Cloud Computing Solutions on IBM z Systems

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Digital Solutions for z Systems

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Why Cloud Computing?

z Systems Cloud Blueprint

Solution Architectures for z Cloud

Linux z & New workloads
Mobile, social, cloud, big data and analytics are changing how we live, work and interact.

- **63% of people** expect to be doing more shopping on their mobile devices over the next couple of years.
- **40% of people** socialize more online than they do face-to-face.
- **57% of companies** using cloud to drive competitive and cost advantages.
- **80% of all data** is unstructured and growing 15x the rate of structured data.
A fundamental change

People can access centralized services

The service can access people everywhere

A service developed in one flavor for all

A service developed in one flavor for all but capable to adapt
But has all really changed? Yes and No!

Find & Walk
Wait
Ask for service
Few physical locations
National

Walk & Find
Self-Service
More physical locations
International

Locate
Self-Service
Anywhere
International
New Capabilities in z13 supporting Cloud Computing

**Up to 10 TB Memory on z13**  
Improves consolidation ratios

**GDPS for Linux on z Systems**  
Disaster Recovery solution for mission-critical workloads

**Increase in # of LPARs on z13**  
Improves TCO

**SMT-2 technology on z13**  
Improves performance and throughput of workloads

**KVM**  
New industry-standard hypervisor (SOD)

**Cloud Manager w/ OpenStack V4.2**  
Heterogeneous platform management from z Systems

**Elastic Storage for Linux on z Systems**  
Enables new class of workloads

Private Cloud  
Hybrid Cloud  
Public Cloud
Contents

- Why Cloud Computing?
- z Systems Cloud Blueprint
- Solution Architectures for z Cloud
- Linux z & New workloads
Cloud Computing Journey

The steps in the cloud journey offer different levels of capability for each customer IT environment.

You can embark on your cloud journey at any step.
First, some differences: VMware, PowerVM & z/VM

**x86 with VMware**
- Hypervisor: ESX
- 1 ESX/physical box

**PowerPC with PowerVM**
- Hypervisor: PowerVM
- 1 PowerVM/physical box

**Physical boxes**
- Virtual machine definition
- Partition - LPAR

**z Systems with z/VM**
- Hypervisor: z/VM
  - Up to 85 LPARs on z13 / Physical box
- Hypervisor: PRSM physical box

Operating System for end user

Can connect to an Operating System for management

Hypervisor – no microcode
Hypervisor – microcode

Hypervisor: KVM (Statement of Direction)
IBM System z Virtualization Leadership
Extreme Levels of Resources Sharing & Agility

"Inside the box" virtual networking

IFL processors have no impact on z/OS license fees
IBM System z Virtualization Leadership : Network Options

- TCP/IP
- Linux
- Linux
- Linux
- Linux
- Linux
- Linux
- Linux
- Linux
- Linux
- z/OS
- Virtual switch
- Internal LAN
- CTC
- z/VM
- SMSG
- IUCV
- Hipersocket LAN #1
- Hipersocket LAN #2
- PR/SM
- OSA
- Access
- Trunk Vlan 4,5,6
z System Strengths for Cloud Computing

- Security
- Availability
- Optimal use of resources
- I/O Processing
- Resilience

INTEGRATION

Traditional IT
z Systems Cloud Blueprint

Integrate

Virtualization

Infrastructure & Virtualization Management

This is where z Systems drives differentiation!

Infrastructure Scalability: Consolidate more workloads per core; elastic scaling using Capacity On Demand

Virtualization Management: More virtual servers in a single footprint

Security: Highest security rating for tenant isolation

Reliability & Availability: Unparalleled in the industry

Automate

Entry Level Cloud

Standardization & Automation

Orchestrate

Advanced Cloud

Orchestration & Optimization
Virtualisation & Centralized Resources Management

z/VM 6.3

Traditional IT
IBM Wave for z/VM

Helps Simplify and Automate Virtualization Management
For z/VM and Linux virtual servers

- Automate, simplify management and monitor virtual servers and resources—all from a single dashboard
- Perform complex virtualization tasks in a fraction of the time compared to manual execution
- Provision virtual resources (Servers, Network, Storage) to accelerate the transformation to cloud infrastructure
- Supports advanced z/VM® management capabilities such as Live Guest Relocation with a few clicks
- Delegate responsibility and provide more self service capabilities to the appropriate teams

A simple, intuitive virtualization management tool providing management, provisioning, and automation for a z/VM environment supporting Linux® virtual servers
**How xCAT Manages z/VM**

**zHardware Control Point:** Manages other VMs via Systems Management APIs and CP Commands. Each z/VM system needs to have a zHCP

**xCAT Maintenance Node:** Central management server. Only one MN is needed for multiple systems.
z Systems Cloud Blueprint

**Automate**
- Customers begin to **standardize** their environments for faster delivery of services.
- **Automation** is employed to provision and deprovision virtual guest environments using a shared pool of resources.
- Some customers may choose to allow end-user **self service** provisioning/deprovisioning.

**Integrate**
- This is where **z Systems drives differentiation**!
  - **Virtualization**
    - Infrastructure Scalability: Consolidate more workloads per core; elastic scaling using Capacity On Demand
    - Virtualization Management: More virtual servers in a single footprint
  - Security: Highest security rating for tenant isolation
  - Reliability & Availability: Unparalleled in the industry

**Orchestrate**
- Advanced Cloud
- Orchestration & Optimization
OpenStack Programs

Image Source: http://docs.openstack.org/admin-guide-cloud/content/conceptual-architecture.html

Compute (Nova)
Block Storage (Cinder)
Network (Neutron)
  Provision and manage virtual resources
Dashboard (Horizon)
  Self-service portal
Image (Glance)
  Catalog and manage server images
Identity (Keystone)
  Unified authentication and authorization
Object Storage (Swift)
  Petabytes of secure, reliable object storage
Telemetry (Ceilometer)
  Data collection
Orchestration (Heat)
  Engine to launch cloud applications based on templates
Database Service (Trove)
  Cloud Database-as-a-Service
Data Processing (Sahara)
  Data processing stack and management
Simplified platform deployment across multiple platforms

IBM Cloud Manager with OpenStack

Administration, self service, monitoring, accounting/billing, roles, approvals “Uniques”

Virtual machine deployment

Image Library

OpenStack & OpenStack API

z/VM, KVM, VMware, Hyper-V, and PowerVM

Compute

Storage

Network

Traditional IT

STANDARDISATION

VIRTUALISATION

INTEGRATION
Everything inside the z/VM LPAR is shipped with z/VM 6.3, up to and including the xCAT interfaces. Versions of DirMaint and PerfKit are included free of charge with the SMAPI server, but these versions of the products only communicate with SMAPI, there is no way to interact with them directly.
**Integrate**

- **Virtualization**
- **Infrastructure & Virtualization Management**

This is where z Systems drives differentiation!

- **Infrastructure Scalability:** Consolidate more workloads per core; elastic scaling using Capacity On Demand
- **Virtualization Management:** More virtual servers in a single footprint
- **Security:** Highest security rating for tenant isolation
- **Reliability & Availability:** Unparalleled in the industry

**Automate**

- **Entry Level Cloud**
- **Standardization & Automation**

- Customers begin to standardize their environments for faster delivery of services.
- **Automation** is employed to provision and deprovision virtual guest environments using a shared pool of resources.
- Some customers may choose to allow end-user self service provisioning/deprovisioning.

**Orchestrate**

- **Advanced Cloud**
- **Orchestration & Optimization**

Finally, some customers will want to evolve and optimize their cloud environment to orchestrate application deployment based on reusable workload patterns in order deliver dynamic cloud services.
A solution for advanced cloud management

Cloud Admins

Cloud Service Users

Services Catalog

Automated Deployment

Image Management

Infrastructure Services

Resources

IBM Cloud Orchestrator

Informatique traditionnelle
The z/VM Directory Manager (DIRMAINT), or an equivalent, provides a command driven interface to manage z/VM directory entries.

The z/VM Systems Management Application Programming Interface (SMAPI) provides programmatic access to DIRMAINT and z/VM system functions.

A Security Manager (such as RACF) provides additional resource protection beyond DIRMAINT and SMAPI authorizations. This is optional, but if it exists it must be configured to support this architecture.

Virtual switches (VSWITCH) provide network connectivity between the management components, to allow command driven requests to come from the z/VM platform or other network connected locations. They also provide the networks on which newly provisioned instances will be connected to.

The Extreme Cloud Administration Toolkit (xCAT) is an open source product for provisioning virtual machines.

The Region Server and Network Server are part of the IBM Cloud Orchestrator infrastructure and run on the x86 platform.

Linux source images are existing Linux guests whose disk images are captured for deployment by IBM Cloud Orchestrator. These guests have specific configuration requirements.

Linux deployed instances are Linux guests created via deployment requests from OpenStack on the zRegion Server or from IBM Cloud Orchestrator; however, they must be deployed from IBM Cloud Orchestrator to be managed by IBM Cloud Orchestrator.

IBM Cloud Orchestrator V2.4 & z/VM
# Virtualization and Cloud Portfolio for Linux on z Systems

## Virtualization
**Servers:** z13, zEC12, zBC12  
- Massively scalable  
- Characterized by great economics / efficiencies  
- Highly secure / available  

**z/VM 6.3**  
- Support more virtual servers than any other platform in a single footprint  
- Integrated OpenStack support  

**IBM Wave for z/VM**  
- A graphical interface tool that simplifies the management and administration of z/VM and Linux environments  

## Entry Level Cloud

### Cloud Manager with OpenStack
- A simple, entry level cloud management stack  
- Based on OpenStack  
- Formerly known as SmartCloud Entry  

## Advanced Cloud

### Cloud Orchestrator
- Based on OpenStack  
- Builds on functionality of **Cloud Manager with OpenStack** and adds runbook automation and middleware pattern support for workload deployment  
- Formerly known as SmartCloud Orchestrator  

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**Differentiation**

**Standardization**

**Service Lifecycle Management**
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Linux z & New workloads
## Typical Pros and Cons of Cloud Deployment Models

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<th>Cloud Type</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public</strong></td>
<td>Multi-tenant environment where compute resources are purchased in desired increments</td>
<td>Flexible Low cost of entry Rapid deployment Scalable Wide availability of vendors Security of data Data residency Control DR Regulatory issues SLA</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>Internally owned, deployed and controlled compute resources</td>
<td>Control Security DR Data ownership Ability to tune Time to implement Silo’d approach Acquisition cost Staffing Planning</td>
</tr>
<tr>
<td><strong>Hybrid</strong></td>
<td>Uses a mix of private, dedicated IT resources in conjunction with public infrastructure</td>
<td>Best of both Fit workload for cost and performance Can be single point of control Initial configuration Network latency Creating controls Management is complex</td>
</tr>
</tbody>
</table>
## Hybrid Cloud use cases

<table>
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<tr>
<th>Next Gen Hybrid Workloads</th>
<th>Hybrid Cloud Brokerage &amp; Management</th>
<th>Hybrid Infrastructure Scale Out</th>
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<tr>
<td><strong>Independent Workloads</strong></td>
<td><strong>Portability &amp; Optimization</strong></td>
<td><strong>Backup and Archive</strong></td>
</tr>
<tr>
<td>Private</td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Public Production</td>
<td>Private</td>
<td>Public Public</td>
</tr>
<tr>
<td>Dev / Test</td>
<td>Public</td>
<td>Private Public Public</td>
</tr>
<tr>
<td><strong>SOE - SOR Integration</strong></td>
<td><strong>Hybrid Cloud Brokerage &amp; Management</strong></td>
<td><strong>Capacity Access</strong></td>
</tr>
<tr>
<td>Private</td>
<td>Public</td>
<td>Private Public Public</td>
</tr>
<tr>
<td>Public Record</td>
<td>Public</td>
<td>Private Public App A (1)</td>
</tr>
<tr>
<td>Systems of Engagement on Public</td>
<td></td>
<td>Public Public App A (2)</td>
</tr>
<tr>
<td><strong>Portability &amp; Optimization</strong></td>
<td><strong>Backup and Archive</strong></td>
<td><strong>Capacity Access</strong></td>
</tr>
<tr>
<td>App A</td>
<td>Public App A</td>
<td>Private Public</td>
</tr>
<tr>
<td>App B</td>
<td>Public App B</td>
<td>Private Public App A (1)</td>
</tr>
<tr>
<td>App C</td>
<td>Public App C</td>
<td>Public Public App A (2)</td>
</tr>
<tr>
<td><strong>Hybrid Cloud Brokerage &amp; Management</strong></td>
<td><strong>Backup and Archive</strong></td>
<td><strong>Capacity Access</strong></td>
</tr>
<tr>
<td>App A</td>
<td>Policy App A</td>
<td>Private Public App A (1)</td>
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<td>App B</td>
<td>Policy App B</td>
<td>Public Public App A (2)</td>
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<tr>
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<td><strong>Capacity Access</strong></td>
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<td>Private</td>
<td>Public</td>
<td>Public Public App A (2)</td>
</tr>
<tr>
<td><strong>Capacity Access</strong></td>
<td><strong>Disaster Recovery</strong></td>
<td>Private Public</td>
</tr>
<tr>
<td>Private</td>
<td>Public</td>
<td>Private Public App A</td>
</tr>
<tr>
<td><strong>Disaster Recovery</strong></td>
<td><strong>Disaster Recovery</strong></td>
<td>Private Public App A</td>
</tr>
</tbody>
</table>

### Choose private, public or hybrid cloud based on independent workload requirements
- Move application DEV to the Cloud
- Integration with services & data outside of the deployed workload

### Systems of Record on Private and Systems of Engagement on Public
- Application and/or data are portable and can go to and from public and private for improved optimization

### Planned or Policy based Management and sourcing across multiple environments (infrastructure, platform & app)
- Planned or Policy based Management and sourcing across multiple environments

### Leverage off-premise resources for backup and archiving of on-premises resources

### Opportunistic use of public cloud as additional resource for large jobs (e.g., HPC, BigData, Batch)

### Setup and make available a parallel environment off-premises
- Leveraging Cloud for extra capacity
- Leveraging Cloud for extra capacity
- Capacity scaling

### Move application
- Workload shifting
- Workload shifting

### Integration with services & data outside of the deployed workload
- Integration with services & data outside of the deployed workload

### Planned or Policy based Management and sourcing across multiple environments
- Planned or Policy based Management and sourcing across multiple environments

### Leverage off-premise resources for backup and archiving of on-premises resources
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### Opportunistic use of public cloud as additional resource for large jobs (e.g., HPC, BigData, Batch)
- Opportunistic use of public cloud as additional resource for large jobs (e.g., HPC, BigData, Batch)
IBM BlueMix – Enabling Next Generation Cloud Applications

Build hybrid environments. Connect to on-premises systems of record plus other public and private clouds. Expose your own APIs to your developers.

BlueMix brings unparalleled speed to development, deployment and IT operations & cuts the time needed to go from idea to running application to days vs months

100% Open Standards-based scalable platform – a competitive differentiation

Allows customers to use the same proven API services that they use on-premises, but in a much simplified, easy to consume and instantly deployed manner

z Systems - BlueMix Integration

Expose z/OS Data as-a-Service via BlueMix to enable system of record to be called by Dev-Ops driven composable apps
Secured Mobile Services

Scenario 1: z/OS Connect
Scenario 2: MobileFirst adapter
Scenario 3: API Management
Scenario 4: BlueMix integration
Scenario 5: DataPower mobile security gateway

- BlueMix
- MobileFirst Server
- Partner
- MobileFirst Server
- Worklight app
- Customers
- Worklight app
- DataPower
- API
- z/OS Connect
- CICS
- MobileFirst Server
- Linux on z
- Employee
- Worklight app
Secured Analytics Services

1. Functionally Complete & Rich
2. Low Latency (Limited Data Flow)
3. Accelerated
4. Ultra-safe

IBM InfoSphere z System Connector for Hadoop

IBM InfoSphere DataStage

COGNOS

SPSS

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Cloud Services Security improved with z System features

Cloud services data is requiring and will required higher and higher levels of security

Secure services

Protected key

AES

CBC 256

Algorithm

Crypto Key Protection Profile

Mode of Operation

Key Size

z13 Mode of operations

Mode of Operation

Original Image

Encrypted using ECB mode

Modes other than ECB result in pseudo-randomness

CBC-PCBC-CFB-OFB-CTR

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Key Size</th>
<th>Crypto Key Protection Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC</td>
<td>256</td>
<td>Protected key</td>
</tr>
<tr>
<td>AES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cloud services data is requiring and will required higher and higher levels of security.
Build your Hybrid Cloud now with z Systems Hybrid Cloud Connect Test Drive

**Enabling Frictionless Hybrid Clouds with z Systems**

*Provides the fundamental capabilities necessary for an enterprise customer to integrate on premise enterprise systems with public cloud offerings.*

*Reduces time, cost and complexity for implementing a Hybrid Cloud with z Systems while preserving the performance, security and reliability that our enterprise customers need.*

*Accelerates time to value for z Systems customers by providing free services from IBM that help a customer get started with their hybrid cloud implementation.*

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**GaaS: Gateway as a Service**

*Agile:* No on premise infrastructure additions required.

*Consistent:* Leverages a cloud offering to support a cloud strategy.

---

**Services Enablement**

*Jumpstart:* Overcomes the initial “where do we start” challenges.

*Partnership:* Experts from IBM combined with customer domain experts

---

*A hybrid cloud* is a composition of an off-premise public cloud with on-premise private cloud or enterprise systems that remain as distinct entities but are bound together by technology that enables data and application portability.
Announcing Custom Patterns for Linux on z Systems

You asked – We delivered!

One dozen patterns covering 50% of Linux on z Systems portfolio revenue

Clear commitment from IBM to pattern-enable middleware products for Linux on z Systems

Organizations will be able to build out complex Cloud workload instances on z Systems in a fraction of the time

Time Savings
- Reduces multi-product deployment durations by up to 80%
- Reduces deployment error/fix durations

Quality and Efficiency
- Reduces need for deep product skills
- Improves quality of delivery

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Create your private cloud with IBM Enterprise Cloud System

Standard Linux Environment
• Red Hat/SUSE
• 3000+ Applications

IBM Deployment Expertise done in the factory with on-site personalization

Fully Automated Cloud Orchestration & Monitoring

EC12, BC12 and z13 compute in any config

Storwize V7000 or DS8870 in any configuration

Cloud Orchestrator
OMEGAMON® for z/VM
TSM
Operations Manager
Backup Manager
IBM Wave

Factory Integrated
• Delivered in ½ time of other Integrated Systems*
• Production Ready in Hours

Scale up to 6000 VMs
• Industry Leading Availability
• Proven Security

*Based on feedback from V-Block distributor
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While Linux looks the same on different platforms, every platform shows different personalities, qualities, features and options derived from the platform architectures.
What is Different about a Linux on IBM System z?

Do more with less
- Deploy more servers, more networks, more applications, and more data
- Achieve nearly 100% utilization of system resources nearly 100% of the time
- Enjoy the highest levels of resource sharing, I/O bandwidth, and system availability

Reduce costs on a bigger scale
- Save on software license fees
- Consume less power and floor space
- Minimize hardware needed for business continuance and disaster recovery

Manage growth and complexity
- Exploit extensive facilities for life cycle management: provisioning, monitoring, security, workload mgmt, capacity planning, charge back, patching, backup, recovery, etc.
- Add hardware resources to an already-running system without disruption
- Workload deployment on a “scale up” machine means fewer cables, fewer components to impede growth

More flexibility, minimize lead time for new projects
- Workload deployment to a single System z server offers significant advantages in terms of flexibility
- Rapid provisioning reduces lead time for new IT projects, helping to increase business agility
Linux on z System, ok but which type of workloads?

Existing major usage patterns

- Oracle Database on Linux on z
- WebSphere (App Servers, Message Broker, MQ, …)
- SAP Application Servers
- Basic Infrastructure Services (HTTP Server, FTP, Apache, Tomcat, Samba, Networking, Tivoli Storage Manager, Domino…)
- Leverage existing ISV Solutions or custom client applications
- DB2 LUW
- Other WebSphere components (Portal Server, Business Process Manager, …)
- ...

New usage patterns

- Mobile on z Systems (IBM MobileFirst Server)
- z/VM Virtualization management (IBM Wave) and Cloud
- Analytics on Linux on z (Cognos, Spss, Infosphere, …)
- OpenSource solutions (Hadoop, PostGreSQL, MariaDB, Docker,…)
- Enterprise Linux Printing (Ubiquitech solution,…..)
- Advanced Case Management (FileNet), Document and customer management (Filenet)
- Migrate Oracle to DB2 UDB on Linux on z (incl. InfoSphere Data Replication)
- UNIX based Solutions from competitive platforms (e.g. Solaris, HP-UX)
- …
Key Takeaways

• Cloud is transforming how service is delivered with efficiency and speed

• z13 delivers a trusted and secure Cloud: Agile, fully virtualized private and hybrid cloud computing now with Enterprise Grade Linux

• z13 Transforms the economics of IT service delivery without the risk
  32% lower TCO when consolidating the work of 50 or more cores from x86 or up to 60% lower cost than public cloud alternatives
Lower TCO With a Mainframe Cloud

More cases on why Linux on z System:
https://www.youtube.com/watch?v=QeZyGzvM41k&feature=youtu.be&sf34372361=1
here http://www-03.ibm.com/systems/z/os/linux/solutions/zlo.html
## Affordability
Attractive price performance. Offers the lowest TCA for Linux deployment of Oracle database workloads over competition - saving over half the cost. Lower costs through reduced complexity - Simplified management, Reduced environmental costs, Greater flexibility to meet changing needs.

## Availability
Near zero downtime/continuous availability, even during maintenance of hardware, OS, database and application components. Enhanced disaster recovery responsiveness.

## Efficiency
Reduced infrastructure complexity through consolidation, automation and virtualization, saving on energy, labor, software, and more. Management of the end to end applications, fast private network, fewer hops and points of failure. High resource utilization.

## Integration
Capability to handle the largest volumes of data, in a day and age when data is booming. Tight integration and simpler management of data and applications on one system. Low latency. Homogeneous system environment.

## Scalability
Flexibility and near-linear large scalability, unmatched in the IT world, to grow with your business. Superior virtualization. Unprecedented scale.

## Security
Comprehensive protection of critical data from all IT security threats. Private server network. Most secure platform with Common Criteria Evaluation Assurance Level 5 (EAL5).

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1 Based on measurements at a large bank comparing a production workload running on Oracle RAC DB on distributed versus Oracle RAC DB on Linux a Enterprise Linux Server with cores running at 5.5 GHz.