

z/VM CPU Pooling and ILMT

Live Virtual Class – October 29, 2014

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Objective:

Review new feature of z/VM 6.3 called CPU Pooling and associated IBM software pricing methodologies to help your clients take advantage of CPU Pools, with examples

Agenda:

- Software pricing methodologies
- Brief review of z/VM scheduling options
- z/VM 6.3 enhancement summary
- Review of CPU Pooling on z/VM V6.3
- Update to IBM License Metric Tool (ILMT) 9.0.1
- Software pricing in action
- Examples

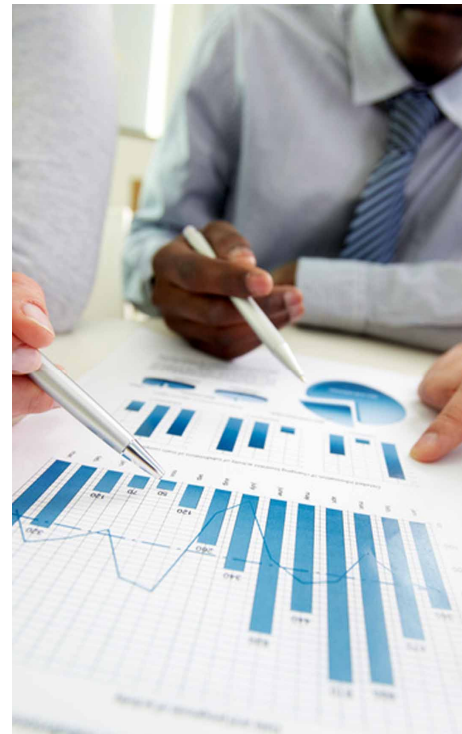
System z software pricing methodologies offer:

- Price-to-value
- Flexibility to run software where it is most efficient
- Capability to predict software charges
- Help with cost of new applications
- Flexibility to pay for software based on workload requirements



Pricing metrics for z/VM IPLA products:

- z/VM V5 and V6 and certain z/VM related products have pricing based on the number of engines. **Engine-based Value Unit** pricing allows for a lower cost of incremental growth with additional engine-based licenses purchased.
- Most IBM middleware for Linux is also priced based on the number of engines. The number of engines is converted into **Processor Value Units** (PVUs) under the Passport Advantage® terms and conditions.
- z/VM 6.3 (with APAR) will allow **CPU pooling**. **ILMT enhancements** available August 12, 2014 enable using ILMT for pooling.



Limiting single virtual machines

- **LIMITHARD** option on **SET SHARE** bounds CPU resource given to a guest
SET SHARE *userid* **RELATIVE 2000** **ABSOLUTE 40% LIMITHARD**
 - **RELATIVE 2000** defines entitlement: if the guest can consume it, it can receive 20 times as much CPU resource as the default (RELATIVE 100) user.
 - **ABSOLUTE 40% LIMITHARD** sets the cap: this guest is forbidden from using more than 40% of the CPU resource on the z/VM system (e.g. 2 IFLs in a 5-IFL VM partition)
- This is an existing feature in all supported z/VM releases
- Applies to CPU resource of the type on which guest is dispatched
- Scheduler divides this limit evenly among virtual CPUs in a virtual MP
 - Omits stopped vCPUs e.g. via *cpuplugd*

Limiting single virtual machines

- Customers have used **SET SHARE LIMITHARD** to
 - Prevent “runaway” virtual machines
 - Limit consumption by less important virtual machines (e.g. test)
 - Help to ensure departmental budgets are not exceeded
 - Control resources available contracting clients (service bureau)
- Some drawbacks:
 - Change in number of logical CPUs (Capacity on Demand, VARY PROCESSOR ON/OFF) affects actual limit imposed
 - Imposed at the individual guest level. Limiting a set of guests may require over-limiting of the individuals.
 - Not recognized as a means of limiting capacity for IBM sub-capacity software license purposes



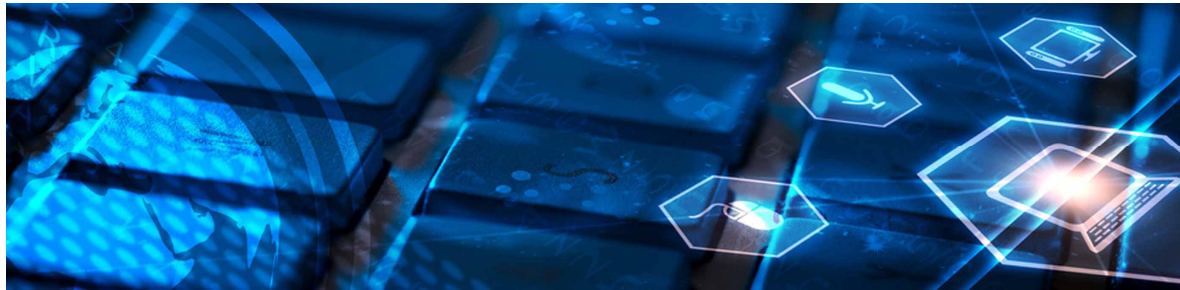
Environment Information Interface

- New interface allow guest to capture execution environment
 - Processor configuration and capacity information
 - Various Levels: Machine, logical partition, hypervisor, virtual machine
- New unprivileged instruction Store Hypervisor Information (STHYI)
- Includes support for CPU Pooling enhancement
- Exploited by ILMT 9.0.1 for sub-capacity pricing of Linux on System z middleware
- Support details:
 - z/VM 6.3 with APAR VM65419 – available June 2014





CPU Pooling with z/VM V6.3



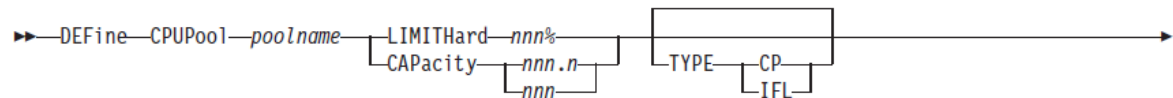
Flexible configuration of pools



- Define named CPU pools with associated capacity
 - Number of CPUs of particular type (CP, IFL)
 - Percentage of CPUs of particular type
- Associate guests with CPU pools
- Limit aggregate guest consumption to pool capacity
 - Coexists with individual guest LIMITHARD setting; both limits enforced
 - Otherwise, resource allotted to group members on demand (“first come, first served”)
- Allows overcommit – no restriction on number of pools or aggregate capacity
- New z/VM facility obtains pool capacity information
 - Eliminates manual configuration of data collection

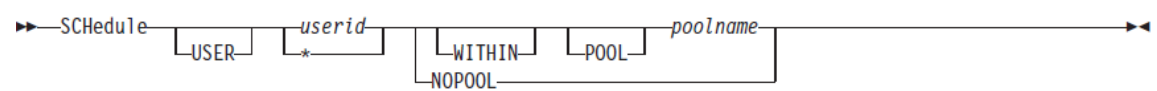
Defining CPU Pools

- Use the **DEFINE CPUPOOL** command to define named pools
 - Define for a particular **TYPE** of CPU (**CP** or **IFL**)
 - Default is the primary CPU type (IFL in an IFL-only partition, otherwise CP)
 - **CAPACITY** – number of CPUs
 - Limit recognized for sub-capacity licensing purposes
 - Can overcommit (i.e. Sum of CPUPOOL CPUs > Logical CPUs)
 - **LIMITHARD** - % of system CPU resources of that type
 - Same enforcement mechanism as SET SHARE LIMITHARD
 - Does not qualify for sub-capacity licensing



Enrolling virtual machines in a pool

- Assign a guest to or remove it from a CPU pool with the **SCHEDULE** command



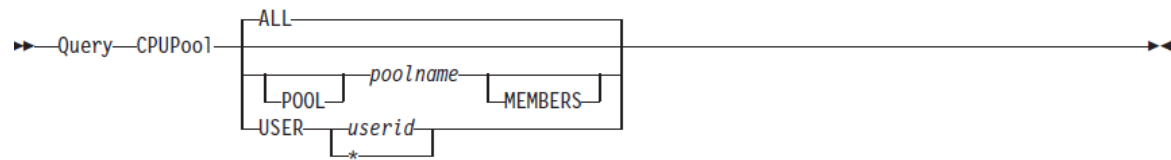
Changing CPU allocation to a pool

- Limits can be changed with the **SET CPUPOOL** command

```
➤➤ Set CPUPool poolname [LIMITHard nnn% CAPacity nnn.n nnn]
```

Displaying CPU Pool information

- Use **QUERY CPUPOOL** to see information about the pools defined on your system



Displaying CPU Pool information

- Display all pool definitions:

```
query cpupool all
```

CPU pool	Limit	Type	Members
LINUXP2	8.0 CPUs	IFL	0
CPPPOOL10	12 %	CP	8
LINUXP3	30 %	IFL	20
LINUXP1	2.5 CPUs	IFL	6

- Display one pool definition and member names:

```
query cpupool linuxp1 members
```

CPU pool	Limit	Type	Members
LINUXP1	2.5 CPUs	IFL	6

The following users are members of CPU pool LINUXP1:

D70LIN12 D79LIN03 D79ADM D79LIN10 D79LIN07
D79LIN04

- Display user's pool name:

```
query cpupool user d79adm
```

User D79ADM is in CPU pool LINUXP1

DELETE CPUPOOL

- Use **DELETE CPUPOOL** to delete a pool definition
- Pool must be empty.
 - Use SCHEDULE ... NOPOOL first to remove each member.

►► ~~DELeTe~~ ~~CPUPool~~ *poolname* ◀◀

Automating CPU Pool Management

- Complication:
 - At VM IPL, no pools are defined. (Not remembered from prior IPL.)
 - Can't add users to the pool until the pool is defined.
- One solution:
 1. COMMAND statements in directory definition of OPERATOR or AUTOLOG1 to define CPU pools

```

USER OPERATOR . . .
. . .
COMMAND DEFINE CPUPOOL WEBSPH CAPACITY 5 TYPE IFL
COMMAND DEFINE CPUPOOL DB2 CAPACITY 3 TYPE IFL
COMMAND DEFINE CPUPOOL QADEPT LIMITHARD 10% TYPE CP

```

Or include 'CP DEFINE ...' commands in AUTOLOG1's PROFILE EXEC.

2. COMMAND statements in virtual machine definitions to place them into pools as they log on

```

USER WASPROD1 . . .
. . .
COMMAND SCHEDULE * WITHIN POOL WEBSPH

```

Single System Image considerations

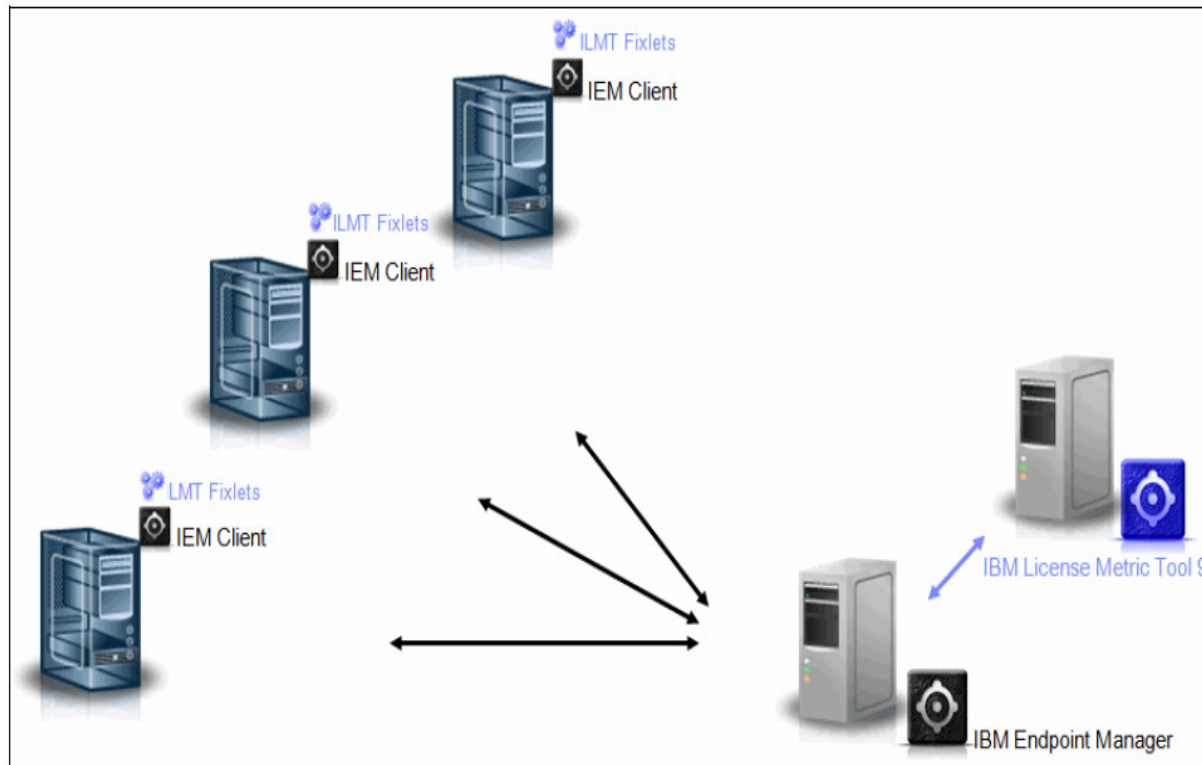
- CPU pools are defined and managed independently on each member of an SSI cluster
- A virtual machine in a CPU pool can relocate to another system if a CPU pool with the same name and CPU type is defined on the target system
 - Need not have the same capacity limit
- Administrator is responsible for adjusting pool limits if needed
 - May affect software license requirements

Track License Requirements with IBM License Metric Tool



- IBM License Metric Tool (ILMT) is a no-charge tool used to determine PVU licensing requirements
- New Linux interface will be exploited by ILMT to assess software license conformance
 - Invokes z/VM Execution Environment Interface
- Ability to track CPU pools available in ILMT 9.0.1 available August 12, 2014
 - Improvements also made to reduce CPU overhead incurred with ILMT
- Using ILMT you are only charged for the CPU pool capacity assigned to Passport Advantage PVU-based software

ILMT Architecture Overview

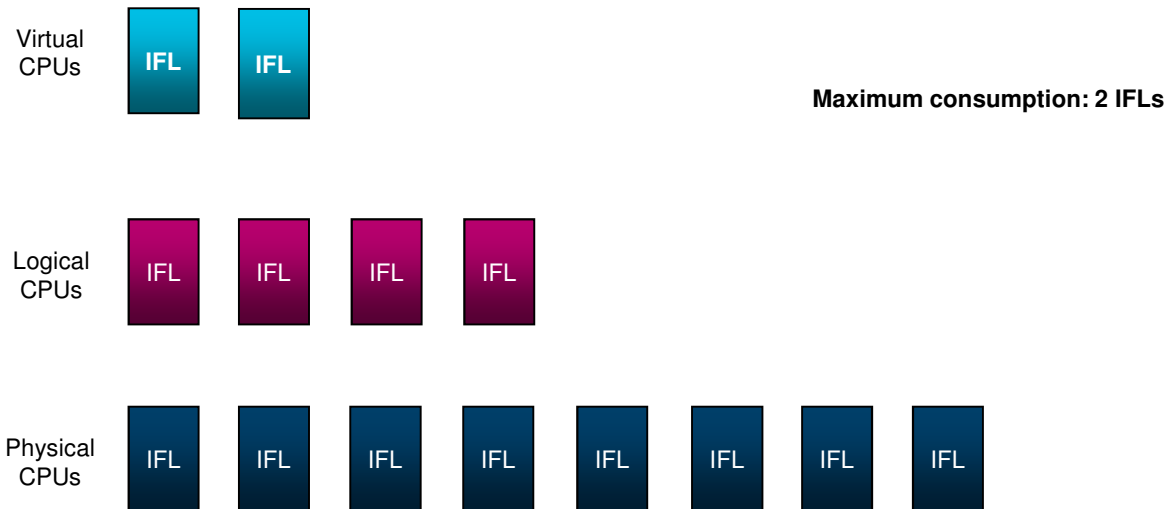


Software Licensing Key Learning Points

- IBM's two Software Categories are System z software and Distributed software and the entitlements are not interchangeable
- Value Units (VUs) are used to license System z IPLA software and Processor Value Units (PVUs) are used to license Distributed Passport Advantage software
- Distributed Sub-Capacity Terms require customers to keep track of the maximum processor capacity available to a program:
 - IBM License Metric Tool calculates this
 - Customers run the tool and retain the reports
- When running z/VM virtual machines and/or LPARs a customer is only required to license for the Real hardware resources actually available to each program, not all the Virtual resources
- PVUs are based on the processor family, for example
 - IFL on z114 might be 100 PVUs while IFL on zEC12 could be 120 PVUs
 - See IBM pricing expert for details

Current Linux Guest Software Pricing

Pricing rule for products in Linux guests: The lower of the sum of the virtual engines available to guests running a product or the engine capacity of the z/VM LPAR from which the guests obtain their resources.



Linux Guest Software Pricing With CPU Pooling



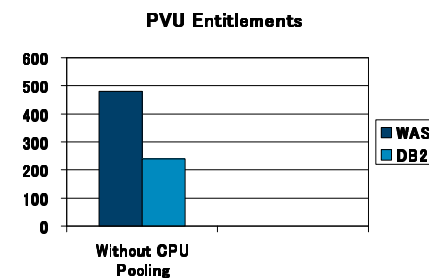
Use cases for CPU Pooling



- Department budgeting
 - Assign each department's guests to CPU pool with contracted capacity
- Grow workloads without affecting the budget
 - Add New Workload
 - Add Capacity
 - Combine LPARs
 - Handle fractional workload requirements
- Prevent resource over-consumption
 - Limit aggressive workloads

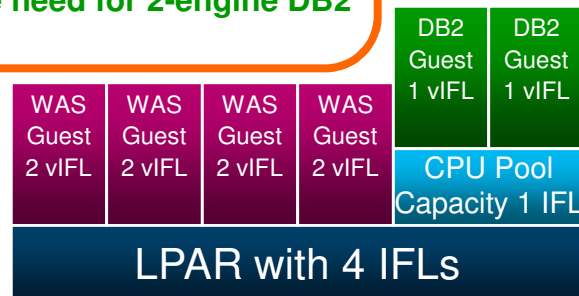
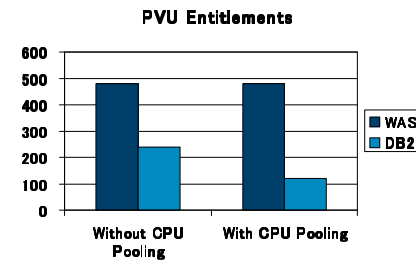
Add New Workload Without CPU Pooling

- 4 WAS production guests
 - Requires 4-engine WAS entitlement
- Add 2 DB2 production guests
 - Requires 2-engine DB2 entitlement



Add New Workload With CPU Pooling

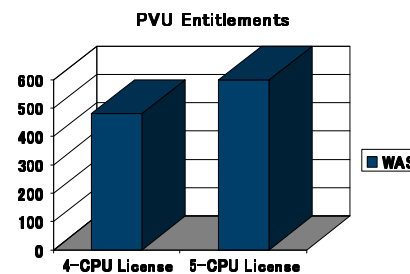
- 4 WAS production guests
 - Requires 4-engine WAS entitlement
- Create a 1-IFL pool
- Put the 2 DB2 production guests in pool
 - Requires 1-engine DB2 entitlement (avoiding the need for 2-engine DB2 entitlement)



- Allows new workloads to be added cost effectively
- Encourages additional workload consolidation after initial success

Add Capacity Without CPU Pooling

- 4 WAS production guests
 - Requires 4-engine WAS entitlement
- Add another IFL to the LPAR
 - Requires increase to 5-engine WAS entitlement

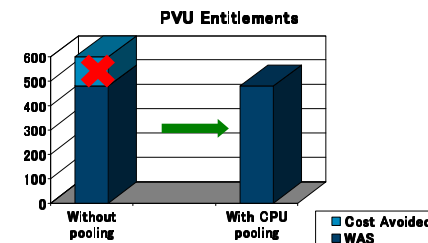
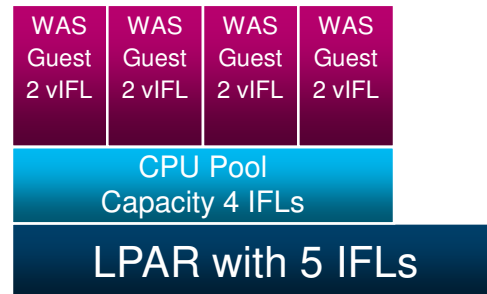


WAS	WAS	WAS	WAS
Guest	Guest	Guest	Guest
2 vIFL	2 vIFL	2 vIFL	2 vIFL

LPAR with 5 IFLs

Add Capacity With CPU Pooling

- LPAR with 4 IFLs
- Set up CPU Pooling for 4 IFLs
 - 4 WAS production guests require 4-engine WAS entitlement
- Add another IFL to the LPAR
- Avoids an incremental WAS entitlement license – allows capacity to be added without increasing software license charges
- Encourages adding capacity for other workloads (e.g., open source applications)



Note: All PVU Entitlement examples based on zEC12 (120 PVU per IFL) – will look proportionally the same on zBC12 (100 PVU per IFL)
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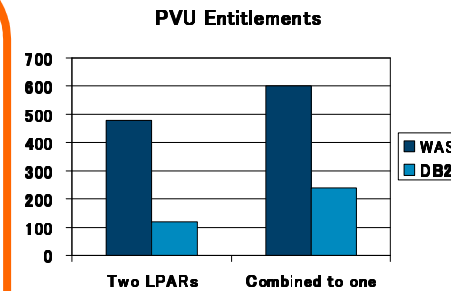
Combine LPARs Without CPU Pooling

- LPAR with 4 IFLs and 4 WAS production guests
 - Requires 4-engine WAS entitlement
- LPAR with 1 IFL and 2 DB2 production guests
 - Requires 1-engine DB2 entitlement



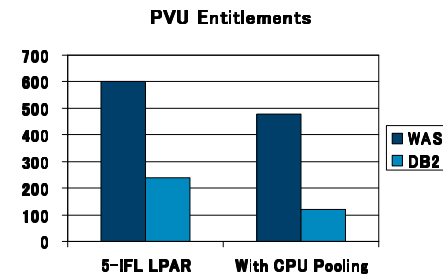
Combine LPARs Without CPU Pooling

- LPAR with 4 IFLs and 4 WAS production guests
 - Requires 4-engine WAS entitlement
- LPAR with 1 IFL and 2 DB2 production guests
 - Requires 1-engine DB2 entitlement
- LPARs merge to one LPAR with 5 IFLs
 - Requires increase to 5-engine WAS entitlement
 - Requires increase to 2-engine DB2 entitlement



Combine LPARs With CPU Pooling

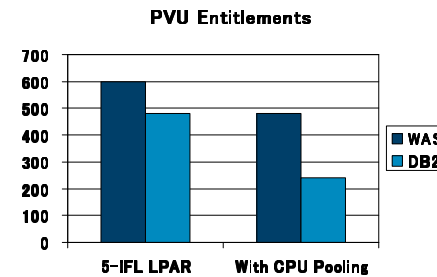
- LPAR with 5 IFLs
- Create 2 Pools – one with 4-IFLs and one with 1-IFL
- Place the four WAS guests in the 4-IFL pool and the two DB2 guests in the 1-IFL pool
 - Requires 4-engine WAS entitlement
 - Requires 1-engine DB2 entitlement



- Avoids increase in software license requirements (and costs)
- Reduces z/VM system management and maintenance workload
- Consolidates resources (memory, paging, network) for greater efficiency

CPU Pools that Overcommit

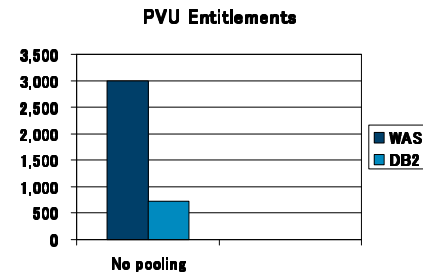
- LPAR with 5 IFLs
- Create 2 Pools – one with 4-IFLs and one with 2-IFLs
- Place the four WAS guests in the 4-IFL pool and the two DB2 guests in the 2-IFL pool
 - Requires 4-engine WAS entitlement
 - Requires 2-engine DB2 entitlement



- Avoids increase in software license requirements (and costs)
- Reduces z/VM system management and maintenance workload

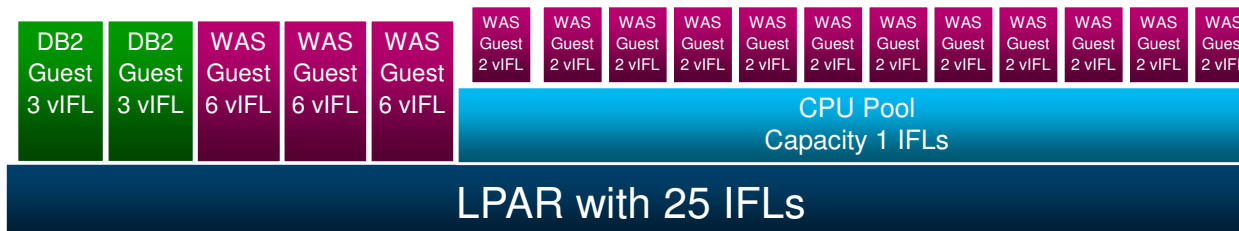
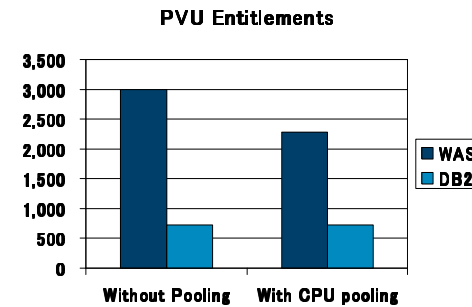
Large system with virtual machines that require fractional IFL capacity

- LPAR with 25 IFLs
- 2 DB2 production guests
 - Requires 6-engine DB2 entitlement
- 3 WAS production guests and 12 small WAS test guests
 - Requires 25-engine WAS entitlement



Align fractional capacity virtual machines to small CPU pools

- LPAR with 25-IFLs
- Set up a 1-IFL pool
- 2 DB2 production guests
 - Requires 6-engine DB2 entitlement
- 3 WAS production guests and 12 small WAS test guests in IFL pool
 - Requires 19-engine WAS entitlement



Note: All PVU Entitlement examples based on zEC12 (120 PVU per IFL) – will look proportionally the same on zBC12 (100 PVU per IFL)

Contain workloads that take too many resources

- LPAR with 18-IFLs
- 2 DB2 production guests and 3 WAS production guests are sharing the 18-IFLs
- Month-end processing or nightly backup uses any available capacity – could take from production guests
- Set up a 1 IFL CPU pool for running these tasks



Summary

- CPU Pooling offers greater control over resource allocation
 - By workload
 - By department
 - By software product

- With ILMT 9.0.1, can limit software license costs, particularly where multiple software products are run in the same z/VM system
 - Enables organic growth of individual workloads
 - Avoids paying for capacity not used for a software product
 - Broadens options for workload consolidation, lowering overhead and administrative costs

More Information

More information

- Passport Advantage Sub-Capacity FAQ:
 - <http://www.ibm.com/software/passportadvantage/subcapfaqov.html>
- Virtualization Capacity License Counting Rules
 - http://www.ibm.com/software/passportadvantage/Counting_Software_licenses_using_specific_virtualization_technologies.html
- ILMT 9.0.1 Blog on August Update with new CPU pooling support
 - <http://ibm.biz/cpupoolilmt>
- IBM Redpaper – Simplify Software Audits and Cut Costs by Using the IBM License Metric Tool (September 2014)
 - <http://www.redbooks.ibm.com/abstracts/redp5107.html?Open>
- ILMT Youtube page
 - <https://www.youtube.com/user/IBMLicenseMetricTool>

Thanks!

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