Choose the Right Architecture and Save Millions - A Customer Case Study

Mark Post
Novell, Inc.

Wednesday, Feb. 27, 2008
9205
Agenda

• Disclaimer
• Caveats and Emptors
• Basic Scenario
• The First Project Meeting
• Internal Constraints
• High-level System Hardware Overview
• Other Hardware
• Software
• Power and Cooling
Agenda (2)

• Floor Space
• Wear and Tear on People
• How Busy Were Those Servers?
• The Mainframe Alternative
• Questions

I'll take questions during the talk unless time gets tight
Disclaimer

• My current employer (Novell) had nothing whatsoever to do with the project I will be describing.

• I will not be talking about which companies were involved, for obvious reasons.

• Costs for the mainframe version will be approximate, since IBM doesn't have list prices, per se, for z9 hardware (except IFLs). I was provided with cost figures (at the very high end), from someone who had access to them.

• I was involved in the project, and still have the scars...
Caveats and Emptors

- All hardware, software and maintenance costs are for 3 years.
  - The numbers for the mainframe get even better over 5 years.
- Not all hardware costs for the Intel deployment will be included in the dollar totals. (Don't worry, it's OK.)
- VMWare, although available at the time of the project, wasn't considered a viable option, so no virtualization was done.
- I'll only be talking about the Linux part of the project.
- z/VM will be configured to “over commit” real storage.
  - Standard operating procedure for z/VM shops
Caveats and Emptors (2)

• z/VM's Virtual Switch will be used to connect the Linux guests to the network.

• Storage will be configured with some percentage as expanded storage.

• Disk mirroring will be done in the DASD storage array, not by Linux or RAID controller.

• SAN costs are assumed to be equal between the two choices.

• People costs are assumed to be equal, even though managing mainframe Linux systems is less people-intensive.
Basic Scenario

- A new client required us to build ~50 Linux systems on Intel-based server class equipment.
- A much smaller number of Windows and Solaris systems were also to be built.
- Due to the client's promises to others, we had 2 months to get everything installed and in production.
- The systems were all going to be remote from where any of the Linux system administrators were located.
- A number of other bidders on the contract refused to commit to the 2-month timeframe.
- The project had upper management “visibility.”
The First Project Meeting

- **No** hardware had been ordered
  - This included racks, power distribution units, etc.

- The account rep. working with the client refused to let us order only two server configurations – they thought the client would complain about the cost of over-spec'ing.

- Pushing the schedule out was not an option.

- All of the teams working on the project were “leveraged,” i.e., not dedicated to one particular client.

- The network was still being designed.

- The requirements for system builds had not yet been received from the customer.
Internal Constraints

• We were supposed to use a commercial system management product to provision and patch midrange systems. This worked best when the system was cabled directly to the provisioning network.
  • We didn't have a place to do that, so other measures were taken to get access to the provisioning network. They weren't terribly reliable/fast.

• All servers had out-of-band remote management cards in them, connected via Ethernet, accessed via SSL-enabled HTTP (port 443).

• Racks could not be fully populated because of data center policies

• Are we having fun yet?
Internal Constraints

• Redundancy requirements
  • At least two CPUs per server
  • 3 internal disks for the operating system
    • 2 mirrored via hardware RAID controller
    • 1 alternate boot
  • Dual power supplies
  • Dual HBA cards for systems needing SAN access
  • 2 NICs for the “front-side,” i.e., customer business
    • Additional NIC ports used to separate backup traffic, administrator access

• Customer data not allowed on disks used for the OS
Development Systems

• 17 Systems
  • Additional GIGe NICs - 17
  • RAM (total of 146GB)
    • 1 x 2GB
    • 6 x 4GB
    • 5 x 8GB
    • 5 x 16GB
  • Processors (3.33 and 3.4 GHz)
    • 2 x 1 CPUs
    • 5 x 2 CPUs
    • 10 x 4 CPUs
  • Internal 72GB SCSI disks - 10 x 4, 7 x 5 = 75
Test Systems

- 7 Systems
  - Additional GIGe NICs - 7
  - RAM (total 96GB)
    - 2 x 8GB
    - 5 x 16GB
  - Processors (3.33 and 3.4 GHz)
    - 5 x 2 CPUs
    - 2 x 4 CPUs
  - Internal 72GB SCSI disks – 7 x 4 = 28
Production Systems

• 27 Systems
  • Additional GIGe NICs - 27
  • RAM (total 254GB)
    • 3 x 2GB
    • 2 x 4GB
    • 14 x 8GB
    • 8 x 16GB
  • Processors (3.33 and 3.4 GHz)
    • 3 x 1 CPU
    • 12 x 2 CPUs
    • 12 x 4 CPUs
  • Internal 72GB SCSI disks – 20 x 4, 7 x 5 = 115
Other Hardware

- HBAs for SAN storage – 56
- Fibre cables for SAN – 56
- RAM expansion boards – 37
- External 72GB disks for alternate boot drives – 37
- External disk enclosures - 19
- SCSI cards for external disk access – 37
- Mezzanine riser cards – 37
- Rack units (42u) – 13 (78 sq. ft.)
- Power distribution units – 26
Other Hardware (2)

- Switch ports – 204
- Ethernet cables – 204
- SAN switch ports - 56
- Hardware support 24x7 – 27 (+10 for ext. storage)
- Hardware support 13x5 – 24 (+9 for ext. storage)

Not including the costs of switches, routers, etc.
- They were leveraged (shared with other clients)
- I don't know how many were used, what kind they were, etc.
Hardware Costs for 3 Years

- $1,212,130.55
  - Doesn't seem too bad for 3 years, does it?

- Total Cost so far:
  $1,212,130.55
Software Licensing

• Test and Development
  • 29 Oracle database (per processor)
  • Oracle maintenance 22% of purchase price per year
  • 24 (3-year) Linux, including 9x5 support

• Production
  • 44 Oracle database (per processor)
  • Oracle maintenance 22% of purchase price per year
  • 27 (3-year) Linux, including 24x7 support
  • 2 clustering software
Software Costs for 3 Years

• $5,077,789.74
  • Ooh, that's gotta hurt.
  • And it doesn't even include all the costs, because I didn't have access to some of them. (Powerpath, for example.) But, it was the majority of them, so good enough.

• Total Cost so far:
  $6,289,920.29
Power and Cooling at Idle

- 5 x 1 CPU, 4GB RAM, 5 disks
  - 258 watts
  - 881 BTUs/hr

- 4 x 2 CPUs, 2GB RAM, 5 disks
  - 337 watts
  - 1150 BTUs/hr

- 5 x 2 CPUs, 4GB RAM, 5 disks
  - 341 watts
  - 1163 BTUs/hr
Power and Cooling at Idle (2)

- 3 x 2 CPUs, 4GB RAM, 4 disks
  - 473 watts
  - 1614 BTUs/hr

- 10 x 2 CPUs, 8GB RAM, 4 disks
  - 476 watts
  - 1622 BTUs/hr

- 12 x 4 CPUs, 8GB RAM, 4 disks
  - 626 watts
  - 2134 BTUs/hr

- 12 x 4 CPUs, 16GB RAM, 4 disks
  - 642 watts
  - 2191 BTUs/hr
Power and Cooling Costs for 3 Years

- 25,738 watts
- 87,782 BTU/hr

- At $0.0936 (US average for 2006) for electricity
  - $25,738 * 24 * 365 / 1000 * 0.0936 = $21,103.51 per year
  - For 3 years, $63,310.53

- At 0.7 of power costs for HVAC:
  - $44,317.37

- Total Cost so far:
  - $6,397,548.19
Floor Space Costs for 3 Years

- Including service clearance, each rack requires ~17.5 sq. ft.
  - At $220 per square foot per year:
    - 13 racks: 17.49 * 13 * 220 = $50,021 per year

- For 3 years = $150,064
Midrange Totals

- Hardware: $1,212,130
- Software: $5,077,789
- Power and Cooling: $107,627
- Floor Space: $150,064
- Midrange Total: $6,547,610
Wear and Tear on People

- Designing servers
- Ordering servers and other equipment
- Assembling servers
- Racking servers
- Verifying servers were assembled with the correct combination of hardware
- Moving parts around between servers
- Getting the remote access cards configured so they could be used
- Configuring the RAID arrays using the internal disks
Wear and Tear on People (2)

- Designing the network
- Running and re-running Ethernet cables
- Testing Ethernet connections to switches, etc.
- Configuring and re-configuring network switches
- Running and re-running fibre cables for SAN
- Testing fibre connections
- Firewalls blocking access to the remote access cards
- Firewalls blocking access to the systems
- Configuring and re-configuring firewalls
- Wrong system build information
Wear and Tear on People (3)

- Wrong network information (IP addresses, network masks, default gateways)
- Getting network connections made in the first place
- Getting correct network connections made
- Getting “final” go ahead to actually build a particular set of systems on Friday afternoons
- System builds and hardening taking hours instead of minutes due to unreliability of workaround for provisioning software
- Hardware failures
Wear and Tear on People (4)

- Having to rebuild systems multiple times due to client requested changes
- Labeling and relabeling servers
- Confusion about what servers were named what, and what rack they were in. (Inventory control.)
- Everyone working too many hours for too long of a period of time
Just How Busy Were Those Systems?

• The operating systems were taking up about 16GB of the 72GB (x2 for mirroring) disk drives
  • This was only because we drastically over allocated space
  • Swap partitions took up another 4GB

• Once the systems were in production, I looked at several 24-hour periods during the week.
  • One system was running around 10-15%
  • The other 50 systems were running < 1%
  • None of them were doing any paging because of the large RAM sizes.
  • Almost all of them had no page space usage.
The Mainframe Alternative - Hardware

• z9 EC (2094-S18)
  • 1 CP (Oddity due to IBM Pricing Policy)
  • 2 IFLs
  • 256GB RAM (16x16GB cards, requires 2 books)
  • 2 FICON Cards = 8 Ports/Channels
  • 2 FCP Cards = 8 Ports/Channels
  • 2 OSA-Express2 1000Base-T

• DASD (DS8100)

• 4 TB ECKD

There was also a lower-cost DS6800 option, which I chose not to take.
Other Hardware

- Hardware support 24x7 – 2 (The z9 and DASD)
- Ethernet Switch Ports – 4
- Ethernet cables – 4
- Fiber cables for FICON DASD – 8
- Fiber cables for SCSI over FCP - 8

- Again, this isn't including switches, routers, firewalls, etc.
Hardware Costs

• The totally unrealistic “reference price” hardware costs for 3 years, including maintenance
  $5,295,092

• The more realistic price:
  $3,575,096

• The IBM business partner who helped me didn't want to send me the reference price:
  “I really hate to give you these prices.. They are so out of line!”
Software Licensing

Software licensing, including support and maintenance

- 2 – z/VM
- 2 – Linux
- 2 - Oracle
- 2 - Dirmaint
- 2 - Performance Tool Kit (substitute your own favorite here)

- Software costs for 3 years: $309,080
Power, Cooling, Floorspace

• Power
  • $6,300 \times 24 \times 365 / 1000 \times 0.0936 = $5,165.60
  • Power for 3 years = $15,496.80

• Cooling
  • $15,496.80 \times 0.7 = $10,847.76$ for cooling over 3 years

• Floor Space Costs
  • z9 BC: $58.7 \times 220 = $12,914 \times 3$ years = $38,742$
## Midrange Versus Mainframe Costs

<table>
<thead>
<tr>
<th>Category</th>
<th>Unrealistic</th>
<th>More Realistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>$5,295,092</td>
<td>$3,575,096</td>
</tr>
<tr>
<td>Software</td>
<td>$309,080</td>
<td>$309,080</td>
</tr>
<tr>
<td>Power and Cooling</td>
<td>$26,345</td>
<td>$26,345</td>
</tr>
<tr>
<td>Floor Space</td>
<td>$38,742</td>
<td>$38,742</td>
</tr>
<tr>
<td><strong>Mainframe Total</strong></td>
<td><strong>$5,669,259</strong></td>
<td><strong>$3,949,263</strong></td>
</tr>
<tr>
<td><strong>Midrange Total</strong></td>
<td><strong>$6,547,610</strong></td>
<td></td>
</tr>
</tbody>
</table>
# Cost Comparison Over 5 Years

<table>
<thead>
<tr>
<th>Category</th>
<th>Unrealistic</th>
<th>More Realistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>$5,555,492</td>
<td>$3,835,496</td>
</tr>
<tr>
<td>Software</td>
<td>$458,960</td>
<td>$458,960</td>
</tr>
<tr>
<td>Power and Cooling</td>
<td>$43,908</td>
<td>$43,908</td>
</tr>
<tr>
<td>Floor Space</td>
<td>$64,570</td>
<td>$64,570</td>
</tr>
<tr>
<td>Mainframe Total</td>
<td>$6,122,930</td>
<td>$4,402,934</td>
</tr>
<tr>
<td>Midrange Total</td>
<td>$8,204,091</td>
<td></td>
</tr>
</tbody>
</table>
Questions?