Economics of Linux on z Systems

Session 17485

Bryan Foley
August 13, 2015
Comprehensive picture with Total Cost of Ownership (TCO)

- Looking at just up-front acquisition costs can be incomplete and misleading

- Total Cost of Ownership is much broader than upfront acquisition-only costs
  - Infrastructure costs (Compute, Storage, Network, Hypervisor, OS, Cloud management software)
  - Middleware costs
  - Labor, power and space costs

- We look at total cost of ownership (TCO) to get an accurate picture
  - 3 year TCO which takes into account workload performance aspects as well
TCO Model Used

- **More than 30 cost variables**
  - Blade and IFL amount and costs
  - Memory amount and costs
  - Storage amount and costs
  - PVU counts
  - Cost of hypervisors
  - Cost of cloud management software
  - Cost of operating system
  - Cost of middleware
  - Cost of hypervisor maintenance
  - Cost of cloud management maintenance
  - Cost of operating system maintenance
  - Cost of middleware maintenance
  - Power consumption
  - Cost of power
  - Space taken
  - Cost of space
  - Admin rate
  - Efficiency factors for labor
  - Number of FTE
  - Number and type of instances
  - Cost of instances
  - Amount of data out
  - Cost of data out
  - Enterprise support costs

- **Placed in three categories**
  - Infrastructure
  - Middleware
  - Labor, Power and Space

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
zCloud Assumptions

• **Infrastructure costs include:**
  – z13 ELS
  – z/VM
  – IBM Wave
  – Memory
  – Storage (Storwize V7000)
  – SLES
  – Cloud management software (Cloud Manager with OpenStack)

• **Middleware costs include:**
  – WebSphere Application Server ND and DB2 EE (for light and medium workloads)
  – Oracle EE (for heavy I/O workloads)

• **Labor costs included to manage both infrastructure and VMs; power/space costs included**
x86 Cloud Assumptions

- **Infrastructure costs include:**
  - x86 competitor hardware
  - Memory
  - Storage (internal SSDs)
  - Competitor hypervisor
  - SLES
  - Cloud management software (Cloud Manager with OpenStack)

- **Middleware costs include:**
  - WebSphere Application Server ND and DB2 EE (for light and medium workloads)
  - Oracle EE (for heavy I/O workloads)

- **Labor costs included to manage both infrastructure and VMs; power/space costs included**
Public Cloud Assumptions

• Each VM deployed as a separate instance
• 3-year all upfront reserved pricing model used
• Infrastructure costs include:
  – Instances in US-East region with SLES
  – Persistent storage (EBS volumes)
  – Networking (data out)
  – Support (enterprise level)
• Middleware costs include:
  – WebSphere Application Server ND and DB2 EE (for light and medium workloads)
  – Oracle EE (for heavy I/O workloads)
• Labor costs included for managing instances
Workload Assumptions

• Workloads run 24x7

• 3 types of workloads

• Light
  – Dev/test web application driving on average 14 transactions per second
  – 2 VMs per workload; each VM requiring 2GB memory and 20GB storage

• Medium
  – Production web application driving on average 77 transactions per second
  – 2 VMs per workload; each VM requiring 4GB memory and 20GB storage

• Heavy I/O
  – Production database application driving on average 255 transactions per second with heavy I/O
  – 1 VM per workload; each VM requiring 122GB memory and 540GB storage (300GB for DB; 200GB for logs; 40G for OS)
Which option costs less for delivering mixed workloads?

- **64 Light Workloads (128 VMs)**
- **32 Medium Workloads (64 VMs)**
- **27 Heavy I/O Workloads (27 VMs)**

123 workloads (219 VMs)

Which option provides the lowest TCO over 3 years?

- **Public Cloud**
- **Private Cloud (x86)**
- **Cloud on z (z13)**

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
Platform Requirements for Deploying Light Workloads

64 Light Workloads

128 VMs total

Public Cloud

m3.medium reserved instances
(with total 128 vCPU)

Private Cloud (x86)

Web Application

WAS DB2

Java-based web workloads each driving 14 transactions per sec;
2 VMs per workload;
Each VM requiring 2GB memory;
20GB storage

Cloud on z (z13)

24 x86 cores

2 IFLs

System configurations are based on equivalence ratios derived from IBM internal studies.
Platform Requirements for Deploying Medium Workloads

**32 Medium Workloads**

- **64 VMs total**
  - WAS
  - DB2

**Public Cloud**
- 64 m3.large reserved instances (with total 128 vCPU)

**Private Cloud (x86)**
- 24 x86 cores

**Cloud on z (z13)**
- 3 IFLs

Java-based web workloads each driving 77 transactions per sec;
- 2 VMs per workload;
- Each VM requiring 4GB memory;
- 20GB storage

System configurations are based on equivalence ratios derived from IBM internal studies.

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
Platform Requirements for Deploying Heavy I/O Workloads

27 Heavy I/O Workloads

27 VMs total

Oracle I/O Intensive Database

Public Cloud
r3.4xlarge reserved instances (with total 432 vCPU)

Private Cloud (x86)
216 x86 cores

Cloud on z (z13)
27 IFLs

High I/O database workloads, each driving 255 transactions per second;
Each VM requiring 122GB memory and 540GB storage

Complete your session evaluations online at www.SHARE.org/Orlando-Eval
System configurations are based on equivalence ratios derived from IBM internal studies.
## Reduce costs with a cloud on z

Example with 123 Workloads (219 VMs)

<table>
<thead>
<tr>
<th></th>
<th>Public Cloud</th>
<th>x86 Cloud</th>
<th>z Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>$1,791,305.62</td>
<td>$819,810.88</td>
<td>$4,048,196.03</td>
</tr>
<tr>
<td>Middleware</td>
<td>$19,083,264.00</td>
<td>$10,129,632.00</td>
<td>$1,500,480.00</td>
</tr>
<tr>
<td>Labor, power, space</td>
<td>$401,780.77</td>
<td>$1,240,096.73</td>
<td>$923,219.36</td>
</tr>
<tr>
<td><strong>Total (3yr)</strong></td>
<td><strong>$21,276,350.39</strong></td>
<td><strong>$12,189,539.61</strong></td>
<td><strong>$6,471,895.39</strong></td>
</tr>
<tr>
<td>Avg. cost per VM per month</td>
<td>$2,698.67</td>
<td>$1,546.11</td>
<td>$820.89</td>
</tr>
</tbody>
</table>
## Public Cloud – Cost Breakdown

<table>
<thead>
<tr>
<th>Public Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure</strong></td>
</tr>
<tr>
<td>Subtotal: $1,791,305.62 (calculated using AWS simple monthly calculator)</td>
</tr>
<tr>
<td>Total One-time payment: $667,993.66</td>
</tr>
<tr>
<td>Total Monthly payment: $31,203.11</td>
</tr>
<tr>
<td>Compute: $1,976.40</td>
</tr>
<tr>
<td>EBS Volume: $2,179.50</td>
</tr>
<tr>
<td>EBS IOPS: $7,020.00</td>
</tr>
<tr>
<td>Reserved Instance (One-time fee): $656,199.00</td>
</tr>
<tr>
<td>AWS Data transfer out: $5,031.47</td>
</tr>
<tr>
<td>AWS Support (Enterprise): $47,104.61</td>
</tr>
<tr>
<td>Free Tier Discount: -$4.26</td>
</tr>
<tr>
<td>Reserved Tier Discount: -$20,309.95</td>
</tr>
<tr>
<td><strong>Middleware</strong></td>
</tr>
<tr>
<td>Subtotal: $19,083,264.00</td>
</tr>
<tr>
<td>Light workloads – WAS: $1,304,576.00</td>
</tr>
<tr>
<td>Light Workloads – DB2: $3,004,288.00</td>
</tr>
<tr>
<td>Medium Workloads – WAS: $1,304,576.00</td>
</tr>
<tr>
<td>Medium Workloads – DB2: $3,004,288.00</td>
</tr>
<tr>
<td>Heavy Workloads – Oracle: $14,774,400</td>
</tr>
<tr>
<td><strong>Labor, power, space</strong></td>
</tr>
<tr>
<td>Subtotal: $401,780.77</td>
</tr>
<tr>
<td>Labor - $401,780.77</td>
</tr>
<tr>
<td>Power and Space - $0.0</td>
</tr>
</tbody>
</table>
# x86 Cloud – Cost Breakdown

<table>
<thead>
<tr>
<th></th>
<th>x86 Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Subtotal: $819,810.88&lt;br&gt;8 24-core HP servers needed - $791,806.52&lt;br&gt;HP ProLiant DL580 Gen8 4U Xeon E7-8857 v2 3.00GHz (2ch/24cores); 512GB memory; 7X400GB SSDs&lt;br&gt;SLES, premium&lt;br&gt;VMware vSphere 5 Enterprise Plus&lt;br&gt;VMware vCenter Standard: $8,292.36&lt;br&gt;Cloud Manager with OpenStack: $19,712.00</td>
</tr>
<tr>
<td><strong>Middleware</strong></td>
<td>Subtotal: $9,856,032.00&lt;br&gt;Light workloads – WAS: $489,216.00&lt;br&gt;Light Workloads – DB2: $1,126,608.00&lt;br&gt;Medium Workloads – WAS: $489,216.00&lt;br&gt;Medium Workloads – DB2: $1,126,608.00&lt;br&gt;Heavy Workloads – Oracle: $7,387,200.00</td>
</tr>
<tr>
<td><strong>Labor, power, space</strong></td>
<td>Subtotal: $1,240,096.73&lt;br&gt;Labor - $1,126,464.78&lt;br&gt;Power - $44,072.03&lt;br&gt;Space - $69,559.92</td>
</tr>
</tbody>
</table>

Complete your session evaluations online at [www.SHARE.org/Orlando-Eval](http://www.SHARE.org/Orlando-Eval)
## z Cloud – Cost Breakdown

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Subtotal: $4,048,196.03</th>
</tr>
</thead>
<tbody>
<tr>
<td>z13 ELS with 32IFL, 3232 GB memory</td>
<td>$2,371,225.03</td>
</tr>
<tr>
<td>Memory (446 GB extra needed)</td>
<td>$133,800.00</td>
</tr>
<tr>
<td>Storage (storwize V7000 – 47x400GB SSDs)</td>
<td>$474,627.00</td>
</tr>
<tr>
<td>SLES premium</td>
<td>$1,011,200.00</td>
</tr>
<tr>
<td>Cloud Manager with OpenStack</td>
<td>$57,344.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Middleware</th>
<th>Subtotal: $1,500,480.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light workloads – WAS</td>
<td>$69,888.00</td>
</tr>
<tr>
<td>Light Workloads – DB2</td>
<td>$160,944.00</td>
</tr>
<tr>
<td>Medium Workloads – WAS</td>
<td>$104,832.00</td>
</tr>
<tr>
<td>Medium Workloads – DB2</td>
<td>$241,416.00</td>
</tr>
<tr>
<td>Heavy Workloads – Oracle</td>
<td>$923,400.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Labor, power, space</th>
<th>Subtotal: $923,219.36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$877,234.02</td>
</tr>
<tr>
<td>Power</td>
<td>$38,001.60</td>
</tr>
<tr>
<td>Space</td>
<td>$7,983.75</td>
</tr>
</tbody>
</table>
A private cloud on z13 yields the lowest costs

System configurations are based on equivalence ratios derived from IBM internal studies. Prices used are published US list prices as of 12/31/2014 for both IBM and competitors. Public cloud case includes costs of infrastructure (instances, data out, storage, support, free tier/reserved tier discounts), middleware and labor. z13 and x86 cases include costs of infrastructure (system, memory, storage, virtualization, OS, cloud mgmt), middleware, power, floor space and labor.

123 workloads (219 VMs)

64 Light Workloads (128 VMs)

32 Medium Workloads (64 VMs)

27 Heavy I/O Workloads (27 VMs)

219 reserved instances
$17.5M (3yr TCO)

264 x86 cores
$10.2M (3yr TCO)

32 IFLs
$6.2M (3yr TCO)

32% less than x86 cloud
60% less than public cloud (with 20% middleware discount applied)
System configurations are based on equivalence ratios derived from IBM internal studies. Prices used are published US list prices as of 12/31/2014 for both IBM and competitors. Public cloud case includes costs of infrastructure (instances, data out, storage, support, free tier/reserved tier discounts), middleware and labor. z13 and x86 cases include costs of infrastructure (system, memory, storage, virtualization, OS, cloud mgmt), middleware, power, floor space and labor.

Complete your session evaluations online at www.SHARE.org/Orlando-Eval.
Mainframes account for 68% of production workloads, but only 6% of IT spend.

Mainframe organizations demonstrate an average of 35% lower IT Cost of Goods; and computational growth roughly 3x more economically efficient.

Superior cloud services at up to 32% lower cost than x86 and up to 60% less than public cloud alternatives.
z13 Capabilities

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

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

**SMT2 technology on z13**
Improves performance and throughput of workloads

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

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

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

**Elastic Storage for Linux on System z**
Enables new class of workloads
z13 the platform for Enterprise Grade Linux

Enterprise Grade Linux

IBM GPFS  IBM zAware  GDPS Virtual Appliance*

Unprecedented Linux Performance

10TB Memory  Exploitation of SMT  85 LPARs  2x Faster I/O

Enabling Open Source Services

Open DB, Tooling, and Management Support

*S All statements regarding IBM’s future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.
Balanced System Design

**I/O and coprocessors bring added compute power to workloads**

<table>
<thead>
<tr>
<th>Up to 141 cores on a CPC</th>
<th>Up to 27 cores for offload system processing</th>
<th>Plus up to 640 POWER cores: I/O and Coprocessors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share up to 141 processors with up to 85 LPARS</td>
<td>24 SAPs</td>
<td>24 SAPs</td>
</tr>
<tr>
<td>Configure the processors as CPs, IFLs, zIIPs, or ICFs</td>
<td>2 Spares</td>
<td>2 Spares</td>
</tr>
<tr>
<td></td>
<td>1 IFP</td>
<td>1 IFP</td>
</tr>
</tbody>
</table>
z13: Redesigned for efficient and trusted cloud services

Up to **8,000** virtual servers per system, more than **50** per core

Open virtualization with new **KVM** support (SOD)*

**z13** brings faster processing and higher throughput of secure transactions (**2X** more throughput on crypto coprocessor)

Business continuity and IT analytics with **enterprise grade Linux solution**

Open support extended with OpenStack, PostgreSQL, Node.JS, and KVM (SOD)

Enterprise-grade Linux provides the foundation for public, private, and hybrid cloud

Patterns for Linux on z Systems to quickly build out complex cloud workload instances

Improved overall system performance leads to a lower TCO compared to public cloud deployments and deployments on x86 architectures

Enabling next generation cloud applications with IBM Bluemix on z Systems

* All statements regarding IBM’s future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.
Thank you!