Capacity Provisioning (CP) for z/OS V2R1 can manage Defined Capacity and Group Capacity limits. It can automatically adjust them based on a predefined policy as well as provides the end user with commands to make the adjustments from a z/OS console rather than the Support Element (SE).

In this blog entry we will share with you our experiences with this new enhancement. From here on we will refer to Defined Capacity as DC and Group Capacity as GC.

Specifically we will talk about:

- High level introduction to DC and GC concepts
- Steps we took to start exploiting DC and GC
- CP for z/OS policy updates we made to let it start managing our DC and GC limits
- CP for z/OS DC support in action
- Links to additional documentation

High level introduction to DC and GC concepts

In various other documentations Defined Capacity and Group Capacity are also referred to as Soft Capping or WLM Capping.

An installation can specify a Defined Capacity expressed in millions of service units per hour (MSU) for an LPAR. The Defined Capacity sets the capacity limit of an individual LPAR when soft capping is in effect.

WLM keeps a 4-hour rolling average of the CPU usage of the LPAR, and when the 4-hour average CPU consumption exceeds the defined capacity limit, WLM dynamically activates soft capping. When the rolling 4-hour average returns below the Defined Capacity, soft capping is removed.

The Group Capacity allows the definition of a group of LPARs on the same CPC and a limit for the combined capacity usage by those LPARs. This allows the system to manage the group in such a way that the limit for Group Capacity in MSU per hour will not be exceeded. PR/SM and WLM work together to enforce the capacity defined for the group and also enforce the capacity optionally defined for each individual LPAR.

An LPAR can be restricted by Defined Capacity and in addition belong to a capacity group.

For more details on Defined Capacity and Group Capacity concepts please refer to the following documentation:

z/OS Performance: WLM Soft Capping Support for Sub Capacity Pricing

- http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/FLASH10099

MVS: Planning: Workload Management

- http://publibz.boulder.ibm.com/epubs/pdf/iea3w100.pdf

Steps we took to start exploiting DC and GC

You need to have DC and GC limits in place before CP for z/OS can start managing them. In other words today CP for z/OS doesn't support initial assignment of these limits but just managing them once they are assigned.

Please note that the DC and GC limits... etc used in this blog entry are by no means recommendations for you. These are just values from one of our various tests. Limits you assign will depend on your configuration and requires capacity & performance planning.

For our test, we decided to assign DC and GC to one of our zEC12 CPCs, referred to as P91 in the examples below. These changes were done using the SE.

First we assigned DC to a set of our LPARs using the *Change Logical Partition Control*s task:

Change Logical Partition Controls - P91

Last reset profile attempted:
Input/output configuration data set (IOCDS): a0 PETHCDD4

CPs | ICFs | zAAPs | IFLs | zIIPs | Processor Running Time

Logical Partitions with Central Processors

--- Select Action --- ▾

Logical Partition	Active	Defined Capacity	WLM	Current Weight	Initial Weight	Min Weight	Max Weight	Current Capping	Initial Capping	Absolute Capping	Number of Dedicated Processors	Number of Not dedicated Processors
JB0	Yes	1035	☑	320	300			No	☐	None	0	61
JD0	Yes	690	☑	180	200			No	☐	None	0	61
JF0	Yes	518	☑	150	150			No	☐	None	0	61
JI0	Yes	518	☑	150	150			No	☐	None	0	61
JJ0	Yes	518	☑	150	150			No	☐	None	0	61
JK0	No	0	☑	0	150			No	☐	None	0	60
J90	Yes	1035	☑	300	300			No	☐	None	0	61
P91AWARE	Yes	0	☐	100	100			No	☑	None	0	2
P91AWAR2	No	0	☐	0	100			No	☑	None	0	2
Z2	Yes	0	☑	142	150			No	☐	None	0	61
Z4	Yes	0	☑	158	150			No	☐	None	0	61
PETLVS	Yes	0	☐	10	10			No	☑	None	0	4
ZG5	Yes	0	☐	75	75			No	☑	None	0	8

Save to Profiles | Change Running System | Save and Change | Export | Reset | Cancel | Help

Next we created an LPAR Group, called PLEX1, using the *Change LPAR Group Controls* task. We added the above mentioned LPARs to it and gave it a GC of 4313.

Change LPAR Group Controls - P91

Edit ▾

Input/Output configuration data set (IOCDS): a0

Group Name	Member Partitions	Group Capacity Value
DEFAULT		0
TESTPLEX		600
PLEX1	JB0 JD0 JF0 JI0 JJ0 J90	4313
PLEX2		1306

[Save to Profiles] [Change Running System] [Save and Change] [Reset] [Cancel] [Help]

Note that these changes can be made dynamically to the running systems and/or saved to the LPAR profiles to take effect in the future. We made the changes dynamically using the *Save and Change* button, shown above, and were able to see the results in RMF right away. Take a peek at the *Image Capacity, Group* and *Limit* fields for system JB0 from the *RMF Monitor III CPC Capacity* panel below.

```
Samples: 118      System: JB0   Date: 12/04/13  Time: 15.55.00  Range: 120

Partition:   JB0            2827 Model 758
CPC Capacity:     5986      Weight % of Max: ****    4h Avg: 856      Group: PLEX1
Image Capacity:   1035      WLM Capping %:    0.0    4h Max: 1010     Limit:  4313

Partition   --- MSU ---   Cap  Proc    Logical Util %    - Physical Util % -
             Def    Act   Def   Num    Effect    Total   LPAR  Effect  Total

*CP                              490                      0.7   37.6   38.3
JB0         1035    802   NO   58.0     13.3      13.4    0.1   13.3   13.4
JD0          690    279   NO   60.0      4.5       4.5    0.0    4.6    4.7
JF0          518    365   NO   60.0      5.8       5.9    0.1    6.0    6.1
JI0          518    228   NO   57.0      3.8       3.9    0.0    3.8    3.8
JJ0          518    311   NO   59.0      5.1       5.1    0.0    5.2    5.2
J90         1035      0   NO   60.0      0.0       0.0    0.0    0.0    0.0
```

Also even though we hadn't made any CP for z/OS changes yet we noticed a few messages in it's job log indicating that it was aware of the above changes:

```
05.45.16 S0022149  CPO3987I Group capacity observed. Current capacity is 4313 MSU for capacity
group PLEX1 of CPC P91
05.45.16 S0022149  CPO3961I Capacity base is 4313 MSU for capacity group PLEX1 of CPC
P91
05.49.17 S0022149  CPO3984I Defined capacity change detected. New defined capacity is  1035
MSU for LPAR JB0 of CPC P91 with system JB0 in sysplex
UTCPLXJ8
05.49.17 S0022149  CPO3960I Defined capacity base is 1035 MSU for LPAR JB0 of CPC P91 with
system JB0 in sysplex UTCPLXJ8
...
```

Since CP for z/OS was already aware of the DC and GC updates we decided to take a look at some of the reports.

DEFINEDCAPACITY report

```
F CPOSERV,APPL=R DC PLEX=UTCPLXJ8 SYS=JB0
```
OR
```
F CPOSERV,APPL=R DC CPC=P91 LPAR=JB0

CPO1095I Defined capacity report generated at 08/05/2013 10:51:26
Defined capacity for system JB0 in sysplex UTCPLXJ8
CPC.LPAR:                         P91.JB0
Sysplex.System:                   UTCPLXJ8.JB0
Management state:                 not increased
Policy limit:                     0 additional MSU
Management base:                  1035 MSU
Managed capacity:                 0 additional MSU
Current capacity:                 1035 MSU
Remaining time until capping:     240 minutes
4 hour rolling average consumption: 856 MSU
End of report
```

GROUPCAPACITY report

```
F CPOSERV,APPL=R GC CPC=P91 GROUP=PLEX1
```
OR
```
F CPOSERV,APPL=R GC PLEX=UTCPLXJ8 SYS=JB0

CPO1096I Group capacity report generated at 08/05/2013 10:53:24
Group capacity for group PLEX1 on CPC P91
Group name:                       PLEX1
CPC name:                         P91
Management state:                 not increased
Policy limit:                     0 additional MSU
Management base:                  4313 MSU
Managed capacity:                 0 additional MSU
Current capacity:                 4313 MSU
End of report
```

CP for z/OS policy updates we made to let it start managing our DC and GC limits

Before we describe the updates we made let us familiarize you with our CP for z/OS environment. Our domain consists of a z10, z196 and a zEC12 with 16 z/OS LPARs distributed across them and managed

by CP for z/OS. We have three rules within our policy.

Name Filter	Description Filter	Default Status Filter
EveningRule	6 PM to 6 AM	☑ Enabled
PrimeRule	6 AM to 6 PM	☑ Enabled
WeekendRule	Weekend 24x7	☑ Enabled

Each rule has a set of recurring time conditions as well as workload conditions and take effect only when both set of conditions are met. For instance the recurring time condition of our Evening rule is specified such that it is only active on week days between 6:00 PM and 6:00 AM.

Nonrecurring Time Conditions | Recurring Time Conditions | Workload Conditions

Name Filter	Start Date Filter	End Date Filter	Mon Filter	Tue Filter	Wed Filter	Thu Filter	Fri Filter	Sat Filter	Sun Filter	Start Time Filter	Deadline Filter	End Time Filter
Evening	Jul 25, 2011	Jul 30, 2029	☑	☑	☑	☑	☑			6:00 PM	5:30 AM	6:00 AM

The workload condition portion of our Evening rule is setup such that if the system Performance Index (PI) for any of our workloads (regardless of priority) exceeds 1.5 for 5 minutes additional resources that are available in our On/Of CoD record will be activated. Similarly once the system PI is 1.1 or less for 5 minutes unnecessary resources will be deactivated.

Importance Filters | Included Service Classes | Excluded Service Classes

Importance Filter	Provisioning PI Filter	Provisioning Duration (Minutes) Filter	Deprovisioning PI Filter	Deprovisioning Duration (Minutes) Filter	PI Scope Filter
1	1.5	5	1.1	5	System
2	1.5	5	1.1	5	System
3	1.5	5	1.1	5	System
4	1.5	5	1.1	5	System
5	1.5	5	1.1	5	System

Now let's go back to our discussion on DC and GC support. First, per system, we added a *Maximum Defined Capacity Scope* to our policy. This value represents the total amount of DC MSU that can be added to that system by all the rules within the policy.

Maximum Processor Scope | Logical Processor Scope | Maximum Defined Capacity Scope | Maximum Group Capacity Scope | Rules

System Filter	Sysplex Filter	Max. Increase (MSU) Filter	Primary Increment (MSU) Filter	Secondary Increments (MSU) Filter
J90	UTCPLXJ8	5198	500	100
JB0	UTCPLXJ8	5198	500	100
JD0	UTCPLXJ8	5543	500	100
JF0	UTCPLXJ8	5715	500	100
JI0	UTCPLXJ8	5715	500	100
JJ0	UTCPLXJ8	5715	500	100

Next we assigned a *Defined Capacity Scope (Max. Increase MSU)*, per system, in all our rules within the policy. This value limits the DC MSU that can be added by the specific rule.

	System Filter	Sysplex Filter	Max. Increase (MSU) Filter
	J90	UTCPLXJ8	5198
	JB0	UTCPLXJ8	5198
	JD0	UTCPLXJ8	5543
	JF0	UTCPLXJ8	5715
	JI0	UTCPLXJ8	5715
	JJ0	UTCPLXJ8	5715

We repeated the same actions for GC. First we added a *Maximum Group Capacity Scope* to our policy.

Group Filter	CPC Filter	Max. Increase (MSU) Filter	Primary Increment (MSU) Filter	Secondary Increments (MSU) Filter
PLEX1	P91	1920	500	100

Then we updated all our rules with a *Group Capacity Scope (Max. Increase MSU)*.

	Group Filter	CPC Filter	Max. Increase (MSU) Filter
	PLEX1	P91	1920

Finally we installed and activated our policy!

CP for z/OS DC support in action

Here are some sample messages related to CP for z/OS DC and GC support.

When CP for z/OS starts you will notice messages, per system and per LPAR group, on whether or not if it is managing DC and GC for those systems.

```
11.50.02 S0031098  CPO3986I Defined capacity observed. Current
capacity is 1518 MSU for LPAR JF0 of CPC P91 with system JF0 in
sysplex UTCPLXJ8
11.50.02 S0031098  CPO3960I Defined capacity base is 1018 MSU for
LPAR JF0 of CPC P91 with system JF0 in sysplex UTCPLXJ8


11.50.02 S0031098  CPO3987I Group capacity observed. Current
capacity is 4313 MSU for capacity group PLEX1 of CPC P91
11.50.02 S0031098  CPO3961I Capacity base is 4313 MSU for capacity
group PLEX1 of CPC P91


11.50.03 S0031098  CPO3966I Defined capacity is turned off for
LPAR TPN of CPC H91 with
   793              system TPN in sysplex UTCPLXJ8. Defined
capacity management for this
   793              system stops
```

As CP for z/OS adjusts DC and GC you will see messages similar to these:

```
12.05.02 S0031098  CPO3964I Defined capacity decrease initiated to
1018 MSU for LPAR JF0 of CPC P91 with system JF0 in sysplex
UTCPLXJ8
12.06.13 S0031098  CPO3984I Defined capacity change detected. New
defined capacity is  443
   443              1018 MSU for LPAR JF0 of CPC P91 with system
JF0 in sysplex UTCPLXJ8
```

Links to additional documentation

For more details on CP for z/OS please refer to: MVS Capacity Provisioning User's Guide

- http://publibz.boulder.ibm.com/epubs/pdf/iea3u100.pdf

Make sure to take a look at their web site as well. I find the *What's New* and *FAQs* sections to be very handy. Also if you are new to z/OS capacity provisioning take a look at the *Further Info* section for some introductory presentations.

- http://www-03.ibm.com/systems/z/os/zos/features/cpm/