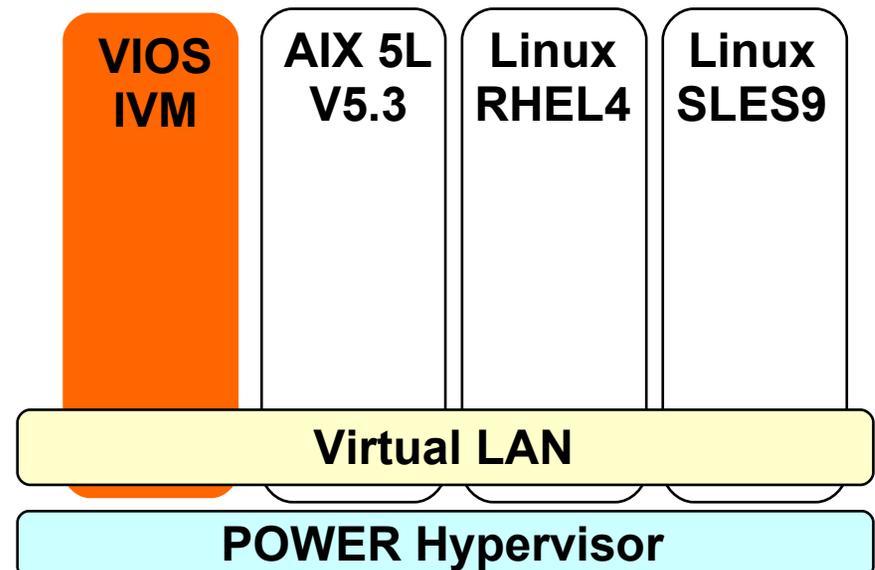# Systemverwaltung 2009
AIX / LPAR

4.0.1

Integrated Virtualization Manager (IVM) (1 of 2)

- Provides support for logical partitions without a physical HMC
- IVM software runs in Virtual I/O Server partition
- Virtual I/O Server partition owns all physical I/O
  - Client partitions can access virtual optical, disk, Ethernet, and console
- Configuration considerations
  - Maximum of two virtual Ethernet adapters per client partition
  - Maximum of four virtual LANs per managed system
  - Maximum of one virtual SCSI adapter per client partition
  - Limited DLPAR functionality
  - Subset of HMC service tools
  - One profile per partition

VIOS IVM	AIX 5L V5.3	Linux RHEL4	Linux SLES9

Virtual LAN

POWER Hypervisor

Integrated Virtualization Manager (IVM) (2 of 2)

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Partitioning Concepts Summary

Part#1	Part#2	Part#3	Part#4	Part#5	Part#6	Part#7-11
Virtual I/O Server	AIX 5L	Linux	i5/OS	AIX 5L	AIX 5L	AIX 5L / Linux

PPPPPP PPPPP | PPPP PPP | P | PPPPPP

MMMMM | MMMM | MMM | MMM | M | MM | M M M M M

AAAAAA | AAAAA | AAA | AAAA | AA | AAA | A   A

Virtual LAN

Virtual I/O

| AIX Kernel | AIX Kernel | Linux Kernel | i5/OS Kernel | AIX Kernel | AIX Kernel | O S O S O S O S O S |

Virtual Ethernet

POWER Hypervisor

LAN

HMC

Virtual I/O Example

Client Partition

Virtual Ethernet

Virtual Ethernet

Client Adapter

DMA Buffer

Virtual Switch

Hypervisor

SCSI RDMA Protocol

Device DMA Transfer

Virtual I/O Server Partition

Virtual Ethernet

Layer 2 Bridge

Physical Ethernet

Physical Network

Logical Disk

Server Adapter

Device Mapping

SCSI, SSA, FC Physical or Logical Disks

Logical Partition References

- Documentation
  - *http://www.ibm.com/support/publications/us/library/*
  - Software and hardware Information Centers available

- LPAR and Advanced POWER Virtualization information
  - *http://www.ibm.com/systems/p/apv/index.html*

- IBM Redbooks
  - *http://www.redbooks.ibm.com/*

- Technical Support Web sites
  - *http://www.ibm.com/servers/eserver/support/unixservers/*
  - *http://www14.software.ibm.com/webapp/set2/sas/f/hmc/*
  - *http://techsupport.services.ibm.com/server/vios/*

- Linux Web site
  - *http://www.ibm.com/systems/p/linux/*

Web links may change over time

Unit Summary

- Logical partitions are independent operating environments
- Resources are processors, memory, and I/O slots
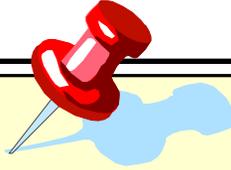 - Dedicated processors and shared processing units
  - Physical and virtual I/O
- The POWER Hypervisor is firmware that provides the isolation between partitions, virtual console support, and virtual memory management
- The HMC is used to manage partition configurations, consoles, and service tools
- With dynamic logical partitioning, changes can be made to a partition's resource allocation without a restart
- Virtual I/O Server software provides the ability to share SCSI devices and Ethernet adapters
- The Advanced POWER Virtualization feature provides Virtual I/O Server, Partition Load Manager, and Micro-Partitioning

Checkpoint (1 of 2)

- *True or False:* A partition is an independent operating environment.

- A partition is a *logical* partition if which **one** of the following is true?
  a. Resource assignments are flexible.
  b. Resources can be moved between partitions without a restart.
  c. Partitioning is not dependent on physical system building blocks.

3. Which of the following are true for dynamic partition operations?
   a. All AIX 5L partitions on POWER5 processor-based systems are capable of dynamic resource allocations.
   b. Virtual I/O devices can be dynamically added or removed but not moved between partitions.
   c. Partitions do not need to be restarted to add, remove, or move resources.
   d. Applications may or may not be DLPAR-aware.

4. List the three types of resources that are configured in partitions.

Checkpoint Solution (1 of 2)

- *True or False:* A partition is an independent operating environment.
  True
- A partition is a *logical* partition if which **one** of the following is true?
  - a. Resource assignments are flexible.
  - b. Resources can be moved between partitions without a restart.
  - (c.) Partitioning is not dependent on physical system building blocks.

3. Which of the following are true for dynamic partition operations?
  - (a.) All AIX 5L partitions on POWER5 processor-based systems are capable of dynamic resource allocations.
  - (b.) Virtual I/O devices can be dynamically added or removed but not moved between partitions.
  - (c.) Partitions do not need to be restarted to add, remove, or move resources.
  - (d.) Applications may or may not be DLPAR-aware.

- List the three types of resources that are configured in partitions.
  Processors, Memory, I/O slots

Checkpoint Solution (2 of 2)

- What system option provides the ability to order additional resources that can be activated when you need them? Capacity on Demand (CoD)

- Which of the following are benefits of using partitions?
  - a. Better management of resources across operating environments
  - b. Isolate applications that were all running on one system
  - c. Better high availability solution
  - d. Manage operational costs by consolidating resources

- What is the system component that performs the resource allocation to partitions? POWER Hypervisor

- What is the system component needed to configure partitions, configure CoD, and provide access to virtual consoles? HMC

- What is the term used for the concept of allocating sub-processors to partitions? Micro-Partitioning

Checkpoint Solution (2 of 2)

- What system option provides the ability to order additional resources that can be activated when you need them? Capacity on Demand (CoD)

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Partition Resources

- **Resources** are allocated to partitions
  - Processors, memory, and I/O slots

LPAR 1	LPAR 2	LPAR 3	LPAR 4	

Processors

Memory

I/O Slots
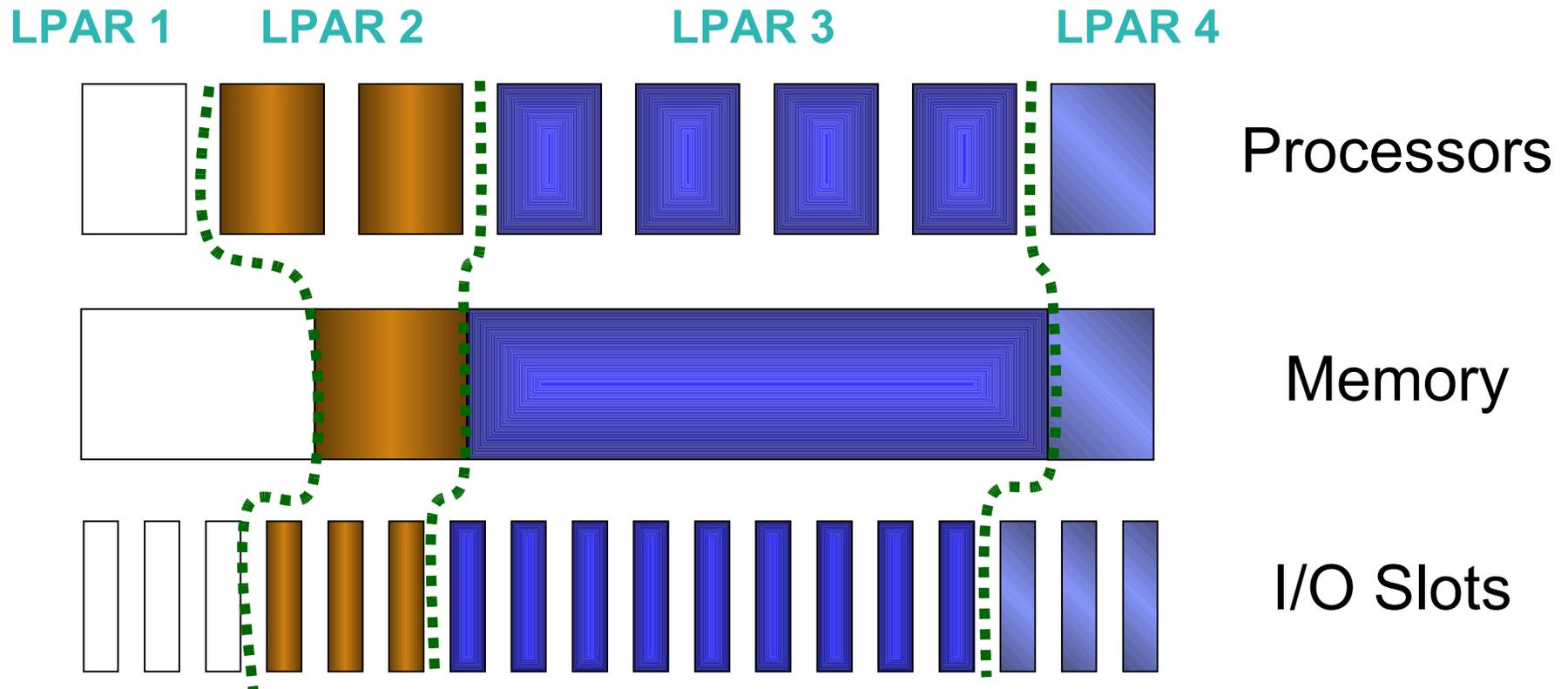
Dividing the System Resources (1 of 2)

- Minimum partition configuration
  - 0.1 processing units if shared; 1 processor if dedicated
  - 128 MB memory
  - Access to necessary I/O devices:
    - Adapter for boot disk
    - Network adapters

- Smallest granularity for allocating additional resources
  - 0.01 processing units if shared; 1 processor if dedicated
  - 1 LMB (16-256 MB) of memory
  - One I/O slot

- Maximum number of partitions depends on system model and available resources
  - Software maximum: 254 partitions

Dividing the System Resources (2 of 2)

- Profiles
  - **Partition profiles** describe configurations for partitions
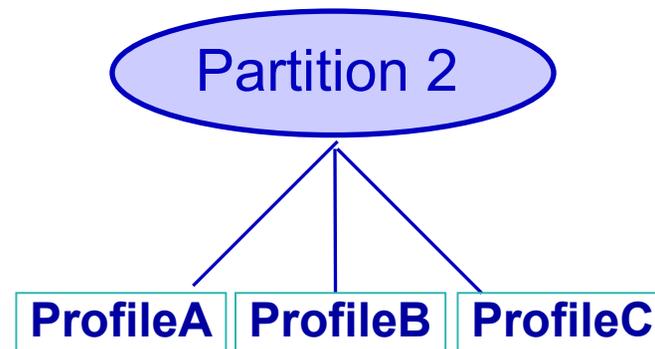 - **System profiles** are collections of partition profiles

Partition 1		
ProfileA	ProfileB	ProfileC

Partition Profiles

Partition 2		
ProfileA	ProfileB	ProfileC
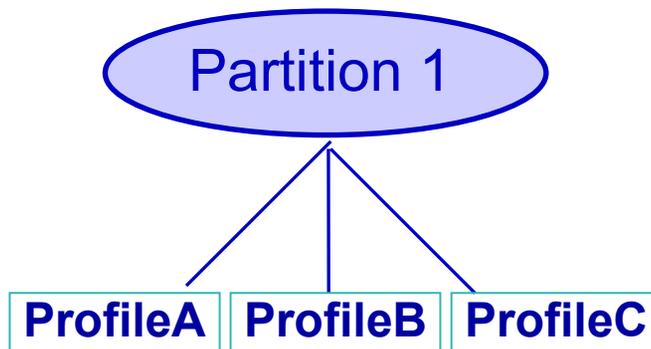
Partition Profiles

Be sure to document the configuration

Memory Resources (1 of 2)

- ## Memory allocation
  - One LMB (16 MB to 256 MB sized logical memory blocks)

- ## For each partition, configure:
  - **Minimum**
    - Partition will not start if this amount is not available
    - Partition can be decreased to this amount if using dynamic LPAR
  - **Desired**
    - Partition will use up to this amount upon activation if available
  - **Maximum**
    - Partition can be increased to this amount if using dynamic LPAR
    - Used for sizing the page table for the partition

Memory Resources (2 of 2)

- Valid memory ranges are based on a ratio for minimum and maximum settings
  - Partitions configured with < 256 MB of memory
    - Maximum cannot be > 16 times actual memory size
  - Partitions configured with >= 256 MB of memory
    - Maximum cannot be > 64 times actual memory size

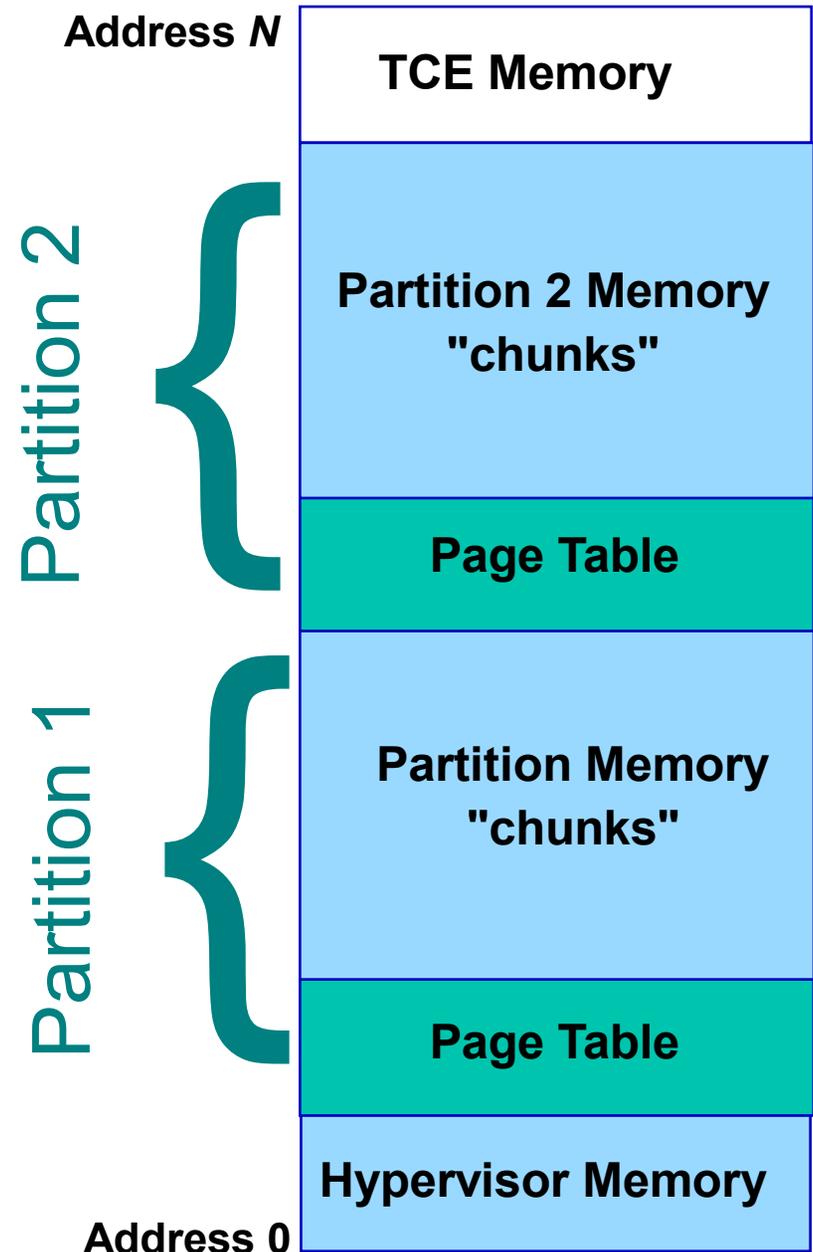| Minimum	Maximum	
128 MB	2 GB	← 1:16 ratio
256 MB	16 GB	← 1:64 ratio
512 MB	32 GB	
768 MB	48 GB	
1 GB	64 GB	

and so forth

Memory Usage (1 of 2)

- Power Hypervisor memory
  - Variable in size

- TCE memory
  - Used for DMA to I/O devices

- Page tables for each partition
  - Used for mapping partition pages
  - Size is 1/64th of partition maximum size

- Partition memory

Address N

TCE Memory

Partition 2

Partition 2 Memory "chunks"
Page Table

Partition 1

Partition Memory "chunks"
Page Table
Hypervisor Memory

Address 0

Unit Summary

- Partition concepts
  - Minimum partition configuration
    - Processors, memory, I/O slots
  - Maximum number of partitions depends on model and amount of resources
  - Partition profiles contain resource configuration information
  - System profiles are lists of partitions and profiles to start in a particular order

- Minimum, Maximum, and Desired settings for memory and processors

- Required and Desired settings for I/O slots

- Create Partition wizard leads you through creating partitions and profiles

- Activate a partition to start it

I/O Resources

- A partition requires a minimum of:
  - One boot device in allocated I/O slot
  - One network adapter in allocated I/O slot
  - Other I/O adapters for storage and network access

- I/O slots can be *required* or *desired*

- Empty slots can be allocated to a partition
  - Useful if not able to allocate dynamically

- Allocation to partitions is by individual slots
  - Multiple devices connected to a single SCSI adapter are allocated together

- *Advanced POWER Virtualization* feature allows for virtual SCSI and Shared Ethernet configurations
 - Must install and configure Virtual I/O Server software

Checkpoint Solution (1 of 2)

1. Match the terms Minimum, Desired, and Maximum to the proper description:

    - This is the upper limit of processors or memory that cannot be exceeded when using dynamic operations. Maximum
    - This is the lower limit of processors or memory when using dynamic operations. Minimum
    - This is the amount of processors or memory that a partition receives if there are more than enough resources on the system when the partition is activated (starts). Desired

- *True or False:* The amount of *desired* processors must always be greater than or equal to the amount of *minimum* processors. True

- What is the minimum amount of memory for an AIX 5L partition? 128 MB or, if the LMB size of the partition is 256 MB, then the minimum would be 256 MB.

- *True or False:* Empty I/O slots can be allocated to partitions. True

Checkpoint (2 of 2)

- What happens if the minimum (or required) amount of a resource is not available when a partition is activated?

- How many processors is a partition allocated if, when it starts, it has a *minimum* of 3 processors, *desires* 5 processors, and 4 processors are currently available on the system?

3. What happens if a partition is currently running with its 3 minimum processors, but it desires 5 processors and another processor becomes available after the partition is started?

4. What is the granularity of allocating processor resources when configuring partitions?

5. When incrementing the amount of memory for a partition profile, the minimum unit is how much?

Processor Concepts - Overview
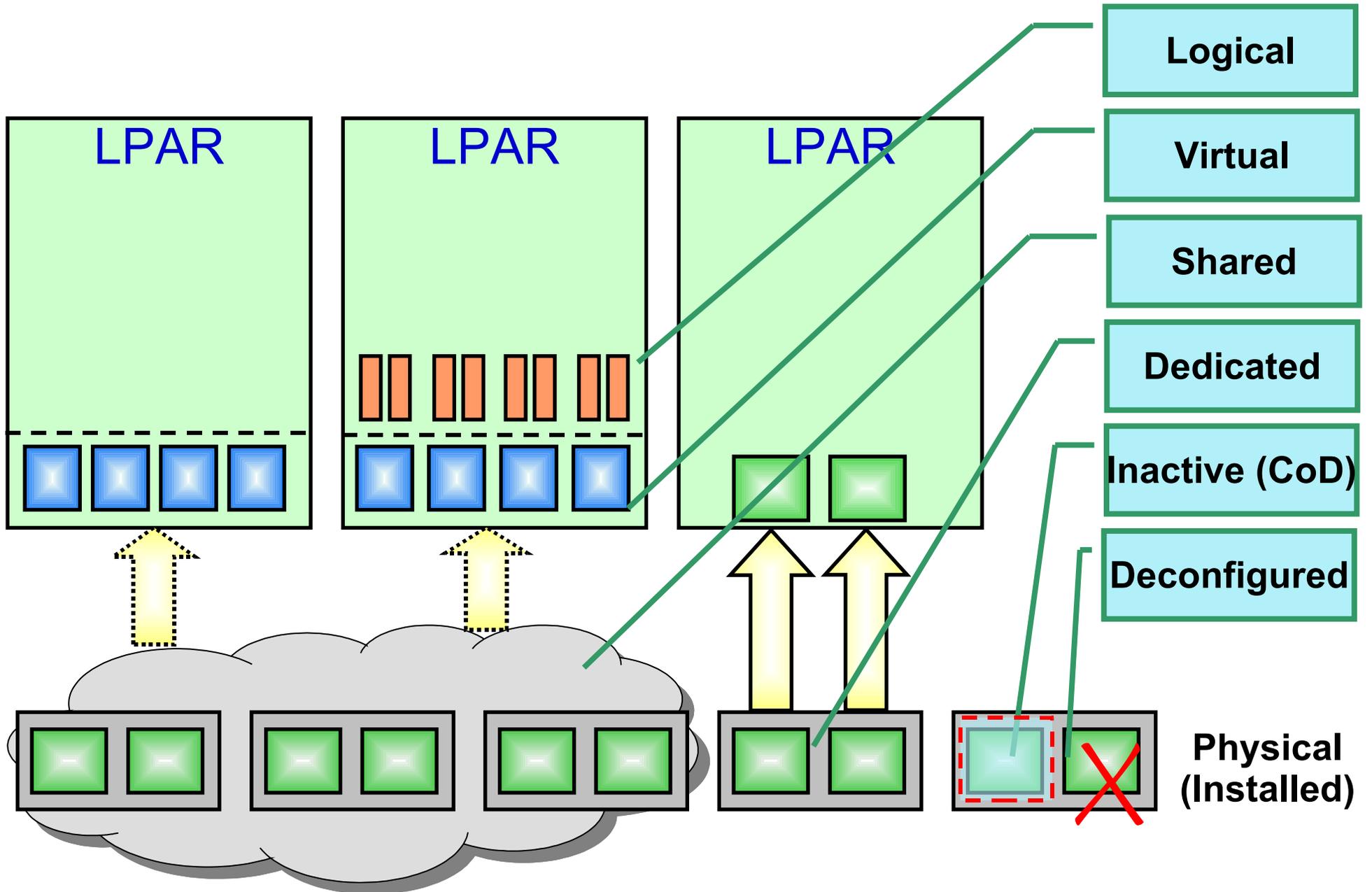
Dedicated Processors

- Allocated as whole processors to a specific partition

- Same physical processors are used for that partition while it is running
  - When partition is stopped, dedicated processors may or may not go to shared pool

- Processor affinity utilized for best performance

LPAR

Dedicated

Physical Processors
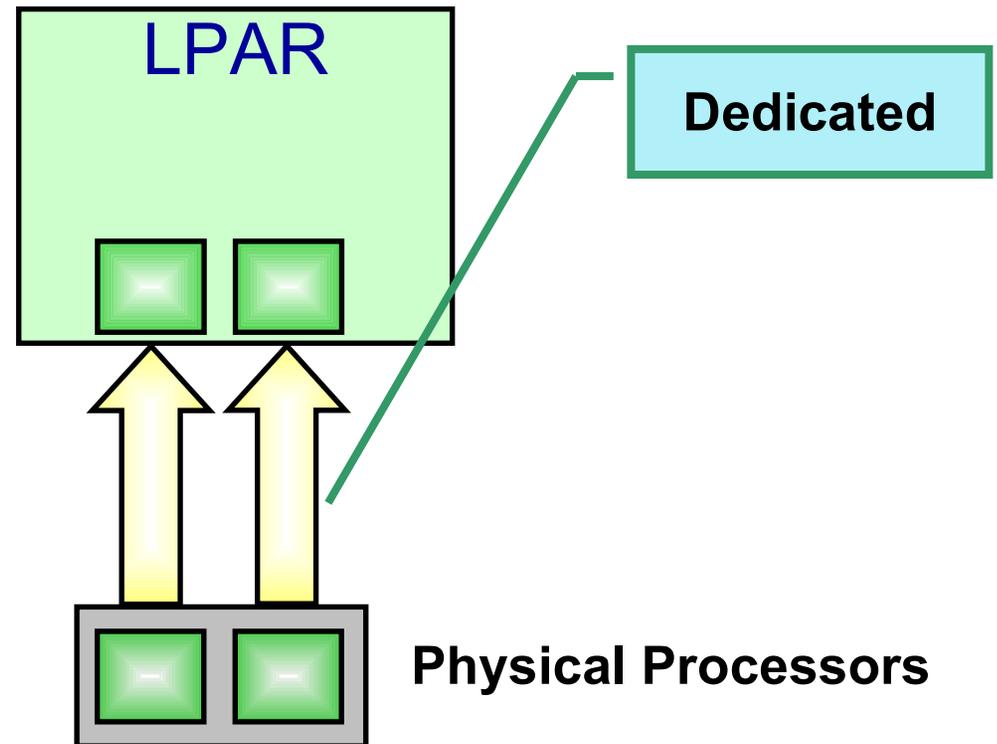
Shared Processors

- Processor capacity assigned in *processing units* from the *shared processing pool*
  - Minimum per partition is 0.1 processing units
  - Additional capacity allocated in 0.01 processing units
- Partition's guaranteed amount is its *entitled capacity*
- Advantages:
  - Configuration flexibility
  - Excess capacity can be used by other partitions
- *Micro-Partition*: A partition utilizing shared processors
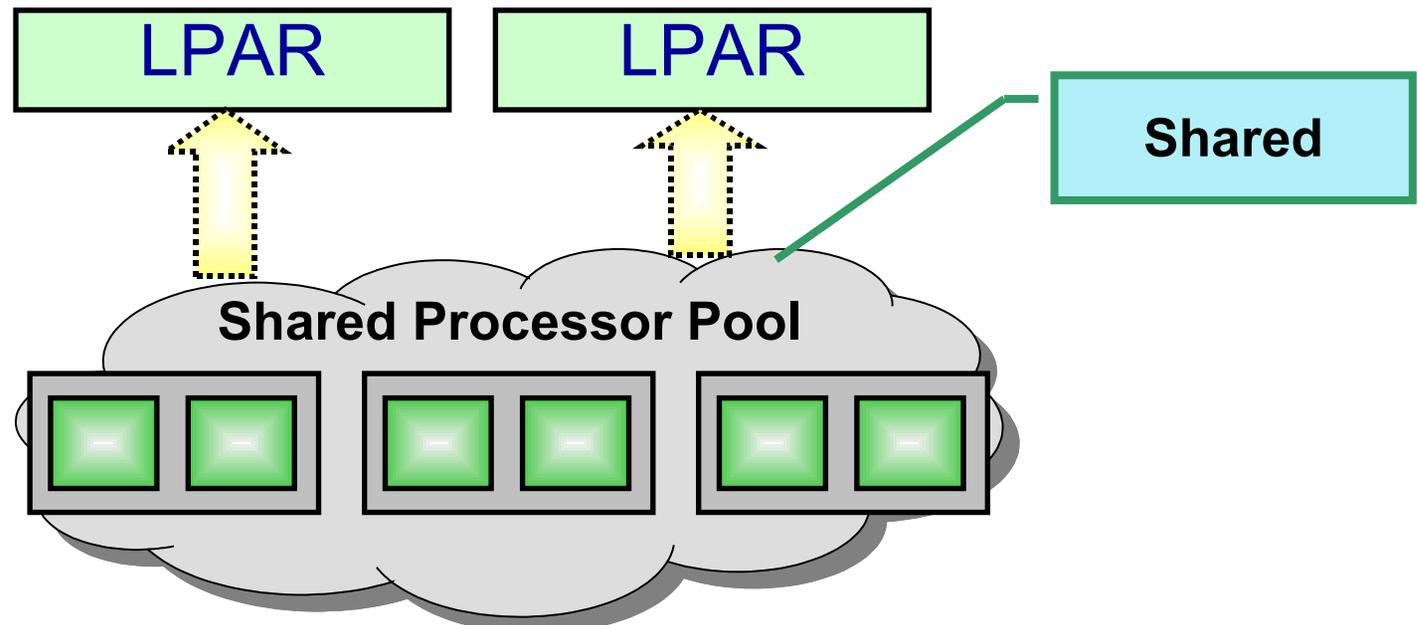
Shared Processor Pool (1 of 2)

- Each partition is configured with a percentage of execution dispatch time for each 10 ms time slice
- Examples:
  - A partition with 0.2 processing units is entitled to 20% capacity during each time slice
  - A partition with 1.8 processing units is entitled to 18 ms of processing time for each 10 ms time slice (using multiple processors)
- The Hypervisor dispatches excess idle time back to pool
- Processor affinity algorithm takes into account *hot* cache

0.2 = 20% of timeslice =
2 ms per timeslice

10 ms   20 ms
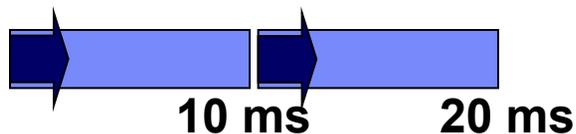
1.8 = 180% of timeslice =
18 ms per 10 ms timeslice

10 ms   20 ms
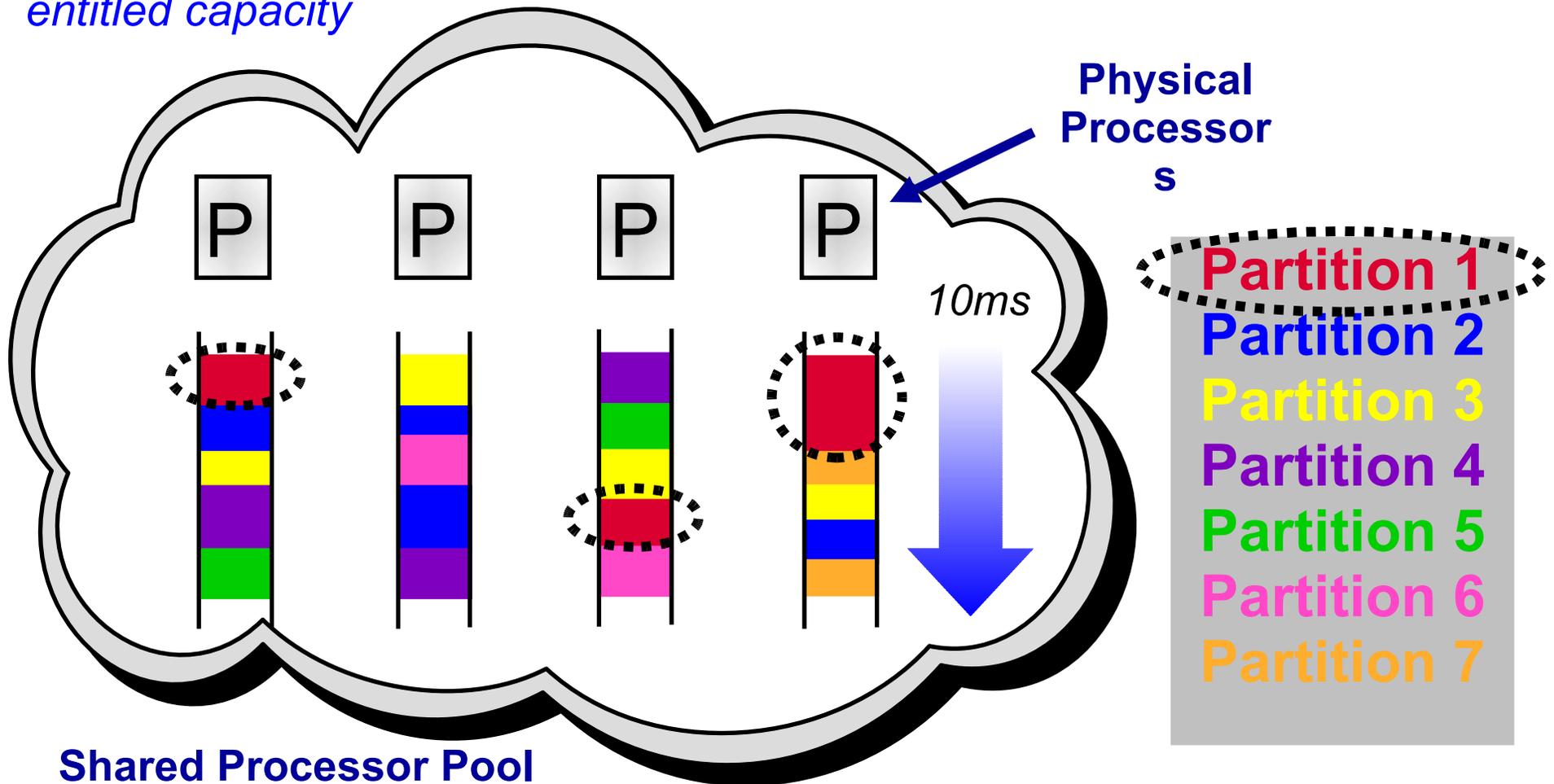
10 ms   20 ms
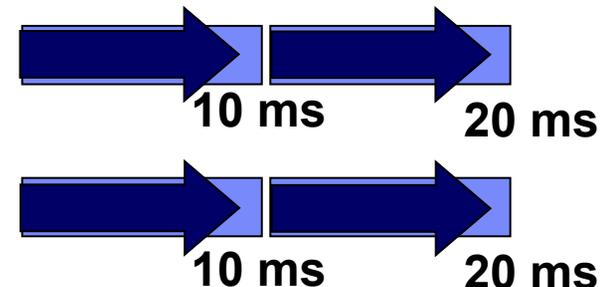
Shared Processor Pool (2 of 2)

- This example shows one 10 ms time slice, 7 running partitions, and 4 processors
  - A partition may run on multiple processors depending on interrupts and its *entitled capacity*

Physical Processors

Shared Processor Pool

10ms

Partition 1
Partition 2
Partition 3
Partition 4
Partition 5
Partition 6
Partition 7

Capped Partitions

- Partitions with shared processors are either *capped* or *uncapped*
- *Capped*: Limited to the entitled capacity
- Example: 1.5 capped processing units means a partition can use *up to* 15 ms of execution time during each time slice, but no more than that

Total processing units →
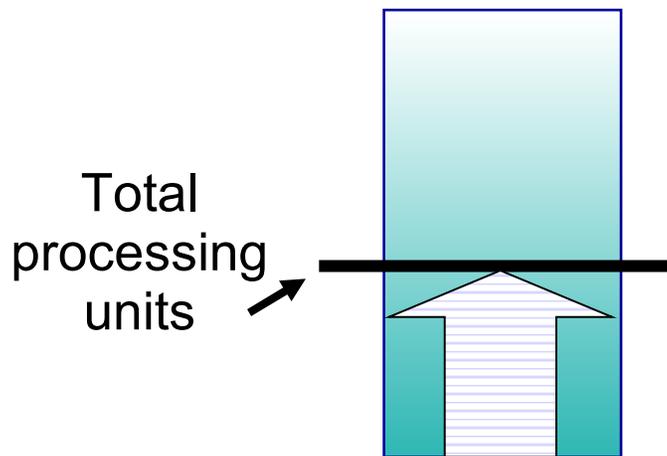
The partition *may* utilize CPU cycles up to its capacity – guaranteed

Excess cycles are ceded back to shared pool

Uncapped Partitions

- *Uncapped*: If a partition needs extra CPU cycles (more than its entitled capacity), it can utilize unused capacity in the shared pool

- Example: An uncapped partition with 1.5 processing units is guaranteed to be able to use 1.5 units, but may use more if necessary (and more is available)

Total processing units
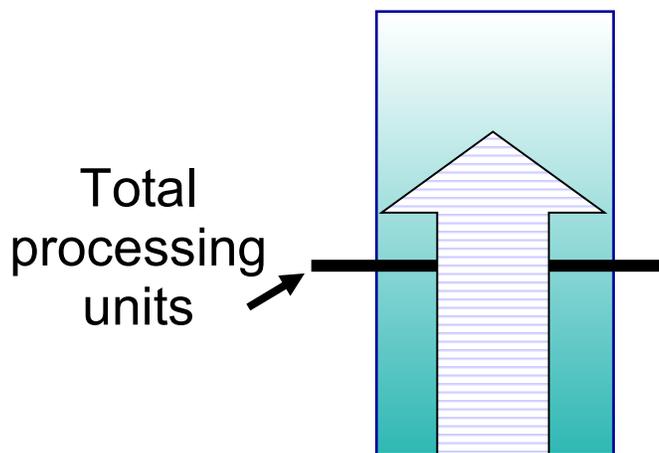
All uncapped partitions share the unused capacity based on user-defined weighting

Weight scale is 0 to 255

Virtual Processors (2 of 3)

- By default, for each 1.00 of a processor, or part thereof, a virtual processor will be allocated
  - Example: 3.6 processing units would have 4 virtual processors

- Up to 10 virtual processors *can* be assigned per processing unit
  - Example: 3.6 processing units can have up to 36 virtual processors

- Both entitled capacity and number of virtual processors can be changed dynamically for tuning
  - Maximum virtual processors per partition is 64

Example:
Partition with 4.2 entitled capacity:

Minimum virtual processors = _____

Maximum virtual processors = _____

Virtual Processors (3 of 3)

- The number of virtual processors does not change the *entitled capacity*

- Example: A partition has 1.5 *capped* processing units
  - For each 10 ms time slice, the partition is only entitled to 15 ms of processing time
  - If 2 virtual processors
    - 7.5 ms runs on 2 physical processors
  - If 4 virtual processors
    - 3.75 ms runs on 4 physical processors

- For uncapped partitions, performance may be limited if the virtual processor setting is too low
  - Number of simultaneous physical processors is limited by the virtual processor setting
  - Each virtual processor is worth up to 10 ms of processing time

Unit Summary

- Processing modes are Dedicated and Shared
- Shared processors are allocated in processing units from one shared processing pool
- Entitled capacity is the amount of processing power a partition is guaranteed
- Entitled capacity is assigned as milliseconds within a 10 ms time slice
- Capped partitions cannot exceed their entitled capacity
- Uncapped partitions may use excess capacity in the shared processing pool
- Priority is determined for uncapped partitions by their weight value
- The operating system in a partition views virtual processors as physical processors

Checkpoint (1 of 3)

1) Match the following processor terms to the statements that describe them:

Dedicated   Shared   Capped   Uncapped   Virtual   Logical

a. _____ These processors cannot be used in Micro-Partitions.

b. _____ Partitions marked as this may use excess processing capacity in the shared pool.

c. _____ There are two of these for each virtual processor if simultaneous multi-threading is enabled.

d. _____ This type of processor must be configured in whole processor units.

e. _____ These processors are configured in processing units as small as one hundredth of a processor.

f. _____ By default, there is one of these for each whole processing unit, or part thereof.

g. _____ Partitions marked as this may use up to their entitled capacity but not more.

2. Can a partition have both dedicated and shared processors?

Checkpoint Solution (1 of 3)

1) Match the following processor terms to the statements that describe them:

Dedicated   Shared   Capped   Uncapped   Virtual   Logical

a. **Dedicated** These processors cannot be used in Micro-Partitions.

b. **Uncapped** Partitions marked as this may use excess processing capacity in the shared pool.

c. **Logical** There are two of these for each virtual processor if simultaneous multi-threading is enabled.

d. **Dedicated** This type of processor must be configured in whole processor units.

e. **Shared** These processors are configured in processing units as small as one hundredth of a processor.

f. **Virtual** By default, there is one of these for each whole processing unit, or part thereof.

g. **Capped** Partitions marked as this may use up to their entitled capacity but not more.

2. Can a partition have both dedicated and shared processors?
   No, a partition must use one or the other.

Checkpoint (2 of 3)

3. *True or False:* Dedicated processors are returned to the shared processor pool if the dedicated partition becomes inactive.

4. If a partition has 2.5 processing units, what is the *minimum* number of virtual processors it must have?
   a. 1
   b. 3
   c. No minimum

5. If a partition has 2.5 processing units, what is the *maximum* number of virtual processors it can have?
   a. 25
   b. 30
   c. Total number of physical processors X 10
   d. No maximum

Checkpoint Solution (2 of 3)

3. *True or False:* Dedicated processors are returned to the shared processor pool if the dedicated partition becomes inactive.
   Trick question! The answer is maybe and it depends on how the dedicated partition is configured.

4. If a partition has 2.5 processing units, what is the *minimum* number of virtual processors it must have?
   a. 1
   b. 3
   c. No minimum

5. If a partition has 2.5 processing units, what is the *maximum* number of virtual processors it can have?
   a. 25 **(Max can be no more than 10 times processing units.)**
   b. 30
   c. Total number of physical processors X 10
   d. No maximum

What is the smallest granularity of processing units when allocating additional processing units to a partition?

- What is the maximum amount of processing units that can be allocated to a partition?

- If there are multiple uncapped partitions running, how are excess shared processor pool resources divided between the partitions?

- *True or False:* If a partition is allocated 2.5 processing units, this means that it can use up to 25 ms of processing time for every 10 ms of clock time.

- What is the maximum number of virtual processors that can be configured for an individual partition?

- What is the minimum number of processing units in a partition?
  0.1 processing units

Checkpoint Solution (3 of 3)

- What is the smallest granularity of processing units when allocating additional processing units to a partition?
  0.01 processing units

- What is the maximum amount of processing units that can be allocated to a partition? **All available processing units**

- If there are multiple uncapped partitions running, how are excess shared processor pool resources divided between the partitions?
  The uncapped weight configuration value is used to allocate excess resources.

- *True or False:* If a partition is allocated 2.5 processing units, this means that it can use up to 25 ms of processing time for every 10 ms of clock time. **True**

- What is the maximum number of virtual processors that can be configured for an individual partition? **Up to ten times the amount of processing units.**

# Virtual Ethernet Overview (1 of 3)

- Virtual Ethernet:

  – Enables inter-partition communication without the need for physical network adapters assigned to each partition

  – Adapters are virtual and if communication is only between partitions on same managed system, no physical Ethernet adapter is needed

  – Requires a POWER5 processor-based system and HMC for configuration

  – Partitions can run either AIX 5L V5.3 or Linux

  – Does not require the purchase of any additional features or software such as the Advanced POWER Virtualization feature

- Up to 256 virtual Ethernet adapters supported per partition

- Support for large MTUs (up to 65394) on AIX 5L

- Supports both IPv4 and IPv6 standards

- Virtual Ethernet adapter with only a PVID is configured just like physical Ethernet adapter

- Virtual Ethernet adapter with multiple VIDs is configured as a VLAN device with tagging

Virtual Ethernet Overview (3 of 3)

- Allows partitions to communicate without using a physical Ethernet adapter
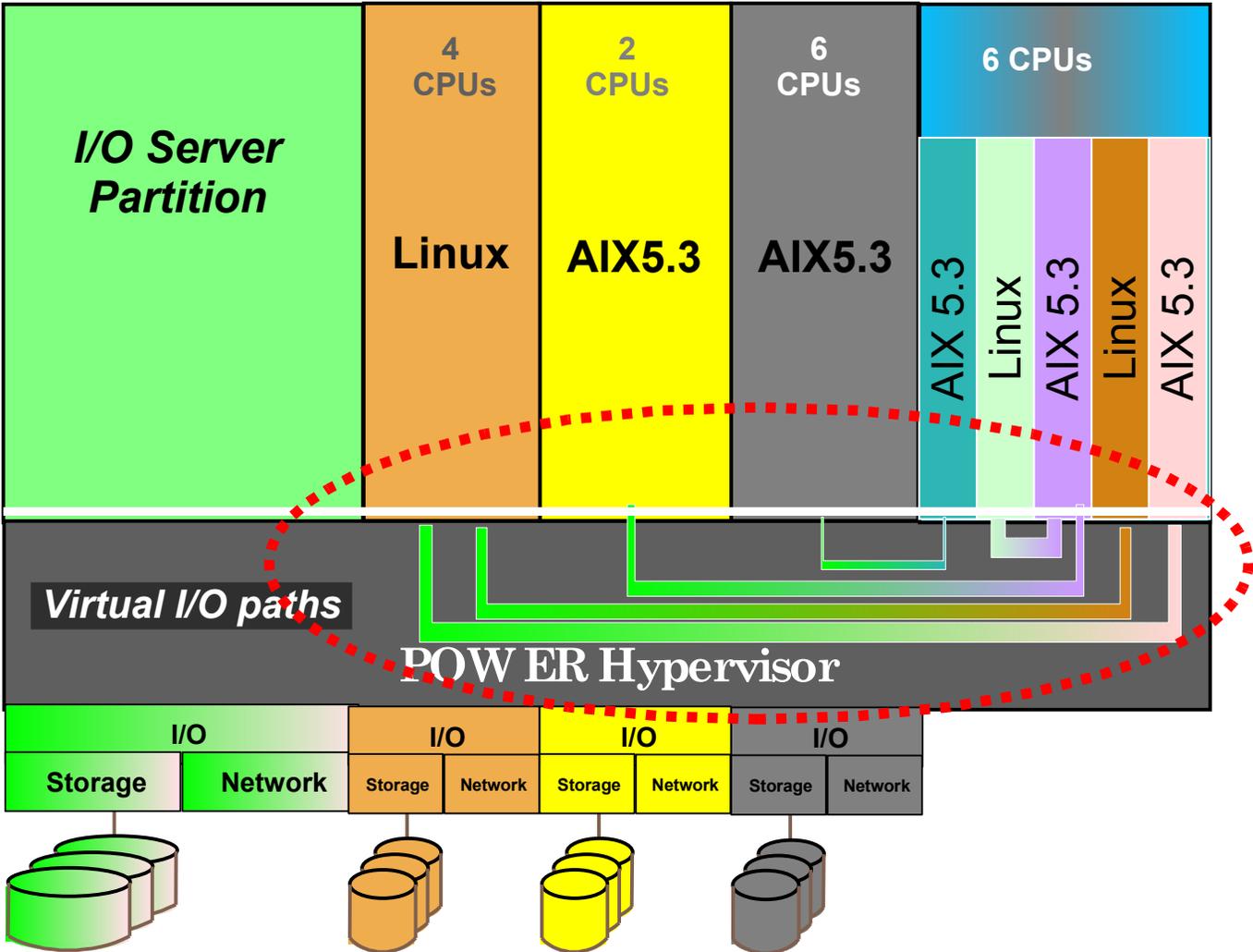
Virtual Ethernet Adapters

- Virtual Ethernet adapters are required to access the Hypervisor Ethernet switch
- Use HMC to create virtual adapters
  - Created in a partition's profile or dynamically
- HMC generates MAC address
  - Local bit to prevent conflict with physical Ethernet
  - Based on machine serial number for uniqueness
- Access to 20 VLAN (VID) networks per adapter (plus the PVID)
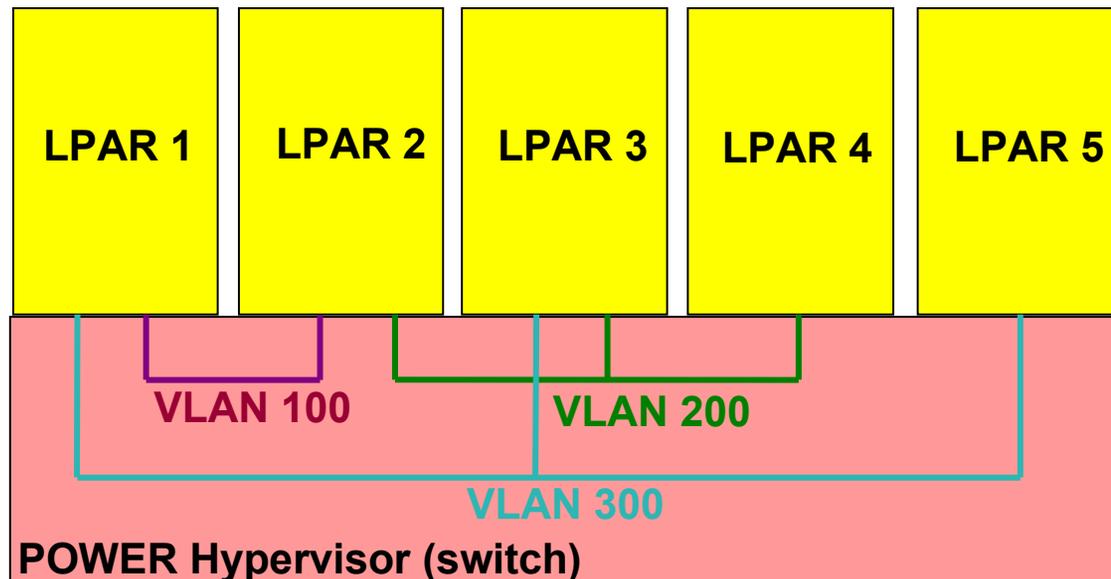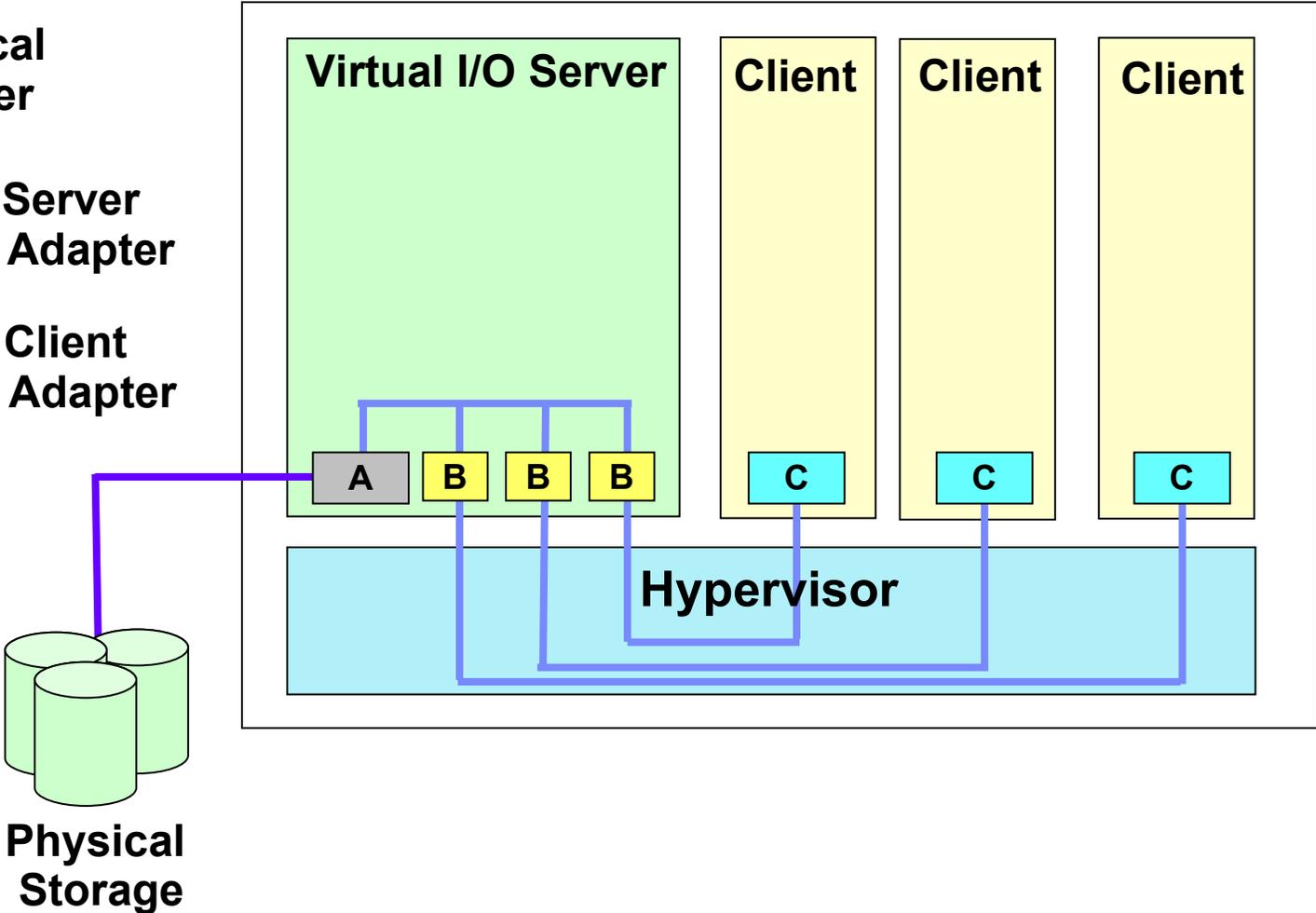
VLAN Configuration Examples
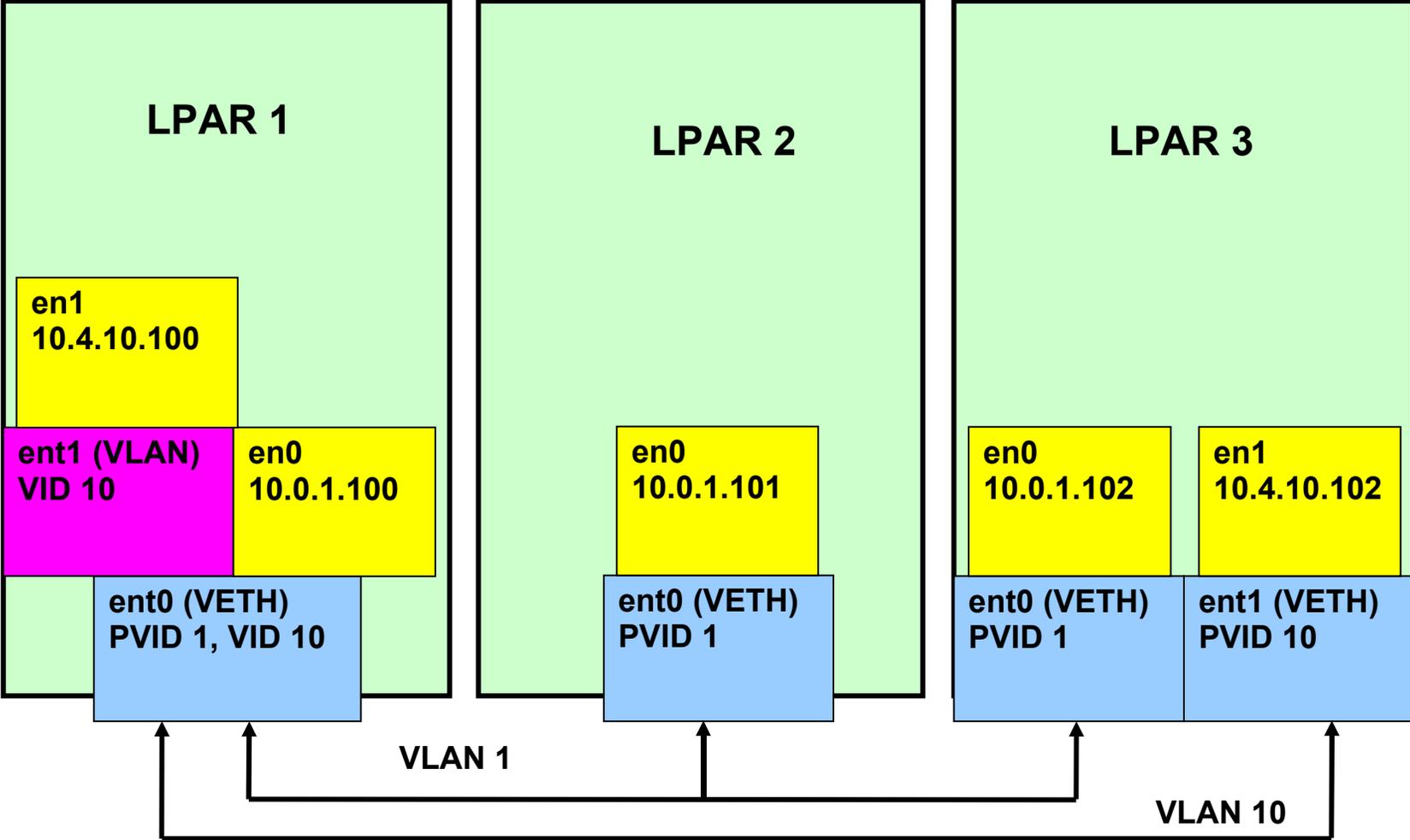
Virtual SCSI Overview (1 of 2)

- Implemented as client/server relationship

- Virtual I/O server owns the physical resource

- Client partition sees standard SCSI devices

- Current device types supported:
  - Disk (backed by physical volume)
  - Disk (backed by logical volume)
  - Optical (DVD-ROM, DVD-RAM, and CD-ROM)

- Inter-partition communication provided by Hypervisor

- Client partition can boot from virtual SCSI devices

Virtual SCSI Overview (2 of 2)

Legend:
- **A** — Physical Adapter
- **B** — VSCSI Server Virtual Adapter
- **C** — VSCSI Client Virtual Adapter

Diagram:
- **Virtual I/O Server** containing adapters **A**, **B**, **B**, **B**
- **Client**, **Client**, **Client** each containing **C**
- **Hypervisor**
- **Physical Storage**

Checkpoint (2 of 2)

- *True or False:* A partition may boot from virtual SCSI disk.

- *True or False:* A partition may not use both virtual SCSI disk and virtual Ethernet at the same time.

- When should the *Access external network* setting of a virtual Ethernet adapter be used?

Checkpoint Solution (2 of 2)

- *True or False:* A partition may boot from virtual SCSI disk. True.

- *True or False:* A partition may not use both virtual SCSI disk and virtual Ethernet at the same time. False. A partition can use both virtual SCSI disk and virtual Ethernet at the same time.

- When should the *Access external network* setting of a virtual Ethernet adapter be used? The setting should be used on the virtual adapter associated with the shared Ethernet adapter used by the virtual I/O server partition to connect internal VLANs to the outside network.
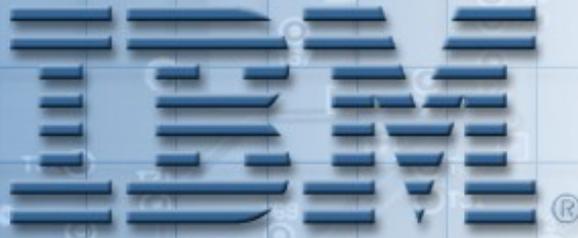
Systemverwaltung 2009
AIX / Hardware

4.0.1

Location Codes

- Types of location codes
  - Physical location codes refer to a specific component
    - A physical location code is a sequence of location labels that, when followed in order, leads to the resource

  - Operating system location codes also refer to components and use a different convention
    - Example for AIX 5L, hdisk0:   05-08-00-3,0

- Virtual devices have codes as if there were on another physical planar

Physical Location Code Convention

- Physical location code format
  - Utttt.mmm.sssssss-additional device information

  Unit Type . Model . Serial number

- Example physical location code
  - U787A.001.DNZ0713-P1-C3
    - *P1* specifies *P*lanar 1
    - *C3* specifies *C*ard slot 3
    - After a card slot, a T followed by a number specifies a particular port
    - If no card slot, a T followed by a number specifies an integrated slot
    - An L followed by a number specifies a logical path identifier specific to the protocol being used (for example, SCSI identifiers)

AIX 5L Location Codes

- Use `lscfg` to see physical location codes
  - For hdisk0
    ```
    lscfg | grep hdisk0
    hdisk0 U787A.001.DNZ00G0-P1-C1-T1-L3-L0
    ```
  - For Ethernet adapter
    ```
    lscfg | grep en
    ent0    U787A.001.DNZ00G0-P1-C3-T1
    ```

- Use `lsdev` to see AIX 5L location code
  - For disks
    ```
    lsdev -Cc disk
    hdisk0 Available 05-08-00-3,0
    hdisk1 Available 05-08-00-4,0
    ```

  - For Ethernet adapter
    ```
    lsdev | grep ent
    ent0  Available 03-08
    ```