iSeries Dynamic Logical Partitioning

Simplicity in an on demand world

iSeries Dynamic Logical Partitioning

Objectives

- Understand the LPAR functionality in OS/400 V5R2
- Practical Scenarios that use new functionality in OS/400 V5R2
- Planning considerations and system requirements

Warning

- This presentation is build on functionalities available on iSeries model 8xx and OS/400 V5R2

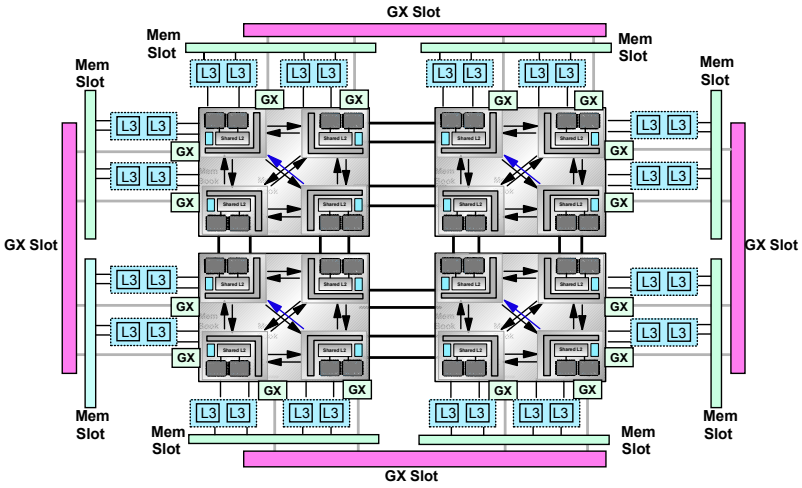
Agenda

iSeries Dynamic Logical Partitioning

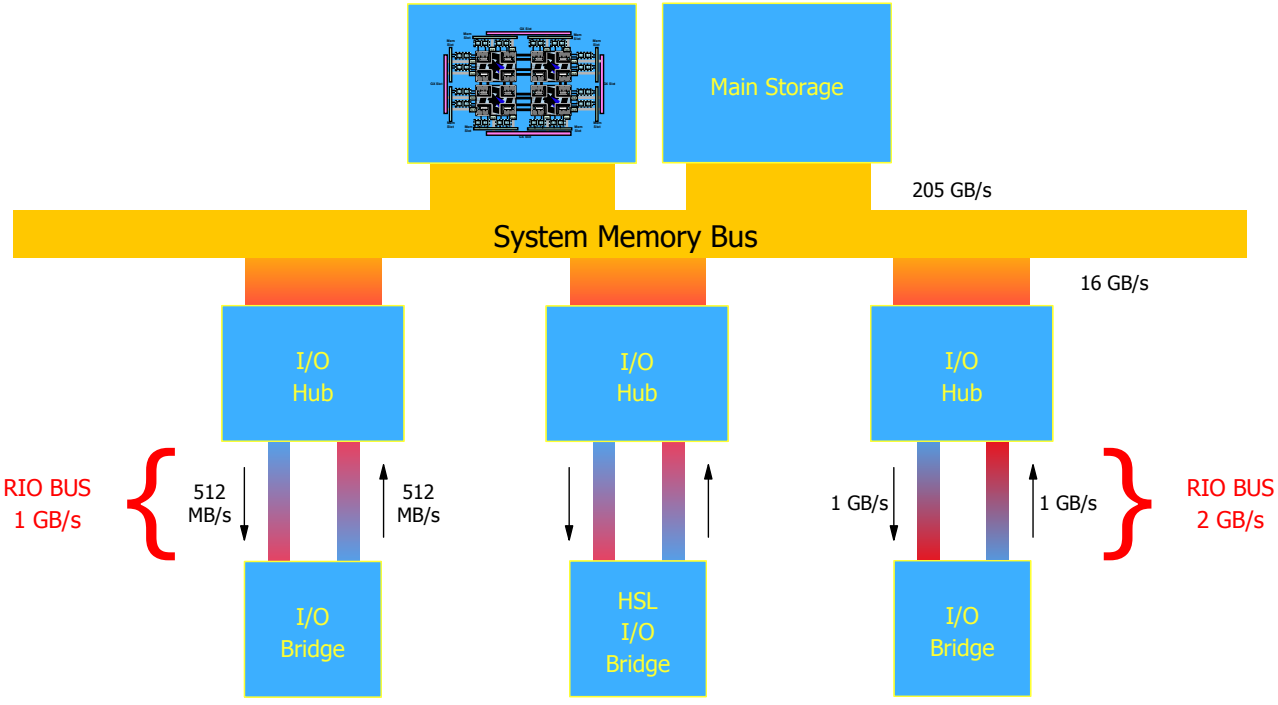
Chapter 1. iSeries Hierarchy of Microprocessors

"High performance on an iSeries server is achieved by using many individual high performance microprocessors, I/O devices, and interconnect technologies"

The processor complex

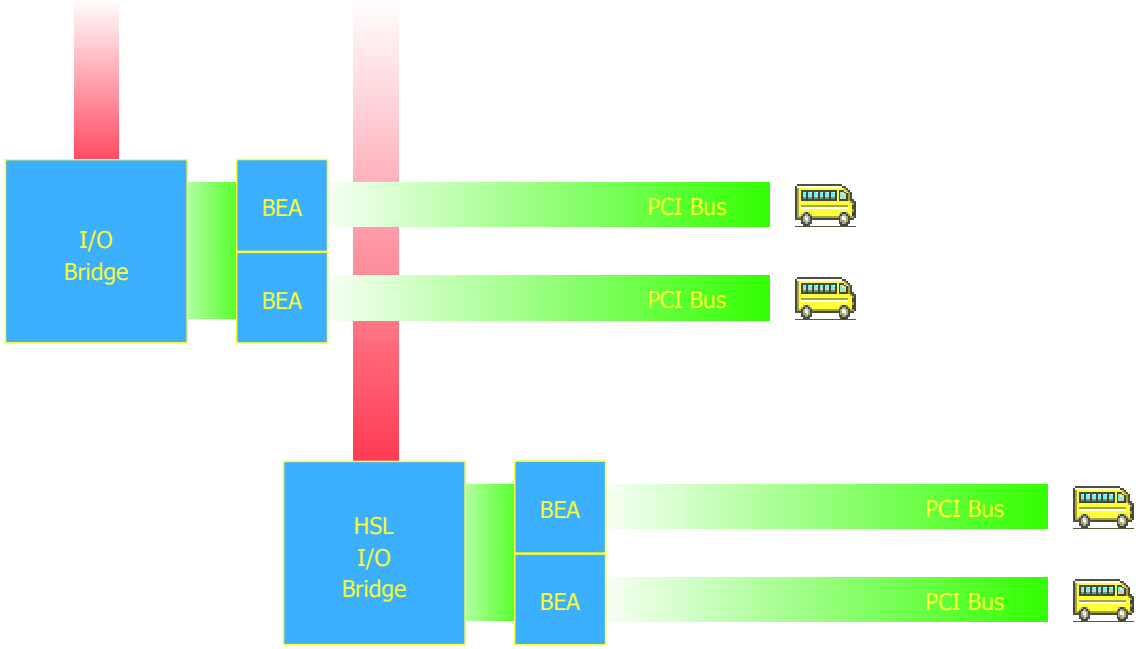


I/O Hubs and I/O Bridges



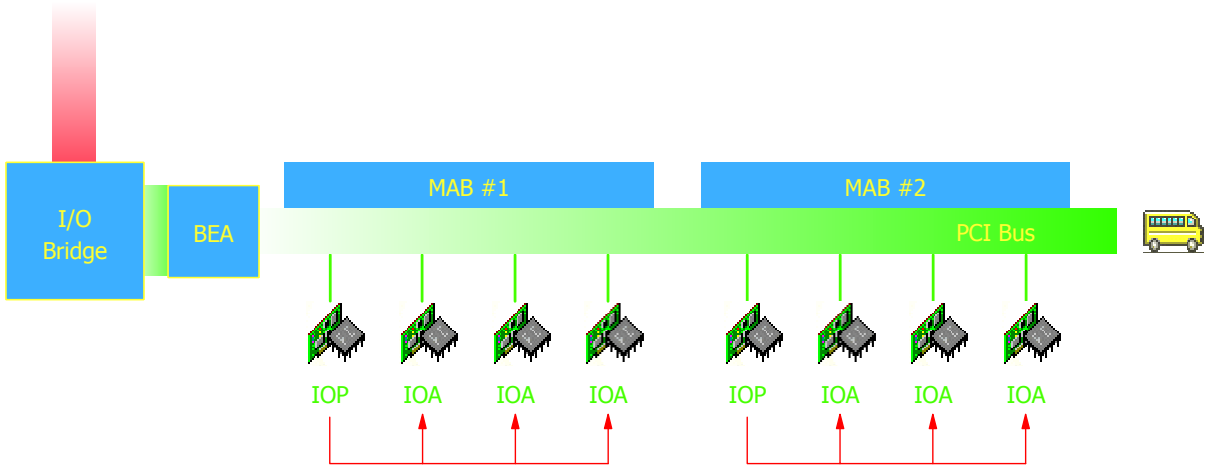
iSeries Hierarchy of Microprocessors

The PCI Buses

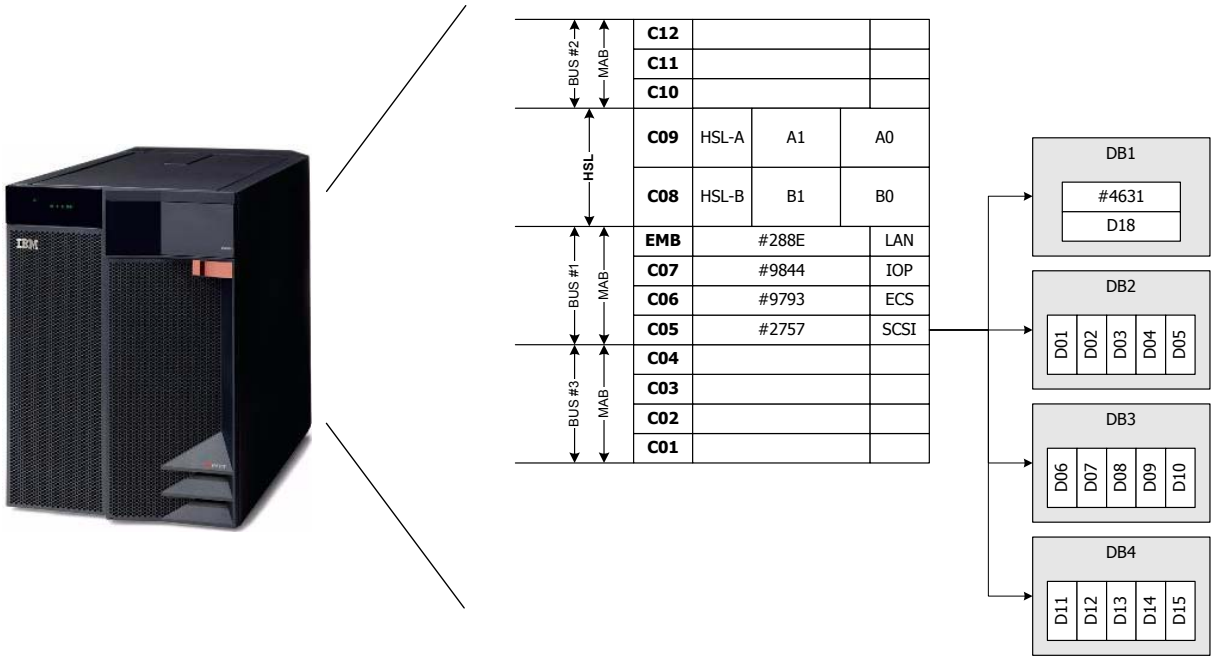


iSeries Hierarchy of Microprocessors

MABs, IOPs and IOAs

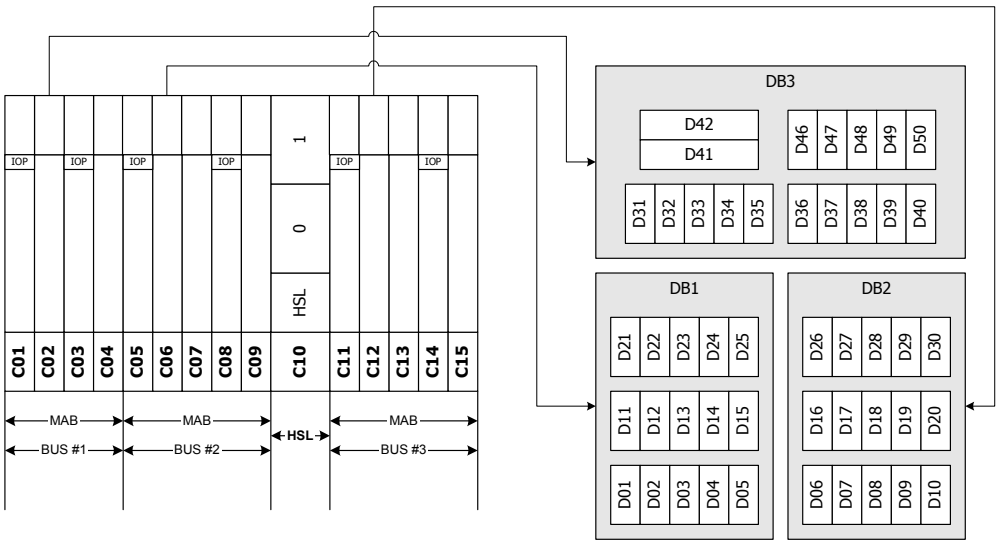


Example : an iSeries model 825 system



iSeries Hierarchy of Microprocessors

Example : a #5094 PCI-X Expansion Tower



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Chapter 2. The LPAR Concepts

Logical Partitioning

- The ability to make a single iSeries Server run as if it were many independent systems
- Each Logical System is called a "Partition"
- Each Partition operates as an independent system

The LPAR Concepts

Primary Partition

- Starting V4R4, every OS/400 is configured with a "Primary Partition"
- The Primary Partition initially owns all the resources available on the machine
  - Processors
  - Main Storage
  - Buses
  - IOPs
- The Primary Partition function as one of the logical system
- The Primary Partition provides functions on which all other partition are dependent
  - Power Management
  - Virtual Operations Panel
  - Logical Partition Definition
  - Integrated Hypervisor
- The Primary Partition is a single point of failure

The LPAR Concepts

Secondary Partition

- Secondary Partitions are created and managed from the Primary Partition
- Secondary Partitions function as independent systems
- Secondary Partitions have their own hardware
  - Processors
  - Main Storage
  - Buses
  - IOPs
- Secondary Partitions have their own software
  - SLIC, OS/400, LPPs, PTFs
  - Primary/Secondary languages
  - System Values, including time-of-day
  - User Profiles
- Secondary Partitions can independently :
  - Power On/Off
  - Dump Main Storage

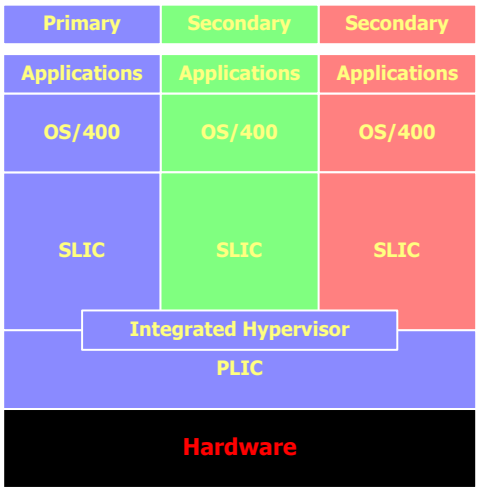
The LPAR Concepts

Integrated Hypervisor

- PLIC
  - Allocating resources to a Partition
  - Installing an Operating System in a Partition
  - Starting and Stopping the Operating System in a Partition
  - Dumping Main Storage of a Partition
  - Communications between Partitions
- SLIC
  - Main Storage management
  - Task management
  - Heap management
  - I/O Subsystem management

The LPAR Concepts

How Does It Work ?



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The LPAR Concepts

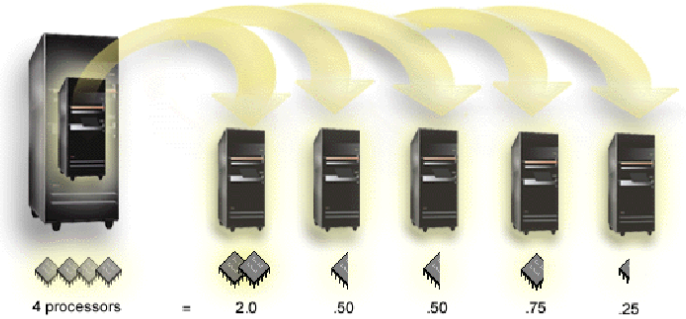
Dedicated Processors

- A *Dedicated Processor* refers to a whole processor that is dedicated to a single partition
- One or more processors can be dedicated to a partition
- Rules & Requirements :
  - A least one dedicated processor
  - Granularity of movements : one processor
  - Processor moves are dynamic, without any IPL while within configured ranges
  - Unallocated processors are not used

The LPAR Concepts

Shared Processors

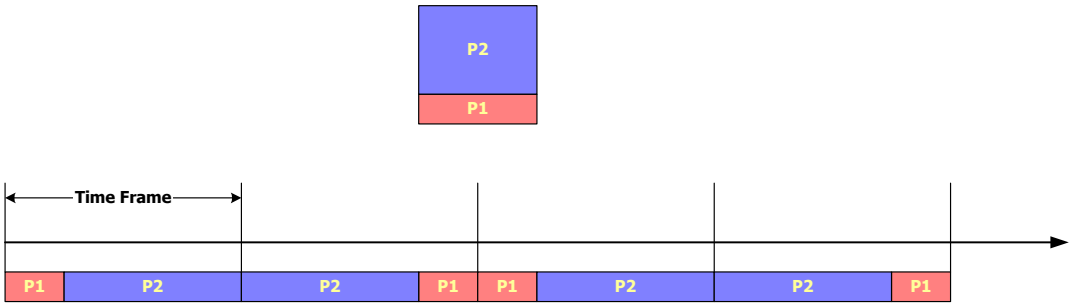
- A *Shared Processor* allows to assign partial processors to a partition
- Physical processors are assigned in a "Shared Processor Pool"
- Rules & Requirements :
  - A least 0.10 processor
  - Granularity of movements : 0.01 processor
  - Processor moves are dynamic, without any IPL while within configured ranges
  - Unallocated processors or partial processors are not used



The LPAR Concepts

Shared Processors

- Example : Single CPU iSeries System with two partitions
  - Partition #1 receive 0.25 processor
  - Partition #2 receive 0.75 processor



The LPAR Concepts

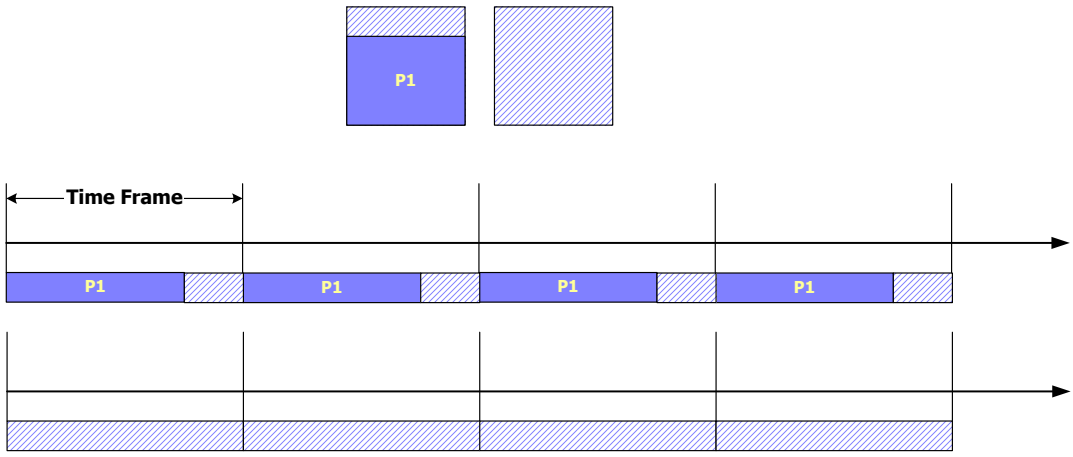
Virtual Processors

- The number of *Virtual Processors* represent the number of parallel threads of execution
- The processing power is spread equally across its virtual processors
- Rules & Requirements
  - The number of virtual processors must be less or equal than the number of processors in the shared pool
  - Changes are dynamic, without any IPL while within configured ranges

The LPAR Concepts

Virtual Processors

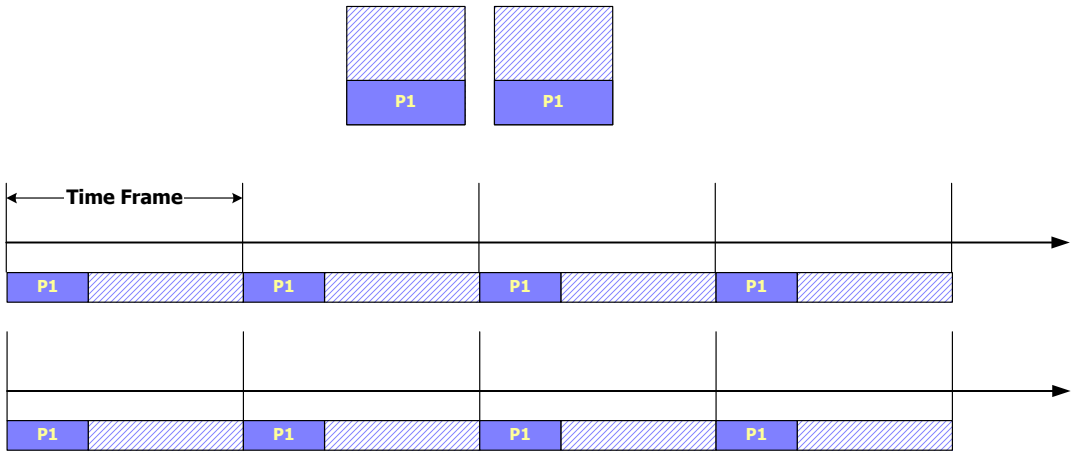
- Example : 0.75 processing unit running on 1 virtual processor



The LPAR Concepts

Virtual Processors

- Example : 0.75 processing unit running on 2 virtual processors



The LPAR Concepts

Interactive Capacity

- Determine the percentage available for each partition
- Rules & Requirements
  - Minimum : 0%
  - Granularity : 1%
  - Maximum : depends on allocated processing power
  - Changes are dynamic, without any IPL while within configured ranges
  - Unallocated interactive capacity is not used

The LPAR Concepts

Main Storage

- Processors use memory to temporarily hold information
- Memory is added into *BASE pool
- Memory is removed from *BASE pool
  - The system will keep the minimum required (determined by system value QBASPOOL)
  - The system will "flush" any data from memory pages to disk before making them available
- Rules & Requirementrs
  - A partition must have a whole number of Megabytes (1 MB = 1024 x 1024 bytes)
  - Primary partition needs a minimum of 256 MB
  - Secondary partitions needs a minimum of 128 MB
  - Granularity of movements : 1 MB (256 pages of 4 KB)
  - Memory moves are dynamic, without any IPL while within configured ranges
  - Unallocated memory is not used

The LPAR Concepts

I/O Partitioning

- BUS-Level
- IOP-Level

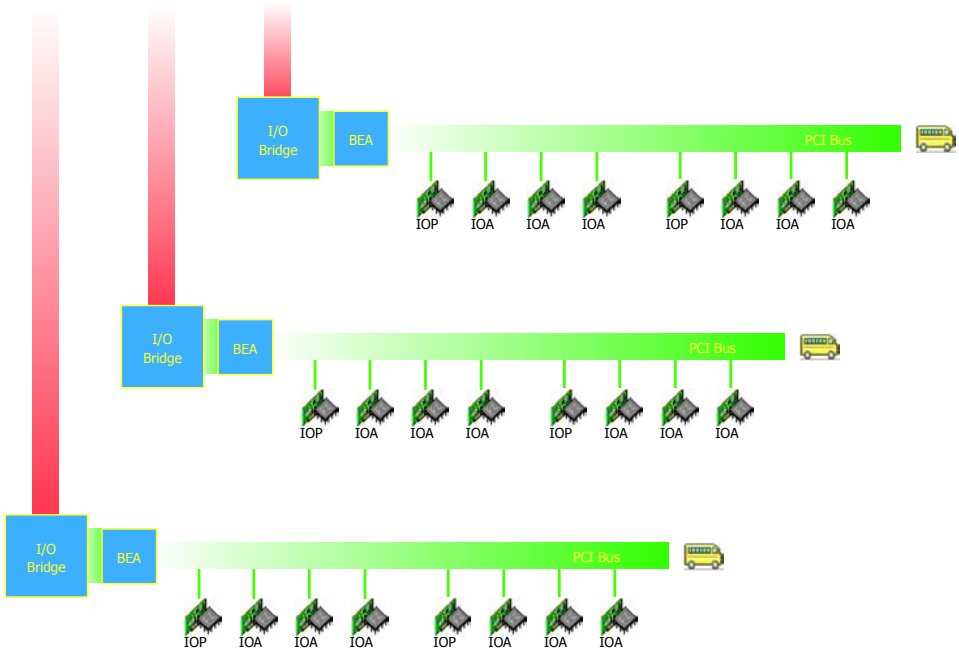
The LPAR Concepts

BUS-Level I/O Partitioning

- A bus and all attached IOPs and devices are dedicated to a single partition
- BUS-Level Advantages
  - Better problem isolation
  - Better availability
  - Better performance
  - More simple hardware management
- BUS-Level Disavantages
  - Lot of additional hardware required
  - Resources cannot be shared between partitions

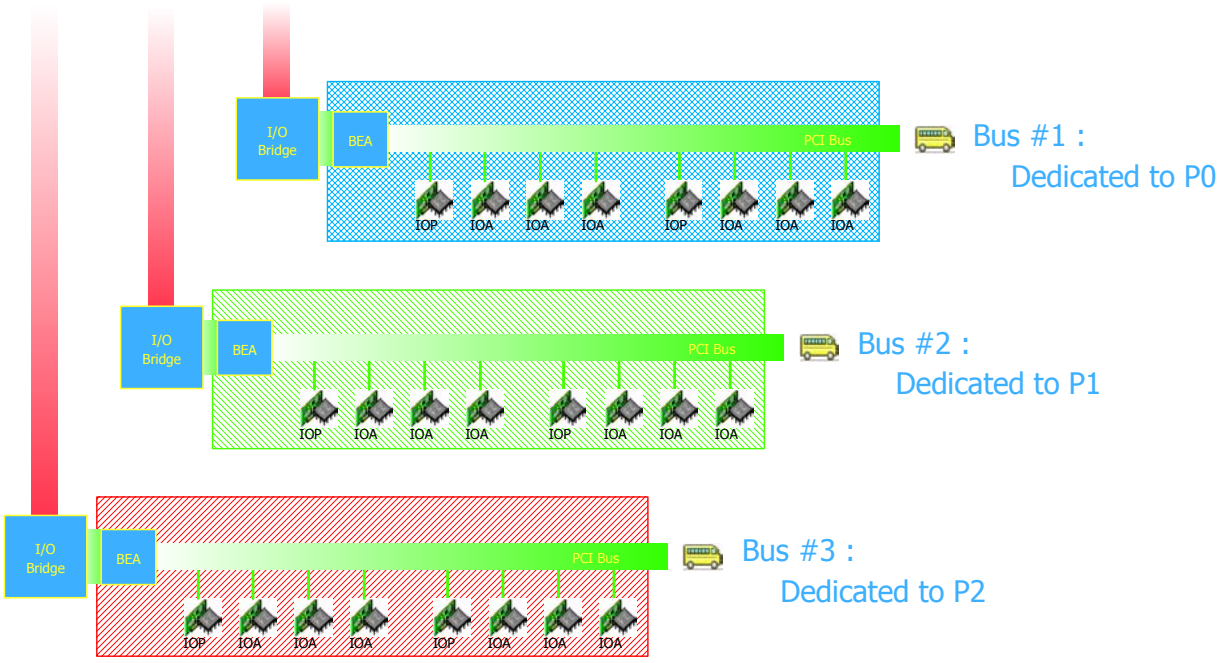
The LPAR Concepts

BUS-Level I/O Partitioning



The LPAR Concepts

BUS-Level I/O Partitioning



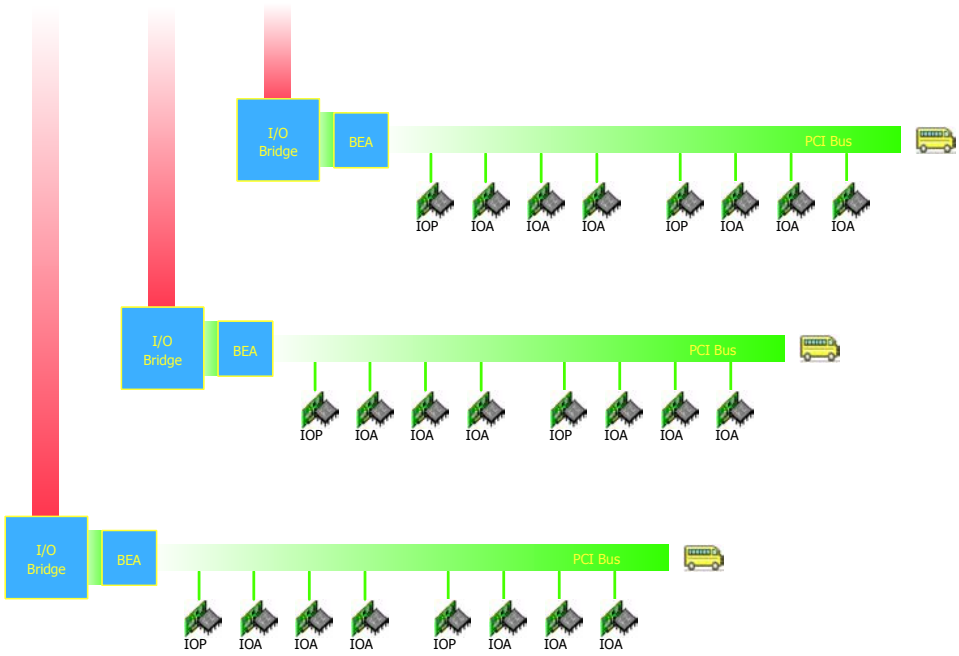
The LPAR Concepts

IOP-Level I/O Partitioning

- Share the bus and divide resources by IOP
- Bus will be defined as :
  - DEDICATED :
    One partition uses all IOPs and IOAs resources
    No other partition can use any resource on that bus
  - OWN SHARED :
    One partition owns the bus and its hardware resources
    The owner partition will allow selective use of resources by another partition.
  - USE SHARED :
    Before using resources on a shared bus, a partition must configure that bus in its configuration
- IOP-Level Advantages
  - Greater flexibility
  - Cost reduction
  - Optimization of harware resources
  - Ability to dynamically switch IOPs between partitions
- IOP-Level Disavantages
  - Requires more depth hardware management skills
  - Requires good record keeping

The LPAR Concepts

IOP-Level I/O Partitioning



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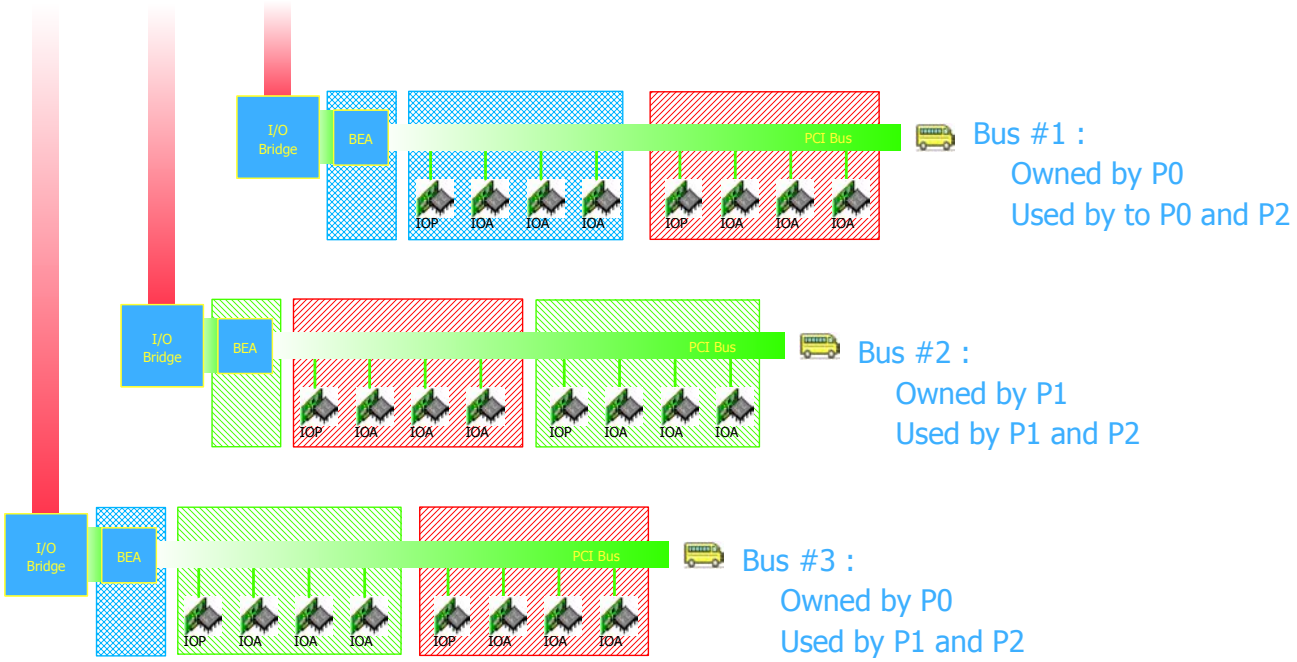
IOP-Level I/O Partitioning

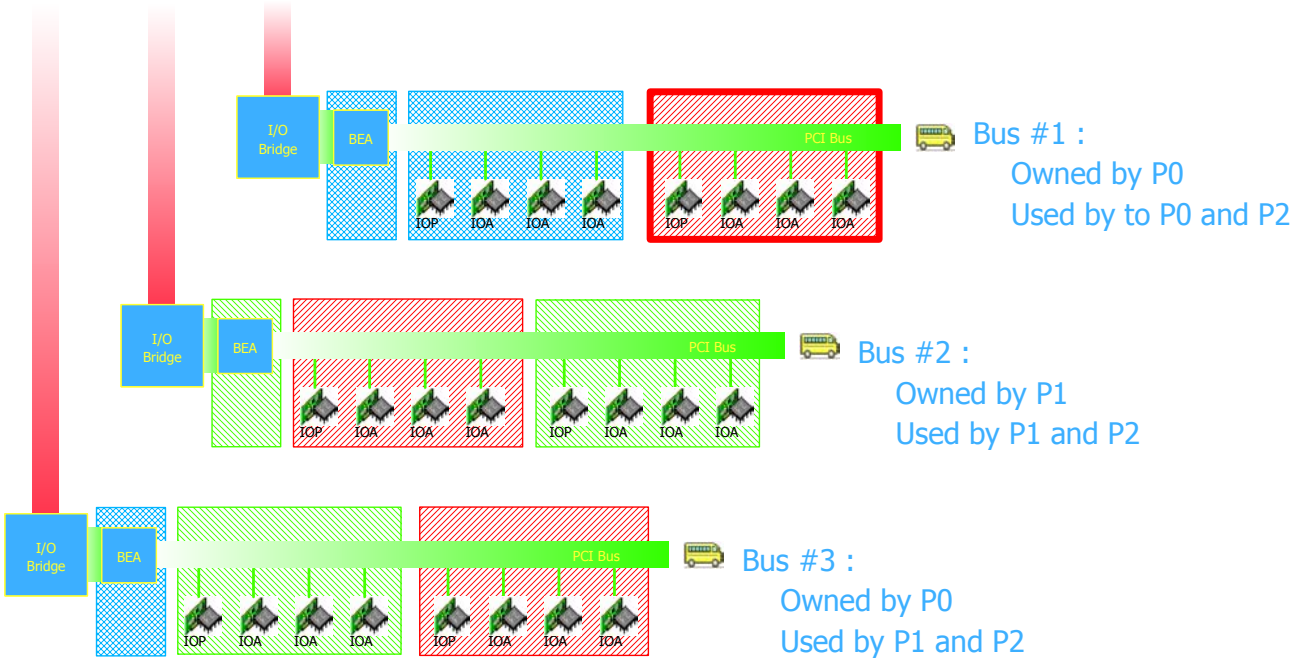


IOP and Device Switching

- Each IOP and all its attached resources can be switched by partitions that share the bus
  - Requires IOP-Level partitioning
- An IOP cannot be usd by two partitions at the same time
- Switching Operations
  - Remove the IOP from its current partition
  - Add IOP to a different partition
- Candidates IOPs are :
  - IOPs which controls high cost devices (Tape Libraries, ...)
  - IOPs which controls low utilization devices (CD-ROM, ...)
  - IOPs which controls communications

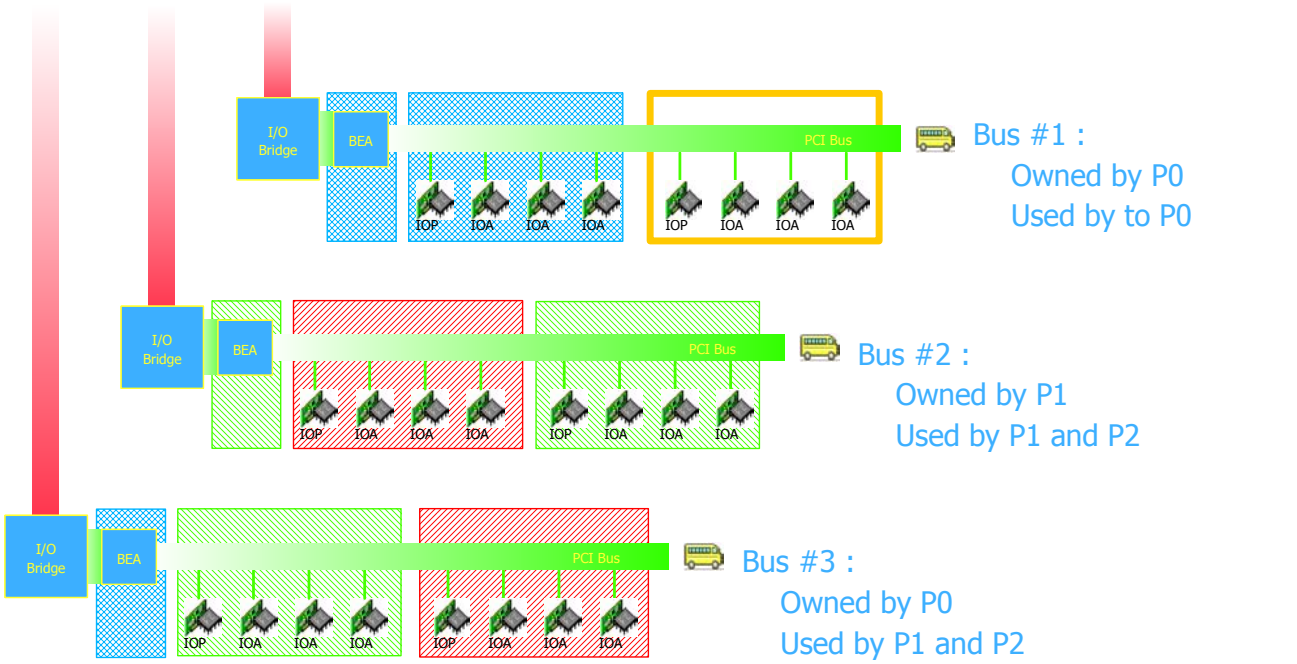
The LPAR Concepts

IOP and Device Switching : Identify resource

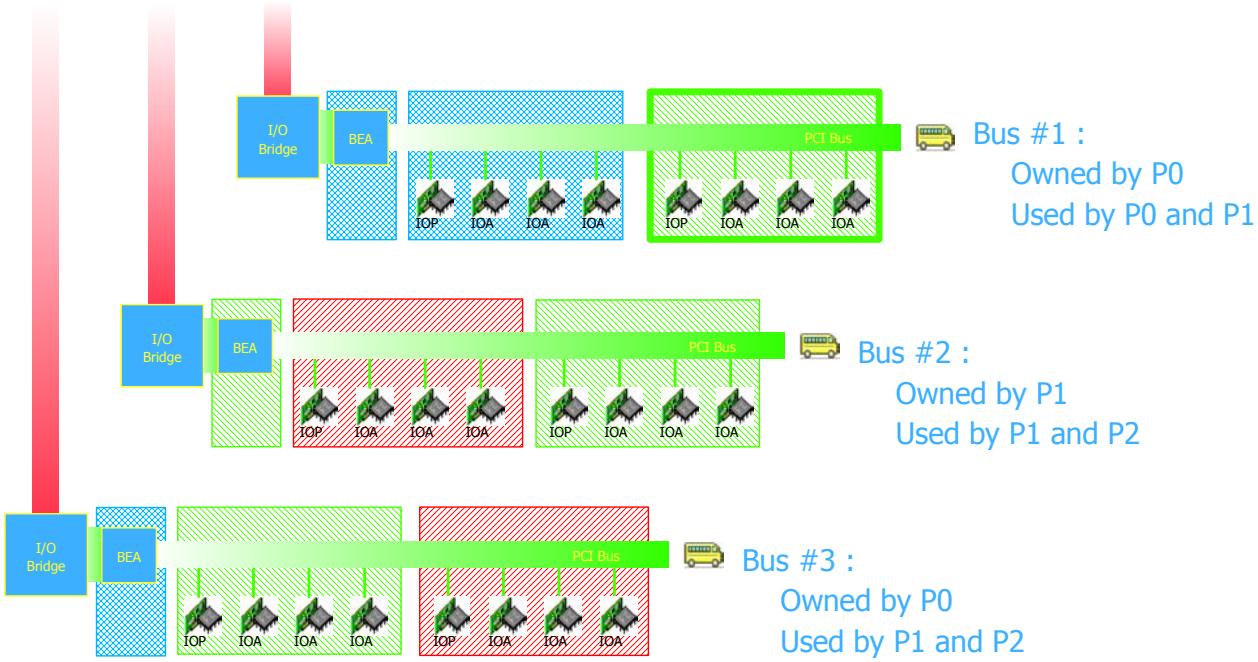


The LPAR Concepts

IOP and Device Switching : Deallocate resource

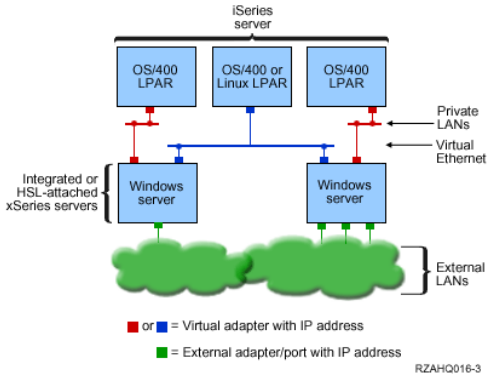


IOP and Device Switching : Allocate resource



Other PLIC Services

- Shared Processor Pool
- Shared Memory Resources
- Virtual LAN
  - High performance communication between partitions
  - Up to 16 different virtual LAN connections thru virtual 1Gbps ethernet IOA
  - Partitions assigned to the same LAN are able to communicate thru that link
  - No additional hardware or software
- Virtual OptiConnect
  - Very high performance communication between partitions
  - Optional OS/400 feature
- HSL OptiConnect
  - Very high performance communication between LPARed systems
  - Optional OS/400 feature



Partitioning offerings from various vendors

	iSeries	Sun	HP	Unisys
Operating System	OS/400	Solaris	HP-UX	Windows 2000
Partitioning type	Logical	Physical (board)	Physical	Physical
Maximum number of partitions	32	16	16	4
Minimum number of processor per partition	0.1	1-4	4	4
Processor increment above minimum	0.01	1-4	4	4
Memory increment above minimum	1 MB	512 MB	512 MB	8 GB
I/O increment above minimum bridge	IOP	2 buses	1 bus	Direct I/O
Independent movement of resource	Yes	No	CPU Only	No
Dynamic resource movement	Yes	Partial	Planned	Yes
High-speed internal communications	Yes	Yes (routing partition)	No	Yes (shared memory)

Understand Requirements (1/2)

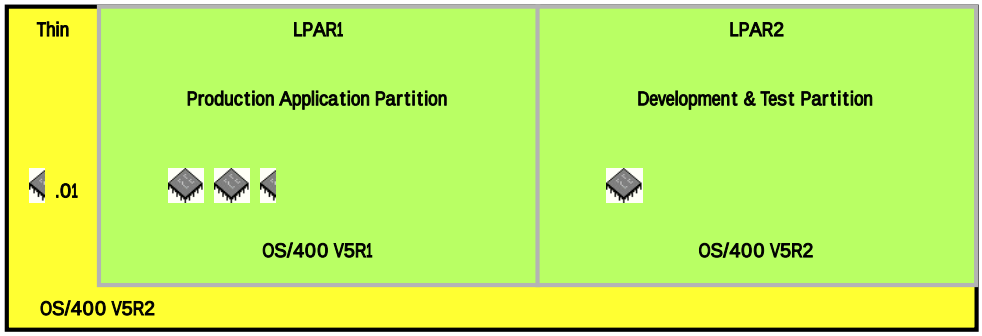
- Rules for SStar Processors
  - Up to 4 OS/400 partitions per processor
  - Up to 10 Linux partitions per processor
  - Up to 10 partitions per processor
  - Up to 32 partitions per system
- Rules for Power4 Processors
  - Up to 10 OS/400 partitions per processor
  - Up to 10 Linux partitions per processor
  - Up to 10 partitions per processor
  - Up to 32 partitions per system

Understand Requirements (2/2)

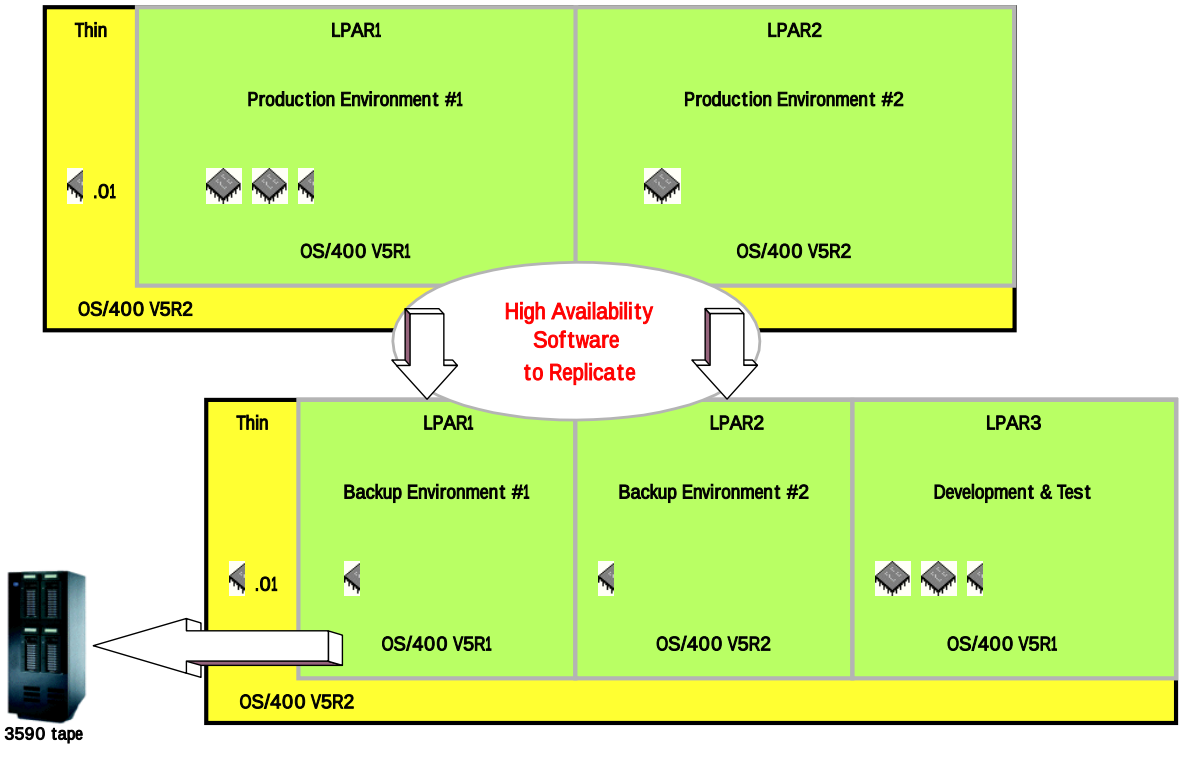
- In order to operates, each Partition must have :
  - Dedicated or Shared Processor
  - Interactive Capacity
  - Main Storage
  - Load Source Unit
  - Available Console
  - Access to Alternate-IPL device
- Consoles
  - Twinax
  - Operations Console, Direct Attach
  - Operations Console, LAN Attach

Chapter 3. The LPAR Benefits

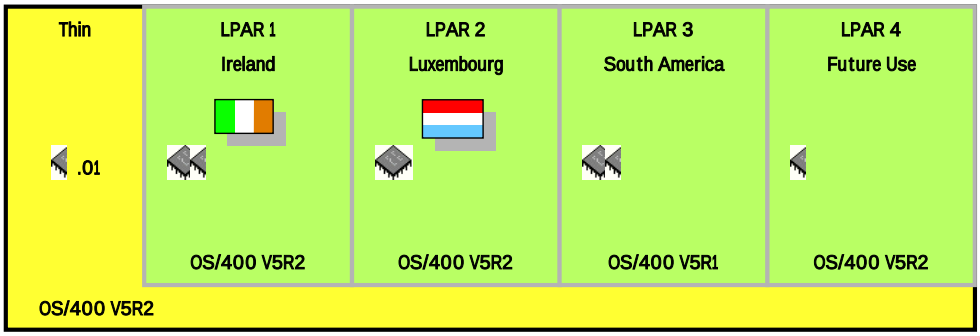
The LPAR Benefits



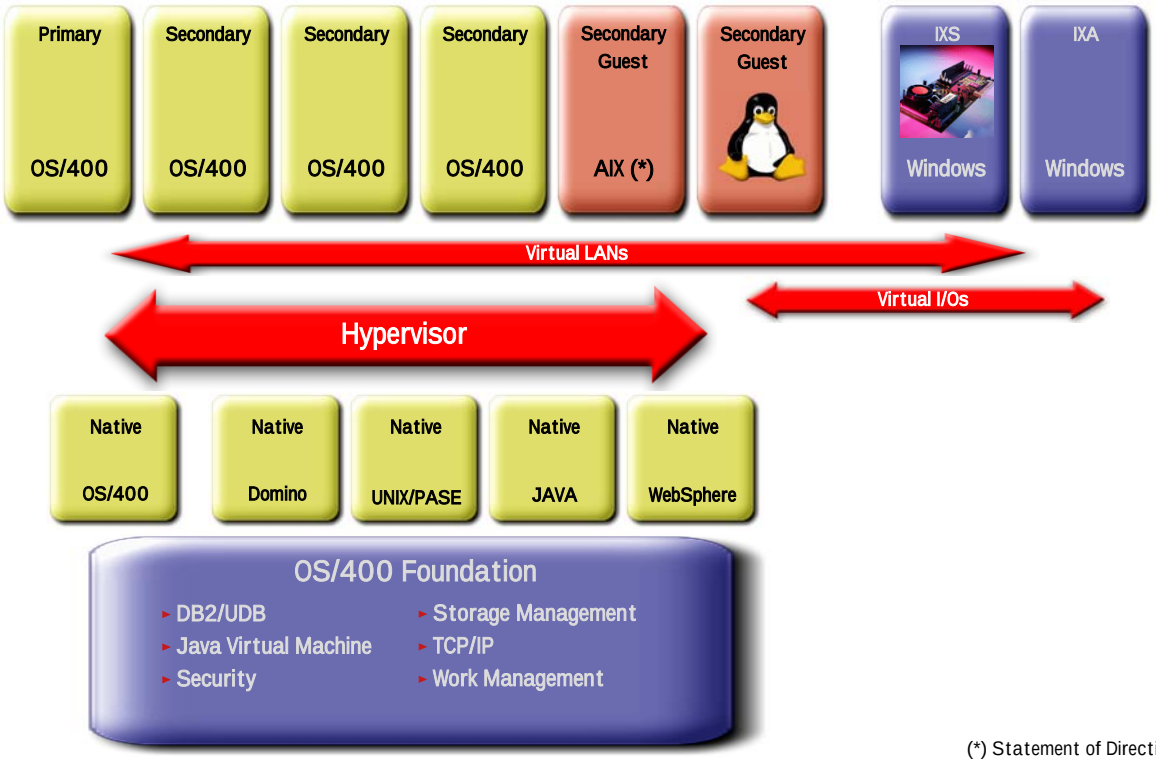
The LPAR Benefits



The LPAR Benefits



The iSeries Benefits



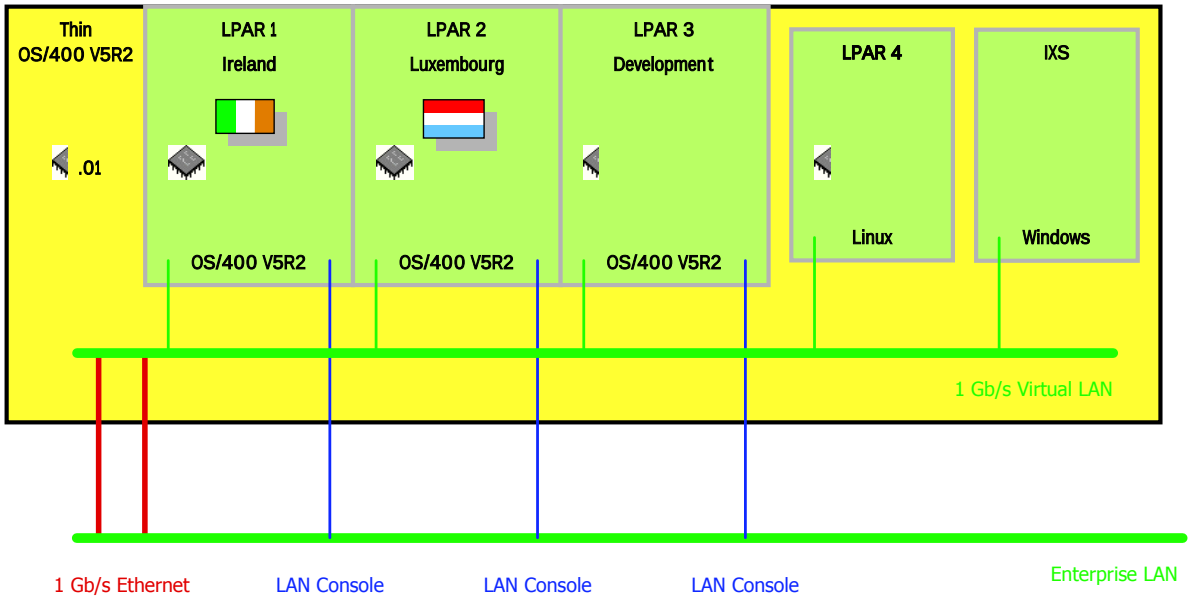
(*) Statement of Direction

Chapter 4. Build and LPARed System by Example

LPAR Planning

- Perform proper capacity planning for each logical system
  - Determine the number of partition needed
  - Determine the size of each
- Call IBM or IBM Business Partner for support
  - Assist with LPAR planning
  - Assist architecting LPAR solution
- Complete the system design phase
  - LPAR Validation Tool (LVT)
  - Configuration planning
  - Work Sheets
- Conduct a Solution Assurance review with IBM or IBM Business Partner
- Order the necessary hardware and software
  - Based on the validated solution
- Install
- Document

Build and LPARed System by Example



Build and LPARed System by Example

Planning - System Selection

System Model	i825	
Processor Package	2473/0873/7416	Enterprise
Interactive Feature	7418	100%
System Memory	8 GB	
Number of Partitions	5	
Number of Processors	3/6	3300/6600 CPW

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Planning - Partition Specifications

Partition	OS Version	Shared	# Processors	Batch CPW	Memory (MB)	Int %	Int CPW
P0 - Primary	V5R2M0	Yes	0.1	116	512	0	0
P1 - Ireland	V5R2M0	Yes	1.0	1166	3072	34	1166
P2 - Luxembourg	V5R2M0	Yes	1.0	1166	3072	34	1166
P3 - Development	V5R2M0	Yes	0.7	816	1280	20	700
P4 - Linux (HOST=P0)	Linux	Yes	0.2	233	256	N/A	N/A
Unallocated	-	-	0.0	3	0	12	
Windows (HOST=P0)	Windows	-	-	-	-	-	-

Build and LPARed System by Example

Planning - Partition Specifications

Partition	DASD	Protection	#4326	Backup	OPTMLB	LAN	WAN
P0 - Primary	-	MIRRORING	2	DVD-RAM	No	1 Gbps	Yes - ECS
P1 - Ireland	300 GB	RAID-5	9	FC TAPE	Yes	Virtual	Yes
P2 - Luxembourg	300 GB	RAID-5	9	FC TAPE	Yes	Virtual	Yes
P3 - Development	500 GB	RAID-5	15	FC TAPE	No	Virtual	No
P4 - Linux (HOST=P0)	100 GB	RAID-5	3	SCSI TAPE	No	Virtual	No
Unallocated							
Windows (HOST=P0)	100 GB	RAID-5	3	SCSI TAPE	No	Virtual	No

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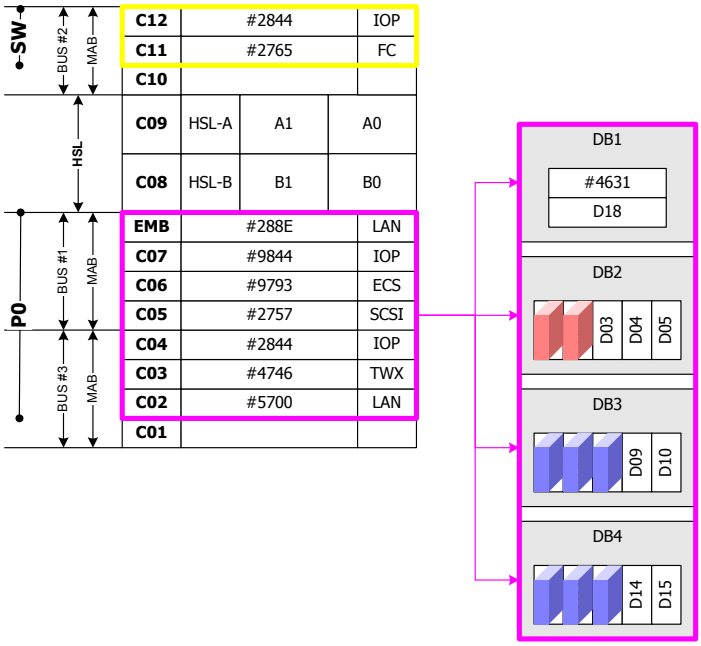
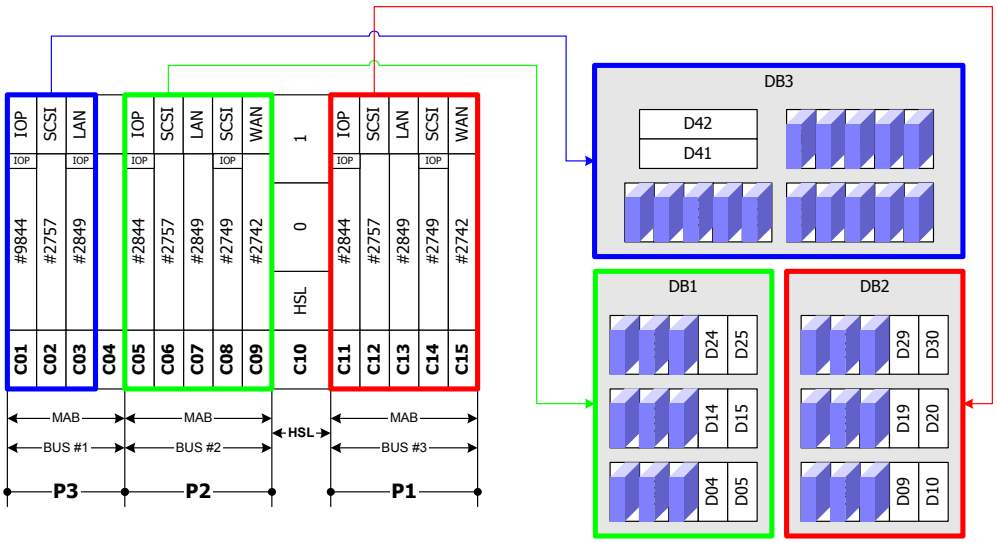
Planning - iSeries 825 System Unit



Build and LPARed System by Example

Planning - #5094 PCI-X Expansion Tower



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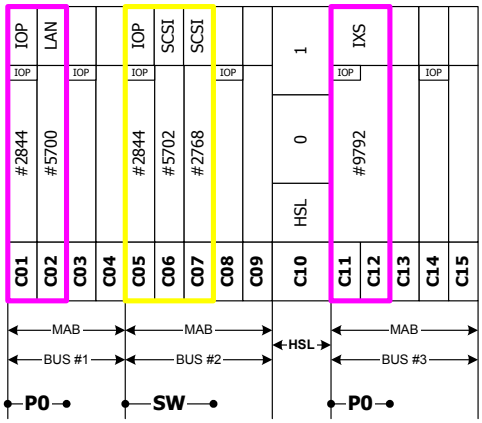
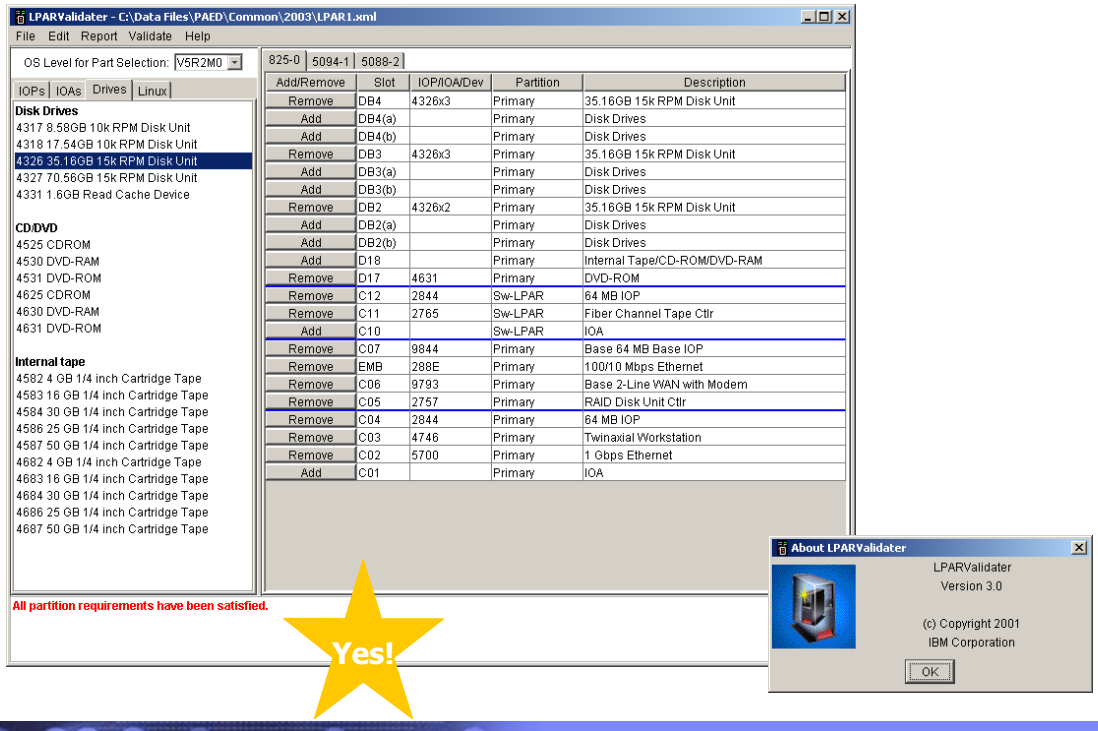
Planning - #5088 PCI-X Expansion Tower



Build and LPARed System by Example

Planning - LPAR Validater Tool



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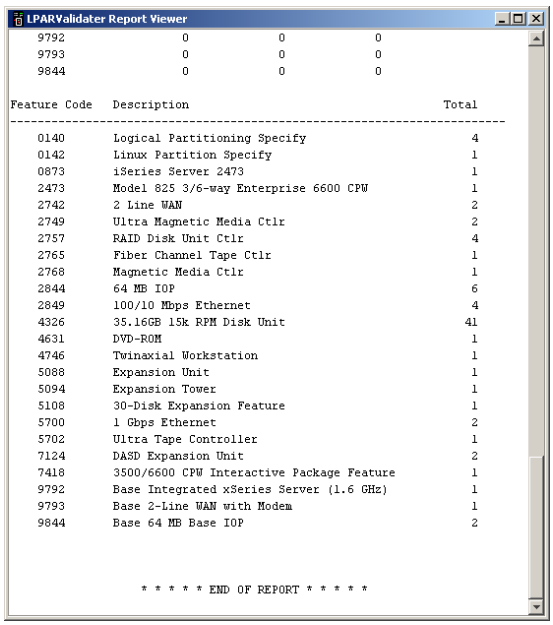
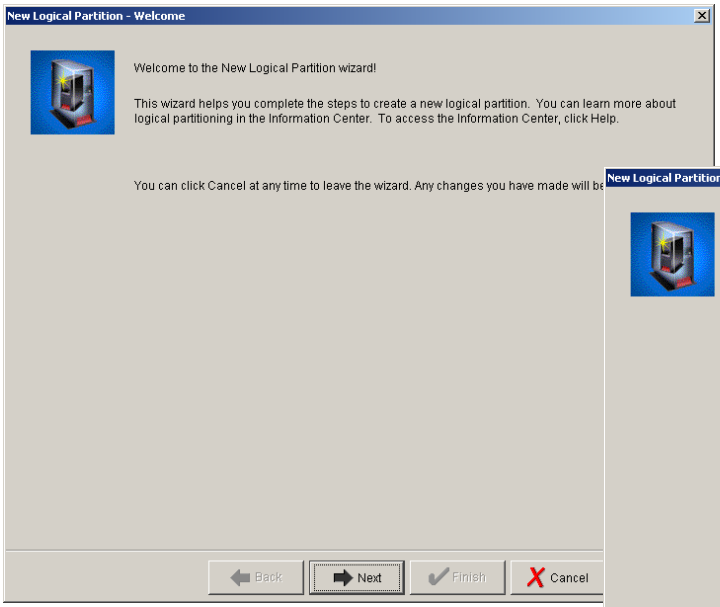
Planning - LPAR Validater Tool

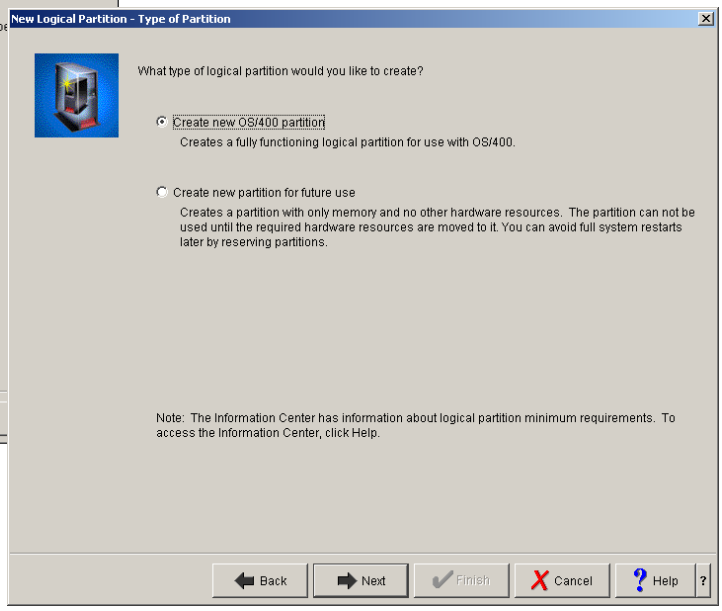


Interfaces available for installation and configuration

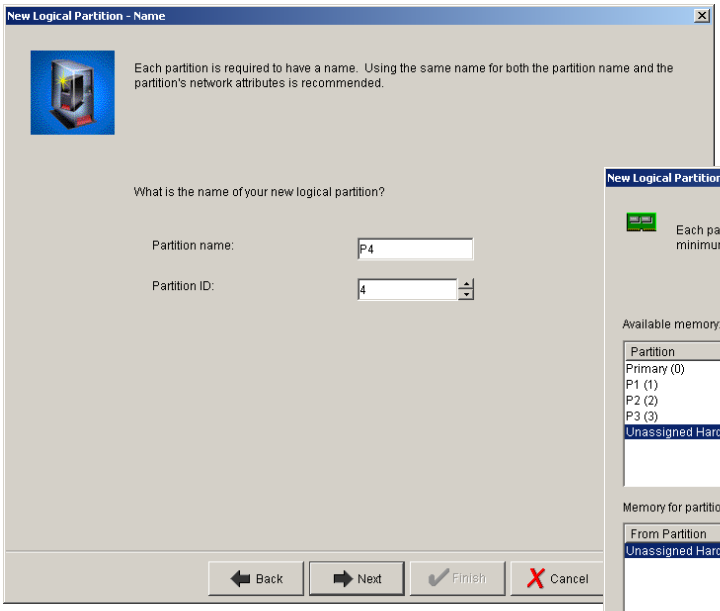
- Via 5250 displays thru DST or SST
- Via iSeries Navigator

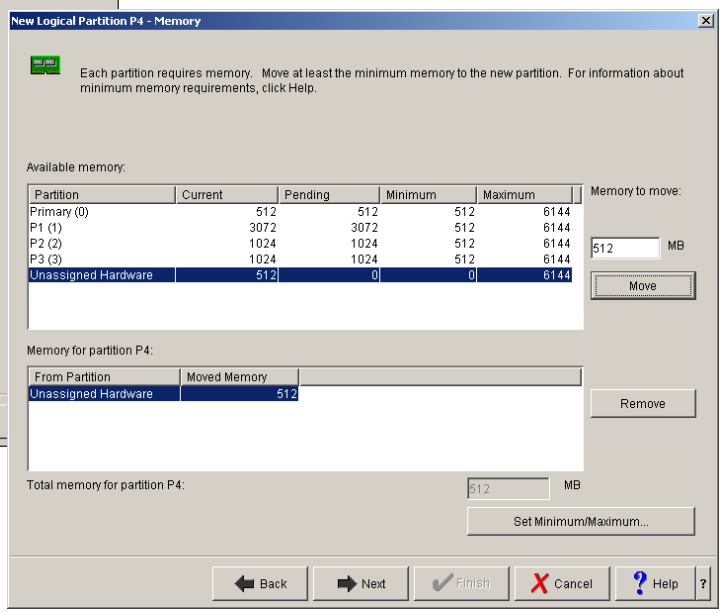
Implementation & Operations





Implementation & Operations





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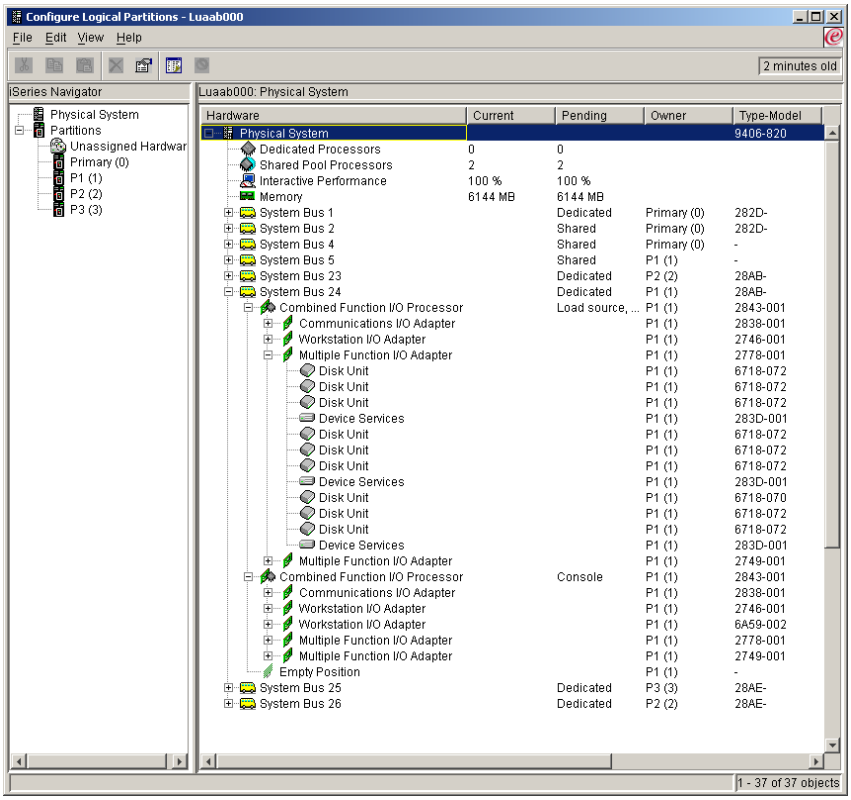
Implementation & Operations



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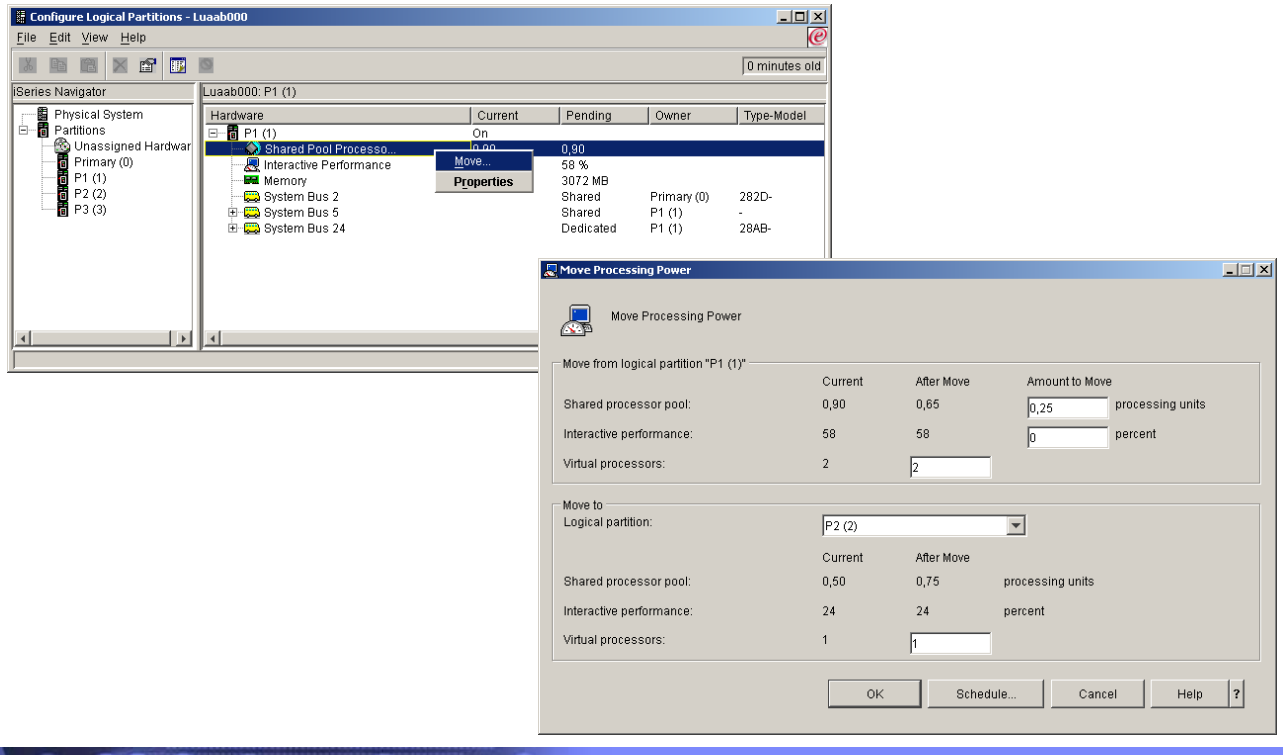

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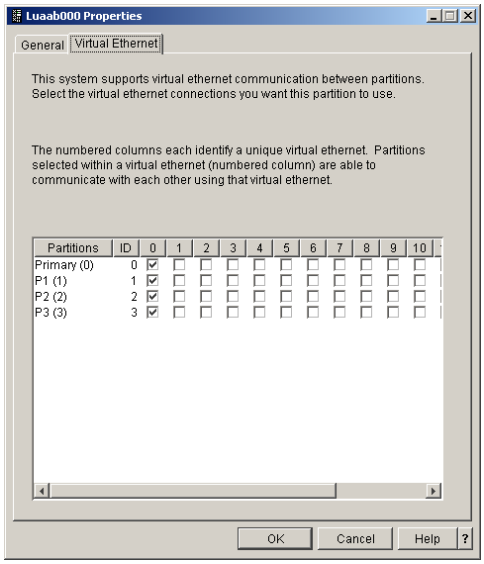


Chapter 5. Linux on iSeries LPAR

Linux on iSeries LPAR

Requirements

- Primary partition must be V5R1 or higher
  - V5R2 recommended to benefit of dynamic CPU and memory allocation
- Hosting partition must be V5R1 or higher
- Linux distribution supported
  - RedHat, SuSE or Turbolinux
  - Power PC Edition (cf. Apple MacIntosh)
  - 32-bits or 64-bits ... Power4 processors requires a 64-bits edition

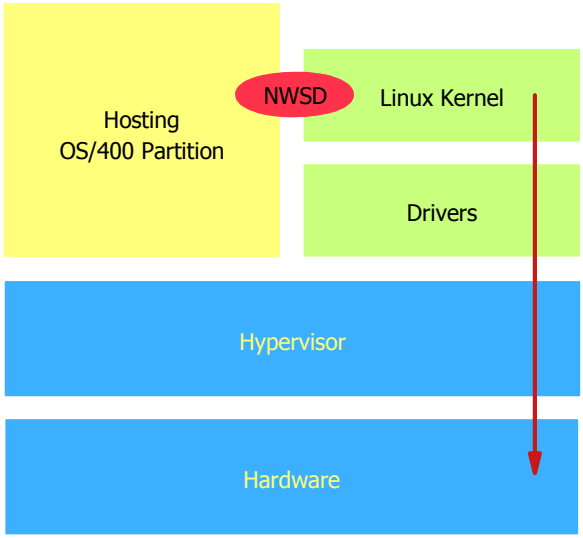
Two ways to implement

- Direct I/O
- Virtual I/O

Linux on iSeries LPAR

Direct I/O

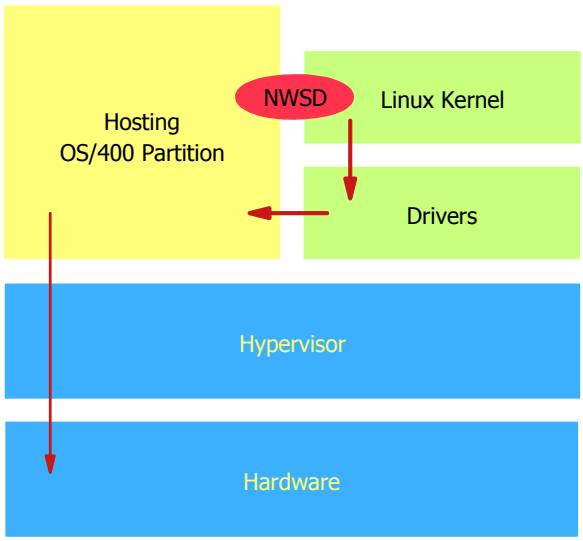
- IOPs are not needed
  - Linux doesn't know what an IOP is !
- Linux owns its (supported) IOAs
  - Drivers are provided to handle them
  - Fibre Channel, Disk Controller, Network Adapter



Linux on iSeries LPAR

Virtual I/O

- No additional hardware is required
  - I/Os are redirected to the hosting OS/400 partition
- Virtual ...
  - CD-ROM, Disk, LAN adapter, Tape

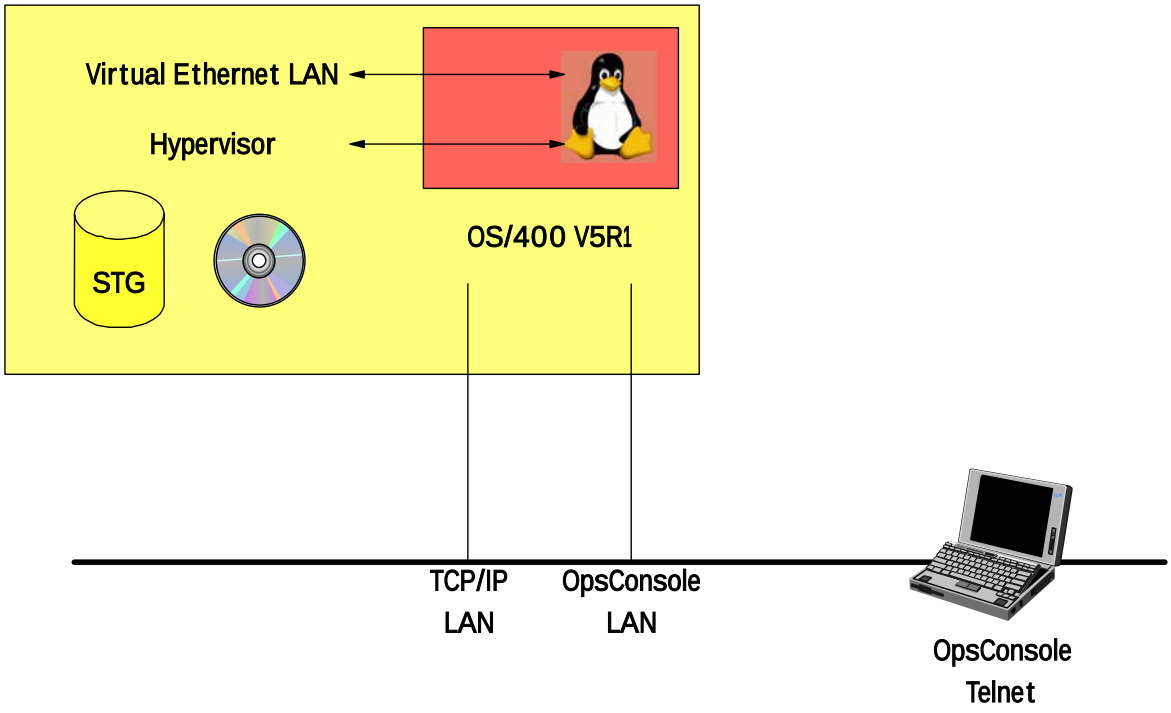


Linux on iSeries LPAR

Operations

- Prepare a Linux Console
  - External workstation with a simple telnet client
  - Telnet the hosting OS/400 partition on port 2301 and select the guest partition to work with
- Create the Guest Linux Partition
  - Allocate resources (processor, memory)
- Create a Network Server Decription (NWSD)
  - Network Server Type = *GUEST, specify Partition ID
  - IPL source is an IFS stream file (boot file)
- Create Network Server Storage Spaces (NWSSTG)
  - For virtual disk I/Os only
- Vary On NWSD
  - Partition starts on IFS stream file
  - Installation continues on CD-ROM
- Process to a regular Linux installation

Linux on iSeries LPAR



iSeries Dynamic Logical Partitioning

Directions

- AIX on an iSeries Partition (2004 as IBM SoD)
- Hardware Management Console
- Dynamic Partition Sizing
- ...

References

- Fortress Rochester : the inside story of IBM iSeries
  - Frank G. Soltis, NEWS/400 Books, 2001
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  - SG24-6209-00, IBM RedBooks, 2001
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  - SG24-6232-00, IBm RedBooks, 2001
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- Internet
  - http://www.ibm.com/servers/eServer/iSeries/LPAR

- E-mail
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Questions ?

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Thank You !