What is NCCI?

• National Council on Compensation Insurance, Inc. – Boca Raton, FL.
• America’s largest workers compensation and health care informatics corporation.
• Owned by workers compensation insurers.
• Offices in 38 states, ~1000 employees, 200 in IT.
Predicament

- Number of servers growing fast.
- Number of applications growing fast.
- Long delays in provisioning new servers.
- Flat budget and no relief in sight.
Introduction

• If this is your situation, we understand your pain.
• Agenda:
  – background
  – benchmarking for sizing hardware
  – business case
  – road map
  – Summary
2004 IT CSI

CIO: find out about Linux and report.
Background

- Centralization $\leftrightarrow$ economies of scale.
- Decentralization $\leftrightarrow$ least powerful computer capable of doing the work.
- Acquisition = $$ 20\% \text{ of life cycle}
- TCO = $$\text{Investment} + $$\text{System Mgt.}
Background

• Legacy Systems on MF:
  – high residual economic value
  – small investment to keep them running
  – high RAS
Background

• Recommendation:
  – Linux makes sense on MF only.
  – MF is needed for legacy systems.
  – MF is efficient in payroll costs.
  – Purchase 1 IFL for PoC application
Background

- In 2005, z890 with 1 IFL and 3 LPAR installed.
- The PoC ran for 1 year.
- In summer 2006, a mission critical application hit the wall and the Linux Benchmark was approved.
Benchmark

• Objectives
  – Feasibility: can we port the application?
  – Performance: will it run faster than AIX?
  – Impact: financial, operational and customers?
Sizing the Target Hardware

1. Freeze application changes.
2. Compare CPU & Memory.
3. Develop Conversion Rules.
4. Size z-Series (z890 and z9).

Benchmark

- 4 CPU's
- 1.654 MHz
- 4 GB MEM
- 2 fiber
- 700 GB disk
- 2 internal disks

- LQ2530 – LQ255F
- PRSP and AROP

- 2 CPU's (IFL)
- 4 GB MEM
- 4 fiber
- 500 GB disk
- no internal disk
Benchmark

• Findings:
  – The P570 slowest at 85% CPU.
  – The z890 faster at 65% CPU.
  – The z9 fastest (x2) at 50% CPU.
Benchmark

• Batch: from ~7 hours to 1.5 hours (P570 to z9)
• CPU = 3:1  (P570 to z9)
• Memory = 2:1  (P570 to z9)
• Assumptions:
  – Oracle 10.2g
  – Java 1.4.3
  – zVM 5.3
  – SLES 9.3
Benchmark

• Findings:
  – Application converted in 1 week
  – No impact to DBA’s
  – We lacked zVM skills
  – Systems management centralization
  – Switched from telnet to ssh
  – Size effort to get ready for production
Architecture

IBM z9

z/VM

Book1 (2007: 6 CPU – 20 GB MEM)

Linux Guests

Applications
Oracle
Oracle RAC

Book2 (2008: + 6 CPU + 32 GB MEM)

Network (OSA)

Points of Failure
Whole Frame
Physical Components
z/VM LPAR
Linux Guest
Database
Application

Risk Mitigation
Redundant Frame (Not today)
Redundant Hardware
2nd z/VM LPAR
2nd Linux Guest on 2nd z/VM (VRRP)
Oracle RAC/ 2nd Guest on 2nd z/VM
2nd Guest

Growth

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Architecture

- DEV, QA and PROD servers
- KeepAlive (VRRP) for HA
- Cluster File System (IBM Global File System)
- RAC for Oracle
- Each DB instance on a guest
- Each Java application on a guest
Develop the Business Case

• Impact on software licenses.
• Find software not supported on Linux/z.
• Transition costs.
• Automate provisioning process.
• Centralize systems management.
• Re-calculate servers to staff ratio.
• Buy-in from customers and IT.
• Prepare TCO and ROI (versus status quo).
Develop the Business Case

• Benefits:
  – HA and Customer Satisfaction.
  – Flexibility due to virtualization.
  – Workload manager to handle peaks.
  – Capacity and business cycles.

• Disadvantages:
  – New skills for new operating system.
  – Some 3rd party software not supported.
  – Transition costs.

• Decision: Go/no-GO.
From our CIO (fall 2006)

- Reach consensus
- Consider all implications
- Freeze budget for AIX
- Get customers onboard
Road Map

• New applications to Linux on z unless not supported, then to SUN.
• From AIX (2007 and 2008):
  – 22 CPU’s for 5 PROD servers
  – 9 CPU’s for 3 DEV servers
  – 11 CPU’s for 3 QA servers
• From SUN (2009+):
  – 37 CPU’s for 8 PROD servers
  – Plus DEV and QA servers
Road Map

• Identify and involve all affected groups.
• Assemble technical team to set up DEV, QA and PROD environments.
• Take to TASC (technical committee).
• Assign Migration projects (per application).
• Follow up, direct and control.
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
In Summary

• Your mileage may vary, run your own benchmark to size your new hardware requirements.
• Make sure your business case is understood and supported not only inside IT but also those users affected by the consolidation.
• Full commitment to the road map by senior management and all members of the team.
Additional Material
Results (Without Optimization)

PRO Benchmark Results

<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>Total</td>
<td>6:04:53</td>
<td>5:28:38</td>
<td>3:00:06</td>
</tr>
</tbody>
</table>

End-to-End | 6:44:19 | 6:15:00 | 3:10:00 |

From A to Z, A Customer Experience
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Results (With Optimization)

z9 PRO Benchmark Results

<table>
<thead>
<tr>
<th>One Concurrent Job</th>
<th>4 IFL</th>
<th>4 IFL</th>
<th>2 IFL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 Threads</td>
<td>6 Threads</td>
<td>3 Threads</td>
</tr>
<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><strong>1:22:38</strong></td>
<td><strong>1:38:21</strong></td>
<td><strong>1:49:41</strong></td>
</tr>
<tr>
<td>End-to-End</td>
<td><strong>1:32:04</strong></td>
<td><strong>1:47:52</strong></td>
<td><strong>2:00:00</strong></td>
</tr>
</tbody>
</table>
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>Not Impacted</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>Code can be developed on SUN or Mainframe and access data on Linux.</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></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>Database Administration</td>
</tr>
<tr>
<td>DBArtisan</td>
<td>Database Administration</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td></td>
</tr>
<tr>
<td>Contol-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>
<tr>
<td>Legacy System Rewrite</td>
<td>• We own our current AIX environment</td>
</tr>
<tr>
<td></td>
<td>• Only stopping further growth and development at this time</td>
</tr>
<tr>
<td></td>
<td>• Migration from AIX can be scheduled with planned system rewrites</td>
</tr>
<tr>
<td></td>
<td>• Not forcing migrations today</td>
</tr>
<tr>
<td>Virtual Mind Set/VM Administration</td>
<td>• VM training</td>
</tr>
<tr>
<td></td>
<td>• Cross-training for system administrators</td>
</tr>
<tr>
<td></td>
<td>• Linux is just another flavor of Unix, and all basic skills exist today</td>
</tr>
<tr>
<td>Security—Linux Open Source</td>
<td>• We currently receive all Linux alerts and separate documentation on high alerts</td>
</tr>
<tr>
<td></td>
<td>• Linux out of box comes with the doors closed and we have to open it up</td>
</tr>
<tr>
<td>Single Hardware Platform</td>
<td>• Create 2 z/VMs to support fail-over for microcode, z/VM, Linux, and application failover</td>
</tr>
<tr>
<td></td>
<td>• Implement Oracle RAC for database fail-over</td>
</tr>
<tr>
<td></td>
<td>• Implement Linux HA for application fail-over</td>
</tr>
<tr>
<td></td>
<td>• Future—If we decide to have separate data centers, we can set up fail-over between sites, eliminating single hardware risk</td>
</tr>
</tbody>
</table>