

z/OS Capacity Provisioning: Overview



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A THROUGH Z.**

Agenda



- *Capacity Provisioning Overview*
- *Capacity Provisioning to simplify management of temporary capacity*
 - *Processing Modes*
 - *CPM Configuration*
 - *Reports, Logs, Audit Trails*
 - *Updates and future enhancements*
 - *Documentation*
- *Implementation Steps*



What offers IBM z/OS Capacity Provisioning?

- Capacity Provisioning ensures that the business has the processing capacity it needs
- Capacity Provisioning allows managing processing capacity faster, more reliably, more predictively
 - Based on deep analysis of capacity, performance and configuration metrics
- Capacity Provisioning provides new, flexible and automated way to control activation of On/Off Capacity on Demand
 - From manual mode to autonomic mode
- Capacity Provisioning Manager (CPM) helps to
 - manage central processor, zAAP and zIIP capacity running z/OS on IBM zEnterprise 196 (z196) or IBM System z10
 - control static power save mode of IBM z196
 - detect logical processor bottlenecks
- Installations that do not utilize On/Off Capacity on Demand can use CPM to analyze their systems for performance problems as defined by their policy.

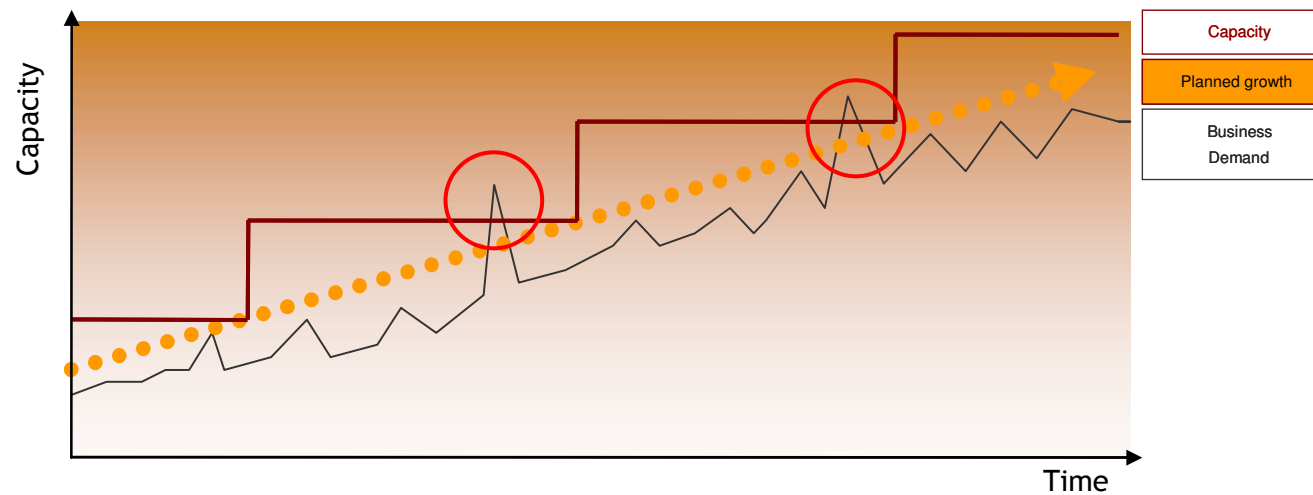


IBM z/OS Capacity Provisioning Basics



- **Contained in z/OS base component free of charge**
 - Requires a monitoring component, such as z/OS RMF, or equivalent
 - Base element since z/OS V1.9

- **Exploits on System z On/Off Capacity on Demand Feature**
 - IBM zEnterprise 196 or System z10



Capacity Provisioning Capabilities Overview



- The Capacity Provisioning Manager (CPM) can control temporary processor resources on IBM z196 or z10
 - Number of zAAPs or zIIPs
 - General purpose capacity
 - Considers different capacity levels (i.e. effective processor speeds) for subcapacity processors (general purpose capacity)
 - Can advise on logical processors
 - Can control one or more IBM zEnterprise or System z10 servers
 - Including multiple Sysplexes
 - Provides commands to control z196 static power save mode

CPM allows for different types of provisioning requests:

- Manually at the z/OS console through Capacity Provisioning Manager commands
- Via user defined policy at specified schedules
- Via user defined policy by observing workload performance on z/OS

Manual capacity upgrades – How it could look like

- | | | |
|----|---|----------|
| 1. | Workload increases | 0 min |
| 2. | Operator realizes bottleneck | 5-10 min |
| 3. | Operator informs system programmers and manager | 2 min |
| 4. | Discussion | 10 min |
| 5. | Logon to HMC, activate record | 5 min |

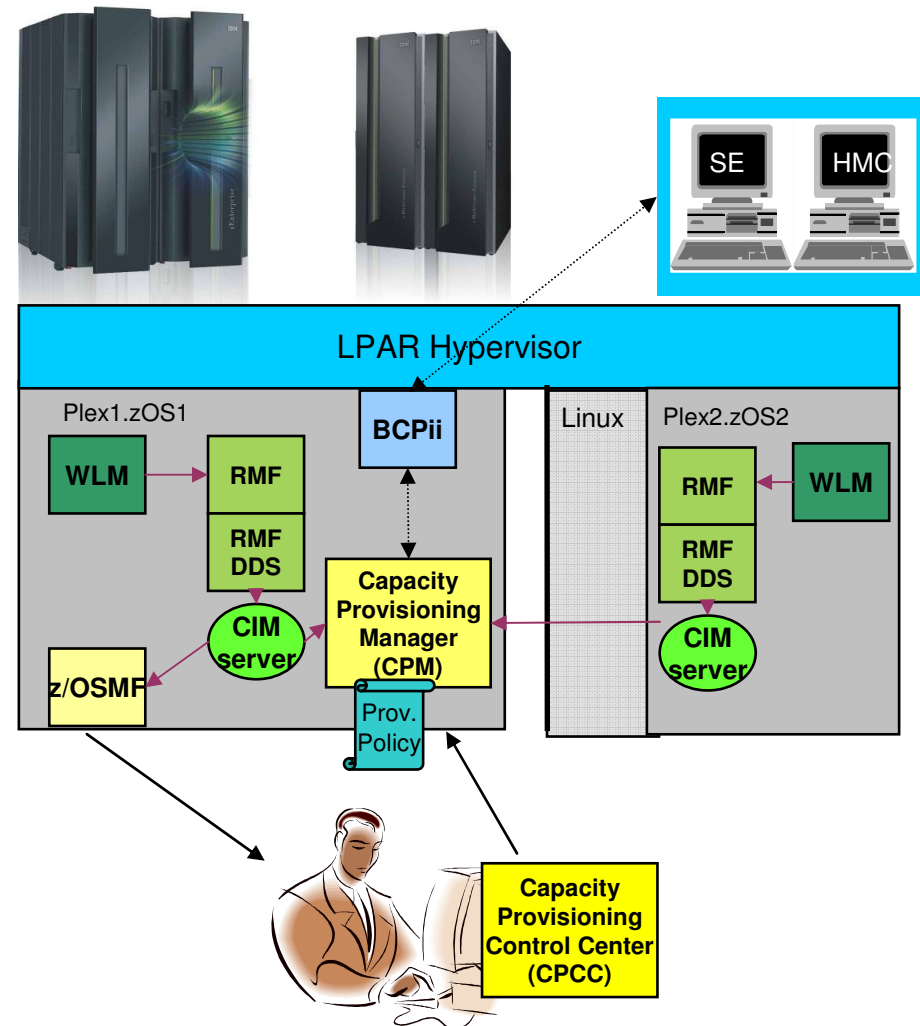
... meanwhile, so much workload may have queued up that one additional processor would be insufficient to decrease the queued workload

→ Two processors have to be added

CPM can react faster and reduce cost

Capacity Provisioning – Infrastructure in a Nutshell

- z/OS WLM manages workloads to goals and business importance
- WLM indicators available through monitoring component
 - E.g. z/OS Resource Measurement Facility (RMF)
 - One RMF gatherer per z/OS system
 - RMF Distributed Data Server (DDS) per Sysplex
- Capacity Provisioning Manager (CPM) retrieves critical metrics through CIM
- CPM communicates to support elements or HMC, via BCPii (recommended) or SNMP.
- Capacity Provisioning Control Center is front end to administer Capacity Provisioning policies
 - Optionally z/OSMF can be used for monitoring



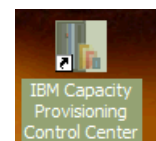
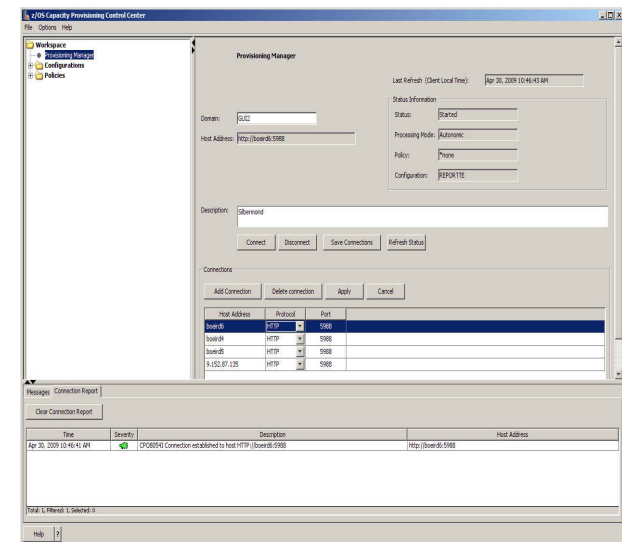
Main Components of Capacity Provisioning

■ The Capacity Provisioning Manager (CPM)

- is the server program that monitors the defined systems and CPCs and takes actions as appropriate and authorized by the policies.

■ The Capacity Provisioning Control Center (CPCC)

- is the Graphical User Interface (GUI) component. It is the interface through which administrators work with provisioning policies and domain configurations.
- Optionally, you can use the CPCC to transfer provisioning policies and domain configurations files to the CPM, or to query the Capacity Provisioning Manager status.
- The CPCC is installed and used on a Windows™ workstation. It is not required for regular operation of CPM.



■ Beginning with z/OS V1.13 z/OSMF is planned to interact with the CPM

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Processing Modes

Capacity Provisioning Manager can operate in one of four modes that allow for different degrees of automation

- **Manual mode**
 - Server capacities can be controlled via CPM commands
 - Command driven mode where no CPM policy is active
- **Analysis mode**
 - CPM processes capacity provisioning policy and informs the operator when a provisioning / deprovisioning action would be due according to criteria specified in the policy.
 - It is up to the operator either to ignore that information or to perform the up-/downgrade manually (using the HMC/SE or the available CPM commands)
- **Confirmation mode**
 - CPM processes the policy and interrogates the On/Off CoD record to be used for capacity provisioning.
Every provisioning action needs to be authorized (confirmed) by the operator.
- **Autonomic mode**
 - Similar to the confirmation mode, except that no human (operator) intervention is required.

Various reports are available with information about workload and provisioning status, and the rationale for provisioning recommendations

Agenda



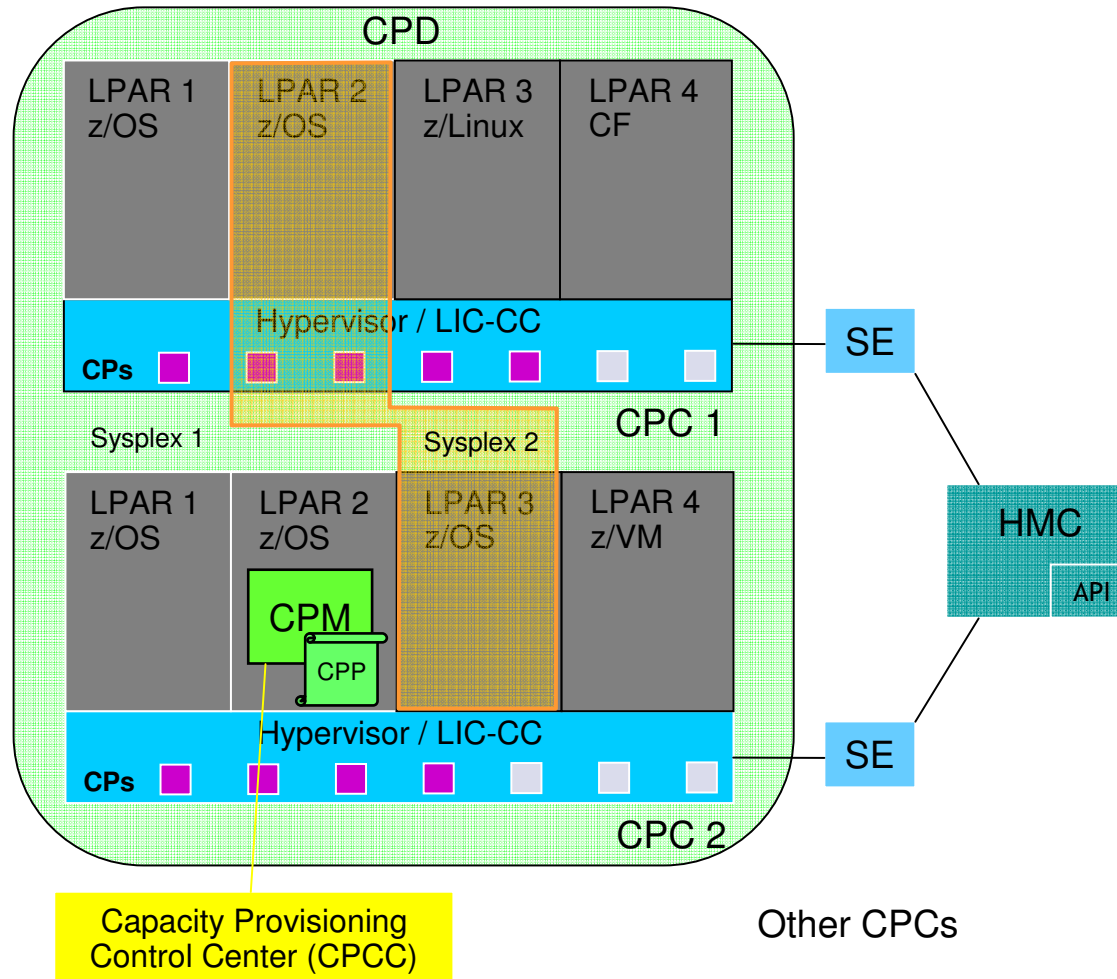
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CPM Policies and Processing Parameters

- CPM server uses three types of input:
 - **Domain configuration** defines the topology and connections, such as the CPCs and z/OS systems that are to be managed by the server
 - **Policy** contains the information as to
 - which work is provisioning eligible,
under which conditions and during which timeframes,
 - how much capacity may be activated when the work suffers due to insufficient processing capacity
 - **PARM** data set contains setup instructions such as UNIX environment variables, and various processing options that may be set by an installation.

Domain Configuration



- The *domain configuration* defines the CPCs and z/OS systems that are controlled by an instance of the CPM
- One or more CPCs, sysplexes and z/OS systems can be defined into a domain
- Sysplexes and CPCs do not have to be completely contained in a domain but must not belong to more than one Capacity Provisioning domain
- One active Capacity Provisioning policy per domain
- Multiple Sysplexes and hence multiple WLM service definitions may be involved

Policy Approach

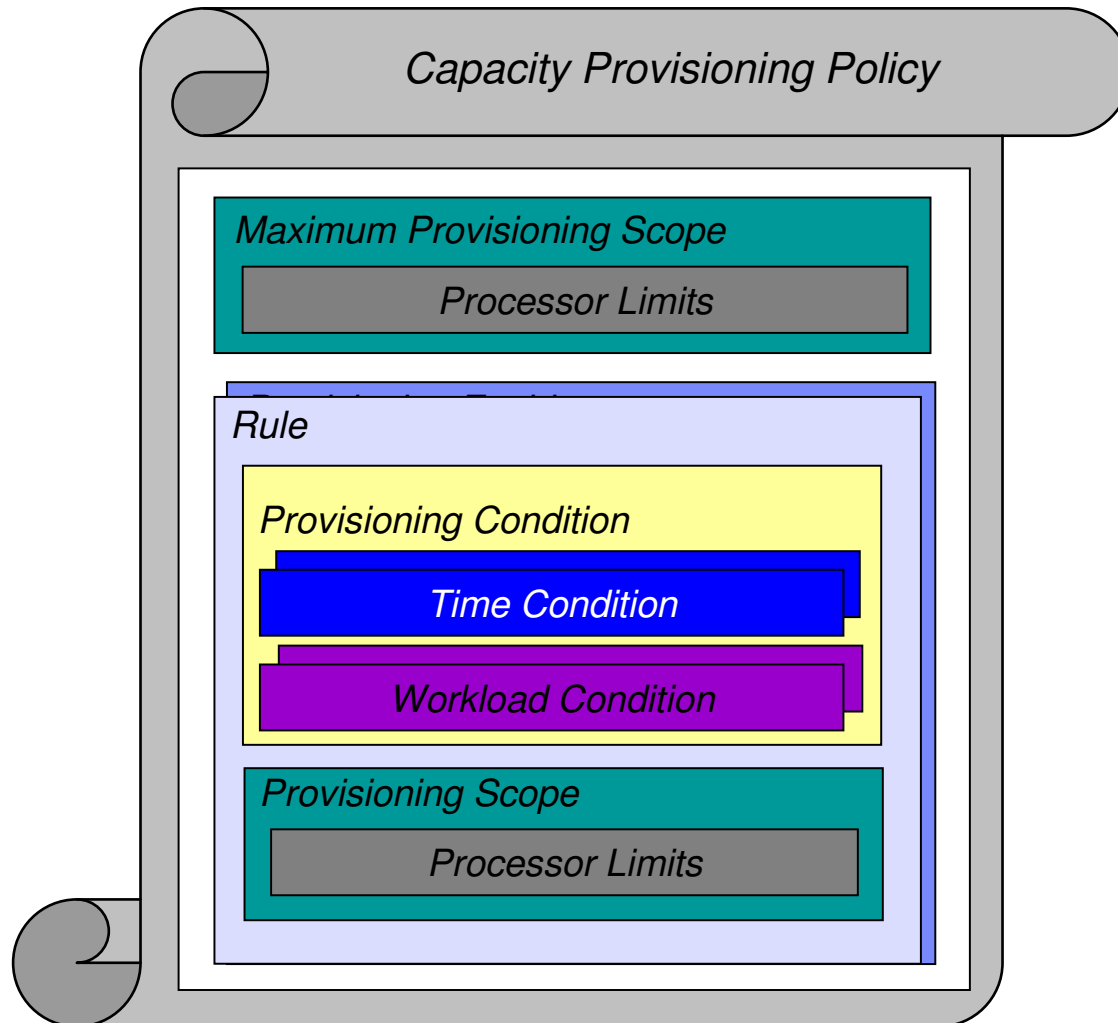
The Capacity Provisioning policy defines the circumstances under which additional capacity may be provisioned:

- Three “dimensions” of criteria considered:
 - **When** is provisioning allowed
 - **Which** work qualifies for provisioning
 - **How much** additional capacity may be activated
- These criteria are specified as “rules” in the policy:

```
If  
{ in the specified time interval  
  the specified work “suffers”  
}  
Then up to  
{ - the defined additional capacity  
  may be activated  
}
```

- The specified rules and conditions are named and may be activated or deactivated selectively by operator commands

Policy Overview

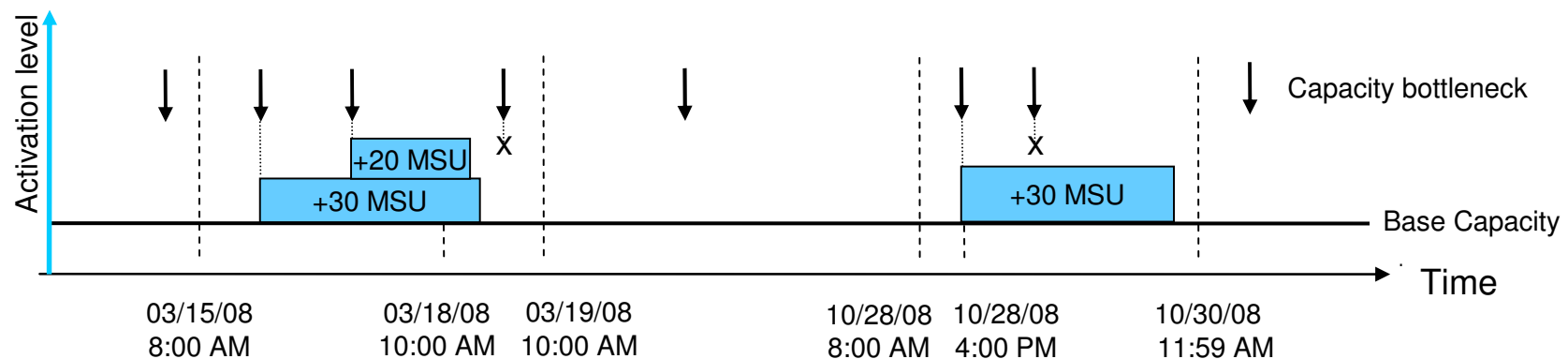


- The „Maximum Provisioning Scope“ defines the maximum additional capacity that may be activated, by all the contained rules
- „Provisioning Condition“ is simply a group of Time and Workload Conditions that can be referred to via its name
- “Provisioning Scope” defines the maximum capacity that may be activated based on the rule
 - Specified as number of zAAP/zIIP processors, or
 - MSU for general purpose capacity

Rules: Provisioning Conditions - Time

- Time condition defines when temporary capacity may be activated. Non-recurring time conditions specify
 - Start Time: provisioning of additional capacity allowed
 - Deadline: provisioning of additional capacity no longer allowed
 - End Time: deactivation of additional capacity should begin

Name	Start Time	Deadline	End Time
TC1	03/15/08 08:00 AM	03/18/08 10:00 AM	03/19/08 10:00 AM
TC2	10/28/08 08:00 AM	10/28/08 04:00 PM	10/30/08 11:59 AM



Rules: Provisioning Conditions - Workload

- Identifies the work that may trigger the activation of additional capacity,
 - when that work does not achieve its goal due to insufficient capacity and additional capacity would help.
 - expressed as one or more WLM service class periods

- CICS or IMS *transaction* service classes can be used with z/OS V1.12, or z/OS V1.10, V1.11 with APAR OA29641

Workload Condition Properties

Policy:

Rule:

Condition:

Workload Condition:

Description:

* Sysplex:

* System:

Importance Filters: **Included Service Classes** Excluded Service Classes

Service Definition	Service Policy	Service Class	P...	Provisioning PI	Duration in min	Deprovisioning PI	Duration ...	PI-Scope
*	*	SCWEB	1	1.6	10	1.3	20	System

Workload Condition Parameters

- Parameters:

- Sysplex/Systems: The z/OS systems that may run eligible work
- Workload specification:
 - Importance Filter:
Eligible service class periods, identified by WLM importance
 - Included Service Classes: Eligible service class periods
Extends the set of Service Class periods with qualified work (extends the default set of default eligible service classes) and may specify different PI criteria
 - Excluded Service Classes: Identifies service class periods, that should not be considered

Workload Condition Parameters cont.

- PI (Performance Index) criteria:

- Activation threshold:

PI of service class periods must exceed the activation threshold for a specified duration before the work is considered to require help.

- Deactivation threshold:

PI of service class periods must fall below the deactivation threshold for a specified duration the work is considered to no longer require help.

- If no workload condition is specified a scheduled activation and deactivation will be performed:

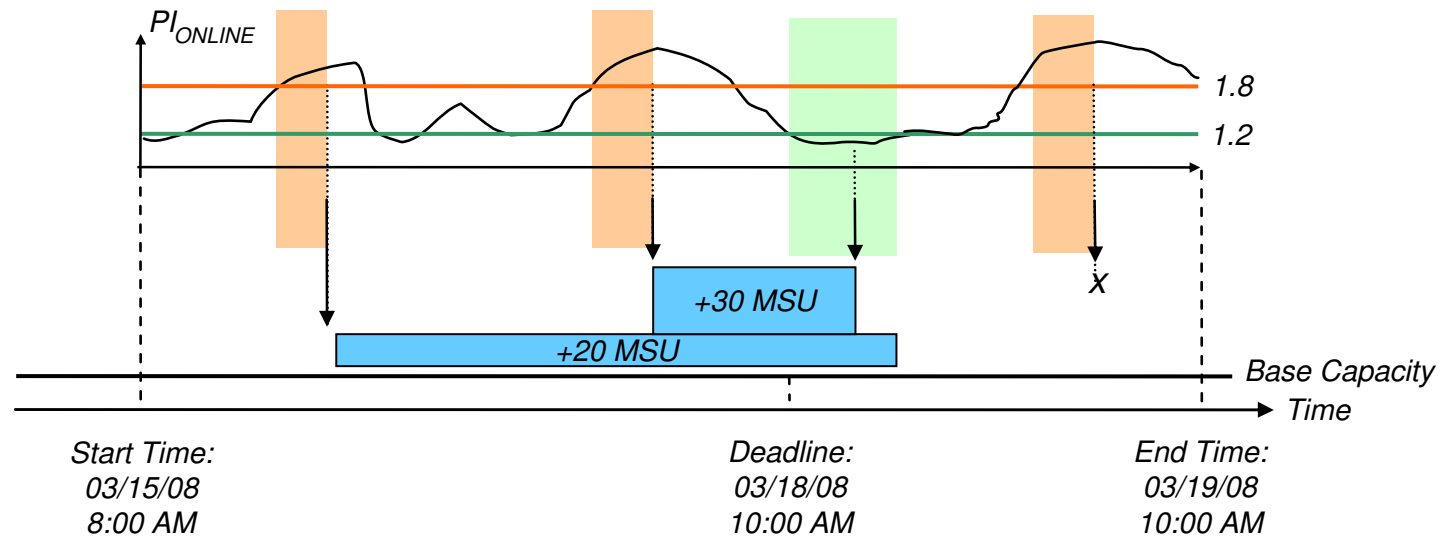
- Full capacity as specified in the rule scope
- Unconditionally at the start and end times of the time condition

Sample Workload Condition

Sample definition:

Name: PT1
Sysplex: PLEX1
System: SYSA
Included Service Class Periods:
 ONLINE in WLMSD with $PI \geq 1.8$ for 10 min until $PI \leq 1.2$ for 10 min
Excluded Service Class Periods:
 BACKUP in WLMSD

Monitor Service Class PI's:



Rule: Provisioning Scope – Processor Limits

- CPC within provisioning domain for which activation of resources is allowed
- Max number of additional MSU/zAAPs/zIIPs that may be activated
 - ✧ Only the required delta capacity will be activated by the CPM
- Provisioning scope exists in two flavors:
 - Maximum provisioning scope defines an upper limit of resources that may be activated in total for all the contained rules at any point in time
 - Provisioning scope on the „rule“ level defines an upper limit of resources that may be activated for the single rule at any point in time
 - Allows for definitions like „I authorize 300 MSU for workload 1 and 200 MSU for workload 2, but at no point in time more than 400 MSU.“

<i>CPC</i>	<i>Max MSU</i>	<i>Max zAAPs</i>	<i>Max zIIPs</i>
CPC1	400	3	5
CPC2	800	0	0

On the side... Additional CPM processing and directives

- For workload-based provisioning it is a *necessary* condition that the performance index exceeds the specified provisioning PI
 - However, it is *not at a sufficient condition*
 - The underlying CPM processing examines many metrics and parameters to ensure that
 - the observed performance bottleneck is caused by a processor capacity shortage of the respective processor type, and
 - that additional capacity could actually be consumed by the workload that incurred the capacity demand
 - Refer to chart [Overview on Observed Metrics](#)
- Deprovisioning is under control of additional parameters
 - The “minimum activation time” specifies for how long any added capacity must remain active *at a minimum*.
 - Specified in the PARM member
- Many aspects of the CPM processing can be controlled in the PARM member
 - Refer to documentation for full list

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Reports, Logs, Audit Trails

- History of actual workload and system activity available with CPM reports
 - Especially REPORT ACTIVITY, REPORT WORKLOAD
 - Available at the z/OS console, at the CPCC,
 - and in the z/OSMF Capacity Provisioning task (planned for z/OS V1.13)
 - Reports can be directed to files and archived
- History of capacity changes available via CPM logging
 - Metrics, decisions and other data can be logged to file system
 - Binary format
- Other information available:
 - RMF Mon III data sets
 - Model and capacity changes recorded outside CPM
 - SMF22
 - RMF 70.1, 72
 - Current capacity information also available via STSI instruction, and related MVS programming interfaces

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New Function Overview



<i>z/OS (CPM) release</i> Function	V1.13	V1.12	V1.11	V1.10	V1.9
<i>Capacity increments Recurring time conditions</i>	+	OA35284	OA35284	OA35284 Toleration- only	
<i>CPCC Windows 7 support</i>	+				
<i>z196 Static Power Save Mode</i>	+	OA30433	OA30433	OA30433	OA30433 Toleration- only
<i>Samples for security definitions (CIM, CPM, z/OSMF)</i>	+	+			
<i>Control Center reporting enhancements, Windows Vista™ support</i>	+	+			
<i>CICS/IMS transaction classes support</i>	+	+	OA29641	OA29641	
<i>RMF provider can locate DDS dynamically</i>	+	+	OA31118	OA31118	
<i>z/OS BCPii Support and Logical Processor Mgmt</i>	+	+	+	OA25426 OA24945	
<i>z/OSMF release</i> Function	V1.13	V1.12	V1.11	V1.10	V1.9
<i>CPM Status Monitoring</i>	+				

Statement of Direction

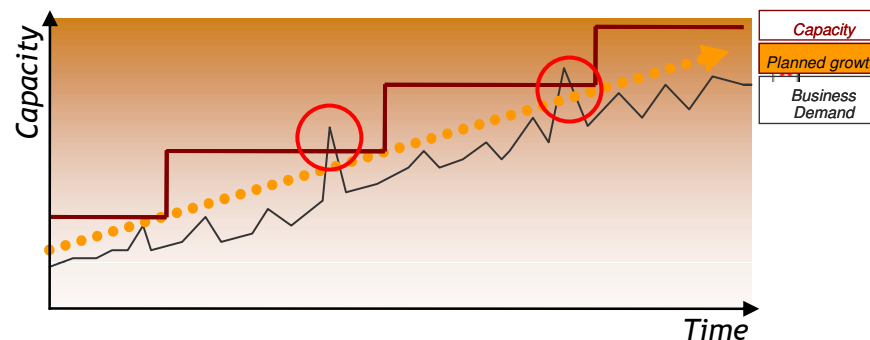
- z/OS V1.13 is planned to be the last release to provide the z/OS Capacity Provisioning support that utilizes the System z API for communication with the Support Element (SE) or Hardware Management Console (HMC). This protocol is based on IP network connection using SNMP.
- IBM recommends configuring the Capacity Provisioning Manager for communication via the z/OS BCP Internal Interface (BCPii) protocol.
- The SE and HMC support for the System z API remains, and is not affected by this withdrawal of support.

Summary



- **Capacity Provisioning allows for faster reaction to workload fluctuations**

- Replacing manual analysis with policy based monitoring of workloads
- Customer defined criteria and objectives
- Supports general purpose, zAAP, and zIIP capacity
- Can be used to control z196 static power save mode



- **Can be configured to different levels of automation**

- z/OS system commands for capacity changes
 - Eliminates need to access HMC
- Scheduled capacity changes
- Provide capacity recommendations to staff
- Optionally, full automation, eliminating human intervention

- **z/OS base component**

- z/OS Release 9 and above
- Utilizes z/OS Resource Monitoring Facility (RMF) or equivalent
- Uses open standards protocol
 - [Common Information Model \(CIM\)](#)

- Mostly zAAP eligible

- **Hardware Pre-requisites**

- IBM zEnterprise 196, or System z10 EC or BC
- Based on System z On/Off Capacity on Demand



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- For more information contact: IBMCPM@de.ibm.com
- Website under the WLM homepage
<http://www.ibm.com/servers/eserver/zseries/zos/wlm/cp>
- z/OS MVS Capacity Provisioning User's Guide, SC33-8299, at <http://publibz.boulder.ibm.com/epubs/pdf/iea2u130.pdf>
- IBM DEMOzone Demonstration of Capacity Provisioning
http://www.demos.ibm.com/servers/Demo/IBM_Demo_IBM_z_OS_Capacity_Provisioning-Jan09.htm

- ITSO Redbook:

System z10 Enterprise Class Capacity on Demand, SG24-7504

<http://www.redbooks.ibm.com/abstracts/sg247504.html?Open>



- Capacity on Demand advancements on the IBM System z10, IBM J. RES. & DEV. VOL. 53 NO. 1 PAPER 15 2009
<http://www.research.ibm.com/journal/abstracts/rd/531/axnix.html>
- “Controlling IBM zEnterprise 196 Static Power Save Mode via MVS Capacity Provisioning Manager (CPM)”
<http://www.ibm.com/support/techdocs/atmastr.nsf/WebIndex/WP101869>



Backup



Overview on Observed Metrics

CPC Metrics

- Per processor type
 - Shared physical utilization
 - Total logical processors
 - Total weights
 - Physical processors

LPAR/System Metrics

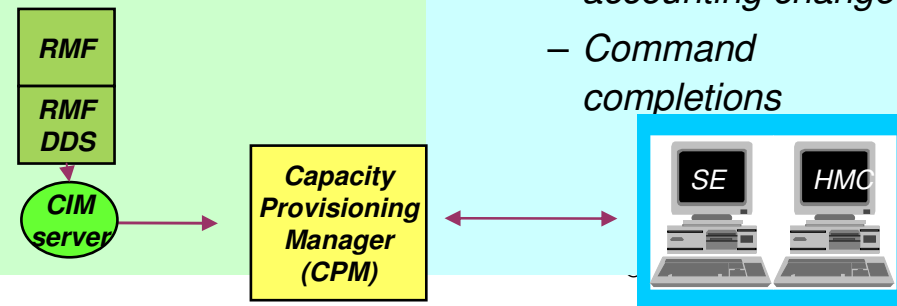
- WLM Service definition, policy, service classes Shared/dedicated
- Initial capping
- Defined capacity
- Capping
- 4h Rolling Average
- Dispatchable units (InR Queue)
- IRD weight & vary CPU mgmt
- Per processor type
 - Online CPs, zAAPs, zIIPs
 - Reserved processors
 - LPAR weight
 - MVS utilization
 - LPAR utilization

Service Class Period Metrics

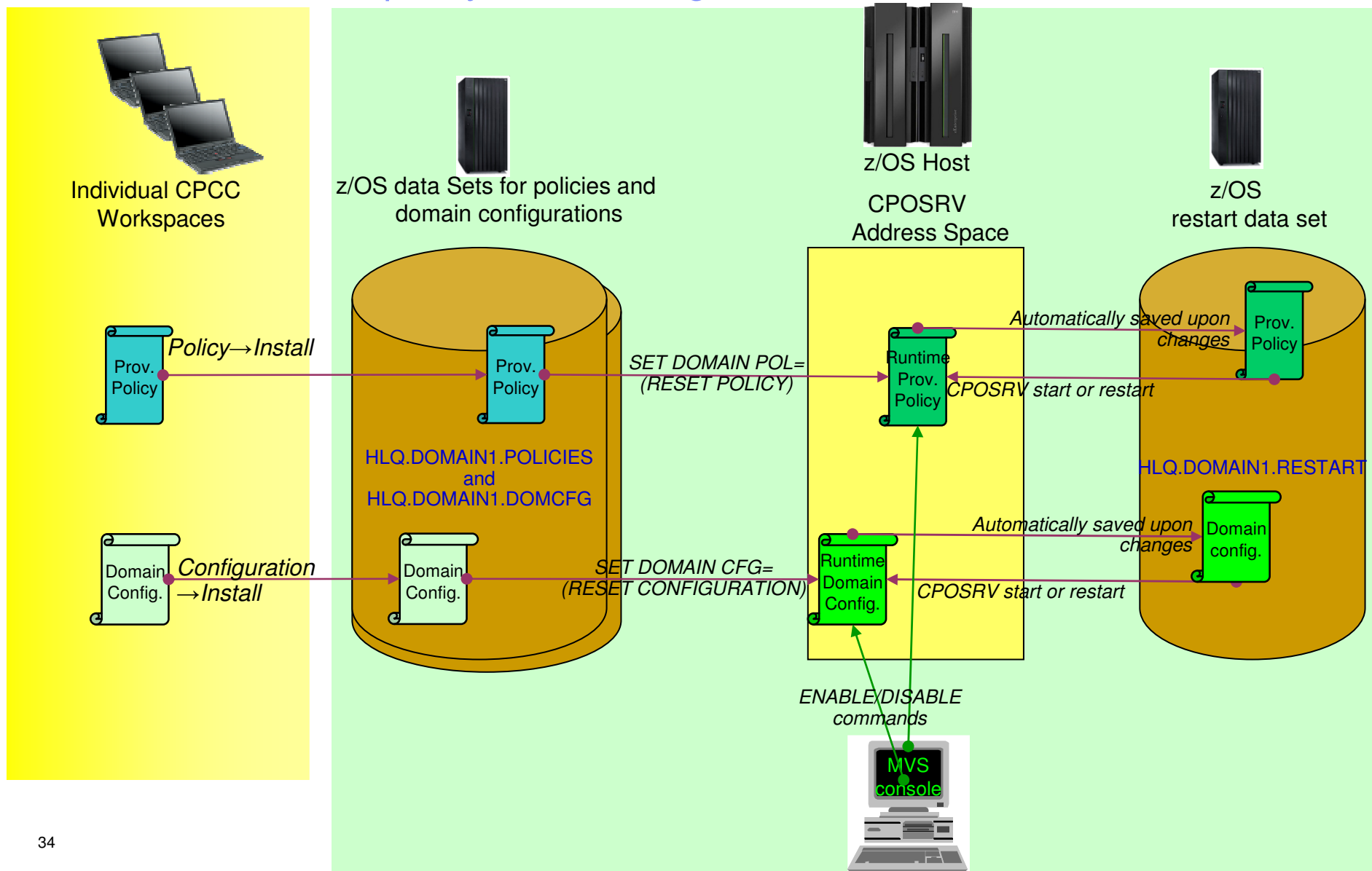
- Local PI
- Sysplex PI
- %Capped
- Delays
 - Processor delays
 - TCB, SRB

Support Element

- H/W model
- Spare processors
- Installed OOCoD records
- Current S/W model
- Current number of processors
- Power save (z196)
- For OOCoD record
 - Activation limits, validity, current activation level
- Event subscriptions
 - Capacity accounting change
 - Command completions



Capacity Provisioning Policy Instances with Workstation Capacity Provisioning Control Center



Interaction with Manual Activations

- Capacity Provisioning tolerates “manual” capacity changes
 - Initiated at HMC/SE, through CPM, or through other automation products (Tivoli System Automation, GDPS)
 - CBU activations are “mostly” ignored
 - CBU can be activated concurrently
 - If OOCoD resources are required to complete “Force” mode CBU activations then CPM prompts to release CBU resources (CPO3034W)
 - On/Off CoD: Only one OOCoD record may be active at a time
 - Because CPM tries to honor concurrent manual actions, such activations reduce the capacity navigation scope of CPM.
 - Messages inform about effects. E.g.
 - CPO4121I Some temporary resources were already active when starting managing the CPC ECL2. Only resources exceeding 2 CP, capacity level 0, 0 zAAP and 0 zIIP will be managed by the Provisioning Manager
 - CPO4101W Manual intervention detected for CPC H87. Continue managing model 404 (0/0) with 4 zAAPs and 0 zIIPs
 - CPO4105I A change of the manually activated resources has been detected for CPC H05. All resources of the defined On/Off CoD record are now managed by the Provisioning Manager

z10 On/Off CoD Overview

- *Temporary CP capacity up to 100% of purchased capacity*
- *Number of temporary zIIPs or zAAPs \leq total number of permanent + temporary CPs*
- *Number of temporary IFLs up to the total of purchased IFLs*
- *Number of temporary ICFs plus permanent ICFs \leq 16*

- *Number of real activations = unlimited, with unlimited duration*

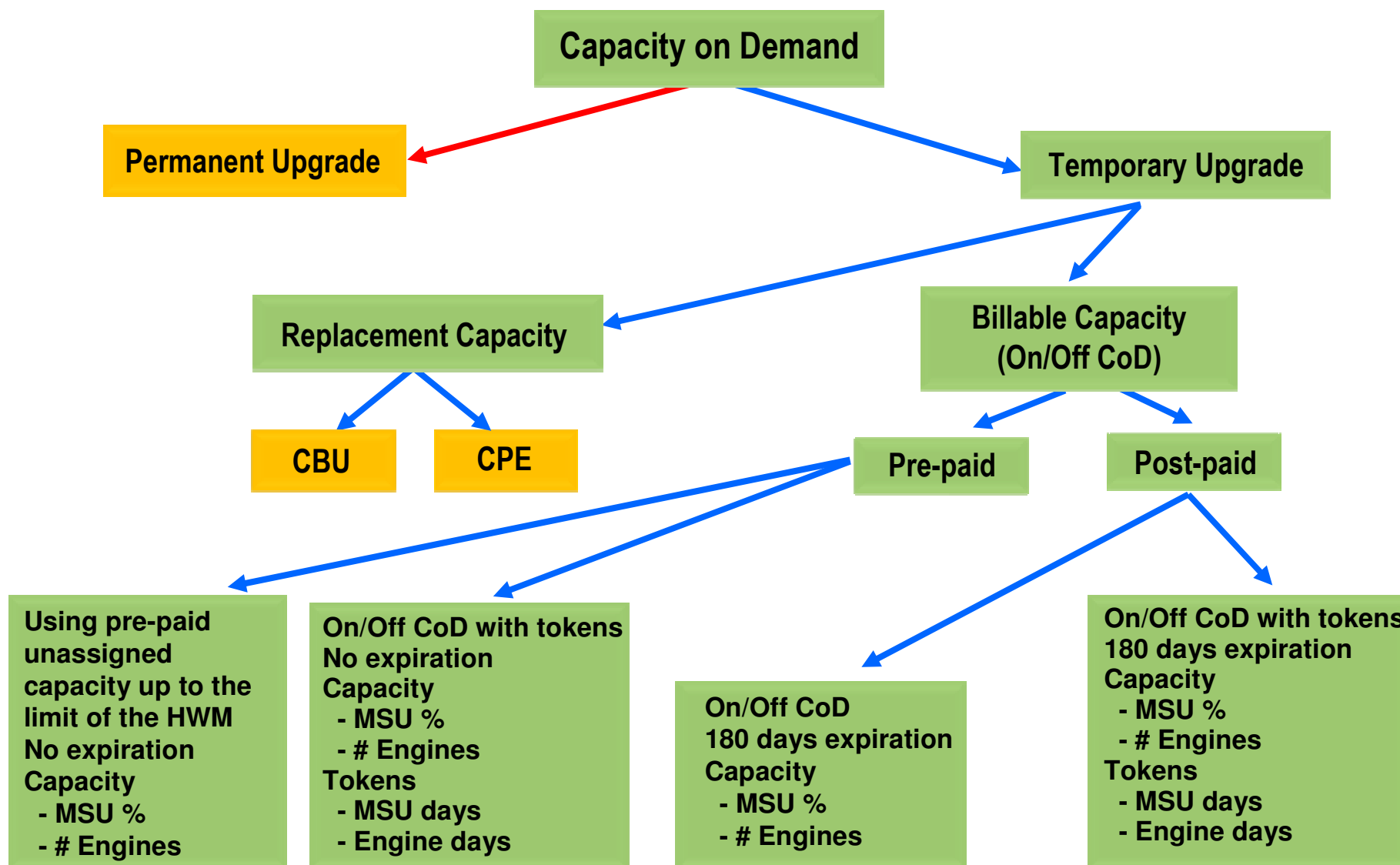
- *Post paid Offering*
 - *record expires after 180 days*
 - *Optional: set spending limits on the offering*
- *Pre-paid Offering*
 - *No expiration date*

- *Tokens to control pre-paid offering or to set spending limits on post-paid offering*
 - *'telephone card'*
 - *Tokens are reduced based on highest usage within a 24 hour period*
 - *'MSU day' tokens for CPs and 'processor day' tokens for specialty engines*

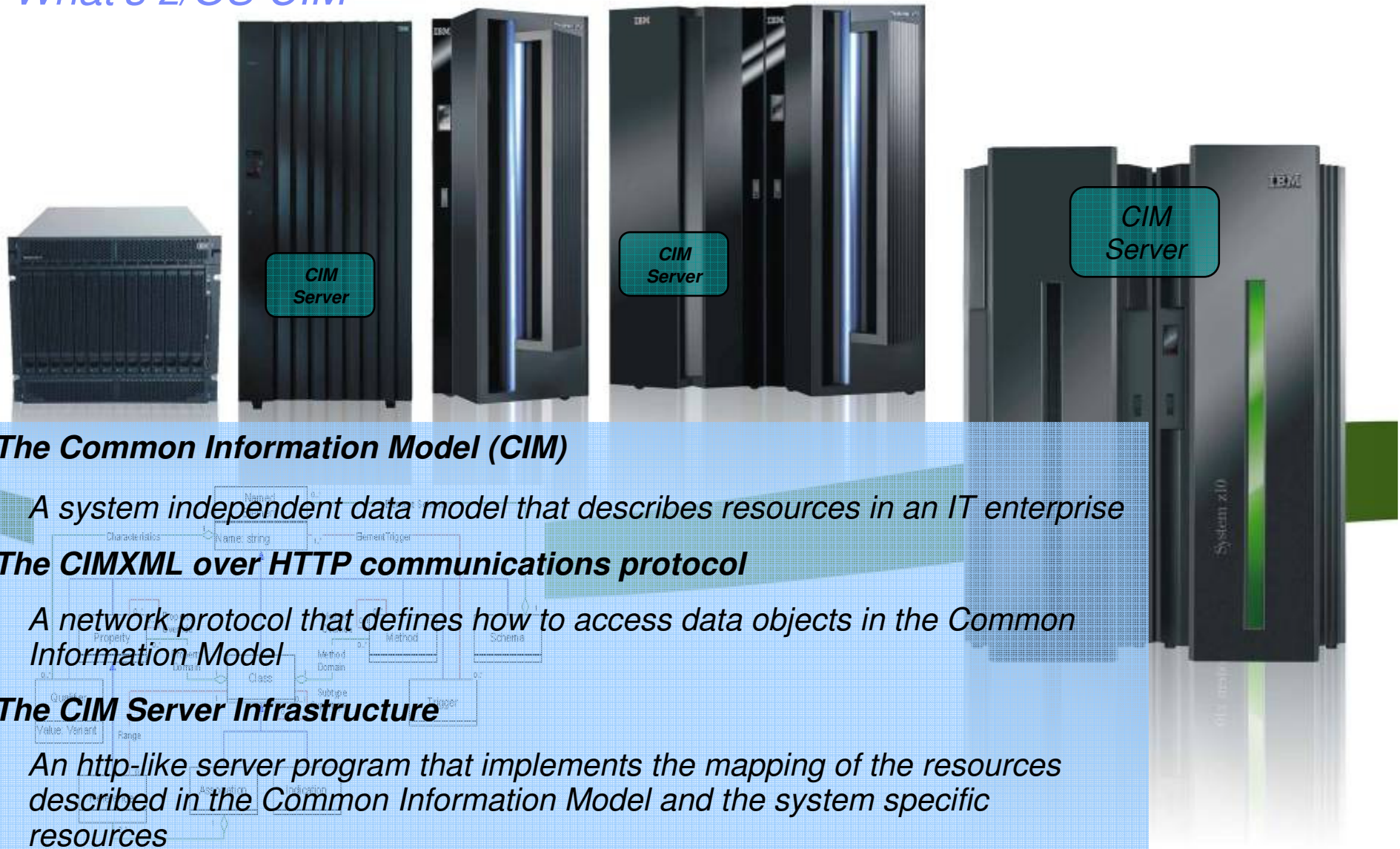
z196 CoD Offerings

- **On-line Permanent Upgrade**
 - Permanent upgrade performed by customer (previously referred to Customer Initiated Upgrade - CIU)
- **Capacity Backup (CBU)**
 - For disaster recovery
 - Concurrently add CPs, IFLs, ICFs, zAAPs, zIIPs, SAPs
 - Pre-paid
- **Capacity for Planned Event (CPE)**
 - To replace capacity for short term lost within the enterprise due to a planned event such as a facility upgrade or system relocation
 - Predefined capacity for a fixed period of time (3 days)
 - Pre-paid
- **On/Off Capacity on Demand (On/Off CoD)**
 - Production Capacity
 - Supported through software offering – Capacity Provisioning Manager (CPM)
 - Payment:
 - Post-paid or Pre-paid by purchase of capacity tokens
 - Post-paid with unlimited capacity usage
 - On/Off CoD records and capacity tokens configured on Resource Link
- **Customer Initiated Upgrade (CIU)**
 - Process/tool for ordering temporary and permanent upgrades via Resource Link
 - Permanent upgrade support:
 - Un-assignment of currently active capacity
 - Reactivation of unassigned capacity
 - Purchase of all PU types physically available but not already characterized
 - Purchase of installed but not owned memory

z196 – Basics of CoD



What's z/OS CIM



The Common Information Model (CIM)

A system independent data model that describes resources in an IT enterprise

The CIMXML over HTTP communications protocol

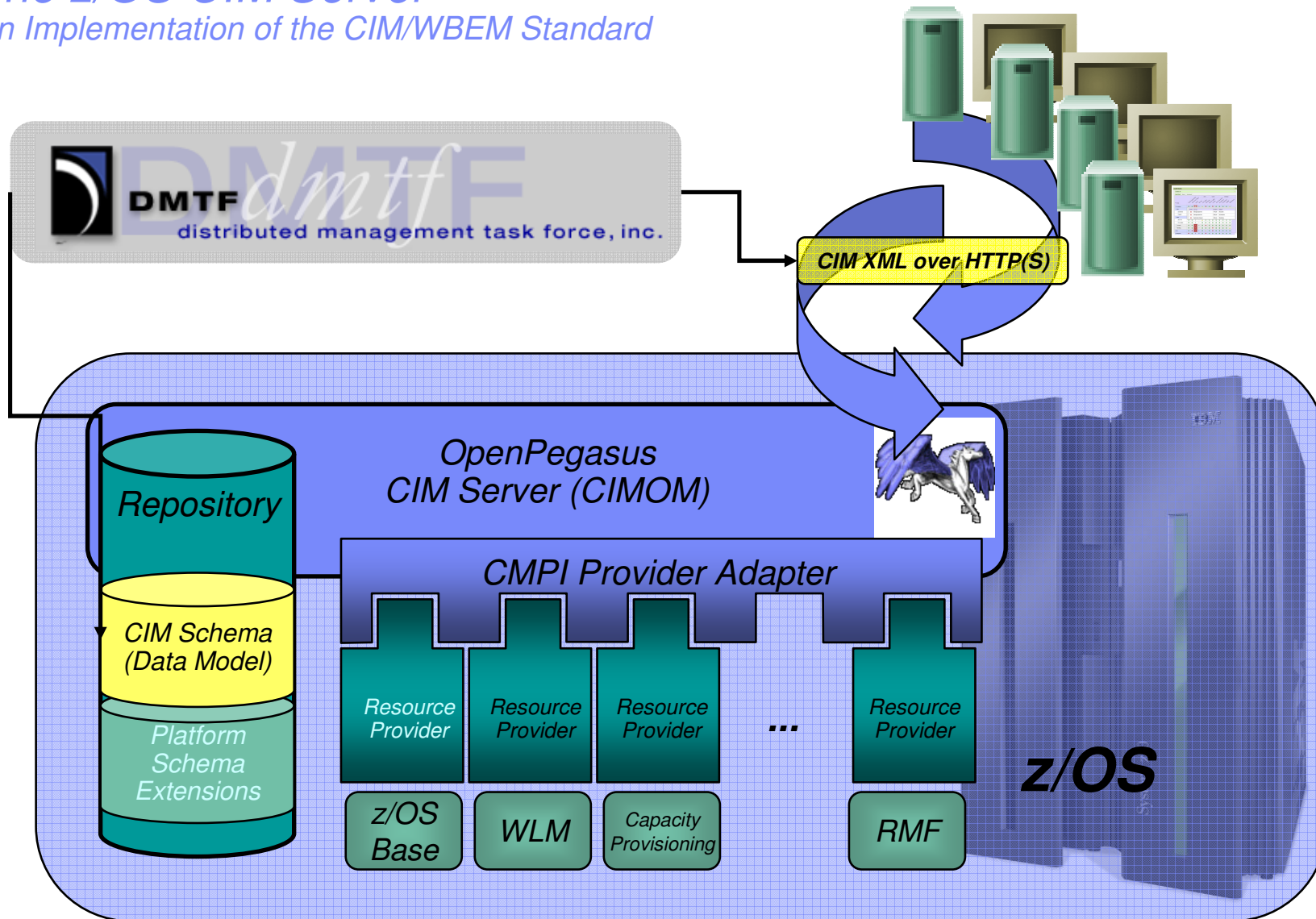
A network protocol that defines how to access data objects in the Common Information Model

The CIM Server Infrastructure

An http-like server program that implements the mapping of the resources described in the Common Information Model and the system specific resources

The z/OS CIM Server

An Implementation of the CIM/WBEM Standard



DATEV eG

Gaining efficiency with IBM z/OS Capacity Provisioning Manager

Business challenge:

DATEV eG in Nuremberg, Germany, supports tax consultants, auditors, lawyers, and their clients with local and central IT services and software, education, and tax law information. The company needed a solution that would help them optimize CPU capacity for the two IBM System z10 mainframe servers it uses to support its client base.

Solution:

DATEV implemented the IBM z/OS Capacity Provisioning Manager feature inherent in z/OS on System z10. This feature monitors z/OS workload performance and manages capacity based on user-defined policies. DATEV is using z/OS Capacity Provisioning Manager in confirmation mode, which triggers automatic functions implemented with Tivoli System Automation for z/OS. DATEV procedures (with Tivoli System Automation for z/OS) differentiate between capped and uncapped state to increase CPs or Defined Capacity (local/group).

Benefits:

- Enables faster response and better service during peak capacity usage
- Enables accurate provisioning based on actual workload performance
- Reduces manual errors with automatic responses based on defined parameters

See this [link](#) for more details.



Zukunft gestalten.
Gemeinsam.

“The z/OS Capacity Provisioning Manager from IBM has led to superior CPU efficiencies, even during peak demand.”

—DATEV eG

Solution components:

- IBM System z10®
- IBM z/OS®
- IBM Tivoli System Automation for z/OS®