IBM Education Assistance for z/OS V2R2

Item: Provisioning based on CPU consumption
Element/Component: z/OS Capacity Provisioning

Agenda

- Trademarks

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Trademarks

- See url http://www.ibm.com/legal/copytrade.shtml for a list of trademarks.

Presentation Objectives

- **Management of additional Processor Capacity based on CPU consumption**

    - Provisioning Manager monitors systems for CPC-wide CPU consumption, tracking potential processor bottlenecks

  - Enhanced Capacity Provisioning Policy allows to define conditions, which qualify for provisioning of additional processor capacity if a certain CPU consumption is exceeded

  - Provisioning Manager can change autonomically or advise to change General Purpose, zIIP or zAAP Processor Capacity based on the settings of the Capacity Provisioning Policy

Overview - 1

- **Problem Statement / Need Addressed**
    - Customers can define Capacity Provisioning Policies for provisioning (OOCoD) processor capacity either through:
        - Scheduled activations, *for anticipated capacity bottlenecks*
        - Workload based activations, driven by WLM service classes exceeding certain PI limits, *for unexpected capacity shortages*

    - Some customers cannot identify suitable WLM service classes which could trigger provisioning, but still need to react to *unexpected processor capacity shortages*
    - Some customers require a faster response to processor bottlenecks than that offered by Workload based activations
    - Most of these customers consider the CPC-wide CPU consumption as the primary and sufficient evidence for a processor capacity shortage

    - Capacity Provisioning does not accept CPU consumption as a primary/unique trigger for provisioning

Overview - 2

- **Solution**
  - Customer specifies in the Capacity Provisioning Policy that processor capacity should be managed driven by CPC-wide CPU consumption
  - Provisioning Manager monitors CPC-wide CPU consumption
  - Based on the consumption data, Provisioning Manager decides or indicates when and which processor capacity (General Purpose, zIIP, zAAP) needs to be provisioned on a CPC

- **Benefit / Value**
  - Utilization Based Provisioning offers a simple CPC-wide criterion for triggering processor capacity provisioning
  - Utilization Based Provisioning allows faster response to processor bottlenecks

Usage & Invocation – Preparation: Definition

- Specifications how Provisioning Manager should react to high CPC-wide CPU consumption, require definitions in **Capacity Provisioning**
  - **Domain Configuration**
  - **Policy**

	Name Filter	CPC Filter	Processor Type Filter	Provisioning Utilization(%) Filter	Provisioning Duration(Minutes) Filter	Deprovisioning Utilization(%) Filter	Deprovisioning Duration(Minutes) Filter
	HIUTIL1	PRODCPC	CP	98	5	75	10

- New **Policy** supporting Utilization Based Provisioning can **only** be defined in z/OSMF for z/OS V2R2

z/OS Management Facility

Version 2.2

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Plugin Name	Version

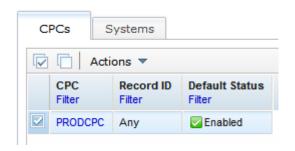# Usage & Invocation – Preparation: Definition steps

- The **Domain Configuration** defines a Capacity Provisioning management domain specifying
  - *CPCs* with processor capacity to be managed
  - ***Systems* in those CPCs, used to observe the CPU consumption**

- The **Policy** defines scopes and rules for changes of Processor Capacity
  - *Processor Scopes* define the total amount of allowed changes
  - *Time Conditions* define when increases and decreases of capacity should, in combination with
  - ***Utilization Conditions* specify when a CPC is constraint and should initiate a step-by-step increase and decrease of processor capacity**
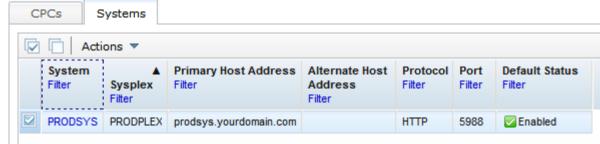
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Usage & Invocation – Preparation: Domain Configuration

- Managed CPCs must be specified, including a valid OOCoD Record ID

Examples in z/OSMF:

CPC Filter	Record ID Filter	Default Status Filter
☑ PRODCPC	Any	☑ Enabled

- At least one system on the managed CPC must be defined, in order to observe the CPC-wide CPU consumption metrics

System Filter	Sysplex Filter	Primary Host Address Filter	Alternate Host Address Filter	Protocol Filter	Port Filter	Default Status Filter
☑ PRODSYS	PRODPLEX	prodsys.yourdomain.com		HTTP	5988	☑ Enabled

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Usage & Invocation – Preparation: Policy 1

- Definition of **how much** additional Processor Capacity should be managed
  - defining the maximum additional capacity the Provisioning Manager is allowed to manage
  - setting step-by-step increments for utilization triggered or workload triggered management (if defined)

- Information **where** and **what kind** of capacity should be managed
  - naming the CPC to manage
  - Differentiating between processor types General Purpose, zIIP and zAAP

- Information **when** and in **which situations** should be provisioned
  - defining time-frames when monitoring and management can happen
  - Specifying CPU consumption limits, which qualify for provisioning

- Provisioning Manager will automatically relate observed systems to their hosting CPC
  - management of the CPC is based on CPC-wide CPU consumption as reported by a observed system running on that CPC

Usage & Invocation – Preparation: Policy 2

- Define **how much** additional processor capacity can be provisioned at most, with the policy-wide *Maximum Processor Scope* and Rule's *Processor Scope*
  - Settings apply to all defined *scheduled activations*, *workload based activations* and **utilization based activations**
  - Combinations of *scheduled activations*, *workload based activations* and *utilization based activations* will never exceed the Max. Activation level
  -

	CPC Filter	Max. Activation (MSU) Filter	Max. zAAP Processors Filter	Max. zIIP Processor Filter	Primary Activation (MSU) Filter	Secondary Activations (MSU) Filter	
☑	PRODCPC	150	0	3	35	20	

Tabs: Maximum Processor Scope | Logical Processor Scope | Maximum Defined Capacity Scope

Actions ▼

Usage & Invocation – Preparation: Policy 3

- Define **where, what kind** *of* capacity should be managed in **which situation**, with the ***Utilization Condition***
  - Located at the same level and can be defined concurrently with *Workload Condition*
  -

Condition UTILIZATION1

Define a provisioning condition. A provisioning condition contains time conditions that define time periods during which and optionally workload conditions and utilization conditions. Workload conditions define the work that is eligible to caus Utilization conditions define utilization thresholds that can trigger activation of additional capacity.
All timestamps below are shown in GMT.

* Condition name:
UTILIZATION1

Description:
Provision General Purpose processors if CPC wide processor consumption is very high

* Default status:
Enabled

Nonrecurring Time Conditions	Recurring Time Conditions	Utilization Conditions	Workload Conditions

Actions ▼

	Name Filter	CPC Filter	Processor Type Filter	Provisioning Utilization(%) Filter	Provisioning Duration(Minutes) Filter	Deprovisioning Utilization(%) Filter	Deprovisioning Duration(Minutes) Filter
☐	HIUTIL1	PRODCPC	CP	98	5	75	10

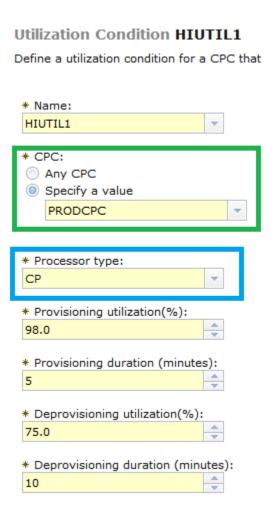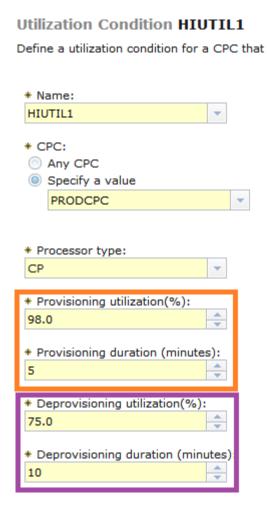# Usage & Invocation – Preparation: Policy 4

▪ Define **where** capacity should be managed, either:
  - A CPC listed in the active *Domain Configuration* and with a defined *Processor Limit*
  - *Any CPC* to apply this condition to all CPCs of the active *Domain Configuration* and with a defined *Processor Limit*
  - The Provisioning Manager will automatically observe suitable systems running on that CPC, to monitor CPC-wide CPU consumption data

▪ Define **what kind** of processor type is managed:
  - General Purpose (CP)
  - zIIP
  - zAAP

Utilization Condition HIUTIL1

Define a utilization condition for a CPC that

* Name:

HIUTIL1

* CPC:
  ◯ Any CPC
  ⦿ Specify a value
  PRODCPC

* Processor type:

CP

* Provisioning utilization(%):

98.0

* Provisioning duration (minutes):

5

* Deprovisioning utilization(%):

75.0

* Deprovisioning duration (minutes):

10

Usage & Invocation – Preparation: Policy 5

- Define **which situations** qualify for provisioning and deprovisioning additional processor capacity:
  - *Provisioning utilization (%)* the CPC-wide CPU consumption level of the given *Processor type* that must be exceeded to trigger provisioning
  - *Provisioning duration (minutes)* the minimum time during which the CPC-wide CPU consumption must exceed the *Provisioning utilization* to trigger provisioning
  - *Deprovisioning utilization (%)* the CPC-wide CPU consumption level of the given *Processor type* must fall below this limit to trigger deprovisioning of additional processor capacity
  - *Deprovisioning duration (minutes)* the minimum time during which the CPC-wide CPU consumption must fall below the *Deprovisioning utilization* to trigger deprovisioning

Utilization Condition HIUTIL1

Define a utilization condition for a CPC that

* Name:

HIUTIL1

* CPC:
- ○ Any CPC
- ◉ Specify a value

  PRODCPC

* Processor type:

CP

* Provisioning utilization(%):

98.0

* Provisioning duration (minutes):

5

* Deprovisioning utilization(%):

75.0

* Deprovisioning duration (minutes)

10

Usage & Invocation – Comparison: Workload Conditions vs. Utilization Conditions 1

- Workload Condition triggered activations depend on a multitude of additional boundary conditions (Additional control parameters `Analyzer.Threshold`) defined in the PARM-member, such as:

Key	Default Value	Description
Analyzer.Threshold. TotalSharedPhysicalUtilZaap	95	Lower limit of physical utilization on shared CPs that must be exceeded before additional general purpose capacity is considered. In some environments, severe processor contention occurs at lower levels of processor utilization. In such environments you can specify a lower percentage value, such as 90.
Analyzer.Threshold.MvsUtilCp	95	Lower limit of MVS utilization on CPs that must be exceeded before additional general purpose capacity is considered. In some environments, severe processor contention occurs at lower levels of MVS utilization. In such environments you can specify a lower percentage value, such as 90.

- Utilization Condition triggered activations do **not** depend on any of the additional boundary conditions defined in the PARM-member

Usage & Invocation – Comparison:
Workload Conditions vs. Utilization Conditions 2

- Workload Condition driven processor activations depend on the performance of a Service Class (PI), measured for a single system or sysplex
  - Allows to qualify only important (business critical) workload for activations

- Utilization Condition driven activations will be triggered by **any** workload driving up the CPC-wide CPU consumption
  - Even unimportant workload (e.g. batch) could cause provisioning

Usage & Invocation – At run time: Messages and Reports

- Messages tell about ...
  - Current processor capacity settings and detected (external) changes
  - Provisioning Manager initiated capacity changes or change intentions

- Reports provide information about ...
  - Monitored CPCs and their relevant processor capacity data
  - Current policy with capacity scopes, time frames and condition settings
  - Situations when utilization qualifies for step-by-step changes of processor capacity
  - Current processor capacity and Provisioning Manager status regarding a specific CPC and OOCoD Record ID
  - Listing of all capacity changes initiated by the Provisioning Manager

Usage & Invocation – At run time: Configuration Report

The Configuration report displays the current Processor Capacity of a CPC

- **Example in z/OSMF:**

CPC Details

This page shows detailed information about the selected CPC. All timestamps below are shown in GMT.

▼ **General**

Configuration:	CKDCONF
CPC:	ECL2
Serial:	000510070B82
Machine type - model:	2097 - E40
Correlation status:	Matched
Correlation status since:	Jan 23, 2015, 9:34:22 AM
Status:	☑ Enabled
Default status:	☑ Enabled
Error status:	No Error

- **Example on console:**

```
MODIFY CPOSERV,APPL=REPORT CONFIGURATION

Domain configuration CPDFCT6 for domain FCTRS is enabled
CPC ECL2 with record 12345678 is enabled (default enabled)
…
 Current model is 728 with 1979 MSU, 4 zAAPs, 4 zIIPs,
  1 IFLs, 1 ICFs, 9 SAPs
 Permanent model is 726 with 1865 MSU
```

▼ **Configuration**

	Current	Permanent
Model	728	726
MSU	1979	1865
zAAPs	4	—
zIIPs	4	—
IFLs	1	—
ICFs	1	—
SAPs	9	—
Spares	2	—

Usage & Invocation – At run time: Policy Report

Policy report displays the active policy's Utilization Conditions

- **Example in z/OSMF:**

Provisioning Manager ▸ Active Policy ▸ Policy Element Details

Policy Element Details

This page shows detailed information about the selected policy element.

▼ **Policy Hierarchy**

Policy:	ECL2U
Rule:	R1
Condition:	CS1

▼ **Utilization Condition Details**

Name:	UC1
CPC:	ECL2
Processor type:	CP
Provisioning utilization:	91.7
Provisioning duration:	2
Deprovisioning utilization:	33.3
Deprovisioning duration:	15

- **Example on console:**

```
MODIFY CPOSERV,APPL=REPORT POLICY

Policy ECL2U is enabled
…
Maximum processor scope:
Limit for CPC ECL2 is 175 MSU, 0 zAAPs, 1 zIIPs
 activation of 58/35 MSU
…
Rule Rule1 is enabled (default enabled)
…
  Utilization condition UC1 for CPC ECL2
    PU/PD/DU/DD/PT 91.7 2 33.3 15 CP
```

Usage & Invocation – At run time: Utilization Report

Current CPU consumption and detected demands for increasing Processor Capacity can be queried as they occur

- **Example on console:**

```
MODIFY CPOSERV,APPL=REPORT UTILIZATION CPC=ECL2

Utilization is observed for 1 CPC(s)
CPC ECL2: utilization from 01/28/2015 14:56
 CP 92.6%, zAAP -%, zIIP -%
 Utilization condition UC1
  PU/PD/DU/DD/PT 91.7% 2 33.3% 15 CP
  Last CPC utilization threshold crossing was at 01/28/2015 14:53
  Demand for additional physical CPs recognized
  Demand for capacity level increase recognized
End of report
```

Usage & Invocation – At run time: Utilization Report Syntax

Syntax:

- Display utilization report for all observed CPCs

  REPORT UTILIZATION

  REPORT UTILIZATION CPC=*

- Display utilization report for specific CPC

  REPORT UTILIZATION CPC=*name*

  short command:

  R U ...

Usage & Invocation – At run time:
Messages of processor capacity changes

Provisioning Manager informs on console about processor capacity changes it initiates and of their successful implementation,
not about the initiating action or policy element

- **Example on console:**

```
CPO4108I Activation of resources for CPC ECL2 successfully initiated:
        model 729 (3/0) with 2 zAAPs and 2 zIIPs

CPO3030I Command completed successfully for CPC ECL2
```

Usage & Invocation – At run time: Record Report

OOCoD information related to a managed CPC, showing temporary capacity, either activated manually or by Provisioning Manager

Example on console ('Allowed models' excerpt):

```
MODIFY CPOSERV,APPL=REPORT RECORD CPC=ECL2

 CPC name:                     ECL2
 …
 Allowed models:
  Model  CP   CLI      MSU        MSU        MSU        MSU      Activation
                     original   absolute   relative   managed      type
    726   0    0         0        1865       -172        --        MAN
    727   1    0        57        1922       -115        --        MAN
    728   2    0       114        1979        -58         0        MAN
    729   3    0       172        2037          0        58        PM
    730   4    0       227        2092         55       113        --
 End of report
```

Usage & Invocation – At run time: Activity Report

Display **all** capacity changes initiated by the Provisioning Manager together with triggering policy elements

- **Example on console:**

```
MODIFY CPOSERV,APPL=REPORT ACTIVITY

Number of activities between 11/26/2014 and 01/28/2015 was 6
Activation for CPC ECL2 at 01/28/2015 15:02:01
 Activation of model 729, 2 zAAPs and 2 zIIPs
 Active resources before activation: model 728, 2 zAAPs, 2 zIIPs
 Inducing policy element is policy ECL2U, rule R1,
  provisioning condition CS1, time condition Year2015
  Inducing utilization condition UC1
…
Activation for CPC ECL2 at 01/28/2015 10:10:38
 Activation of model 728, 2 zAAPs and 2 zIIPs
 Active resources before activation: model 727, 2 zAAPs, 2 zIIPs
 Inducing policy element is policy CKPOLICY, rule R1,
  provisioning condition C1, time condition nRTC1
  Inducing system is IRD5 in sysplex IRD4PLEX
  Inducing workload is WLM service definition WLMCPOS1,
   policy CPOPOL#1, service class period CPULOW.1
```

Migration & Coexistence Considerations

- Capacity Provisioning Domain Configurations prior to z/OS V2R2 are compatible with z/OS V2R2 Provisioning Manager and vice versa

- Capacity Provisioning Policies prior to z/OS V2R2 are compatible with z/OS V2R2 Provisioning Manager

- z/OS V2R2 Capacity Provisioning Policies are compatible with Provisioning Managers prior to z/OS V2R2, **unless** they specify Utilization Conditions

- Restart Data of Provisioning Manager prior to z/OS V2R2 is compatible with z/OS V2R2 Provisioning Manager

- Restart Data of z/OS V2R2 Provisioning Manager will be compatible with Provisioning Managers prior to z/OS V2R2, with corresponding Toleration APARs (z/OS V1R13 and z/OS V2R1)

Presentation Summary

- Provisioning Manager is capable of managing additional (OOCoD) processor capacity based on *Utilization Conditions,* policy elements that describe which CPU consumption levels qualify for provisioning of processor capacity

- Editing of such policies which is done exclusively in the z/OSMF V2R2 Capacity Provisioning task

- z/OSMF and Provisioning Manager provide various messages and reports about related Policy elements, monitored CPU consumption, and processor capacity provisioned on behalf of *Utilization Conditions*

Appendix

- MVS Capacity Provisioning User's Guide, SC34-2661-01