated I/O attachments
18) Increased ability to divide resources into multiple, logically independent and isolated systems, each running its own operating system – LPAR.
19) Enhanced clustering technologies (e.g. Parallel Sysplex) Architecture describes the organizational structure of a system.
20) In a Parallel Sysplex cluster, it is possible to construct a parallel processing environment with no single points of failure. Because all of the systems in the Parallel Sysplex can have concurrent access to all critical applications and data, the loss of a system due to either hardware or software failure does not necessitate loss of application availability.

21) A single mainframe can reduce the cost of maintaining hundreds of servers (only use power per MCM up to 1800W) [6] [7].
22) Reduced cooling cost in datacenters and Reduction in server administration cost [6].

There are many ways to reduce your mainframe cost structure without investing in a major migration project:

- Determine if you are taking maximum advantage of IBM's lower-cost specialty engines.
- Check that you are optimizing the use of sub capacity software pricing models.
- Take advantage of the IBM and third-party workload tools that can determine if you are running your workloads in an optimal manner.
- Take advantage of more current (and more efficient) compilers.
- Eliminate redundant software products and, if practical, win now the number of software vendors with whom you work.
- Calculate if upgrading to current hardware will lower total cost of ownership (TCO), because of offsetting software and maintenance savings.
- If the Resource Demand Distribution report allows a high value for files in the 'CAUSING CPU WAIT', to determine why the files are causing wait. Explore whether the Performance profile relates this wait to internal contention or high physical access or whether it suggests the possibility of external contention.
- If the high physical access causing wait time, we may again take directions from Resource Demand Distribution report which indicates that the high percentage appear for ddnames in the 'CAUSING CPU WAIT' column under the PERCENT OF RUN TIME SPENT heading. Here you may find that options such as the default values for block sizes and buffering are creating undue wait. For files with access methods such as VSAM, the Dataset Characteristic Supplement report and VSAM LSR Pool Statistics report, which details buffering, provide important information

It is important to work out the impact on current business. To protect themselves, enterprises should have a BCP (Business Continuity Plan), which is a logical plan describing a practiced and validated methodology. It then helps to fully recover from disasters and to restore partially, or even better, completely their critical functions to continue business process. There are many ways to do it, but the most efficient is to have a full backup of its production Data Center. It is as if customers had a spare of their entire system, if you prefer.

A distributed system should be very difficult to replicate exactly. Even if efficient cluster solutions exist, they remain long and complex to configure, even more if the machines number is high. Now, when distributed servers environment begins to show their limits and defects, consultants discovers once again qualities of the Mainframe.

The Mainframe's technologies still remain the most advanced, and it's not surprising. Indeed, IBM invests more than $1 billion for each Mainframe generation, to offer the most advanced hardware and system. There is not much marketing about system Z and others IBM platform products, only 20% of its budget is dedicated to it. The goal is to offer nothing but innovations.

V. PROMISING TECHNIQUES USED IN MAINFRAME

1) Worldwide IT Spending on Servers, Power, Cooling and Management Administration
2) Smarter computing is required!
3) Adopting Smarter Computing Strategies Reduces Costs and Improves Value.
4) Consolidate servers on virtualized platforms
5) Leverage systems optimized for specific workloads
6) Reduce labor costs with a private cloud – Management
7) Architecture describes the organizational structure of a system via Parallel Sysplex [13] [14].

These three concepts are also known as "RAS". RAS is one of the most important things when you talk about a system or an infrastructure, as it includes numbers of aspects of a computer and application, revealing its capacity to be in service every time [10] [11] [13]. In fact, we can define a system in seconds knowing its RAS level. The more an infrastructure RAS level is high, the more it may be trusted. We can then talk about a 24/24 and 7/7 service, which mean there is no down-time accepted, and we expect IT infrastructures with RAS characteristics to have a full up-time. These features help a system to stay fully operational for a very long period (months and even years for Mainframes) without reboot or crash. It seems important to define precisely each terms of RAS. As you may notice, these are hardware and software attributes, which may be founded in distributed environment systems but which truly are prized by Mainframe users. Here is the definition of each characteristic.

A. Reliability

Ability to avoid faults, if founded, they're very quickly fixed [13].

B. Availability

Deals with the up-time, which means the amount of time a machine will be running and being fully operational, even if a problems occurs. For example, a system with continuous availability would stop a process causing problem and will go on without having to launch other services after fail [13].

C. Serviceability

Ability of the system to diagnose itself. It can then detect faults before they happen and fix them. It avoids significant human intervention and downtime caused by maintenance [10] [11].

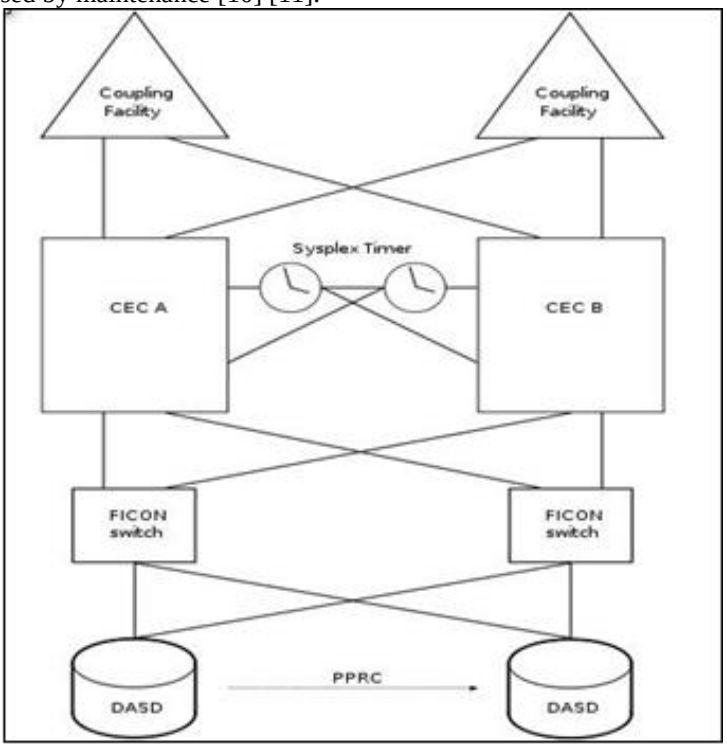

Fig. 1:

In computing, a Parallel Sysplex is a cluster of IBM mainframes acting together as a single system image with z/OS. Used for disaster recovery, Parallel Sysplex combines data sharing and parallel computing to allow a cluster of up to 32 systems to share a workload for high performance and high availability. The Parallel Sysplex was introduced with the addition of the Coupling Facility (CF) with coupling links for high speed communication, with MVS/ESA operating system support, together with the mainframe models.

The primary goal of a Parallel Sysplex is to provide data sharing capabilities, allowing multiple databases for direct reads and writes to shared data [8] [9].

This can provide benefits to

- Help remove single points of failure within the server, LPAR, or subsystems
- Application Availability
- Single System Image
- Dynamic Session Balancing
- Dynamic Transaction Routing
- Scalable capacity

VI. CONCLUSIONS

This is the only system we expect to NOT stop, crash or fail. It requires unmatched qualities, such as security, availability and integrity. Supporting hundreds of thousands I/O operations due to numbers of simultaneous transactions which can be potentially vital for initiators, it just have to be sure. In people mind, a machine crash is a "normal" thing, it can happen anytime for any reasons, you just have to reboot it, and that's it. A Mainframe executes so much critical applications it cannot crash [13].

Mainframe technology has been around for over 50 years and has evolved into the IBM zEnterprise System, the first, truly integrated and virtual system of systems [4]. Incorporating some of IBM's leading software and hardware technologies, the zEnterprise allows clients to run appropriate workloads – from database and transaction processing to analytics to Web-based interactions – on the best server available for the job. While some pundits continue to dismiss the mainframe as "yesterday's technology".

IBM continues to provide companies, big and small, new levels of integration that drive down costs, save energy and provide the levels of performance required for a smarter planet. Far from being "dead" or irrelevant, the mainframe is uniquely positioned to service present and future enterprise computing requirements with efficiency and effectiveness that distributed systems cannot match [5] [17].

The reality is Mainframe Technology is vibrant and improving each generation which are designed to run many workloads at high utilization rates. Customers can leverage their legacy application with modernization to achieve business advantages, already number of available applications on the mainframe is growing. The mainframe's hardware and virtualization capabilities process more work per KW consumed than distributed technologies.

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