6.1 Introduction

When the business grows, utilizing the space you already have is extremely important. Every organization is now going to make info available to their customer digitally. IBM z computer System saves the money for company growth value space while bringing it to top performance in Trusted Cloud computing as well [9]. Enable your company with Cloud on z to save you the server space equivalent of a football field. Adopting cloud can be a huge risk [58], but not with z System's lower risk of exposure and a reported annual downtime of less than 4 hours. Remove core IT complex processes leaving the enterprise with resources and timings for achieving organizational goals. The System offers an enterprise with expanded visibility, control and automation for cloud deployment and service management. New marketing strategy forces to change the phase of each industry and requires each business to transform and embrace digital business. It supports existing clients with newest offers and services, while helping new citizens and businesses gaining accessing to services and products and societal benefits. The transformation requires an infrastructure of IT which will be secure, efficient, integrated and adaptive [33]. It provides designs for handling broad growth of increasing mobile clients to leverage broad data amounts, and offer deepest real-time insight for highest impact of business. The used resilient and secure infrastructure cloud is ready.

6.2 Secure and resilient cloud ready infrastructure

Several topics have been discussed to address the cloud computing need and now it’s time to concentrate on the need of infinite power resilient and secure cloud infrastructure. Some of the research communities have addressed different aspects of problem, highlighting research traditions, problem perspectives, and analytical techniques [1][40]. While we don’t have all the answers, it appears that a few themes are key to solution: the
rules of Business and open standards. Let us look at both. Instead of saying “z is best” or “SoftLayer is best,” let business rules dictate the deployment platform. The rules are making decision which is based upon certain features of workload like:

Does workload need a higher SLA in uptime or response time?

Is workload data protection requirement and there is a regulatory need to keep the data on-premises?

Is there a potential for a lower total cost deployment?

These points are captured in number of business rules which is executed when service is requested by the customer. It is based upon business outcome rule that the “BEST FIT” cloud infrastructure is selected. The options for cloud infrastructure can span to off-premises environments. OpenStack, Open standards in particular, play an important role. Underlying the infrastructure resources should be accessed in the same standard-based way regardless of real platform selected. OpenStack offers number of APIs which allow this standardized access. This is fine if we spin up a bunch of VMs. But in many cases, it goes beyond that. Patterns simplify use of complex applications during reducing risk [58].

There are two parts to a patterns discussion— the infrastructure itself and the software configuration on top of that. Open approaches are needed here. The Heat Orchestration Template is a document that describes the deployment pattern. The Heat Orchestration Template is an OpenStack construct that deploys the infrastructure pattern defined in a HOT document, using OpenStack APIs. When infrastructure is used, middleware is required to configured and installed.

Open technologies like Chef help automatic software configuration. The Chef server manages software configuration policies and stores resources (recipes, cookbooks, etc.) which define how the software configuration can proceed. The Chef client is asked from Chef server what it will look like, pull the configuration down, and proceeds with the software configuration. HEAT and Chef comes together to provide open standards based patterns to deploy infrastructure and software together. IBM is making 13 such available patterns that work with Linux on z. Clients can customize them, or build their own using
editors like UrbanCode Deploy with Patterns. We require an eco-system for developing here, where open standards based patterns are published and consumed by IBM, partners, and clients.

I believe this method of automation and standardization makes first-class z Systems participant in the strategy of enterprise hybrid cloud [40]. In special issue the three articles are representing three individual views as to how distinct IT professionals thinsk of clouds and cloud computing [44]. In the first article, “Navigating the Application of Next-Generation Architecture,” Chuck Hutchinson, Karen Castilon, and Jeff Ward suggest which cloud computing is referred to convergence of added technologies. This article illustrates the newest core components and cloud computing-oriented application architecture. He discusses how organizations should react to the challenges from both a business and technical perspective. In this paper, Robert Grossman highlights “The Case for Cloud Computing,” uniqueness of clouds providing the ability to offer resources and services on network with unprecedented scale and simplicity [10][27]. The paper is categorized into two types of clouds based upon goals, one providing on-demand compute instances and another providing capacity of on-demand computing[36][43]. The thesis discusses cloud hosting, a pricing model, and cloud deployment challenges [15]. In the final article, “Business Models in the Service World,” Christ of Weinhardt, Arun Anandasivam, Benjamin Blau, and Jochen Stober focus on comparing the differences between grid computing and cloud computing through criteria [17][18][28]. This thesis proposes cloud business model ontology and uses it to analyze several well-known service providers. As you read the three focused theories in this issue, we invite you to keep an open mind about what is or is not cloud computing [28].

Are you thinking that the offered paradigm is different?

Is it same old IT packaged up in new bottle? Or is it really new wine?

This research talks about the noise which is prevalent everywhere about clouds and cloud computing [28]. Although this concept has gained momentum significantly and in industry and academia attention, no definitions exist yet [1][47][55][56], which begs the
question, how can there be so much buzz about something without an accepted definition(s)? It seems quite counterintuitive. It is widely accepted that the cloud computing is referred to newest IT paradigm for customers [28][37][55]. But before the premise, see the historical perspective 2 where cloud computing fits in and is adapted in different or next fashion. Cloud services are representing cost-efficient and attractive continuation of application service provider and server-based computing models. In combination with universal thin client solutions, the cost benefits apply not only to the data center but also to desktops.

Security in the cloud and on the Desktop via Surveys like the aforementioned IDC study proves that users expect ever increasing competence from cloud computing providers when it comes to data security [4][6][29][38]. In Switzerland, 70% banks are outsourced part of IT, according to Services4Banks provider AG [12]. Important factors are outsourcing service provider which has professional know-how, information is anonymized and data availability is guaranteed by service level agreements. An example from Germany is Finanz Informatik, the IT service provider for the Sparkassen-Finanzgruppe, where a German saves the banks group which completes the bank solution of OSPlus that encompasses thin client computing to remote support and administration. Along with, thin clients scenarios can support different encryption and virtual private networks methods [53].

6.3 One Architecture fits all – IBM Mainframe

IBM z13 Mainframe Launches -- Most Powerful and Secure System Ever Built enabled for processing transactions 2.5 billion per day, mobile build for economy that is possible to make real-time encryption on the mobile transactions for scaling, embedded analytics with mainframe system provides real time transaction 17X insights faster than comparing competitive systems for fraction of cost which is delivering economics and scale together with analytics and real-time encryption for meeting the expectations of users for safety and speed for billions of transactions in mobile economy [48]. The z13 is private ideal or hybrid cloud architecture, legendary to scale and reliably and securely handle multiple
workloads. In scale-out model, it is running up to 8,000 virtual servers - more than 50 virtual servers per core, help to lower software, facilities and energy costs [25][40][50].

The z13 cost is lower than running cloud. To compare the environments, it is estimated that a z Systems cloud on a z13 contains a 32 percent lower cost of the ownership over three years than an x86 cloud and 60 percent low cost ownership over three years than a public cloud. In addition, the z13 has been based upon fully support Linux, open standards and OpenStack. IBM Global Finance is offering newest model z13 including customize Market Value lease with payment deferral for credit qualified customers which is upgraded into old models to z13, converting owned z system for lease during upgrade, or acquire newest z13.

Their comparison Performance is based upon Internal IBM test which is compared with IBM z13 cloud with privately configured x86 cloud and comparable configuring public cloud running on an aggregation of light, heavy and medium workloads which is designed for replicating workload usage IBM customer in market [9]. System configuration is based upon equivalent ratio which is derived from the IBM internal study and is as follows: Public Cloud configuration: total of 219 instances (128 for light workloads, 64 for medium workloads and 27 for heavy workloads); x86 Cloud configuration: total of eleven x86 systems each with v2 3.0GHz cores, 24 Intel E7-8857, 7x400GB SSDs, 512GB memory, ; z13 Cloud configuration: total of 3806GB memory, 32 IFLs and 47x400GB SSDs with Storwize v7000. Price comparison is estimated based upon the 3YR Total Cost of Ownership with use of publicly available U.S. prices current as of January 1, 2015. Public Cloud TCO estimate includes costs of infrastructure, labor and middleware. Z13 and x86 TCO is estimated is included costs of infrastructure, middleware, power, floor space and labor. Results may vary based on actual workloads, system configurations, customer applications, queries and other variables in a production environment and may produce different results. Users of this document should verify the applicable data for their specific environment. The z/OS mainframe is cloud platform, fifty years ago; IBM unveiled the System/360—the first purpose compute system is
designed specifically for business—calling it “the beginning of a newest generation, not only of computers, but of their applications in business, science and government” [59].

Cloud on Mainframe - The IBM z13™ is based on a heterogeneous infrastructure, with end-to-end management capabilities for flexible delivery of high value services. The requirement is for all these infrastructure components to be managed from a single, central Common Cloud Management Platform and be able to place instances of each cloud service on the corresponding infrastructure [31]. The list of software designed to run on System z and IBM Power servers is long, but what's compatible with x86 is much longer. IBM can talk about support for Linux, KVM virtualization, and OpenStack, and ambitions to see all sorts of third-party software running on mainframe [35]. But the software that can run System z today and what IBM hopes for are two different things.
Where big companies already have big-iron workloads, the System z has already proven its appeal in workload consolidation, private cloud, and hybrid cloud scenarios[40]. But where the core of cloud deployment and big data activity is concerned, it will be an uphill climb for IBM to persuade those communities to run on System z, no matter how trivial porting software might be.

The z13 better addresses mobile workloads simply by offering more processing power [48]. Another answer here is z/OS Connect, a connector technology that supports the delivery of information from CISC, IMS, and DB2 in a restful manner with simple API calls. Billed as a linchpin of Web, cloud, and mobile enablement for mainframe, z/OS Connect as introduced last year. It is compatible with z12 servers [23][27][49].

IBM also hopes that mobile apps might be developed to run on the mainframe. Here, IBM has ported its Mobile First mobile app development portfolio to run on zSeries, and IBM says there are also plans to support IBM's Cloudant NoSQL database service and third-party products like MongoDB on mainframe. NoSQL platforms, often running in the cloud, are where the lion's share of mobile development and application delivery is happening these days. It remains to be seen whether third-party vendors and customers will bring this work onto the IBM mainframe in IBM's cloud [35].

IBM says z13 can easily support distributed systems that have become synonymous with big data analytics, but here, too, IBM's ambition will confront market realities. IBM has ported its own BigInsights Hadoop distribution to run on mainframe, for example, but there hasn't been a stampede of third-party players in the big data community following suit. Veristorm, for one, has a Hadoop distribution ported to run on System z, but most distributed big data platforms -- Hadoop and NoSQL databases -- were designed specifically to run on commodity x86 servers. The whole idea is cheap compute. IBM says that with virtualization, one System z chip can handle the equivalent of 15, 20, or even 25 x86 chips. But if the software was designed to run on x86 and nobody has bothered to port it, it's a theoretical argument.
Linux on a mainframe is not a new idea. Red Hat and SUSE are already there. Linux on an affordable mainframe is the new idea [22]. It was this vision for computing that made possible the creation of bar codes, ATMs, electronic stock trading, online travel reservations, weather modeling and countless other inventions that have changed the way the world works. Sixteen years ago, the future of Linux, then a new software phenomenon, was hanging in the balance. IBM rode to its rescue by endorsing it for the mainframe. The IBM seal of approval removed doubts among enterprise users about the viability of using Linux and other open source code in the data center. Now, IBM is hoping Linux will, in turn, ride to the rescue of the mainframe. IBM’s statement is as timely and true today as it was then, in the context of the evolution that’s occurring within IT via cloud computing. The System/360 ushered in the era of flexibility, adaptability, and economy for IT. It pioneered the concepts of backward and forward compatibility, the ability to add capacity as you needed it, and protecting the client’s investments in their technology, applications and data [7].

As we talk about the next inevitable phases of cloud, like platform as a service (PaaS) and software as a service (SaaS) [3][14][15][33][35][36][45][46][54], we encounter some very specific themes and challenges that cry out for systems with those qualities:

- How do I provide multi-tenancy with the greatest number of people sharing the same machine as possible, securely and efficiently?
- How do I dynamically scale an environment immediately without waiting for provision?
- How do I provide each user a unique performance experience on the smallest number of systems possible?
- How do I keep track of how much capacity each user is using?
- How do I support thousands of users with a handful of IT professionals?

If there were an ideal operating system that could provide multi-tenancy, dynamic scaling, a unique user experience, fine-grained usage monitoring, and that could support
thousands of users with a small group of admins, PaaS and SaaS solutions would be simple [3][14][33][35][36][45][54]. Oh wait, there is—z/OS available.

There are two sides as to why the mainframe market is still going strong. One is lock-in—an old business-critical application running on a mainframe, with many years of business logic built into it, costs a fortune to migrate elsewhere. The other is the mainframe's relevance in modern hybrid cloud architecture [50], running VMs on-premise and storing petabytes of data. The mainframe "has evolved a lot over the years. You can run Linux on the mainframe. We're leveraging Linux to do a VMware-like cloud environment—essentially a private cloud—on the mainframe."

"A lot of what these big providers are doing is really trying to recreate the mainframe by hashing together a lot of servers."

A private cloud made from many commodity boxes—one that can provide, say, 5,000 virtual machines—has things in common with a mainframe. Both contain huge pools of CPU and memory for virtual machines, and massive amounts of storage for objects and images. Both run an OS that virtualizes workloads to maximize efficiency. Both can deal with high volumes of transactions. Many of the scaling problems being encountered in the cloud were solved long ago by mainframe technicians [40][45]. An enterprise that runs Java on-premise may find a mainframe useful—ZAAP to execute java code. "z/OS is probably the most efficient place to run Java. You put the code where the data is, and you get to remove any network latency for the transaction" [10][46]. The Mainframe's place in the modern cloud world deliver the agility, efficiency, and quality that cloud computing provides. One beefy mainframe can be more useful than a fleet of commodity boxes, but only for certain types of work. No one is going to buy a new IBM z10 for small workloads—that would be like buying a big truck for the school run—but on a large scale it can be a better choice [49]. Despite the high cost, mainframe use may be cheaper than commodity hardware use for enterprise-scale workloads. They might not be as fashionable as cloud computing, but the mainframe remains at the heart of many computing environments. These behemoths of computing might not be as exciting to
young developers as cloud and mobile projects, but mainframes are still the power behind many business applications.

According to a survey of CIOs more than half (55 percent) of enterprise applications call upon the mainframe to complete transactions. And that shows little sign of decline – nine out of ten of the CIOs surveyed said their mainframe workloads are increasing, and distributed applications have caused a 44 percent increase in workload over the past five years. Nine out of ten said new customer-facing applications are accessing the mainframe; however this combination of old and new technologies is adding to the CIOs' headaches - three quarters of CIOs said the complexity of applications working across distributed and mainframe environments is making problem resolution take longer. Four out of five said they had no visibility of the actual end-user experience and 63 percent of companies admitted they were often unaware of performance problems until calls start coming into the help desk [34][40][45]. Mainframes tend to be stable and reliant pieces of infrastructure, bought so long ago that the costs have long since been written off. And while cloud services might be attractive for new or particularly burst type of applications, for long-standing and predictable processing jobs these hunks of big tin are still extremely useful to IT departments. In addition, rewriting mainframe applications for the cloud age is no easy feat. One problem with mainframes is that most of the engineers with the relevant skills are nearing retirement: one company recently described the search for younger staff with the right skills as "looking for a unicorn." The web did not kill print, MP3s did not kill the record industry, the mobile phone did not kill the desktop, and cloud computing has not killed off the mainframe. These disruptive technologies have caused drastic shifts in their markets. Hodgson compared today's IBM z10 mainframe with the original System/360. "It's a 50 year old machine, in a sense.

It's evolved and improved and IBM's poured billions of dollars into it, so it's kept pace." You could say the mainframe of old really is dead—adaptation of each new IT disruption has changed it into a different beast. What was once only accessible to COBOL and Assembler programmers is now available to anyone. Today, a team of young IBM hardware and software developers is creating simple web-based interfaces for z/OS,
which will allow any programmer with web development experience to use this powerful
platform for PaaS and SaaS [3][23][27][35][36][54].

IBM also continues to refine the technology and the delivery of mainframe computing for
cloud applications [57]. The new IBM Enterprise Cloud System can support up to 6,000
virtual machines in a single system, provide a secure multi-tenant environment and
dynamically share resources across enterprise workloads, with higher system efficiency
and greater scalability that lowers the total cost of Linux cloud deployments by up to 55
percent over comparable x86- based cloud infrastructure [45][52]. And the new “IBM
MSP Utility Pricing for System z” pricing model, delivered through IBM Global
Financing, provides consumption-based pricing designed especially to make mainframe
technologies more widely accessible to Managed Service Providers. This consumption-
based approach allows MSPs to focus on building their businesses, rather than on the cost
of their infrastructure.

These innovations unlock the potential for z/OS and the modern mainframe to be the
cloud platform of choice, enabling people to create business solutions built on the most
secure, available, reliable cloud infrastructure ever known. The mainframe is IT’s original
cloud, and there are still ways to float cloud operations onto big iron today. The
mainframe is the original cloud. Since the 1970s, big iron has shared a virtualized
environment between hundreds of users and processes. The cloud world inherited some
concepts from the mainframe world that came before it. The consumption-based pricing
model, Linux virtual machines, and multi-tenancy came from that previous mainframe
generation. NASA got rid of its mainframes, but these massive machines can still be
found in many large organizations. Just as on the cloud today, mainframe users weren't
aware of the computer's location or its configuration; they just used the applications as a
service. All the shared resources, centrally administrated, wrought maximum efficiency
out of space and power. This matches today's definition of cloud computing [8][31].

137
6.4 Solution overview

As an example of thesis cloud solution, we have used a telecom provider that selected the IBM z Systems platform for the provider's Linux operating system consolidation and virtualization. That company wants to build a cloud platform but also wants to reduce its cost of operation and overall data center footprint. The company's strategy is to improve provisioning time for its business support system (BSS) and operational support system (OSS) to satisfy server requests of its users.

Perhaps the most obvious example of a mainframe cloud today is IBM's Linux on System z (zLinux) guests on the mainframe hypervisor z/VM, running on Integrated Facility for Linux processor engines. Automation lets developers create customized zLinux images on demand [14][43]. Administrators in production can bring the servers up or down as needed. The z/VM hypervisor supports z/OS guests as well. For example, I've worked
with fully automated z/VM scripts that initial program loaded an MVS image, started
CICS, ran test transactions, gathered performance data and then shut everything down.
Creating z/OS images is a little more complicated than zLinux, and z/OS brings in IBM's
capacity-based pricing.

IBM also offers a zPDT personal development tool for running a z/OS image of x86
server hardware. With the right planning and infrastructure, enterprises can use zPDT to
create many "little" mainframes for developers and systems programmers. A little
creativity could also extend the mainframe cloud concept to many popular subsystems.
IBM sells Batch Terminal Simulator (BTS) for IMS developers. Originally intended to
test online IMS programs in batch, BTS now extends to Terminal Sharing Option users.
Through BTS, each user has a copy of IMS, along with access to local or global
databases. DB2, IBM's relational database management system, tends to be monolithic,
but supports a three-level table naming scheme. This means an IT shop could conjure a
strong naming convention and a database utility infrastructure to enable developers to
cloned private copies of production databases. CICS can play the mainframe cloud game
too. Most shops run CICS online transaction processing as a started task, but there's no
reason that stops an application programmer from submitting an instance as a batch job.
The IT shop needs some infrastructure to tailor, create and submit the CICS instances to
the developers' specifications. But, once the job is submitted, each programmer has a
CICS instance to mangle to their own delight.

The z13 isn’t the first mainframe that IBM has promoted for cloud. In fact, the company
has been actively pitching such solutions for over half a decade, starting in 2009 when
Brazil-based Hoplon Infotainment began using an IBM z System “gameframe” (a
mainframe bolstered with GPUs) to host online gaming services and communities.
However, the mainframe’s association with cloud began well before that. Cloud, after all,
is simply the latest term for highly virtualized systems monitored and managed with
mainly automated tools. IBM led the way to that destination in 1972 with its VM/370
system and these technologies have played a major role in the mainframe ecosystem ever
since. The mainframe is also centered to IBM’s belief that public clouds should support
multiple hardware platforms. Why so? Because it allows cloud infrastructures to adequately or utterly mirror customers’ private IT environments and thus fully achieve the vision of hybrid cloud. In fact, mainframes are used in the company’s managed cloud offerings, and are a notable part of the success IBM Cloud enjoys among large enterprise customers.

What makes the z13 cloud-ready? Is the new z13 as firm a foundation for the cloud as IBM claims? Consider first what business customers want or need from the cloud. At one level, the cloud represents a successful implementation of the “utility” computing vision vendors and businesses have been espousing since the late 1990s. That is, a service that allows customers to turn on compute capacity like a light switch, and dial it up/down as they would water from a faucet. Delivering “instant on” features and virtually unlimited scalability requires computing platforms to support remarkable Reliability, Availability and Serviceability (RAS) capabilities and business continuity. Plus, security is a big deal for enterprises, which is not surprising since 2014 was a banner year for business-focused hackers [4][24][26][29][38][40][41][42]. Don’t forget candidness – with the understandable exception of Microsoft’s Azure, virtually all of the world’s major clouds leverage Open Source OSs, software and tools. Lastly, organizations want the cloud to support both the processes they use today and the applications and use cases they expect will arise in future. According to IBM, a single z13 system can support as many as 8,000 virtual servers, and is significantly cheaper to operate than x86 and public cloud alternatives, making the z13 a capacious and cost-effective cloud by any measure.

In study after study, IBM mainframes deliver higher levels of RAS and business continuity than virtually any other hardware platform. The z13 should be no exception. Mainframe security has long been world class which is why the vast majority of banks and other financial institutions buy and use IBM’s z Systems. The z13 builds on that with acceleration technologies that double encryption speed. Enterprise-grade Linux and open technologies have long been key to IBM’s mainframe success story, representing over half of z System annual sales. With this launch, the company has added several updated cloud-centric features along with the new zKVM hypervisor and Cloud Manager with
OpenStack v4.2, meaning that the z13 can be configured as an entirely open cloud environment.

Finally, at the launch IBM’s announced increased mainframe connectivity to Bluemix, a Cloud Foundry-based platform that can be used to easily and rapidly develop next generation mobile and web applications [27][44]. There are multiple levels of redundancy and the mainframe can be configured while it is running. Applications, or workloads, run in logical partitions, IBM's term for virtualization, which it introduced on the System/370 mainframe in 1973. A platform for modern times - The mainframe has kept up with shifts in computing paradigms and application systems, such as the move to the web and mobile technology [1][37][55]. "The platform is continually reinventing itself to remain relevant for cloud and mobile computing and to be able to run the most popular application server packages". This means the mainframe is behind much of the technology in modern society. "If you are using a mobile application today that runs a transaction to check your bank balance or transfer money from one account to another, there are four in five chances that there is a mainframe behind that transaction" [16].

The mainframe has also enabled customers to evolve legacy applications to modern computing. The application logic remains unchanged, but the user interface is now being rendered on a mobile device or a web page. According to analyst Gartner, 92 out of the 100 largest banks in the world, use System z mainframes. But since the dawn of the client server era of computing, IT shops have been trying to migrate away from mainframe systems [20]. The biggest threat to the mainframe is arguably hyper-scale computing, favored by the big internet companies. New age web-scale IT organizations such as Amazon, Google, Facebook and PayPal do not choose to run their applications on mainframes, says Gartner [30][32]. A 2012 study from WinterGreen Research demonstrated the savings of an IBM zEnterprise 114 mainframe over a VMware setup using HP ProLiant DL685. WinterGreen Research calculated that a suite of Linux web services applications running on 80 HP blade servers with VMware would cost $127,225 a year, while the same application configuration on the zEnterprise 114 would cost $67,787.
The zEnterprise 114 (or z196) server is cost-efficient because it uses less power and fewer software licenses, the study said. Such savings make the mainframe a logical choice for running public cloud services, yet, major hardware firms, including IBM, have failed to gain traction here. IBM System z workloads and initiatives, says: "It's an uphill battle with tier 1 cloud service providers because they grow their own [IT] capabilities, and take a custom approach with white boxes." Instead, IBM has positioned the mainframe as a cloud in a box for tier 2 cloud service providers, which are looking for off-the-shelf products. Of late, IBM has been lowering mainframe prices so that it can continue to play a role in the cloud. It has taken steps to make the mainframe a more attractive host for cloud service suppliers. It announced the first cloud oriented, System z-based offering, the IBM Enterprise Cloud System. The Cloud System is based on a zBC12 or zEC12 mainframe. As it was announced some time back, the zBC12 retailed for about $75,000. In comparison, 2003's mainframe model, the z990 T-Rex, retailed for $1 million.

IBM has announced that the mainframe is now a cheaper environment than x86 servers on which to run Linux virtual machines. Unlike the mainframes that run IBM's proprietary operating systems, the Enterprise Cloud System is geared to run Linux and Linux virtual machines. "Thanks to higher system efficiency and greater scalability, the total cost of some Linux on System z cloud deployments can be up to 55% less than comparable x86-based cloud infrastructure," IBM claims. The cloud mainframes are equipped with special power processors geared to running Linux virtual machines, called Integrated Facility for Linux (IFL) [33]. Each IFL can host 60 virtual machines, and a zEC12 is capable of mounting 100 IFLs. Hence, IBM comes up with a figure of 6,000 VMs for a single mainframe host. An Enterprise Cloud System, in addition to a mainframe Linux server, includes IBM v7000 or DS8000 storage; IBM Wave z/VM; and IBM Cloud Management Suite. End to end solution includes Smart Cloud Orchestrator for configuring and deploying virtual machines; Omegamon XE for monitoring and managing performance of workloads; and Tivoli Storage Manager [9][34]. The suite is the IBM software that provides the automated Linux VM spin up, deployment, and management. IBM introduced new consumption-based pricing models for managed
service providers. If a service provider builds infrastructure based on mainframes, it can pay off the mainframe bill based on its use by customers, instead of an upfront payment. IBM's example of a company that is doing so is Business Connexions, the largest enterprise service provider in Africa. The firm is packaging mainframes into "pop-up" datacenters that can be installed in Telco's remote office to provide Internet services to a previously unreachable area [11][15].

6.5 Advantages for continued success for decades

The mainframe offers many advantages for cloud computing [27]. Below are nine advantages that you should consider:

1. Flexible infrastructure: System z supports a variety of virtualized environments for cloud implementation including the z/VM operating system running virtual servers, hypervisors, blade servers, and logical partitions (LPARs).

2. Scalable support: Mainframe’s provide the ideal platform for big data analytics, data warehouses, production processing, and web applications while supporting millions of users with superior performance [9][27][34][51].

3. Centralized data hub: Estimates prove that up to 70% of corporate production data still resides on the mainframe. This means that private clouds residing on System z have secure access to essential information that can be shared if necessary with adequate access controls, encryption, data security, data masking and integrity [18][46].

4. Compliance: Support for industry standards, compliance regulations and best practices that require data encryption, separation of duties, privileged user monitoring, secure communication protocols, audit reporting and more.

5. Resiliency: The modern mainframe offers a highly resilient platform with the maximum level of availability, reliability, recoverability, security, integrity and performance [18].
6. Security: Mainframe private cloud implementation allows better control with a high level of security transparency providing a view across the enterprise. Enterprises can automate the monitoring and analysis of potential internal and external threats. Mainframe clouds can also decrease the security threats inherent on public clouds with open networks [6][10][24][26][49].

7. Migration: Easy migration of distributed workloads over to the mainframe virtualized environment reduces the number of distributed systems that need to be managed [34][42].

8. Consolidated Workloads: Once the virtual environment is optimized, it is easy to consolidate various workloads on the mainframe while providing any necessary isolation between virtual systems. This also helps reduce licensing fees that would be incurred with distributed systems.

9. Reduced Total Cost of Ownership (TCO): An ease of security management study found that the overall total cost of ownership (TCO) over 3 years for a private cloud based on IBM zEnterprise systems was 76% less than a third-party service provider's public cloud.

Cloud orchestration is the end-to-end automation of the deployment of services in a cloud environment. More specifically, it is the automated arrangement, coordination, and management of complex computer systems, middleware, and services—all of which helps to accelerate the delivery of IT services while reducing costs. It is used to manage cloud infrastructure, which supplies and assigns required cloud resources to the customer like the creation of VMs, allocation of storage capacity, management of network resources, and granting access to cloud software [10][27]. By using the appropriate orchestration mechanisms, users can deploy and start using services on servers or on any cloud platforms [77].

There are three aspects to cloud orchestration:

- Workload orchestration, where workloads are shared between the resources
• Resource orchestration, where resources are allocated

• Service orchestration, where services are deployed on servers or cloud environments

Figure 6.3 demonstrates how cloud orchestration automates the services in all types of clouds—private, public and hybrid.

6.6 Summary

The new z13 certainly isn’t the first IBM mainframe to be “cloud ready,” but it offers numerous features that are crucial to the success of every cloud-bound service provider and business. I don’t expect every vendor or business to appreciate these points, but those who do will discover in IBM’s z13 robust capabilities and powerful benefits that will be difficult to find in many other cloud solutions. As cloud computing becomes more important to organizations of all sizes, does this mean that the venerable mainframe is on
its deathbed? Some suppliers, such as ASG Software Solutions and IBM, think that cloud computing will rule the next 50 years of mainframe use. So it stands to reason, that if you want to reap the benefits of cloud computing, while addressing the top concerns or security and minimizing risk [38][58], that you would select a platform with a reputation for secure architecture, hardware security, operating system integrity, strong security controls, data protection controls, application security, and virtualization isolation [2][13][18][29][34]. It makes sense to develop your cloud computing platform on an industrial strength, scalable, secure foundation – the system z modern mainframe [51].

IBM Cloud Manager with OpenStack for z Systems is an easy-to-use cloud management solution that serves as a control point for cloud managed resources based on the OpenStack. IBM Cloud Manager with OpenStack for z Systems can operate as a cloud management hub that can manage IBM z Systems, IBM Power Systems and x86 resources from a central point of control [31]. IBM Cloud Manager with OpenStack for z Systems also helps cloud administrators manage their cloud resources for IaaS and PaaS offerings [14][35][36][54]. IBM mainframes offer unique capabilities, in terms of virtualization, performance, scalability, security, reliability and availability [14][34][40]. These capabilities have been developed and refined over several decades, and are key to any cloud-based service [60].

Furthermore, IBM combines zEnterprise Linux Server (zBC12 or zEC12), IBM Storage with IBM z/VM, IBM Wave for z/VM and IBM Cloud Management Suite (SmartCloud Orchestrator, OMEGAMON XE and Tivoli Storage Manager) to provide fully automated cloud management and infrastructure foundation. In addition, IBM z Systems will offer IBM Cloud Manager with OpenStack for the z13, opening up z13 to new platforms and simplifying management of virtualized environments [34][60]. OpenStack is a free and open-source cloud computing platform for building and managing cloud environments.