

\* **Cloud computing** is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.  
NOTE: A cloud can be public, private, or a hybrid of both.

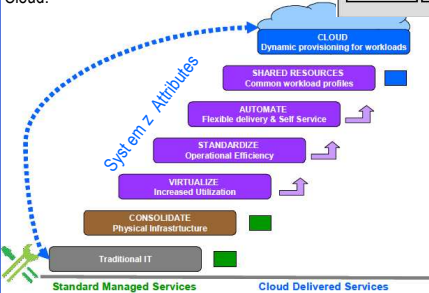
- With cloud computing, the application can be running on a server anywhere in the world.
- It is changing the way companies provide services to their clients and suppliers.
- \* The **IBM Cloud Computing Reference Architecture** defines the fundamental architectural elements constituting a cloud computing environment. It is required that all of these infrastructure components be managed from a single, central Common Cloud Management Platform with the ability to place instances of each cloud service on the respective infrastructure.

- This requirement perfectly fits the **zEnterprise System**, with its end-to-end management capabilities for flexible delivery of high-value services.

\* **Virtualization** is the foundation for "cloud," and the benefits of consolidation and virtualization are widely accepted by the IT community.

- Adding **standardization** and **automation** to a virtualized environment will enable IT optimization for cloud computing.
- **Workflow orchestration, monitoring, and metering** for accounting are other major components of cloud computing.

**NOTE:** Deploying a cloud infrastructure is not a simple process, but there is a defined path that can be followed depicts the path from Standard Managed Services to Cloud.

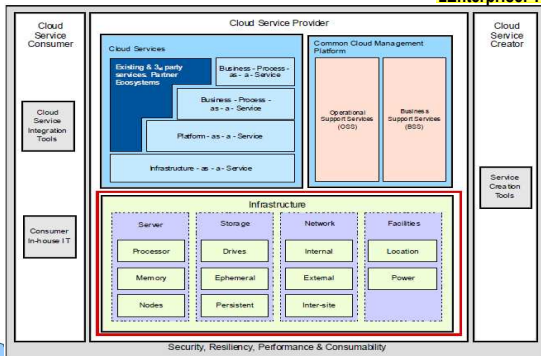
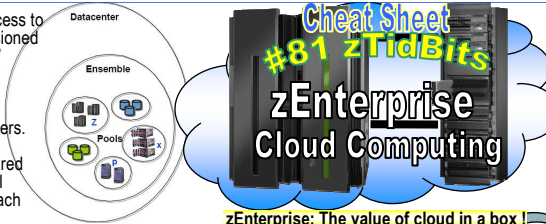


**Security** remains a major concern for any cloud computing environment. For over 40 years the System z platform has focused on providing security for applications and sensitive data in virtual environments. It is the most secure platform in the industry today, beginning with the hardware and integrated throughout the stack. System z has an **Evaluation Assurance Level (ELA) of 5** for its logical partitioning (LPAR) technology, this remains the highest level of security certification in the industry, and an **ELA rating of 4+** for the use of Linux under this environment.

- \* The System z integrated hardware **cryptographic coprocessors** also provide additional levels of security. Linux virtual machines can take advantage of the same cryptographic coprocessors that are used by z/OS.
- \* The security of System z has been extended to the high performance private network of zEnterprise which helps to improve **network security with lower latency**. A private internal data network connects the virtual servers to the z/OS transaction and data services running in the same machine that support business critical data. This provides the opportunity to handle production workloads with more security than development or test workloads and its security protects critical and sensitive business data in the cloud.
- \* zEnterprise brings the value of reduced networking and **simplified server control** resulting in tighter overall security for the complete cloud infrastructure. Its decades proven security stands out as a major reason for deploying a private cloud with zEnterprise.
- Greater reliability and availability** of resources are key factors when selecting a cloud delivery option.
- \* The System z platform has a long history of reliability and availability which enables it to host cloud environments at **unmatched levels of service**. System z has built-in hardware redundancy and fewer points of failure and is a proven reliable platform that provides high availability and achieves SLAs objectives.
- \* **Memory and processors can be added and enabled dynamically on System z**, allowing for continuous service and availability with no interruption. The System z platform five 9's of availability and Mean Time to Failure are measured in decades. zEnterprise has improved and simplified cross-platform availability procedures.
- With its upward migration compatibilities, **System z elevates the process of re-commissioning servers and reusing space** in the data center. Another valuable System z feature is **push pull**, the server life cycle management capability to upgrade without major disruptions of service.

**More efficient data center** The simplification of the infrastructure with zEnterprise results in **greater efficiencies in the data center**. zEnterprise reduces the energy, cooling, and floor space requirements resulting in lower overall costs and greater operational efficiency.

- \* With zEnterprise there are **fewer parts or components to monitor**. zEnterprise and IBM Tivoli products can be used to manage the entire enterprise wide IT environment and the Unified Resource Manager can manage workloads across platforms.



- Virtualization**
- Higher utilization
- Economy-of-scale benefits
- Lower capital expense
- Lower operating expense
- Standardization**
- Easier access
- Flexible pricing
- Reuse and sharing
- Easier integration
- Automation**
- Faster cycle times
- Lower support costs
- Optimized utilization
- Improved compliance
- Optimized security
- Better user experience

**Virtualization** is the first key step in building a cloud infrastructure. The fundamentals of virtualization have been part of the System z platform since its inception and it is a leader in platform virtualization. This virtualization technology allows heterogeneous operating system instances to share the same system resources in a "shared everything" architecture while maintaining workload integrity.

- \* The concept of a Virtual Machine (VM) defines IBM's **ultimate virtualization hypervisor** based operating system IBM z/VM. z/VM's ability to host large numbers of virtual machines makes it possible to achieve massive consolidation and same system growth with limited real resources.
- \* Virtualization with zEnterprise allows the **dynamic provisioning of resources**, over allocation of real resources and the ability to easily consolidate standardized virtual images. zEnterprise can host more virtual machines with z/VM than any other platform, run thousands of virtual servers on a single IBM zEnterprise 196 (z196) or IBM zEnterprise 114 (z114) and can deploy virtual servers quickly, non-disruptively without the dependency to first acquire new hardware.

The zEnterprise is a heterogeneous system capable of **hosting many workloads integrated together and managed as one single entity**. The IBM zEnterprise System includes the zEnterprise CPCs (z196 and z114), the zEnterprise IBM BladeCenter Extension (zBX), and the **Unified Resource Manager**. A zEnterprise can deploy and manage workloads across **mainframe and distributed technologies** with a single management interface.

The ability of zEnterprise to manage all the real or virtual machines working under the **control of the different hypervisors** delivers the greatest value for cloud computing solutions. Although each hypervisor has its own functional control of the resources that reside within it the ability to manage the workloads running across all of them is critical and the Unified Resource Manager is able to **manage workloads across different platforms**.

In your cloud environment you may need to provide **virtualization management** for IBM and non IBM resources. To extend the management of virtual machines and their operating system images across several hypervisors, for example, z/VM, PowerVM, ESX (VMware), Hyper-v (Microsoft), Xen. A virtualization management suite, like **IBM System Director VMControl**, can complement the Unified Resource Manager to be able to use the same console for zEnterprise and non-zEnterprise hypervisors.

- \* Enterprise workloads are deployed on servers to **work closely with business critical data** and to be located near where the data is housed.
- Cloud computing with zEnterprise supports this **strong affinity to z/OS environment** that continues to be the backbone in many organizations.
- It allows moving the supporting **distributed workloads closer to the data and to the processing**.

**Greater scalability** Another strength of the System z platform is its **scalability** which meets changing business requirements and accommodates growth. System z allows you to **dynamically add additional capacity** increasing the elasticity of the environment. As your workload demands increase, vertical and horizontal growth becomes dynamic and automated, enabling your organization to focus on the business of software innovation rather than worrying about the acquisition and provisioning of new resources. With zEnterprise you can **run multiple copies of z/VM** on a single mainframe for enhanced scalability and failover capability for the virtual servers.

**Increased productivity** zEnterprise provides increased productivity with easy technology refresh, rapid provisioning and superior life-cycle management. The **fast and easy technology refresh with zEnterprise** allows you to react quickly to technology changes.

- \* The efficient, **rapid provisioning of virtual and real system resources** means you can quickly meet your business demands. Server life-cycle management allows for upgrades without disruption of service.
- \* The increased productivity removes barriers to the rapid delivery of new services and provide you with the time to explore new technologies to drive innovation in your business.
- Ease of use** The **zEnterprise Unified Resource Manager** provides **integrated management** with a single easy-to-use interface, which simplifies operations across all the application environments. Another benefit of zEnterprise for cloud computing is that different workloads can run on disparate systems but behave and are protected like a single system.
- \* This also **increases workload optimization** since each application runs on the best suited platform from an architectural point of view.
- \* As priority resource control exist at guest, LPAR or system level, maintaining a defined SLA for production or critical workloads for each defined environment is simplified because **everything can run from within the same system**.
- \* **Problem determination is also simplified**.
- \* Development and test environments can be deployed on the same zEnterprise system **with little or no impact to production workloads that run on the same box**.
- Once a release or project has passed acceptance testing parameters they can be **pushed right into production**.

**Cost savings** Many organizations are focused on reducing expenses. Implementing a private cloud on zEnterprise can **dramatically reduce the total cost of ownership (TCO)**, specifically for IT and cloud operating expenses.

- \* zEnterprise offers the **most consolidation per platform** possible today which results in significant cost savings.
- \* Most cloud computing models include a **pay-as-you-go** or grow ability feature and requires the automation of the processes that define this ability. zEnterprise **On/Off Capacity on Demand** processors can be turned on temporarily to meet business peak demands.
- **Payment for this additional capacity** is only for the time period requiring the extra resources.
- Cost savings is also obtained with the **ability to run multiple instances of a software product per processor**, reducing the per core charges for most workloads.
- **The benefits with these economies of scale increases** since the pool of available resources and systems are managed from a single place, the Unified Resource Manager. This can reduce the number of people required to maintain the infrastructure which helps lower the total administration costs.
- zEnterprise heterogeneous environment across platforms is **optimized for workloads** in a private cloud model and can result in a **dramatic reduction in costs** compared to like services offered from other cloud computing models.

\* With the introduction of the IBM zEnterprise System, this **first system of systems enabled operational and capital expense reduction**. It avoided the previous duplication of processes by standardizing and unifying the management processes across multiple server architectures. It follows two simple principles:

1. The more you virtualize your IT infrastructure, the lower your capital expenditures
  2. The more you standardize your infrastructure, the lower your operating expenses
- Integrated Software Stack** A cloud computing environment not only needs to rely on robust hardware or hypervisors, it needs to have the functions to **ease the deployment and the management of your cloud services** and for the platform management itself. These integrated service management functions provides the capabilities for centralizing management of the operating systems, middleware, storage, networks, and other resources needed to deliver business services.
- Provisioning Management** The Provisioning Manager component provides a **solution for the automation of middleware applications, physical switches, storage, etc.** for the technical deployments across your datacenter. It can be placed directly on top of your current hypervisors management suite or on top of the previous virtualization management suite for example, **IBM System Director VMControl**.

In the cloud computing **software stack** the provisioning management layer has been **integrated with a service automation management suite**. This solution adds the **service management layer** you need to automate, not only the technical deployments but also the **service delivery processes**.

