From A (AIX) to Z (Linux/z):
A Customer Experience

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By Uriel Carrasquilla
Agenda

• Initial Scope: Benchmark Linux
  – Objectives
  – Application Profile
  – H/W Configurations
  – Results

• New Scope: Sunset AIX
  – Reach Consensus
  – Linux on System z9
  – Linux and Our Environment
  – Unix Roadmap

• Summary
Benchmark Objectives

• Original Proposition:
  – Feasibility:
    • Can we run a mission-critical application under Linux/z?
  – Performance:
    • Will it run faster than AIX?
  – Support:
    • Can we do it with the same head count?
  – Infrastructure:
    • What else do we need?
  – Cost benefits and ROI over three years
Benchmark Plan

• Freeze application changes before benchmark
• Oracle: same versus optimized parameters
• Run on z890, P570, and z9 (IBM WA Center)
• Document effort to convert APP to Linux
• DBA’s effort to support Linux
• SysAdmin effort to support Linux/zVM
• Size z890 and z9
Application Profile

• Java, multithreaded, with Oracle back end
• About 700 GB disk in production and growing
• Mission-critical but fail-over missing
• Heavy I/Os (40% of CPU power under AIX going to support I/Os)
• Long batch in AIX with 14 CPUs (10+ hours)
• AIX online response time acceptable to Web
Benchmark Realities

• Application improvements during benchmark:
  – Triangle step was converted from single to multi-threaded, saving 1.5 hours in the critical path
  – Closed “connects” (z9 was fast)
  – Scripts were written to simplify multiple runs of same benchmarks
  – Compiled application for each platform
  – Ran same code and same data on all platforms after application changes
Run Results (Three Threads/DEV)

- The P570 is the slowest at over 85% CPU
- The z890 is faster at 65% CPU
- The z9 is the fastest (x2) at 50% CPU
- Hardware/software used
  - P570: 4 (1.6 GHz) CPU, 4 GB MEM, Oracle 9i
  - z890: 2 IFL, 4 GB MEM, Oracle 10g
  - z9: 2 IFL, 4 GB MEM, Oracle 10g
# Results (Without Optimization)

## PRO Benchmark Results

### One Concurrent Job

<table>
<thead>
<tr>
<th>Step</th>
<th>P570</th>
<th>z890</th>
<th>z9 (2IFL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSL</td>
<td>1:24:00</td>
<td>1:17:54</td>
<td>0:28:26</td>
</tr>
<tr>
<td>SL</td>
<td>0:59:04</td>
<td>1:02:10</td>
<td>0:51:41</td>
</tr>
<tr>
<td>SP</td>
<td>0:15:30</td>
<td>0:11:28</td>
<td>0:03:21</td>
</tr>
<tr>
<td>PC</td>
<td>0:03:39</td>
<td>0:04:04</td>
<td>0:01:34</td>
</tr>
<tr>
<td>PM</td>
<td>1:02:29</td>
<td>1:09:32</td>
<td>0:54:48</td>
</tr>
<tr>
<td>CG</td>
<td>0:39:08</td>
<td>0:19:13</td>
<td>0:11:35</td>
</tr>
<tr>
<td>LP-DS</td>
<td>0:18:49</td>
<td>0:06:46</td>
<td>0:00:39</td>
</tr>
<tr>
<td>2SL</td>
<td>0:08:38</td>
<td>0:03:30</td>
<td>0:00:25</td>
</tr>
<tr>
<td>SMP</td>
<td>0:19:22</td>
<td>0:03:30</td>
<td>0:00:31</td>
</tr>
<tr>
<td>TRI</td>
<td>0:54:14</td>
<td>1:09:53</td>
<td>0:27:06</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6:04:53</strong></td>
<td><strong>5:28:38</strong></td>
<td><strong>3:00:06</strong></td>
</tr>
</tbody>
</table>

### End-to-End

- **P570**: 6:44:19
- **z890**: 6:15:00
- **z9 (2IFL)**: 3:10:00
## Results (With Optimization)

### z9 PRO Benchmark Results

<table>
<thead>
<tr>
<th>Step</th>
<th>4 Threads</th>
<th>6 Threads</th>
<th>3 Threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSL</td>
<td>0:19:14</td>
<td>0:21:35</td>
<td>0:32:16</td>
</tr>
<tr>
<td>SL</td>
<td>0:15:23</td>
<td>0:28:50</td>
<td>0:19:03</td>
</tr>
<tr>
<td>SP</td>
<td>0:02:39</td>
<td>0:02:53</td>
<td>0:03:02</td>
</tr>
<tr>
<td>PC</td>
<td>0:01:07</td>
<td>0:01:12</td>
<td>0:01:15</td>
</tr>
<tr>
<td>PM</td>
<td>0:14:02</td>
<td>0:14:29</td>
<td>0:21:23</td>
</tr>
<tr>
<td>CG</td>
<td>0:04:42</td>
<td>0:03:41</td>
<td>0:07:00</td>
</tr>
<tr>
<td>LP-DS</td>
<td>0:00:24</td>
<td>0:00:21</td>
<td>0:00:36</td>
</tr>
<tr>
<td>2SL</td>
<td>0:00:18</td>
<td>0:00:15</td>
<td>0:00:26</td>
</tr>
<tr>
<td>SMP</td>
<td>0:00:24</td>
<td>0:00:26</td>
<td>0:00:26</td>
</tr>
<tr>
<td>TRI</td>
<td>0:24:25</td>
<td>0:24:39</td>
<td>0:24:14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1:22:38</td>
<td>1:38:21</td>
<td>1:49:41</td>
</tr>
<tr>
<td><strong>End-to-End</strong></td>
<td>1:32:04</td>
<td>1:47:52</td>
<td>2:00:00</td>
</tr>
</tbody>
</table>
Findings: App to Linux

- No effort involved to move application
- Same PC-based DEV environment
- Java is 100% equivalent
Findings: DBA R&R

- No changes in tools
- No changes in GUI
- Very much BAU
- Tuning required when moving to z
- Self-tuning in 10
Findings: SysAdmin on Linux

• We have been doing it for just over a year
• Some time to get used to MF H/W and zVM
• Some different tools versus AIX and SUN
• Project was in progress to fully integrate
• Some functionality might need to be investigated (ext3/xfs/jfs, SLES 10)
• More training is needed
Findings: SysAdmin and zVM

- Our zOS systems programmer was a valuable resource.
- Our Linux systems administrator became proficient with zVM and mainframe hardware.
- This group is the most impacted by this change.
- Patience will be expected from our DEV customers during early stages.
- AIX to Linux skills are transferable.
Recommendations for APP

• DEV/QA/PROD applications to z9
• Three-tier: APP and DBMS zVM guests
• Will need 16 GB MEM (2:1 virtualization)
• Will need 4 IFLs for APP migration (4:1)
• Will need 2 IFLs for CAPLAN, STS, UC4
• Java HA: KeepAlived (VRRP) Master/Slave
• Oracle HA: RAC for seamless fail-over
Stop the Press/New Scope

- IT management expanded the scope to include the AIX platform elimination
  - Five PROD servers (22 CPUs)
  - Three supporting DEV servers (9 CPUs)
  - Three supporting QA servers (11 CPUs)
- Investigate HA and propose new architecture
- Advise on Sun environment: 8 PROD servers with 37 CPUs plus DEV and QA servers
New Scope: Sunset AIX

• From our CIO:
  – Reach consensus
  – Consider all implications of this change
  – Freeze budget for AIX
  – Get customers onboard
# Linux on System z9 HA

## IBM z9

<table>
<thead>
<tr>
<th>Book1</th>
<th>Book2</th>
<th>Book3</th>
<th>Book4</th>
<th>Book5</th>
<th>Book6</th>
</tr>
</thead>
<tbody>
<tr>
<td>z/VM</td>
<td>Linux Guests</td>
<td>Applications</td>
<td>Oracle</td>
<td>Oracle RAC</td>
<td>Linux Guests</td>
</tr>
</tbody>
</table>

## Network (OSA)

- 2nd Data Center
- 2nd IBM z9

## Points of Failure

<table>
<thead>
<tr>
<th>Points of Failure</th>
<th>Risk Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Frame</td>
<td>Redundant Frame (Not today)</td>
</tr>
<tr>
<td>Physical Components</td>
<td>Redundant Hardware</td>
</tr>
<tr>
<td>z/VM LPAR</td>
<td>2nd z/VM LPAR</td>
</tr>
<tr>
<td>Linux Guest</td>
<td>2nd Linux Guest on 2nd z/VM (VRRP)</td>
</tr>
<tr>
<td>Database</td>
<td>Oracle RAC/ 2nd Guest on 2nd z/VM</td>
</tr>
<tr>
<td>Application</td>
<td>2nd Guest</td>
</tr>
</tbody>
</table>

## Growth

- Book5
- Book6

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Linux on System z9 Virtualization

- Consolidation—fewer servers doing more work
- Greater utilization—ability to handle increased workloads and multiple applications on a single machine
- Standardization—ability to apply standard management tools across a diverse work environment
- Application workloads are shared for better utilization
- Server resources are allocated dynamically based on demand
Linux on System z9
Flexibility

- Simplifies systems management through centralization
- Prioritizes workloads
- Prevents runaway processes from degrading performance of other applications
- Increases capacity to handle unpredictable fluctuations, as well as planned increases
- Provides a low level of granularity for resource allocation and control
Linux on System z9 Performance

• Separate I/O processors allow for parallel processing for I/O and application at the same time
  – Our tests showed I/O rates of 1ms on z9 compared to 9ms on z890 and 11ms on AIX
• Deployment of new server/LPAR from days/weeks to hours
• True shared resources (processors, memory, I/O, network, z/VM)
• Internal communications between LPARs via Hypersockets™ (dedicated 10GBs compared to 1GB)
• Faster recovery time at DR—Linux and all LPARs come up with the mainframe

Hypersockets™ is an IBM product.
Linux on System z9
Cost Avoidance

• Software Licensing
  – Multiple servers on one physical engine
  – Oracle pricing by engine (AIX 40 engines, System z approximately 1/3 required)

• Environmental
  – Reduction on external cabling, routers, hubs, switches, energy, and floor space
Linux on System z9
Redundant Hardware

- Transparent CP sparing
- Fault-tolerant interconnect design
- Dynamic memory sparing
- Enhanced firmware simulation
- Remote operations support
- N+1 power supply technology
- Concurrent channel, OSA-E, and coupling link maintenance
- Dynamic I/O reconfiguration
- FICON purge path extended
- Enhanced book availability
- System Assist Processor (SAP) reassignment and sparing
- Sparing for storage protect preservation keys
- Partial memory restart

- Dual support elements
- Hybrid cooling
- Concurrent hardware management console (HMC) and support element
- Redundant I/O interconnect
- Enhanced driver maintenance
- Dynamic oscillator switchover
- Enhanced application preservation
- Failure containment for MBA
- Concurrent book add
- Dynamic channel path management
- Concurrent power and thermal maintenance
- Enhanced dynamic reconfiguration management

Single points of failure exist, but mean time between failure = 100 years.
Linux and Our Environment

Areas that Linux may impact:

• Application Development
• Change Management
• Security
• Languages and Integration
• Linux Management Tools
• Risks
## Linux and Our Environment: Application Development

<table>
<thead>
<tr>
<th>Development Platforms</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Studio</td>
<td>Not Impacted</td>
</tr>
<tr>
<td>PL/SQL Developer</td>
<td>Not Impacted</td>
</tr>
<tr>
<td>J Developer</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development Languages</th>
<th>Linux Supported</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>C/C++</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Cobol</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Stored Procedures</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Perl</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Ksh Shell</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>SAS</td>
<td>NO</td>
<td>Code can be developed on SUN or Mainframe and access data on Linux.</td>
</tr>
</tbody>
</table>

**Note:** Have the ability to install VMWare Virtual Server on PC desktop to load Linux and have a local development environment on PC.
Linux and Our Environment: Change Management

Same tools and processes as current Change Management.

<table>
<thead>
<tr>
<th>Tools Used</th>
<th>Supported on Linux</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeamTrack</td>
<td>NA</td>
<td>Migration Requests and Special Run Request</td>
</tr>
<tr>
<td>ChangeMan DS</td>
<td>Yes</td>
<td>Code Repository, Check-in/Check-out/Promote</td>
</tr>
</tbody>
</table>
Linux and Our Environment: Security

- Batch Application Security Architecture
  - Will be the same as on AIX

- Batch Application Security Administration
  - Will be the same as on AIX

- End User Security Administration
  - Password Synchronization and Group Membership Management
    - BMC has reported that they will provide a connector that supports SuSE Linux on zVM by February 2007. This connector will allow us to manage end user security in the same manor as currently on AIX.

- Monitoring
  - BindView does not currently support Linux on zVM
  - Will need to procure the BindView Agentless version to get functionality
## Linux and Our Environment: Languages and Integration

<table>
<thead>
<tr>
<th>Software</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database Connectivity</strong></td>
<td></td>
</tr>
<tr>
<td>Oracle TNS</td>
<td>Access Oracle</td>
</tr>
<tr>
<td>DB2 Connect</td>
<td>Access DB2</td>
</tr>
<tr>
<td><strong>Messaging</strong></td>
<td></td>
</tr>
<tr>
<td>MQ Series</td>
<td>Messaging between DBs and Systems</td>
</tr>
<tr>
<td><strong>Languages</strong></td>
<td></td>
</tr>
<tr>
<td>Cobol, C/C++, Java, Perl, KSH, PL*SQL</td>
<td>Coding between DBs and Systems</td>
</tr>
<tr>
<td><strong>Extract/Transform/Load (ETL)</strong></td>
<td></td>
</tr>
<tr>
<td>DTS, SSIS (Microsoft)</td>
<td>Integrated Development Platform</td>
</tr>
</tbody>
</table>
## Linux and Our Environment: Linux Management Tools

<table>
<thead>
<tr>
<th>Tool/Process</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database</strong></td>
<td></td>
</tr>
<tr>
<td>Grid Control</td>
<td>DBMS Administration</td>
</tr>
<tr>
<td>DBArtisan</td>
<td>DBMS Administration</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td></td>
</tr>
<tr>
<td>Ctrl-SA</td>
<td>1st Qtr 2007—Password Sync</td>
</tr>
<tr>
<td>BindView</td>
<td>Procure Agentless Version—Reporting</td>
</tr>
<tr>
<td>MANUAL/YaST</td>
<td>ID Setup</td>
</tr>
<tr>
<td><strong>Scheduling</strong></td>
<td></td>
</tr>
<tr>
<td>UC4</td>
<td>Scheduling</td>
</tr>
<tr>
<td><strong>Change Management</strong></td>
<td></td>
</tr>
<tr>
<td>ChangeMan DS</td>
<td>Source Code Migration and Control</td>
</tr>
<tr>
<td><strong>System Administration</strong></td>
<td></td>
</tr>
<tr>
<td>YaST</td>
<td>Linux Administration, Installation</td>
</tr>
<tr>
<td>SAR</td>
<td>Linux Performance/Accounting</td>
</tr>
<tr>
<td>VMWare</td>
<td>VM System Management</td>
</tr>
<tr>
<td><strong>Backup and Recovery</strong></td>
<td></td>
</tr>
<tr>
<td>Netbackup</td>
<td>Backup/Restore/Recovery</td>
</tr>
</tbody>
</table>
# Linux and Our Environments: Risk Mitigation

<table>
<thead>
<tr>
<th>Risks</th>
<th>Risk Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor Support</td>
<td>• Vendor does not support Linux but can use Sun/Solaris</td>
</tr>
</tbody>
</table>
| Legacy System Rewrite              | • We own our current AIX environment  
• Only stopping further growth and development at this time  
• Migration from AIX can be scheduled with planned system rewrites  
• Not forcing migrations today |
| Virtual Mind Set/VM Administration | • VM training  
• Cross-training for system administrators  
• Linux is just another flavor of Unix, and all basic skills exist today |
| Security—Linux Open Source         | • We currently receive all Linux alerts and separate documentation on high alerts  
• Linux out of box comes with the doors closed and we have to open it up |
| Single Hardware Platform           | • Create 2 z/VMs to support fail-over for microcode, z/VM, Linux, and application failover  
• Implement Oracle RAC for database fail-over  
• Implement Linux HA for application fail-over  
• Future—if we decide to have separate data centers, we can set up fail-over between sites, eliminating single hardware risk |
In Summary

Linux runs on many platforms, but running it on a System z9 provides additional benefits in the following areas:

• High availability (HA) and customer satisfaction

• Flexibility
  – Virtualization to minimize scheduled downtime
  – Workload management to handle peaks

• Performance and capacity to grow the business

• Cost savings in terms of TCO