Advisory

The Mainframe as a Cloud Architecture

Introduction

As we watch many information technology (IT) executives build distributed cloud computing environments, we wonder why they *build in so much complexity*. The way we see it, IT managers:

- Start building their cloud after they undertake a major asset/inventory effort (as these managers try to figure out which applications are running on which systems);
- Then go through a major consolidation effort (as these managers attempt to consolidate their applications and databases on larger, scale-up servers);
- Then they move to virtualize their new scale-up servers in order to increase utilization rates while reducing the number of high-availability servers needed;
- Then they struggle to figure out how to effectively manage physical as well as virtual resources (they especially struggle with virtual server sprawl);
- Then they try to back-fit security and resilience into their distributed cloud environment; and, ultimately,
- They turn their attention to how to tune and troubleshoot applications that run in their newly-created, amorphous, distributed cloud.

Now contrast this approach with an approach that uses a centralized mainframe computing environment as a computing cloud:

- A mainframe can support thousands of different applications all within the same chassis — so the need to go out and find where applications may be running (as distributed systems managers do) is no longer required;
- Mainframes can consolidate thousands of severs into a single architecture (so scalability and headroom issues suddenly dissipate);
- Mainframes offer the richest virtualization environment in the industry — bar none (replete with advanced virtualization infrastructure and management tools) — so building and managing virtualized pools is straightforward (even simple…);
- Mainframes offer the industry's strongest security environment (EAL level 5 — the only commercial server that has ever achieved this rating) — and security is designed-into the mainframe architecture — so no "back-fitting" is required;
- Mainframes have a high-speed internal bus that provides incredible bandwidth such that applications and databases can rapidly communicate with one without being bogged down by network latency (improving overall performance); and,
- Mainframes offer broad and deep integrated service management software that allows administrators to visualize and control mainframe resources — as well as enable the automation of rote management tasks.

Further, all of this functionality is integrated into mainframe architecture — as opposed to being a collection of parts that require integration (like the distributed computing cloud model). With all of this built-in functionality, a mainframe can essentially be positioned as an easy-to-deploy, highly-scalable, highly-secure/resilient turnkey cloud-in-a-box!

In this *Advisory*, *Clabby Analytics* discusses cloud architecture as it pertains to mainframe (IBM System z) environments. We start with a discussion of the benefits of cloud architecture (primarily a way to greatly lower data center operational costs) — and follow that discussion with our perspective on why mainframes make ideal cloud environments. We then take a closer look at a class of management tools that can greatly simplify cloud management (integrated service management — ISM — tools). And we conclude with a summary that describes why we believe that a mainframe, when coupled with ISM, provides a better, more highly-integrated, turnkey alternative to distributed cloud architecture.

Cloud Computing: Simply a Different Way to Deliver IT Services

There are probably a hundred different definitions for the term "cloud computing". To us, a computing cloud is simply: "a computing model that pools resources found on the public Internet and/or within private Intranets, and makes those resources available to applications and users via several distribution models". These models can include traditional billing approaches where departments pay for the services they need; and/or clouds can offer service using other service delivery models such as pay-as-you-go usage models.

Why Build a Cloud?

The big reason to move to cloud architecture is to support business growth without growing operational costs at the same rate. Well architected clouds allow enterprises to maximize the use of their systems, storage, and networking resources — and help cut operational costs by assigning the right workloads to the right server; by automating the management of resources; and by automating business process flows.

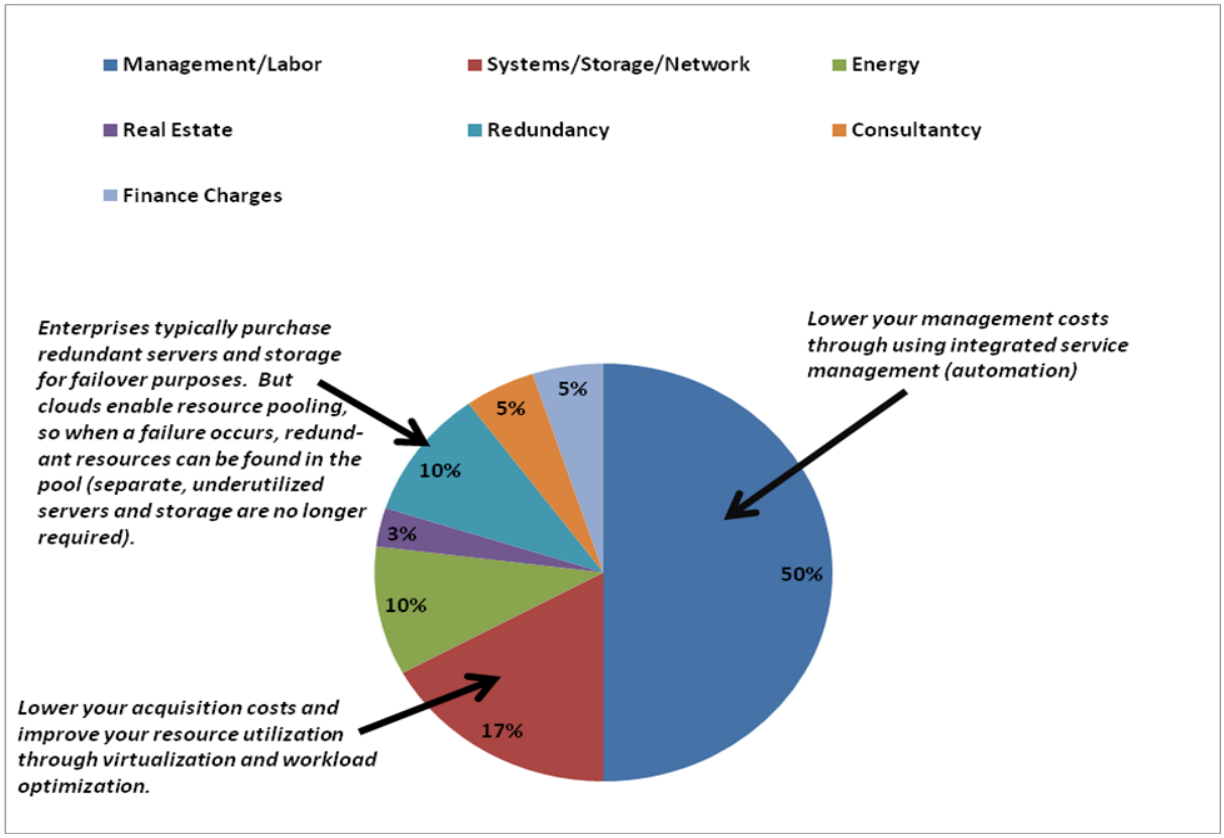
How Does a Cloud Save Enterprises Big Money? Consider Your IT Budget Expenditures

The IT operational budget is usually spent on eight line items:

1. Management labor (often the highest operational cost in the data center);
2. Equipment acquisition costs;
3. Energy consumption (power, cooling, conversion);
4. Redundancy (for high-availability including systems and power/cooling equipment);
5. Real estate;
6. Physical plant (wiring, cabling, fire protection, …)
7. Consultancy; and,
8. Finance charges.

These costs are highly variable, largely dependent on geographic location — but Figure 1 typifies the IT spend we typically see when conducting data center research.

Figure 1: Data Center Operational Costs



Source: Clabby Analytics: December, 2010

The way we see it, cloud computing helps lower IT costs in three ways:

1. By automating rote, repetitive management tasks — serving to greatly lower IT management costs (shown in Figure 1 on the right — the blue 50%);
2. By virtualizing resources — leading to improved resource utilization (the red 17%); and by
3. By pooling resources, enterprises can eliminate the need for redundant servers, network devices, and storage (the light blue 10% slice of pie).

Why Mainframes Make Ideal Cloud Environments

As stated in the previous section, mainframes make ideal, turnkey cloud environments. And the reasons for this are that mainframes are highly-integrated, highly-scalable, highly resilient general purpose computing environments with best-in-class service level capabilities (such as best-in-the-industry security, high-speed internal networking, and so on).

The thing that makes a mainframe different from any other server architecture in the industry is the way that it manages and controls the resources within its boundaries. Mainframes offer the most advanced workload management facilities of any server on the market; the most advanced virtualization facilities; the most automated provisioning capabilities; and the most advanced integrated service management (providing dashboard views of systems performance, security, capacity, power usage, and so on).

If you think about what a cloud does — it matches workloads to available resources. And if you think about how a mainframe operates, it has been designed to match various workloads to available resources in a highly-balanced fashion — while at the same time providing the industry's highest degrees of quality of service. This integrated design — coupled with outstanding quality of service capabilities and superior manageability — is why we believe that mainframe architecture is the best architecture for enterprise-level cloud deployment.

Virtualization Is a Major Differentiator for the Mainframe

The mainframe's advanced virtualization plays a huge role in positioning the mainframe as a cloud-in-a-box environment. Virtualization is all about the pooling and management of resources. Resource virtualization was introduced on the IBM mainframe (System z predecessors) almost 40 years ago — decades ahead of when virtualization was introduced on Unix-based servers and almost 30 years ahead of when virtualization was introduced on x86 architecture. As a result, mainframe virtualization facilities are functionally richer, better integrated, more scalable, more flexible, and better integrated with other infrastructure and management facilities than Unix and x86 virtualization offerings. (Figure 2 shows how mainframe virtualization compares in terms of sophistication to the other virtualization environments).

Figure 2 — System z Virtualization Compared to Other Architectures

Attribute	VMware ESX 4.0	PowerVM	z/VM V6.1
Scalability and Performance			
Real CPU sharing	Up to 20 VMs per CPU (workload dependent)	Micro-partitiong allows dynamic adjustments of 1/100th of a CPU between running VMs	Architecturally limitless; more than 60 VMs per CPU (workload dependent)
Architected maximum number of VMs	320 per copy of VMware	1000 per physical server using PowerVM	Thousands per copy of z/VM
Practical maximum number of VMs	Tens per copy of VMware	Hundreds per server using PowerVM	Hundreds per copy of z/VM
Real CPU and memory capacity on demand	No	Yes, non-disruptively	Yes, non-disruptively
In-memory support	Shared virtual memory pages (detected via background operation)	Active memory sharing dynamically flows memory between running VMs	Minidisk cache; Virtual Disks in Storage; DCSS (shared program executables)
Virtual Machine (VM) scalability	Up to 8 CPUs, 255 GB of memory, modest I/O bandwidth	Up to 256 CPUs, 8 TB of memory, extensive I/O bandwidth	Up to 64 CPUs, 1 TB of memory, extensive I/O bandwidth
Run multiple copies of hypervisor on single server	No	No	Yes; share CPU, I/O, and networking resources with up to 60 copies of z/VM on one mainframe
Flexible Operations			
Command and control, monitoring, automation infrastructure	Modest, yet easy to use	Extensive, robust	Pervasive, robust, time-tested
System co-residency with z/OS	No	No	Yes; LPAR technology lets users run z/VM side-by-side z/OS inside the same machine
Hypervisor-on-hypervisor support	No	No	Yes; run multiple copies of z/VM as guests of z/VM (even new release levels on old releases)
Resource over-commitment support (memory, CPU, network, I/O)	Modest	Extensive	Extensive
Virtual Machine mobility support	Yes; essential for workload mgmt across multiple copies of VMware	Yes, live partition migration supported across (and between) POWER6 and POWER7 servers and blades	Planned future support; dynamic scalability of z/VM lessens need to relocate guest images
Infrastructure Economics			
Cost-efficient disaster recovery	No; typically requires a duplication of hardware and software license fees	Yes, including PowerHA and VMControl system pools	Yes; Capacity Backup on Demand CPUs offer inexpensive multi-system failover options
Cost-efficient technology refresh	No; typically requires re-purchasing new hardware and application verification	Yes, including live migration of VMs from POWER6 to POWER7 servers	Yes; mainframe upgrades offer investment protection and application compatibility

Source: IBM, December, 2010

Figure 2 also shows that mainframes have major advantages in scalability and performance thanks to their sophisticated virtualization capabilities. But it should also be noted that mainframes are also far superior to other virtualization offerings in the areas of automated provisioning and workload management. And this is important because cloud computing is all about maximizing the use of resources.

Clouds maximize resource utilization by:

- Assigning available resources to virtualized pools (where those resources can be exploited by users and applications that need them); and,
- Provisioning those resources (building those resources up with the proper systems/application images in order to execute a workload assignment — and then tearing down those resources when completed and returning those unused resources to the resource pool).

Mainframes are outstanding at managing physical and virtual resources — and at handling workload assignment in a prioritized fashion to virtualization pools.

> ***In our opinion, there is no server architecture in the commercial server marketplace with richer, deeper virtualization facilities — and no commercial server with more advanced provisioning and workload management facilities than an IBM System z.***

Integrated Cloud Service Management Is Also a Huge Differentiator for the Mainframe

As discussed earlier, one of the biggest data center operational costs is directly related to the management and administration of information systems and associated applications and databases. To reduce these costs, we strongly recommend that IT buyers look closely at a class of software known as "integrated service management" because this class of software helps automate time-consuming functions that IT managers and administrators perform manually today.

The fundamental concepts behind ISM software are to provide operators with ***visibility*** into the health of the IT environment being managed; provide ***controls*** to undertake corrective action or provide other functions; and allow for the ***automation*** of repetitive tasks. At present users of mainframes can gain insights into service delivery and process automation, service availability and performance management, storage, security/risk/compliance, data center transformation, assets, and networks (see Figure 3).

Figure 3 — ISM Categories

Source: IBM — December, 2010

A Closer Look at IBM's "Business Continuity" and "Systems Automation" ISM Offerings

As shown in Figure 3, there are several types of services that can be managed using integrated service management software — including services that manage networks, storage, and assets. There are also ISM services that focus their effort at managing specific platforms, and related infrastructure and associated quality-of-service levels. These services include:

1. Service delivery and process automation services;
2. Service availability and performance management services; and,
3. Security, risk, and compliance management services.

On the mainframe, the products that provide these types of services can be found in IBM's Tivoli product line under business continuity services and systems automation services. More precisely, these products include IBM's Business Continuity Process Manager and various "systems automation" integrated service management offerings (described below).

Mainframe Business Continuity

Mainframes have long been known for their reliability (mainframes offer the highest meantime-between-failure in the commercial server industry — sometimes exceeding 20 years of continual operation). But having reliable computing equipment is only part of the continuity equation. Should a failure occur, a business need to ensure that it can quickly recover its IT environment — and this means that recovery processes need to be put in place. For some businesses, these processes are manual in nature (and prone to mistakes and delays). For mainframe customers, however, IBM's *Business Continuity Process Manager* can automate recovery processes — helping customers quickly recover in the event of a failure. (Suggestions for building an automated, resilient cloud environment, can be found in our report entitled: "Business Resiliency in the New Enterprise Data Center" at http://www.clabbyanalytics.com/uploads/BusinessResiliencyFinal.pdf).

Mainframe Reliability/Availability, Optimization, and Integration ISM Products

IBM groups several of its mainframe ISM products together under the heading of "Systems Automation". These products provide visibility, control and automation facilities for mainframe cloud environments, and include:

- IBM"s *Systems Automation for Integrated Operations Management* raises the visibility of issues, helping managers and administrators to avoid issues before those issues impact customers.
- IBM's *Systems Automation Application Manager* can be used to ensure that applications run optimally within a mainframe cloud environment, thus delivering tuned, rapid application performance to mainframe cloud users;
- IBM's *System Automation for Multiplatforms* extends automation and high availability services to other platforms within a cloud environment; and,
- IBM's *System Automation for z/OS focuses* on ensuring that the operating environment and related infrastructure remain always available.

Enterprises looking to build resilient, highly-tuned, performance-optimized cloud environments that feature advanced, automated management facilities (that reduce human error, ensure reliability/availability, and that provide integration with other server environments) would be wise to closely examine IBM's mainframe-based ISM tools.

ISM in the Real World: Enterprise Examples

Who is using ISM software today to build clouds and/or to drive down management costs? *Clabby Analytics* generally finds ISM deployed in: 1) large enterprises; 2) outsourced service provider environments; and, 3) in mid-sized businesses.

Large Enterprises

When we talk to large enterprises about their deployments of cloud architecture, the dominant reason they give us for adopting cloud computing is related to cost. Their biggest target is to drive down management costs. But they also look to drive down costs in the areas of acquisition (both hardware and software) — and by pooling resources in order to have access to additional capacity in case of a system failure. Figure 1 (the pie chart at the beginning of this report) shows these three areas to be the areas of largest expenditure within the data center. Cloud computing combined with ISM helps attack and lower these costs.

Service Providers

The service provider model relies heavily on taking management costs out, because by so doing margins can be increased. If managers are given advanced tools, they spend less time performing repetitive and/or manual functions — and are able, accordingly, to manage more systems. Fewer people translates into lower costs (and fewer errors) — and these lower costs mean greater profits.

One of the best examples of a service provider that makes heavy use of ISM tools that we found was at IBM's own site in North Carolina — where a single administrator can simultaneously manage up to 300 physical/virtual server environments. This facility also makes heavy use of ISM tools and utilities to drive down power consumption costs as well as to ensure service deliver (in order to meet its client's service level expectations).

DATEV, a mid-sized software supplier/service provider, uses IBM z/OS Capacity Provisioning Manager to monitor z/OS workload performance and manage capacity based on user-defined policies in its cloud environment. DATEV also uses z/OS Capacity Provisioning Manager in confirmation mode, which triggers automatic functions implemented with IBM Tivoli System Automation for z/OS. The benefits that DATEV is seeing by using these tools include:

- Faster response and better service during peak capacity usage;
- Accurate provisioning based on actual workload performance; and,
- Reduction in manual errors with automatic responses based on defined parameters.

Midsized Businesses

ISM is now gaining traction in the mid-market — largely due to mid-sized enterprise focus on driving down costs related to management. FIDUCIA, an Internet registrar, is an excellent example of this drive-down-the-cost-of-management focus. FIDUCIA uses IBM's Tivoli System Automation for z/OS software to add automation capabilities to its mainframe environment. And IBM's Tivoli NetView enables FIDUCIA to automate mainframe operations so that the system can run almost completely unattended.

In addition to driving down management costs, FIDUCIA has also found that using ISM tools and utilities:

- Helps to ensure high availability in case of faults or outages;
- Centralizes system administration and message management; and,
- Enables smooth integration with other Tivoli products.

Summary Observations

In this *Advisory* we explained how clouds can be built — and we then described why we believe that a mainframe (System z) is the best architecture for building a highly-virtualized, automatically provisioned, well managed, highly-secure cloud environment.

As we see it, the benefits of building a mainframe cloud include:

- *Mainframe virtualization* — mainframes use a "share all" approach to system resources to maximize efficiency — and offer the most advanced virtualization facilities in the industry (efficient virtualization is key to cloud architecture);
- *Reduced risk* — ISM tools provide healthful, state-based automation, high availability, and business continuity;
- *Agility* — mainframe managers/administrators can respond quickly and efficiently to meet the demands from users and data (and in many cases, these responses can be automated to speed their response);
- *Availability* — mainframes offer 24x7x365 operation to keep the business always available to customers;
- *Security* — mainframes offer highly certified hardware security (EAL level 5 – the best in the industry), and role-based software security; and,
- *Green* — mainframes offer advanced resource management software to ensure the most effective use of resources to reduce energy consumption and to help avoid additional costs.

We did not dwell on the challenges of building a distributed cloud environment — but perhaps we should have. The level of complexity involved in building a networked group of servers — and deploying a virtualization schema across those servers and then trying to service manage those servers — is far, far, far more complex than simply deploying a highly-scalable, level-of-service rich mainframe environment. Plus mainframes have forty years of systems software that can be used to manage applications as they hop through the cloud. Mainframes are essentially turnkey, advanced cloud environments.

The bottom line in this report is this: with advanced virtualization, best-in-the-industry security, best-in-the-industry reliability/availability; and a wealth of integrated service management tools, mainframes provide a means to rapidly build a rich, secure, reliable, low-cost-to-manage cloud environment. IT executives who fail to examine mainframe architecture when building enterprise cloud computing environments may find that they will need to spend a small fortune trying to implement what a mainframe combined with integrated service management tools can already deliver today.

Note: This report can be viewed as a Webinar.
Register at: http://www.ibm.com/software/systemz/webcast/jan13, and then view the report at:
http://event.on24.com/r.htm?e=268584&s=1&k=7C015E7DF63AF59A76D043DFE885ED69.

Clabby Analytics
http://www.clabbyanalytics.com
Telephone: 001 (207) 846-6662

© 2011 Clabby Analytics
All rights reserved
January, 2011

Clabby Analytics is an independent technology research and analysis organization. Unlike many other research firms, we advocate certain positions — and encourage our readers to find counter opinions — then balance both points-of-view in order to decide on a course of action. Other research and analysis conducted by Clabby Analytics can be found at: www.ClabbyAnalytics.com.