Virtualization on the Mid-Range

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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

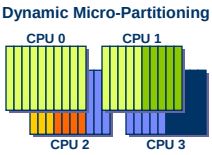
- Required to partition any box
- Can use HMC to manage systems
- Provides a console to manage hardware
- Detecting, reporting and storing changes in hardware
- Service focal point (requires Ethernet)
- Vterms to partitions

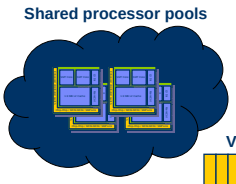
Terminology

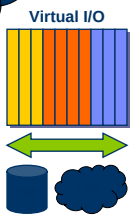
- Hypervisor
- MicroPartitioning
  - Shared Processor Pool
  - Capped
  - Uncapped
  - Virtual Processors
  - Entitled Capacity
- Virtual I/O Server
- Virtual Ethernet
- Shared Ethernet Adapter (SEA)
- Virtual SCSI Server

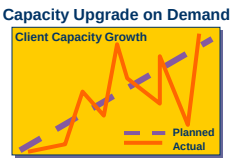
POWER Hypervisor functions

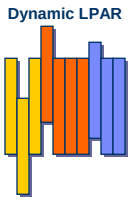
- Same functions as POWER4 Hypervisor.
  - Dynamic LPAR
  - Capacity Upgrade on Demand
- New, active functions.
  - Dynamic Micro-Partitioning
  - Shared processor pool
  - Virtual I/O
  - Virtual LAN
- Machine is always in LPAR mode.
  - Even with all resources dedicated to one OS



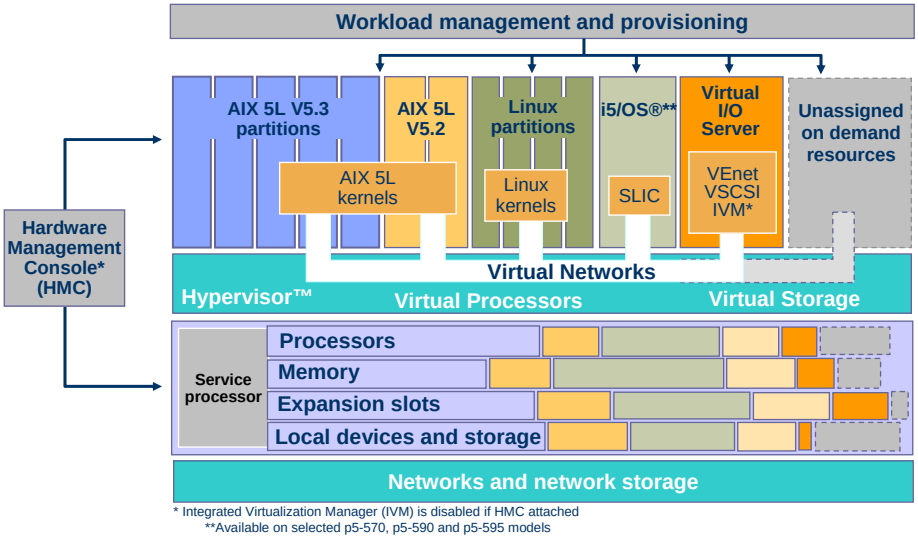








POWER5 / 5+ virtualization architecture



* 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

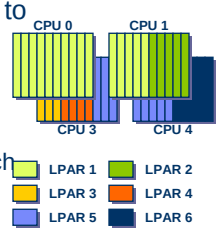
- Included on 590 and 595
- Optional on all other p5 boxes
- Enables:
  - MicroPartitioning
  - Virtual I/O Server
  - Shared Ethernet Adapter
  - Virtual SCSI Server
  - Partition Load Manager

Micro-Partitioning

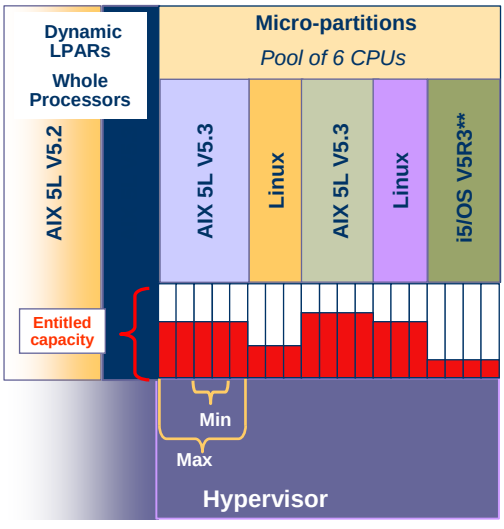
- Mainframe inspired technology
- Virtualized resources shared by multiple partitions
- Benefits
  - Finer grained resource allocation
  - More partitions (Up to 254)
  - Higher resource utilization
- New partitioning model
  - POWER Hypervisor
  - Virtual processors
  - Fractional processor capacity 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



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

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

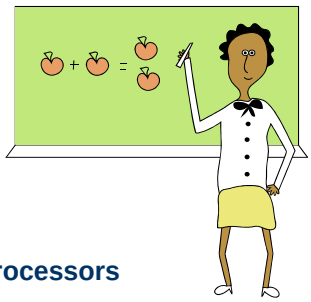
Capped or uncapped partitions

*on p5-590 and p5-595
** on p5-570, 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

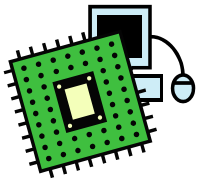


- 8w 1.45g p650 is 16.88 rperf
- 2w 1.45g p650 is 4.43 rperf
- So 1w is probably 2.21
- Now back to Math 101

Wkld	Rperf Needed	Processors on p650	
A	6.03	3	(6.64)
B	2.27	2	(4.42 - 2.27 is > 2.21)
C	2.48	2	(4.42 – 2.48 is > 2.21)
D	4.87	3	(6.64 – 4.87 is > 4.42)
Total =	15.65	10	(22.12)

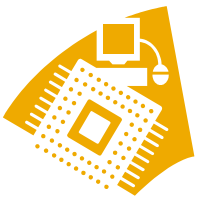
- Watch for granularity of workload

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



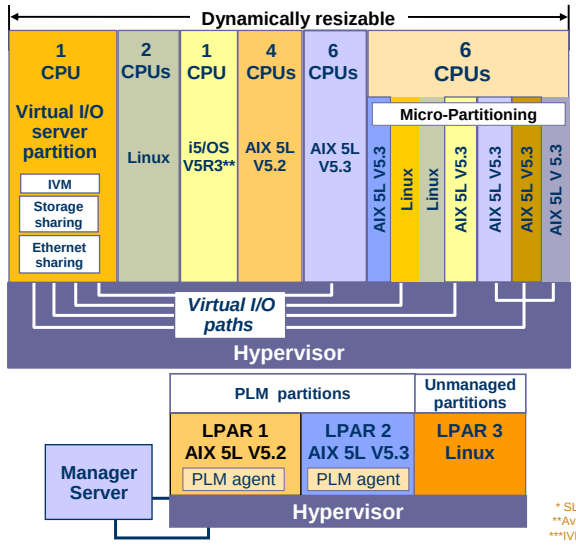
- Partitions are assigned Pus (process units)
- VPs are the whole number of concurrent operations
- VPs round up from the PU by default
  - .5 Pus will be 1 VP
  - 2.25 Pus will be 3 VPs
  - You can define more and may want to
- VPs put a cap on the partition if not used correctly
  - i.e. define .5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

Virtual I/O Server

Can you have your cake and eat it?

- 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

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***

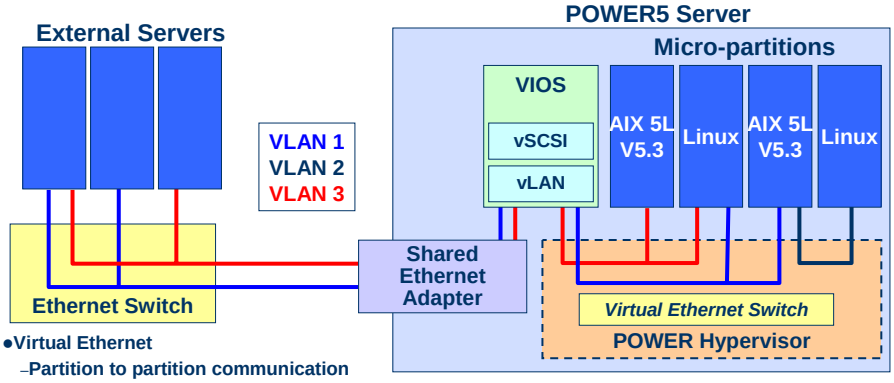
* SLES 9 or RHEL AS 4 and above
**Available on selected p5-570, p5-590 and p5-595 models
***IVM on p5-560Q and below

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



- Virtual Ethernet
  - Partition to partition communication
  - Requires AIX 5L V5.3 and POWER5
- Shared Ethernet Adapter
  - 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

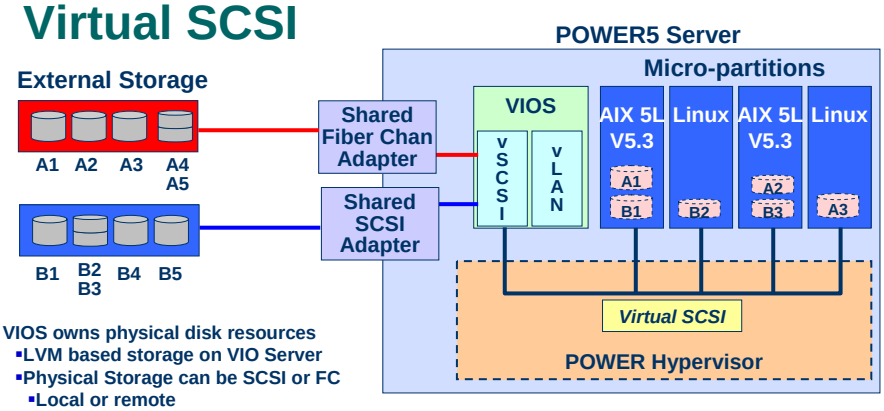
- IEEE VLANS
  - Up to 4096 VLANS
  - Up to 65533 vENET adapters
  - 21 VLANS per vENET adapter

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

Virtual I/O helps reduce hardware costs by sharing disk drives

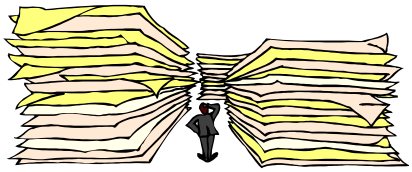


VIOS owns physical disk resources
- LVM based storage on VIO Server
- Physical Storage can be SCSI or FC
  - Local or remote

Micro-partition sees disks as vSCSI (Virtual SCSI) devices
- Virtual SCSI devices added to partition via HMC or IVM
- LUNs on VIOS accessed as vSCSI disk
- VIOS must be active for client to boot

Multiple LPARs can use same or different physical disk
- Configure as logical volume on VIOS
- Appear a hdisk on the micro-partition
- Can assign entire hdisk to a single client

Workload Manager

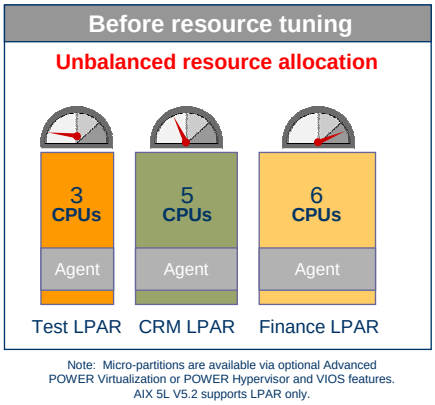


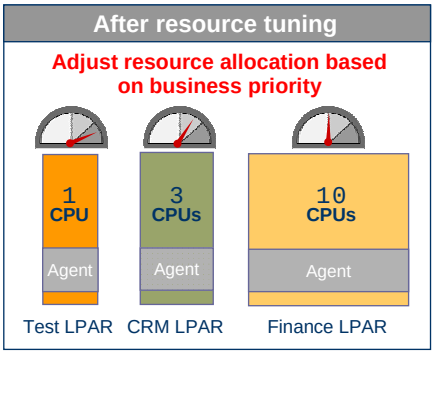
- Around since AIX v4.3.3
- Used to control resources in one O/S instance
- Controls:
  - CPU
  - Memory
  - I/O Bandwidth

- References:
  - SG24-5977 AIX 5l Workload manager
  - http://www.eservercomputing.com/ibmunix/archives/index.asp?a=1&id=998

Partition Load Manager for AIX 5L

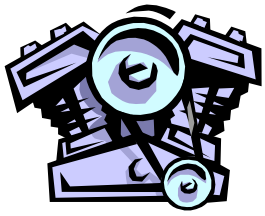
- Policy-based, automatic partition resource tuning
- Dynamically adjust CPU and memory allocation





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

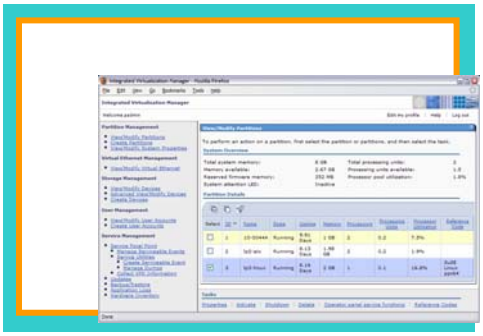
Virtualization Engine



- 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*



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.

*Optional on System p5 560Q and below, selected ~ p5 servers and ~ OpenPower servers
**IBM Hardware Management Console not required

Capacity on Demand for POWER5 and POWER5+ systems

Capacity Upgrade on Demand

- Upgrade system with processors and/or memory
- No special contracts, no required monitoring (no ability to turn off the capacity)
- Purchase an activation

On/Off Capacity on Demand

- Temporary use of requested number of processors or amount of memory
- Client selects the capacity and activates the resource (registered system)
- Capacity can be turned on and off by the client
- Information reported to IBM

Reserve Capacity on Demand

- Processor resources only (processor days)
- Capacity can be turned on and off by the client
- Prepaid debit agreement
- Requires AIX 5L V5.3 or Linux and Advanced POWER Virtualization

Trial Capacity on Demand

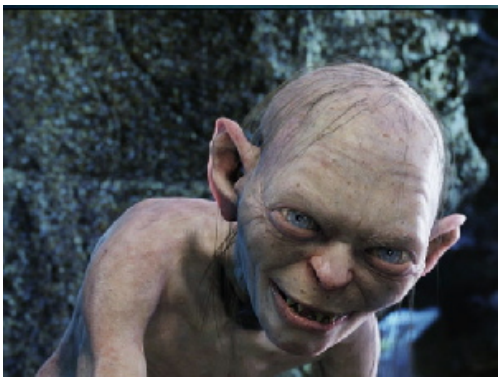
- Allow clients to test the effects of additional processors and/or memory
- Partial or total activation of processors and memory
- Resources available for fixed time

Available on select models

Traps for Young Players

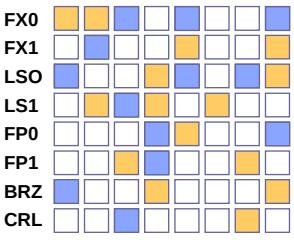
- Under-sizing VIOS
- Forgetting Memory and processor Overhead
- Planning for what should and should not be virtualized
- Misunderstanding needs
- Workload Granularity
- Undersizing memory and overhead
  - Hypervisor
  - I/O drawers, etc
  - VIOS requirements

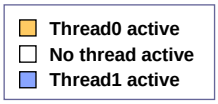
Questions?



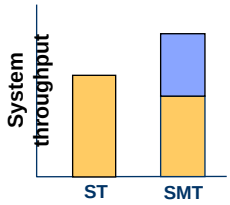
p5: Simultaneous multi-threading

POWER5 (simultaneous multi-threading)





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



- 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***