Virtualization on the Mid-Range

Jaqui Lynch
Mainline Information Systems

What is Virtualization?

- Being able to dynamically move resources
- Being able to share resources
- Making better use of the resources
- Driving utilization up
- Etc etc etc

- Some think it is 42
Dynamic LPAR

- Add processors to partition
- Move processors between partitions
- Remove processors from a partition
- Add memory to a partition
- Move memory from one partition to another
- Remove memory from a partition
- Add a PCI adapter
- Move a PCI adapter
- Remove a PCI adapter

Reasons to Partition

- Consolidation
- Production and Test on same hardware
- Multiple Operating Systems
- Consolidate Applications on different time zones
- Complying with license agreements
Role of the HMC

- Required to partition any box
- Can use HMC to manage systems
- Provides a console to manage hardware
- Detecting, reporting and storing changes in hardware
- Service focal point (requires Ethernet)
- Vterms to partitions

Terminology

- Hypervisor
- MicroPartitioning
  - Shared Processor Pool
  - Capped
  - Uncapped
  - Virtual Processors
  - Entitled Capacity
- Virtual I/O Server
- Virtual Ethernet
- Shared Ethernet Adapter (SEA)
- Virtual SCSI Server
POWER Hypervisor functions

- Same functions as POWER4 Hypervisor.
  - Dynamic LPAR
  - Capacity Upgrade on Demand
- New, active functions.
  - Dynamic Micro-Partitioning
  - Shared processor pool
  - Virtual I/O
  - Virtual LAN
- Machine is always in LPAR mode.
  - Even with all resources dedicated to one OS

POWER5 / 5+ virtualization architecture

- Workload management and provisioning
- Virtualization layers:
  - Hypervisor
  - Virtual Processors
  - Virtual Storage
- Hardware Management Console (HMC)
  - Processors
  - Memory
  - Expansion slots
  - Local devices and storage
- Virtual Networks
  - AIX 5L V5.3 partitions
  - AIX 5L V5.2 partitions
  - Linux partitions
  - IBM iyp
  - VSCSI
  - VEnet
  - IVM
- Virtual I/O Server
  - Virtual Storage
  - Unassigned on demand resources

*Integrated Virtualization Manager (IVM) is disabled if HMC attached
**Available on selected p5-570, p5-590 and p5-595 models
APV Advanced Power Virtualization Feature

- Included on 590 and 595
- Optional on all other p5 boxes
- Enables:
  - MicroPartitioning
  - Virtual I/O Server
  - Shared Ethernet Adapter
  - Virtual SCSI Server
  - Partition Load Manager

Micro-Partitioning

- Mainframe inspired technology
- Virtualized resources shared by multiple partitions
- Benefits
  - Finer grained resource allocation
  - More partitions (Up to 254)
  - Higher resource utilization
- New partitioning model
  - POWER Hypervisor
  - Virtual processors
  - Fractional processor capacity partitions
  - Operating system optimized for Micro-Partitioning exploitation
  - Virtual I/O
Shared processor partitions

- Micro-Partitioning allows for multiple partitions to share one physical processor
- Up to 10 partitions per physical processor
- Up to 254 partitions active at the same time
- Partition’s resource definition
  - Minimum, desired, and maximum values for each resource
  - Processor capacity
  - Virtual processors
  - Capped or uncapped
    - Capacity weight
  - Dedicated memory
  - Minimum of 128 MB and 16 MB increments
  - Physical or virtual I/O resources

Micro-Partitioning technology

- Micro-Partitioning technology allows each processor to be subdivided into as many as 10 “virtual servers”, helping to consolidate UNIX® and Linux applications.

Partitioning options
- Micro-partitions: Up to 254*
- Dynamic LPARs: Up to 32*
- Combination of both

Configured via the HMC

Number of logical processors
- Minimum/maximum

Entitled capacity
- In units of 1/100 of a CPU
- Minimum 1/10 of a CPU

Variable weight
- % share (priority) of surplus capacity

Capped or uncapped partitions

Note: Micro-partitions are available via optional Advanced POWER Virtualization or POWER Hypervisor and VIOS features.

* on p5-570 and p5-595
** on p5-590 and p5-595
Math 101 and Consolidation

- Consolidation Issues
- Math 101
  - 4 workloads
    - A 6.03
    - B 2.27
    - C 2.48
    - D 4.87
    - Total = 15.65
- P650 8way 1.45ghz is 16.88
- Is it big enough to run these workloads in 4 separate LPARs?
- NO

Why micropartitioning is important

- 8w 1.45g p650 is 16.88 rperf
- 2w 1.45g p650 is 4.43 rperf
- So 1w is probably 2.21
- Now back to Math 101

<table>
<thead>
<tr>
<th>Wkld</th>
<th>Rperf Needed on p650</th>
<th>Processors</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.03</td>
<td>3 (6.64)</td>
</tr>
<tr>
<td>B</td>
<td>2.27</td>
<td>2 (4.42 - 2.27 is &gt; 2.21)</td>
</tr>
<tr>
<td>C</td>
<td>2.48</td>
<td>2 (4.42 – 2.48 is &gt; 2.21)</td>
</tr>
<tr>
<td>D</td>
<td>4.87</td>
<td>3 (6.64 – 4.87 is &gt; 4.42)</td>
</tr>
<tr>
<td>Total</td>
<td>15.65</td>
<td>10 (22.12)</td>
</tr>
</tbody>
</table>

- Watch for granularity of workload
Defining Processors

- Minimum, desired, maximum
- Shared or dedicated
- For shared:
  - Capped
  - Uncapped
    - Variable capacity weight (0-255 – 128 is default)
    - Weight of 0 is capped
  - Minimum, desired and maximum Virtual Processors

Virtual Processors

- Partitions are assigned Pus (process units)
- VPs are the whole number of concurrent operations
- VPs round up from the PU by default
  - .5 Pus will be 1 VP
  - 2.25 Pus will be 3 VPs
  - You can define more and may want to
- VPs put a cap on the partition if not used correctly
  - i.e. define .5 PU and 1 VP you can never have more than one PU even if you are uncapped
Virtual I/O Server

- Custom AIX v5.3 partition
- Provides services for:
  - Shared Ethernet Adapter
  - Built on Virtual Ethernet
  - Virtual SCSI Server
- Owns the physical resources
- Run 2 if in production
- Can use SDD or Powerpath for multipath I/O
- Can do Etherchannels
- Maximum of 65535 virtual I/O slots
- Max of 256 VIO slots per partition

Can you have your cake and eat it?

Advanced POWER Virtualization option

Virtual I/O Server
- Shared Ethernet
- Shared SCSI and Fibre Channel-attached disk subsystems
- Supports AIX 5L V5.3 and Linux* partitions

Micro-Partitioning
- Share processors across multiple partitions
- Minimum partition 1/10th processor
- AIX 5L V5.3, Linux*, or i5/OS**

Partition Load Manager
- Balances processor and memory request
Managed via HMC or IVM***

* SLES 9 or RHEL AS 4 and above
** Available on selected p5-570, p5-590 and p5-595 models
*** IVM on p5-560Q and below
Virtual Ethernet

- Enables inter-partition communication.
  - In-memory point to point connections
- Physical network adapters are not needed.
- Similar to high-bandwidth Ethernet connections.
- Supports multiple protocols (IPv4, IPv6, and ICMP).
- No Advanced POWER Virtualization feature required.
  - POWER5 Systems
  - AIX 5L V5.3 or appropriate Linux level
  - Hardware management console (HMC)

Virtual networking

- Virtual Ethernet helps reduce hardware costs by sharing LAN adapters
- Partition to partition communication
- Requires AIX 5L V5.3 and POWER5
- Provides access to outside world
- Uses Physical Adapter in the Virtual I/O Server
- VLAN – Virtual LAN
  - Provide ability for one adapter to be on multiple subnets
  - Provide isolation of communication to VLAN members
  - Allows a single adapter to support multiple subnets

- IEEE VLANS
  - Up to 4096 VLANS
  - Up to 65533 vENET adapters
  - 21 VLANS per vENET adapter
Virtual SCSI

- Allows sharing of storage devices
- Vital for shared processor partitions
  - Overcomes potential limit of adapter slots due to Micro-Partitioning
  - Allows the creation of logical partitions without the need for additional physical resources
- Allows attachment of previously unsupported storage solutions

Virtual SCSI helps reduce hardware costs by sharing disk drives.
Workload Manager

- Around since AIX v4.3.3
- Used to control resources in one O/S instance
- Controls:
  - CPU
  - Memory
  - I/O Bandwidth
- References:
  - SG24-5977 AIX 5l Workload manager

Partition Load Manager for AIX 5L

- Policy-based, automatic partition resource tuning
- Dynamically adjust CPU and memory allocation

Before resource tuning

Unbalanced resource allocation

<table>
<thead>
<tr>
<th></th>
<th>3 CPUs</th>
<th>5 CPUs</th>
<th>6 CPUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test LPAR</td>
<td>Agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRM LPAR</td>
<td></td>
<td>Agent</td>
<td></td>
</tr>
<tr>
<td>Finance LPAR</td>
<td></td>
<td></td>
<td>Agent</td>
</tr>
</tbody>
</table>

After resource tuning

Adjust resource allocation based on business priority

<table>
<thead>
<tr>
<th></th>
<th>1 CPU</th>
<th>3 CPUs</th>
<th>10 CPUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test LPAR</td>
<td>Agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRM LPAR</td>
<td></td>
<td>Agent</td>
<td></td>
</tr>
<tr>
<td>Finance LPAR</td>
<td></td>
<td></td>
<td>Agent</td>
</tr>
</tbody>
</table>

Note: Micro-partitions are available via optional Advanced POWER Virtualization or POWER Hypervisor and VIOS features. AIX 5L V5.2 supports LPAR only.
Virtualization Engine

- Enables individual distributed resources across the enterprise
- IBM Enterprise Workload Manager
- IBM Director Multiplatform
- IBM Tivoli® Provisioning Manager
- IBM Grid Toolbox V3 for Multiplatforms
- Base infrastructure — Virtualization Engine console, installer and common runtime
- Available Aug 27, 2004

Point, click, consolidate!

Browser-based Integrated Virtualization Manager*

*Optional on System p5 560Q and below, selected p5 servers and ~ OpenPower servers

The cost-saving benefits of IBM virtualization have never been easier or available at such a low system price!**

- Provides single system partitioning without a Hardware Management Console (HMC)
  - Create LPARs
  - Manage virtual storage and virtual Ethernet
- Eliminates need to purchase dedicated hardware console
- Included at no additional charge with purchase of optional Advanced POWER Virtualization feature or POWER Hypervisor and VIOS features.

**IBM Hardware Management Console not required
### Capacity on Demand for POWER5 and POWER5+ systems

<table>
<thead>
<tr>
<th>Capacity Upgrade on Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade system with processors and/or memory</td>
</tr>
<tr>
<td>No special contracts, no required monitoring (no ability to turn off the capacity)</td>
</tr>
<tr>
<td>Purchase an activation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>On/Off Capacity on Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary use of requested number of processors or amount of memory</td>
</tr>
<tr>
<td>Client selects the capacity and activates the resource (registered system)</td>
</tr>
<tr>
<td>Capacity can be turned on and off by the client</td>
</tr>
<tr>
<td>Information reported to IBM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reserve Capacity on Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor resources only (processor days)</td>
</tr>
<tr>
<td>Capacity can be turned on and off by the client</td>
</tr>
<tr>
<td>Prepaid debit agreement</td>
</tr>
<tr>
<td>Requires AIX 5L V5.3 or Linux and Advanced POWER Virtualization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial Capacity on Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow clients to test the effects of additional processors and/or memory</td>
</tr>
<tr>
<td>Partial or total activation of processors and memory</td>
</tr>
<tr>
<td>Resources available for fixed time</td>
</tr>
</tbody>
</table>

Available on select models

### Traps for Young Players

- Under-sizing VIOS
- Forgetting Memory and processor Overhead
- Planning for what should and should not be virtualized
- Misunderstanding needs
- Workload Granularity
- Undersizing memory and overhead
  - Hypervisor
  - I/O drawers, etc
  - VIOS requirements
p5: Simultaneous multi-threading

- Utilizes unused execution unit cycles
- Presents symmetric multiprocessing (SMP) programming model to software
- Natural fit with superscalar out-of-order execution core
- Dispatch two threads per processor: “It's like doubling the number of processors.”
- Net result:
  - Better performance
  - Better processor utilization

*POWER5 (simultaneous multi-threading)*

- Thread0 active
- No thread active
- Thread1 active

Appears as 4 CPUs per chip to the operating system (AIX 5L V5.3 and Linux)

System throughput

<table>
<thead>
<tr>
<th></th>
<th>ST</th>
<th>SMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thread1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No thread</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>