

# Experiences with Using IBM zEC12 Flash Memory

**Session 14119**

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ATS - IBM Corporation

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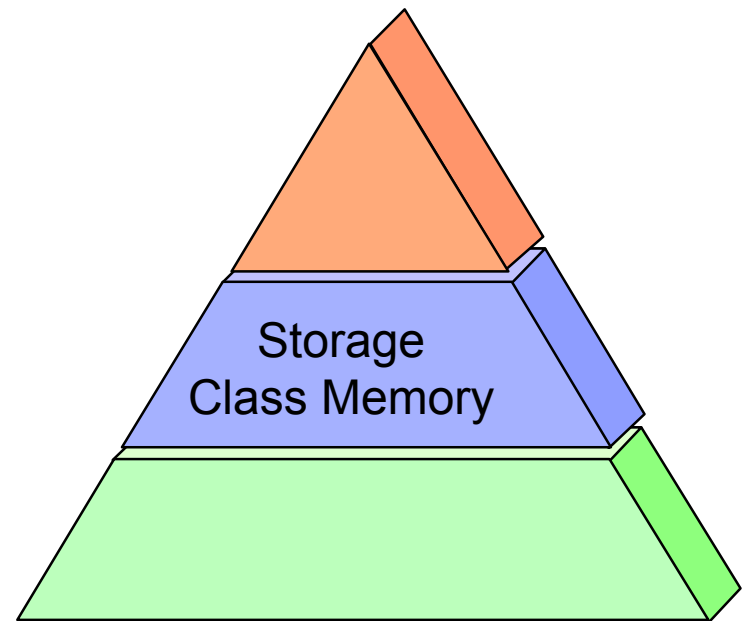
## Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

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## Storage Class Memory (SCM)

- ◆ Overview
- ◆ Assigning flash memory to partitions
  - Where are allocations specified?
  - Can allocations be increased?
- ◆ Using SCM in z/OS
  - What is new in z/OS for SCM?
  - Can SCM be added / removed?
- ◆ Finding SCM information in RMF



# What is Flash Express ?

New feature on the IBM zEnterprise EC12 and BC12

Designed to provide improved performance and availability

Internal storage implemented with Flash solid state drives

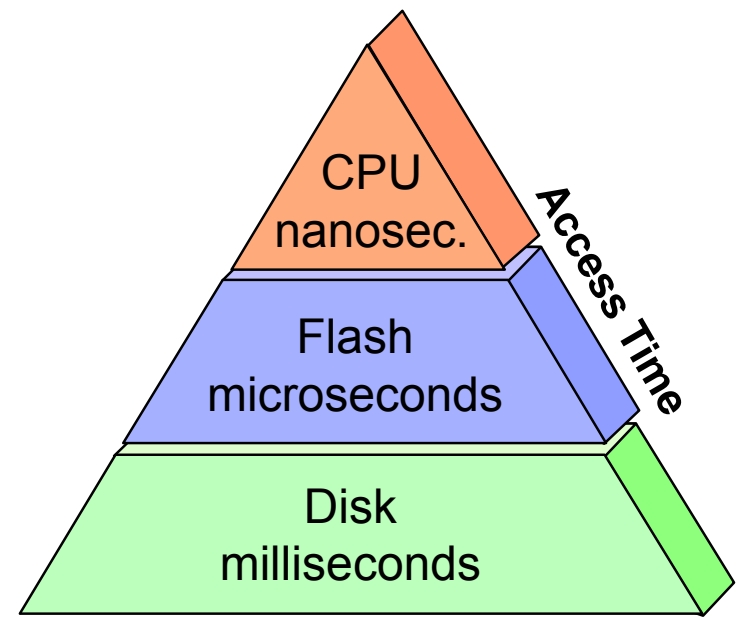
- ◆ Flash Express cards plug as pairs into the PCIe I/O drawers (PCIe = Peripheral Component Interconnect express)
- ◆ A pair of cards provides 1.4 TB of usable storage
- ◆ A maximum of 4 pairs are supported (4 pairs \* 1.4 TB/pair = 5.6 TB)

A new tier of memory

Storage Class Memory (SCM)

Accessed using the Extended Asynchronous Data Mover (EADM)

- ◆ Optimized path for flash access
- ◆ Access initiated with Start Subchannel instruction



# Flash Express Feature

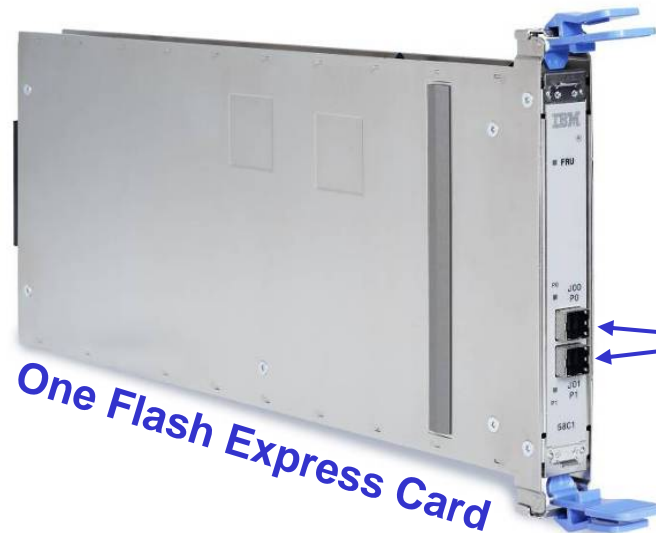
Flash cards are always installed in pairs

Each pair is installed in PCIe I/O drawer with one card per I/O domain

Pair is connected with interconnect cables

Card pair are a RAID 10 mirrored pair

- ◆ If one card fails, data is available on the other card
- ◆ Card replacement is concurrent



Two ports to form a RAID 10 mirrored pair with the second Flash Card

# Using Flash Express

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Flash memory is assigned to logical partitions

- ◆ Each partition's Flash memory is isolated from other partitions
- ◆ Increment size is 16 GB

Assignment performed at the SE or HMC using the Flash Memory Allocation panel

- ◆ Assignment is by memory amount
- ◆ Specify initial and maximum amount to be available to a partition
- ◆ Additional Flash memory can be dynamically configured online to a logical partition

# Manage Flash Allocation

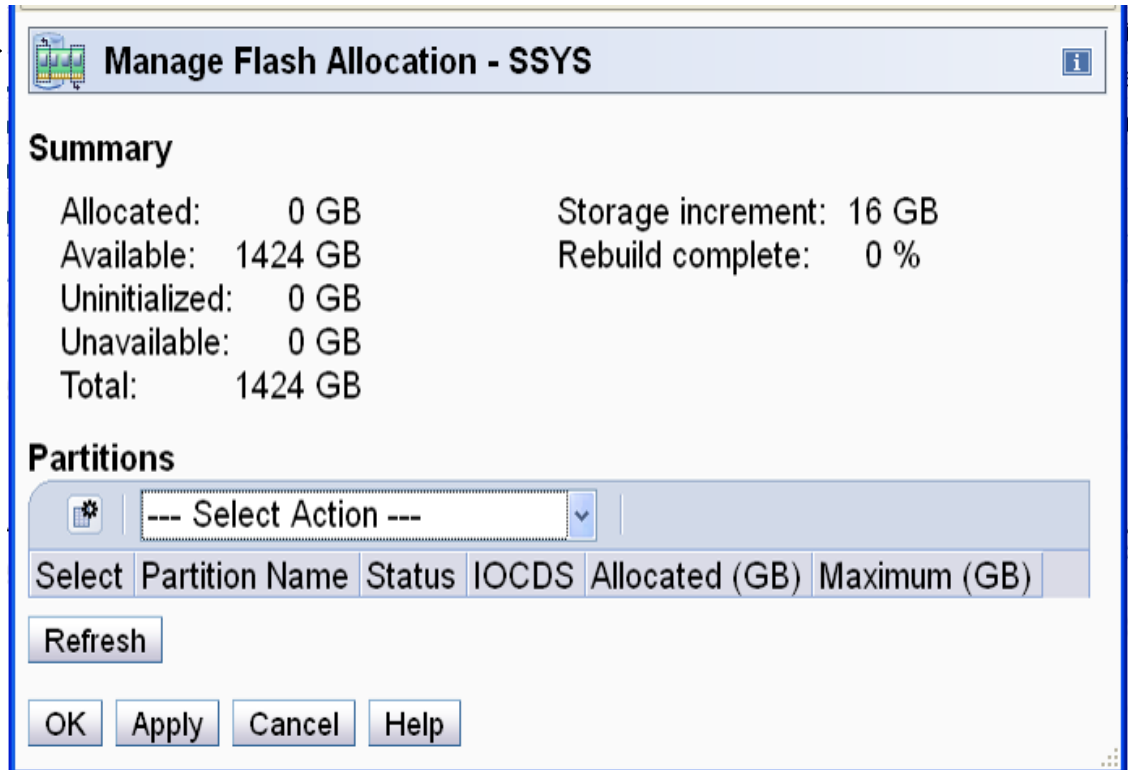


Manage Flash Allocation panel to define flash memory to a partition

Summary shows

Allocated – 0 GB

Available – 1424 GB



**Manage Flash Allocation - SSYS**

**Summary**

Allocated:	0 GB	Storage increment:	16 GB
Available:	1424 GB	Rebuild complete:	0 %
Uninitialized:	0 GB		
Unavailable:	0 GB		
Total:	1424 GB		

**Partitions**

--- Select Action ---

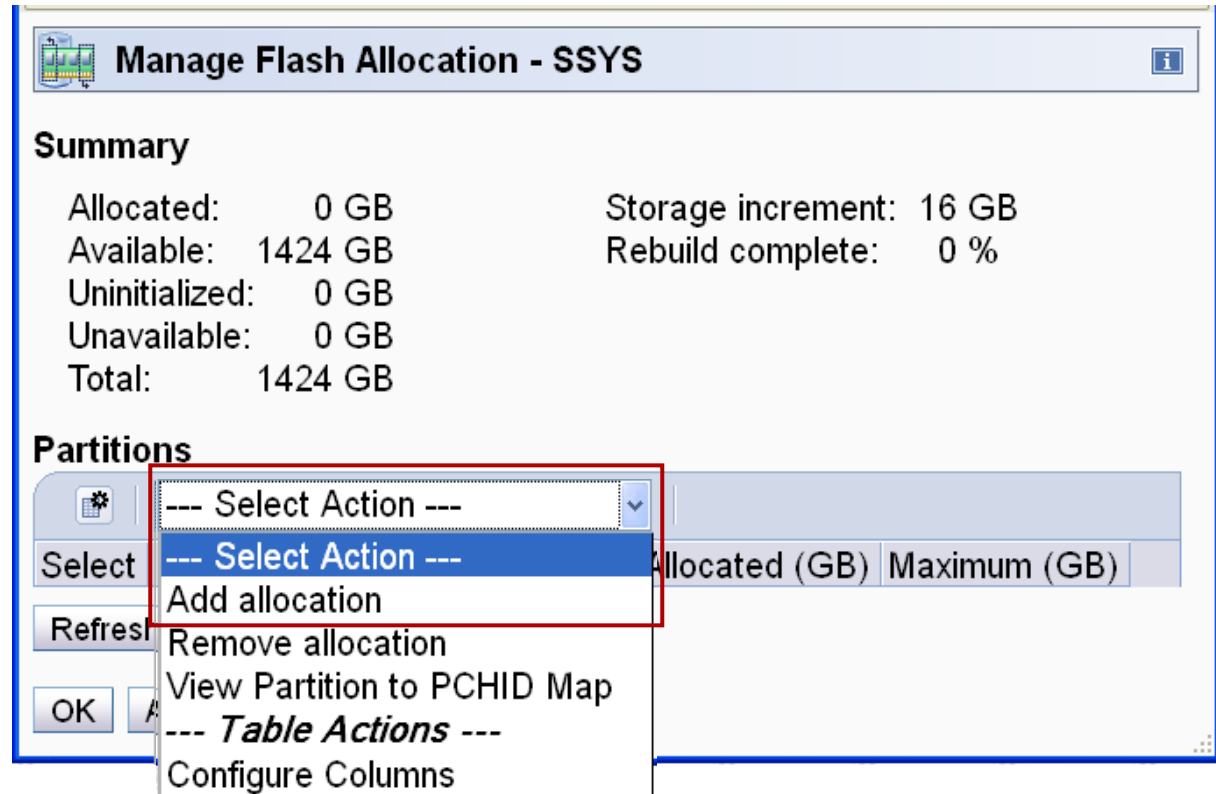
Select	Partition Name	Status	IOCDS	Allocated (GB)	Maximum (GB)
--------	----------------	--------	-------	----------------	--------------

Refresh

OK Apply Cancel Help

# Allocate Flash Memory

Select  
Add allocation



**Manage Flash Allocation - SSYS**

**Summary**

Allocated:	0 GB	Storage increment:	16 GB
Available:	1424 GB	Rebuild complete:	0 %
Uninitialized:	0 GB		
Unavailable:	0 GB		
Total:	1424 GB		

**Partitions**

	Allocated (GB)	Maximum (GB)
---		

Context menu actions:

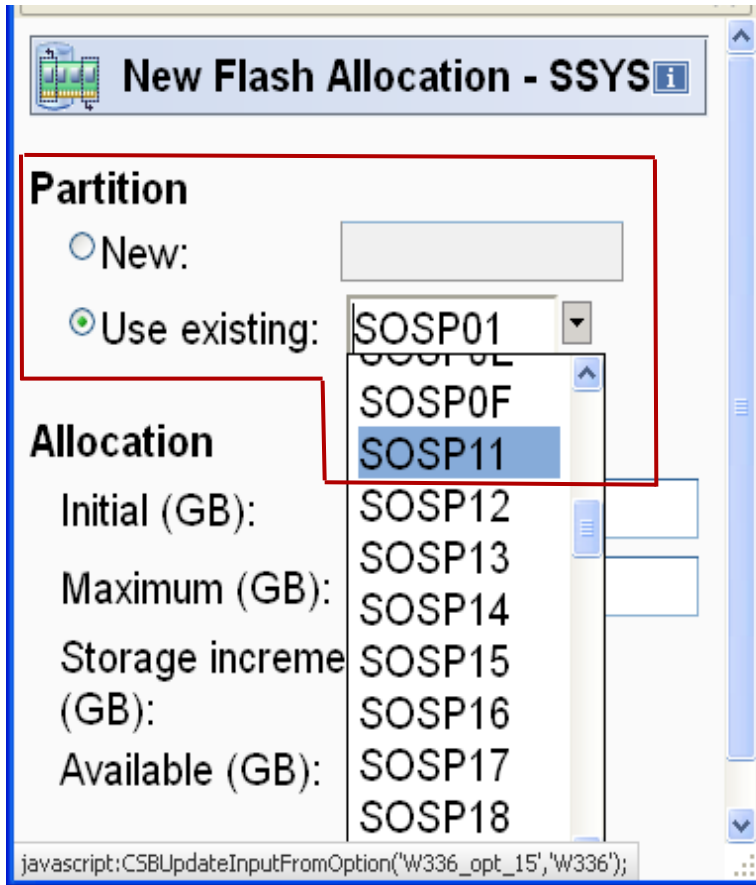
- Select Action ---
- Select Action ---
- Add allocation
- Remove allocation
- View Partition to PCHID Map
- *Table Actions* ---
- Configure Columns



# Allocate Flash Memory - cont.

Select Partition – SOSP11

Specify memory Allocation - Initial and Maximum



**New Flash Allocation - SSYS**

**Partition**

New:

Use existing:

- SOSP0E
- SOSP0F
- SOSP11**
- SOSP12
- SOSP13
- SOSP14
- SOSP15
- SOSP16
- SOSP17
- SOSP18

**Allocation**

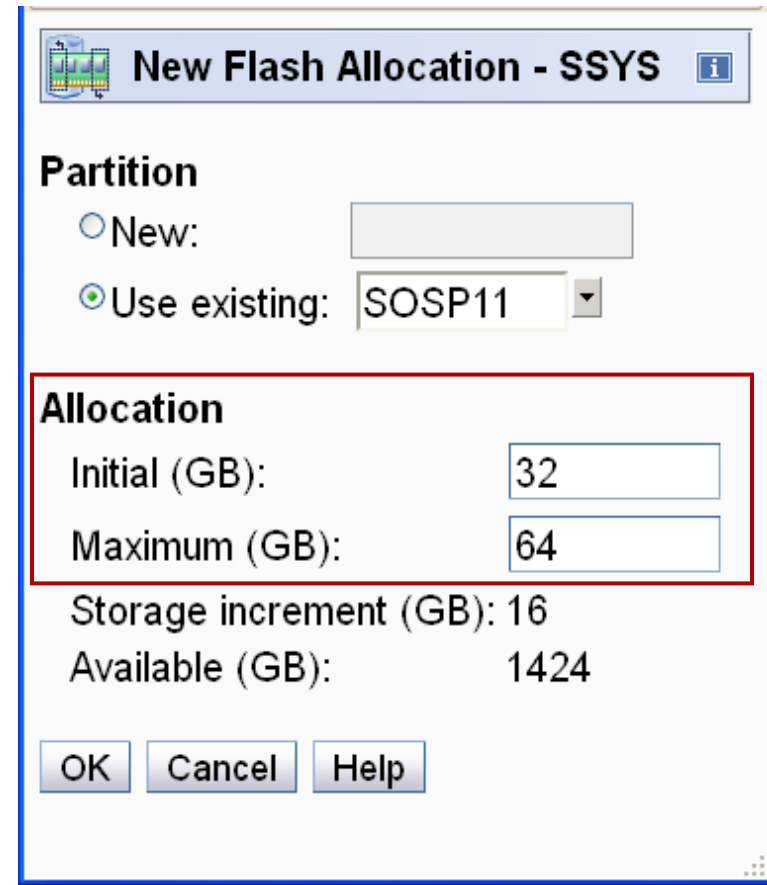
Initial (GB):

Maximum (GB):

Storage increment (GB):

Available (GB):

javascript:CSBUupdateInputFromOption('W336\_opt\_15','W336');



**New Flash Allocation - SSYS**

**Partition**

New:

Use existing:

**Allocation**

Initial (GB):

Maximum (GB):

Storage increment (GB): 16

Available (GB): 1424

# Allocate Flash Memory - cont.

**i Manage Flash Allocation - SSYS** i

The Add Flash Express Allocation request was successful.

**OK**


Flash memory  
allocated to  
partition SOSP11

**Manage Flash Allocation - SSYS** i

**Summary**

Allocated:	32 GB	Storage increment:	16 GB
Available:	1392 GB	Rebuild complete:	0 %
Uninitialized:	0 GB		
Unavailable:	0 GB		
Total:	1424 GB		

**Partitions**

  v

Select	Partition Name	Status	IOCDS	Allocated (GB)	Maximum (GB)
<input checked="" type="radio"/>	SOSP11	Active	A0,A1,A2,A3	32	<input type="text" value="64"/>

**Refresh**

**OK** **Apply** **Cancel** **Help**

# Improve Availability & Performance

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Flash Express is intended to improve System z availability and performance

- ◆ **Slash latency delays from paging**
  - Flash Memory is much faster than HDD
  - Flash Memory is much slower than main memory
- ◆ **Help key workloads at critical processing times**
  - Accelerate start of day processing – batch to online
  - Handle paging spikes
- ◆ **Reduce frustrating delays from SVC Dump processing**
- ◆ **Enable the use of large 1 MB pageable pages**

z/OS and Flash memory

- ◆ **SCM can be added dynamically to z/OS system**
- ◆ **SCM is used for paging, as part of paging subsystem**
- ◆ **New fields in RMF reports**

# z/OS Changes for SCM



New PAGESCM parameter in IEASYSxx defines amount of flash memory to be reserved for paging at IPL

- ◆ NONE - do not use flash memory for paging
- ◆ ALL – all flash memory is reserved for paging (default)
- ◆ 0, 0M, 0G, 0T - no flash memory is reserved for paging, allocated as needed for demand paging

## New messages issued at IPL

- ◆ IAR032I USE OF STORAGE-CLASS MEMORY FOR PAGING IS NOT ENABLED – PAGESCM= NONE
- ◆ IAR031I USE OF STORAGE-CLASS MEMORY FOR PAGING IS ENABLED - PAGESCM=ALL, ONLINE=00032768M
- ◆ IAR031I USE OF STORAGE-CLASS MEMORY FOR PAGING IS ENABLED – PAGESCM=00000000M, ONLINE=00032768M

## Operator commands to display SCM information

- ◆ D M=SCM online/offline status for SCM increments & usage
- ◆ D M=SCM(DETAIL) details for each online increment
- ◆ D ASM displays page data set and SCM information
- ◆ D ASM,SCM summary of SCM usage

# Add Flash Memory to z/OS System

D IPLINFO,PAGESCM - Check value of PAGESCM parameter

IEE255I SYSTEM PARAMETER 'PAGESCM': NOT\_SPECIFIED  
IEE255I SYSTEM PARAMETER 'PAGESCM': ALL

D M=SCM - Check SCM on system

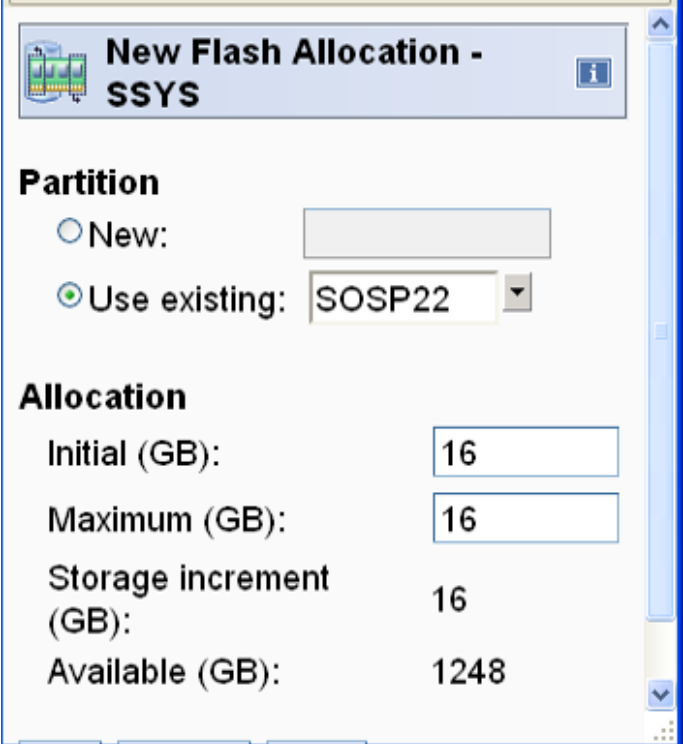
IEE174I 16.26.10 DISPLAY M  
STORAGE-CLASS MEMORY STATUS  
16G DEFINED  
16G OFFLINE-AVAILABLE

CF SCM(16G),ON - Add SCM increment

IEE195I SCM LOCATIONS 0G TO 16G ONLINE  
IEE712I CONFIG PROCESSING COMPLETE

D M=SCM - Verify increment online

IEE174I 16.29.46 DISPLAY M  
STORAGE-CLASS MEMORY STATUS  
16G DEFINED  
ONLINE  
0G-16G  
0G OFFLINE-AVAILABLE  
0% IN USE



**New Flash Allocation - SSYS**

**Partition**

New:

Use existing:

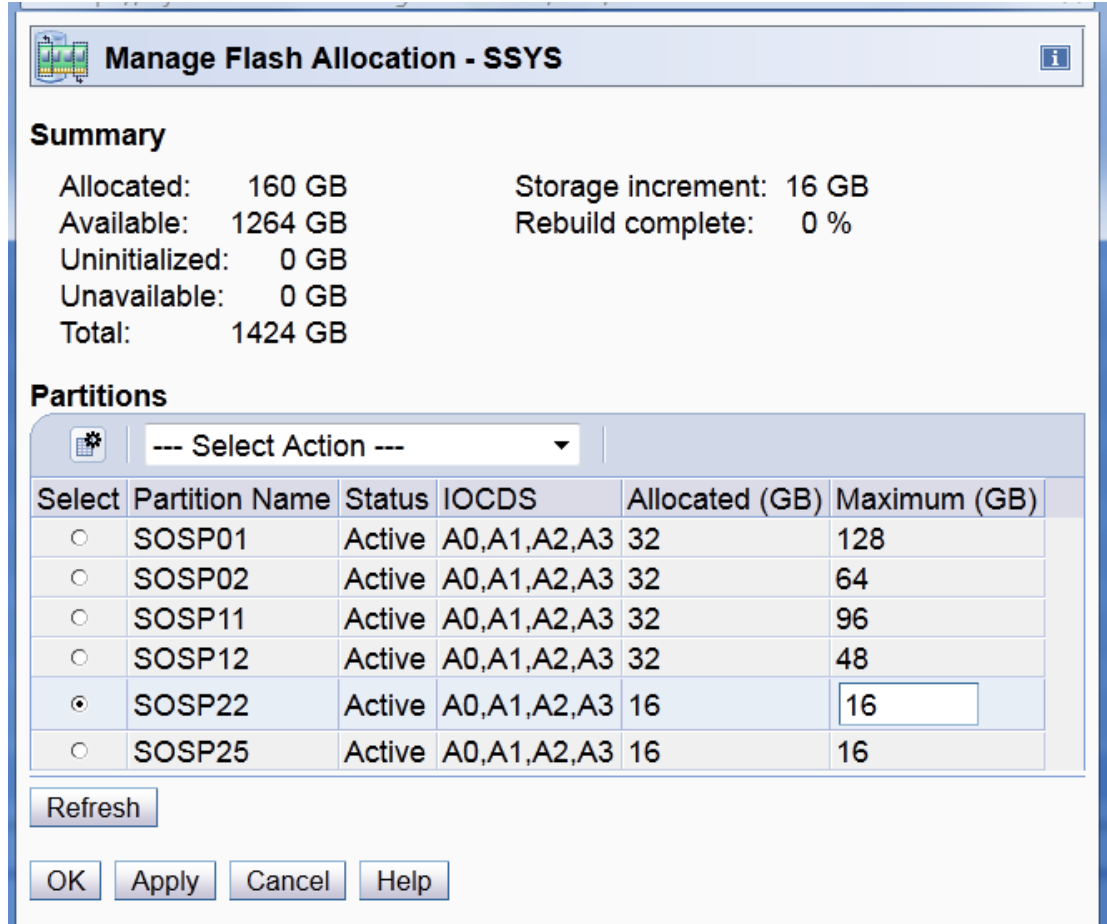
**Allocation**

Initial (GB):	<input type="text" value="16"/>
Maximum (GB):	<input type="text" value="16"/>
Storage increment (GB):	16
Available (GB):	1248

# Add SCM Increments

Select partition  
Enter new Maximum value

Select SOSP22  
Change Max. 16 to 32 GB



**Manage Flash Allocation - SSYS**

**Summary**

Allocated:	160 GB	Storage increment:	16 GB
Available:	1264 GB	Rebuild complete:	0 %
Uninitialized:	0 GB		
Unavailable:	0 GB		
Total:	1424 GB		

**Partitions**

--- Select Action ---

Select	Partition Name	Status	IOCDS	Allocated (GB)	Maximum (GB)
<input type="radio"/>	SOSP01	Active	A0,A1,A2,A3	32	128
<input type="radio"/>	SOSP02	Active	A0,A1,A2,A3	32	64
<input type="radio"/>	SOSP11	Active	A0,A1,A2,A3	32	96
<input type="radio"/>	SOSP12	Active	A0,A1,A2,A3	32	48
<input checked="" type="radio"/>	SOSP22	Active	A0,A1,A2,A3	16	<input type="text" value="16"/>
<input type="radio"/>	SOSP25	Active	A0,A1,A2,A3	16	16

Refresh

OK Apply Cancel Help

# Add SCM Increment

**Manage Flash Allocation - SSYS**

The Change Flash Express Allocation request was successful.

OK

Maximum flash storage for SOSP22 is 32 GB

**Manage Flash Allocation - SSYS**

**Summary**

Allocated:	160 GB	Storage increment:	16 GB
Available:	1264 GB	Rebuild complete:	0 %
Uninitialized:	0 GB		
Unavailable:	0 GB		
Total:	1424 GB		

**Partitions**

--- Select Action ---

Select	Partition Name	Status	IOCDS	Allocated (GB)	Maximum (GB)
<input type="radio"/>	SOSP01	Active	A0,A1,A2,A3	32	128
<input type="radio"/>	SOSP02	Active	A0,A1,A2,A3	32	64
<input type="radio"/>	SOSP11	Active	A0,A1,A2,A3	32	96
<input type="radio"/>	SOSP12	Active	A0,A1,A2,A3	32	48
<input checked="" type="radio"/>	SOSP22	Active	A0,A1,A2,A3	16	<input type="text" value="32"/>
<input type="radio"/>	SOSP25	Active	A0,A1,A2,A3	16	16

Refresh

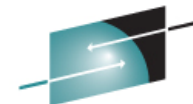
OK Apply Cancel Help

D M=SCM(DETAIL) to show offline and online increments

```
IEE174I 15.05.50 DISPLAY M
  STORAGE-CLASS MEMORY STATUS - INCREMENT DETAIL
  32G DEFINED
  ADDRESS IN USE STATUS
    0G    0% ONLINE
  ONLINE: 16G OFFLINE-AVAILABLE: 16G PENDING OFFLINE: 0G
  0% IN USE
  SCM INCREMENT SIZE IS 16G
```



# Display ASM Information



## D ASM

```
IEE200I 16.27.24 DISPLAY ASM 688
TYPE          FULL  STAT   DEV  DATASET NAME
PLPA          9%    OK    C141  SAOSYS.SYSB.PAGE.PLPA
COMMON        0%    OK    C014  SAOSYS.SYSB.PAGE.CSA
LOCAL         0%    OK    C014  SAOSYS.SYSB.PAGE.LOCAL1
LOCAL         0%    OK    C12B  SAOSYS.SYSB.PAGE.LOCAL2
LOCAL         0%    OK    C141  SAOSYS.SYSB.PAGE.LOCAL3
LOCAL         0%    OK    C041  SAOSYS.SYSB.PAGE.LOCAL4
SCM           5%    OK    N/A   N/A
```

## D ASM,SCM

```
IEE207I 15.39.13 DISPLAY ASM
STATUS      FULL          SIZE          USED          IN-ERROR
IN-USE      5%          8,388,608    429,031         0
```

# Paging Space Options

---



SCM provides additional flexibility for allocating page space

May be used for PLPA, Common, and local paging

Potential to improve performance of paging operations

## PLPA and Common pages

At IPL, PLPA pages are paged to both SCM and PLPA page data set

PLPA data sets used for warm starts, SCM to resolve page faults

May omit PLPA and/or Common page data set by specifying \*NONE\* on the PAGE parameter in IEASYSxx

PLPA page data set is still needed for warm starts, as SCM data is not persistent across IPL

## Local Page Data

Local page data set on DASD is required for paging VIO data

Page data sent to preferred storage medium based on response times

# SCM for PLPA & Common



SYS1.PARMLIB(IEASYSxx)

```
PAGE>(*NONE*,  
      *NONE*,  
      SAOSYS.&SYSNAME..PAGE.LOCAL1,  
      SAOSYS.&SYSNAME..PAGE.LOCAL2,  
      SAOSYS.&SYSNAME..PAGE.LOCAL3,  
      SAOSYS.&SYSNAME..PAGE.LOCAL4,L),
```

X  
X  
X  
X  
X

## D ASM

<b>IEE200I 13.14.32 DISPLAY ASM 630</b>				
<b>TYPE</b>	<b>FULL</b>	<b>STAT</b>	<b>DEV</b>	<b>DATASET NAME</b>
LOCAL	0%	OK	C014	SAOSYS.SYSB.PAGE.LOCAL1
LOCAL	0%	OK	C12B	SAOSYS.SYSB.PAGE.LOCAL2
LOCAL	0%	OK	C141	SAOSYS.SYSB.PAGE.LOCAL3
LOCAL	0%	OK	C041	SAOSYS.SYSB.PAGE.LOCAL4
SCM	0%	OK	N/A	N/A

Our system has a minimum page data set configuration

Two local page data sets

Someone started a WebSphere application server with multiple servant regions

Demand for storage caused a paging spike

Without SCM, an auxiliary storage shortage would have occurred and possibly an IPL

With SCM, the pages were written to SCM and the application server regions initialized

# Paging Spike - RMF Summary Report



Paging spike at 12.51.00 - demand paging jumps to 15243

R M F S U M M A R Y R E P O R T											
z/OS	V1R13	SYSTEM ID WSYA				START	12/10/2012-12.47.00	INTERVAL 00.04.45			
		RPT VERSION V1R13 RMF				END	12/10/2012-13.19.00	CYCLE 1.000 SECONDS			
DATE	TIME	INT	CPU	DASD	DASD	STC	STC	OMVS	OMVS	SWAP	DEMAND
MM/DD	HH.MM.SS	MM.SS	BUSY	RESP	RATE	MAX	AVE	MAX	AVE	RATE	PAGING
12/10	12.47.00	01.00	0.6	0.8	12.1	66	65	7	7	0.00	0.17
12/10	12.48.00	00.59	0.5	0.8	10.0	65	65	7	7	0.00	0.00
12/10	12.49.00	01.00	37.9	1.1	129.5	69	68	7	7	0.00	4.42
12/10	12.50.00	00.59	10.3	1.3	45.9	69	69	7	7	0.00	1.63
<b>12/10</b>	<b>12.51.00</b>	<b>01.00</b>	<b>41.7</b>	<b>0.8</b>	<b>114.2</b>	<b>71</b>	<b>70</b>	<b>7</b>	<b>7</b>	<b>0.00</b>	<b>15243</b>
12/10	12.52.00	01.00	100.0	1.1	414.4	71	71	7	7	0.00	632.20
12/10	12.53.00	00.59	65.0	0.9	634.6	72	71	7	7	0.00	32.90
12/10	12.54.00	01.00	70.7	0.9	468.4	74	73	7	7	0.00	433.25
12/10	12.55.00	00.59	73.7	1.0	501.6	75	75	7	7	0.00	3291.1
12/10	12.56.00	00.59	71.3	0.9	454.5	75	75	7	7	0.00	857.81
12/10	12.57.00	00.59	4.4	0.8	11.8	75	75	7	7	0.00	436.09
12/10	12.58.00	01.00	1.2	0.8	19.6	76	75	14	8	0.00	68.88
12/10	12.59.00	01.00	1.0	0.8	10.4	73	73	13	13	0.00	28.88
12/10	13.00.00	00.59	1.1	0.7	11.9	73	73	13	13	0.00	46.93
12/10	13.01.00	00.59	2.9	0.8	31.0	73	73	13	13	0.00	281.77
12/10	13.02.00	01.00	1.3	0.8	15.3	73	73	13	13	0.00	42.57
12/10	13.03.00	01.00	31.6	0.7	58.5	82	77	16	11	0.00	2587.3
12/10	13.04.00	01.00	26.3	0.7	31.0	80	71	10	9	0.00	1213.9
12/10	13.05.00	00.59	0.7	0.9	15.8	69	67	10	9	0.00	39.13
12/10	13.06.00	00.59	0.4	0.8	10.4	66	66	9	9	0.00	2.58

# Paging Spike - RMF Page Data Set



SCM – 1.3 M pages transferred  
 No activity to local page data sets

## PAGE DATA SET ACTIVITY

z/OS V1R13                      SYSTEM ID WSYA                      START 12/10/2012-12.51.00                      INTERVAL 000.01.00  
    RPT VERSION V1R13 RMF                      END 12/10/2012-12.52.00                      CYCLE 1.000 SECONDS

NUMBER OF SAMPLES = 60

### PAGE DATA SET AND SCM USAGE

PAGE SPACE TYPE	VOLUME SERIAL	DEV NUM	DEVICE TYPE	SLOTS ALLOC	----- SLOTS USED ---	BAD SLOTS	% IN USE	PAGE TRANS TIME	NUMBER IO REQ	PAGES XFER'D	I O	V DATA SET NAME
PLPA	WPAGA2	331A	33903	179999	17614 17614 17614	0	0.00	0.000	0	0		WSYA.PAGE.PLPA
COMMON	WPAGA1	321A	33903	179999	36 36 36	0	0.00	0.000	0	0		WSYA.PAGE.CSA
LOCAL	WPAGA1	321A	33903	413999	1 1 1	0	0.00	0.000	0	0	Y	WSYA.PAGE.LOCAL1
LOCAL	WPAGA2	331A	33903	413999	1 1 1	0	0.00	0.000	0	0	Y	WSYA.PAGE.LOCAL2
<b>SCM</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>8389K</b>	<b>185915 395294 266479</b>	<b>0</b>	<b>41.67</b>	<b>0.000</b>	<b>271612</b>	<b>1.323M</b>		<b>N/A</b>

# Paging Spike - Demand Paging



## PAGING ACTIVITY

z/OS V1R13                    SYSTEM ID WSYA                    START 12/10/2012-12.51.00    INTERVAL 000.01.00  
 RPT VERSION V1R13 RMF        END    12/10/2012-12.52.00    CYCLE 1.000 SECONDS  
 OPT = IEAOPT01    LFAREA SIZE =            0    CENTRAL STORAGE PAGING RATES - IN PAGES PER SECOND

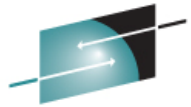
CATEGORY	PAGE IN				PAGE OUT				
	SWAP	BLOCK	NON SWAP	TOTAL	SWAP	BLOCK	NON SWAP	TOTAL	
			NON SWAP	RATE	%		NON SWAP	RATE	%
TOTAL SYSTEM									
HIPERSPACE		0.00		0.00	0		0.00	0.00	0
VIO		0.00		0.00	0		0.00	0.00	0
NON-VIO	0.00	0.00	15,243	15,243	100	0.00	6,814	6,814	100
SUM	0.00	0.00	15,243	15,243	100	0.00	6,814	6,814	100
SHARED			0.00	0.00			0.00	0.00	

PAGE MOVEMENT WITHIN CENTRAL STORAGE            1,226.83  
 PAGE MOVEMENT TIME %                                    0.0  
 AVERAGE NUMBER OF PAGES PER BLOCK                0.0  
 BLOCKS PER SECOND                                        0.00  
 PAGE-IN EVENTS (PAGE FAULT RATE)                    15,243.46

Page In

Page Out

# Page Spike - Page Slots Used Before & After



**SHARE**

Technology - Connections - Results

## P A G I N G   A C T I V I T Y

z/OS V1R13

SYSTEM ID WSYA  
RPT VERSION V1R13 RMF

START 12/10/2012-13.03.00    INTERVAL 000.01.00  
END    12/10/2012-13.04.00    CYCLE 1.000 SECONDS

LOCAL PAGE DATA SET SLOTS	TOTAL	AVAILABLE	BAD	NON-VIO	VIO
-----	-----	-----	-----	-----	-----
MIN	827,998	827,979	0	5	14
MAX	827,998	827,979	0	5	14
AVG	827,998	827,979	0	5	14
SCM PAGING BLOCKS	TOTAL	AVAILABLE	BAD	IN-USE	
-----	-----	-----	-----	-----	
MIN	8,388,608	7,382,827	0	910,092	
MAX	8,388,608	7,478,516	0	1,005,781	
AVG	8,388,608	7,459,603	0	929,005	

After paging spike

## P A G I N G   A C T I V I T Y

z/OS V1R13

SYSTEM ID WSYA  
RPT VERSION V1R13 RMF

START 12/10/2012-12.48.00    INTERVAL 000.00.59  
END    12/10/2012-12.49.00    CYCLE 1.000

SECONDS

LOCAL PAGE DATA SET SLOTS	TOTAL	AVAILABLE	BAD	NON-VIO	VIO
-----	-----	-----	-----	-----	-----
MIN	827,998	827,996	0	1	1
MAX	827,998	827,996	0	1	1
AVG	827,998	827,996	0	1	1
SCM PAGING BLOCKS	TOTAL	AVAILABLE	BAD	IN-USE	
-----	-----	-----	-----	-----	
MIN	8,388,608	8,202,053	0	186,418	
MAX	8,388,608	8,202,190	0	186,555	
AVG	8,388,608	8,202,112	0	186,496	

Before paging spike



# Adding and Removing SCM

---



SCM storage may be dynamically added and removed

Demonstrate with program with many storage requests

Page data data fills SCM storage

Auxiliary storage shortage

Issue CF SCM(16G),ON command to add 16 GB SCM

Program ends

Issue CF SCM(16G),OFF command to remove 16 GB SCM

# Aux Storage Shortage

17:13:43.76 IRA250I 80% OF STORAGE CLASS MEMORY IS ALLOCATED  
17:14:09.76 IRA205I 50% AUXILIARY STORAGE ALLOCATED  
17:16:05.77 \*IRA200E AUXILIARY STORAGE SHORTAGE  
17:16:05.77 \*IRA206I ASTLEY6 ASID 0046 FRAMES 0001192848 SLOTS  
% OF AUX 66.3

## D ASM

IEE200I 17.16.10 DISPLAY ASM				
TYPE	FULL	STAT	DEV	DATASET NAME
PLPA	10%	OK	331B	WSYB.PAGE.PLPA
COMMON	0%	OK	321B	WSYB.PAGE.CSA
LOCAL	38%	OK	321B	WSYB.PAGE.LOCAL1
LOCAL	40%	OK	331B	WSYB.PAGE.LOCAL2
LOCAL	27%	OK	321D	WSYB.PAGE.LOCAL3
LOCAL	28%	OK	331D	WSYB.PAGE.LOCAL4
LOCAL	26%	OK	321F	WSYB.PAGE.LOCAL5
LOCAL	27%	OK	331F	WSYB.PAGE.LOCAL6
SCM	99%	OK	N/A	N/A

# Resolving Aux Storage Shortage

Provide more paging space – add SCM

D ASM,SCM

```
IEE207I 17.16.30 DISPLAY ASM
STATUS      FULL          SIZE          USED          IN-ERROR
IN-USE      99%          4,194,304    4,194,276     0
```

D M=SCM(DETAIL)

```
IEE174I 17.16.37 DISPLAY M
STORAGE-CLASS MEMORY STATUS - INCREMENT DETAIL
32G DEFINED
ADDRESS    IN USE    STATUS
   0G      100%    ONLINE
ONLINE: 16G  OFFLINE-AVAILABLE: 16G  PENDING OFFLINE: 0G
100% IN USE
SCM INCREMENT SIZE IS 16G
```

CF SCM(16G),ON

```
IEE195I SCM LOCATIONS 16G TO 32G ONLINE
IEE712I CONFIG PROCESSING COMPLETE
```

D M=SCM(DETAIL)

```
IEE174I 17.17.25 DISPLAY M 627
STORAGE-CLASS MEMORY STATUS - INCREMENT DETAIL
32G DEFINED
ADDRESS   IN USE   STATUS
         0G     100%  ONLINE
         16G      6%  ONLINE
ONLINE:  32G  OFFLINE-AVAILABLE: 0G  PENDING OFFLINE: 0G
53% IN USE
SCM INCREMENT SIZE IS 16G
```

```
IRA202I AUXILIARY STORAGE SHORTAGE RELIEVED
IRA252I STORAGE CLASS MEMORY ALLOCATION IS NOW BELOW 49%
IRA501I ASTLEY6, IN ASID 0046 NOW SWAPPED IN
```

D ASM,SCM - Before program ends

<b>IEE207I 17.20.23 DISPLAY ASM</b>				
<b>STATUS</b>	<b>FULL</b>	<b>SIZE</b>	<b>USED</b>	<b>IN-ERROR</b>
<b>IN-USE</b>	<b>75%</b>	<b>8,388,608</b>	<b>6,354,341</b>	<b>0</b>

D ASM,SCM - After program ended

<b>IEE207I 17.20.47 DISPLAY ASM</b>				
<b>STATUS</b>	<b>FULL</b>	<b>SIZE</b>	<b>USED</b>	<b>IN-ERROR</b>
<b>IN-USE</b>	<b>3%</b>	<b>8,388,608</b>	<b>268,058</b>	<b>0</b>

CF SCM(16G),OFF and D M=SCM(DETAIL)

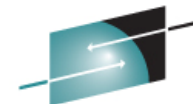
<b>IEE195I SCM LOCATIONS 16G TO 32G OFFLINE</b>	
<b>IEE712I CONFIG PROCESSING COMPLETE</b>	

<b>IEE174I 17.29.23 DISPLAY M 652</b>		
<b>STORAGE-CLASS MEMORY STATUS - INCREMENT DETAIL</b>		
<b>32G DEFINED</b>		

<b>ADDRESS</b>	<b>IN USE</b>	<b>STATUS</b>
<b>0G</b>	<b>6%</b>	<b>ONLINE</b>

<b>ONLINE: 16G</b>	<b>OFFLINE-AVAILABLE: 16G</b>	<b>PENDING OFFLINE: 0G</b>
<b>6% IN USE</b>		

# Page Slots Interval SCM Added



**SHARE**  
Technology - Connections - Results

## PAGING ACTIVITY

SYSTEM ID WSYB

DATE 08/06/2013

INTERVAL 00.59.966

TIME 17.16.00

CYCLE 1.000 SECONDS

LOCAL PAGE DATA SET SLOTS	TOTAL	AVAILABLE	BAD	NON-VIO	VIO
-----	-----	-----	-----	-----	-----
MIN	3,203,994	2,217,563	0	942,068	1
MAX	3,203,994	2,261,925	0	986,430	1
AVG	3,203,994	2,224,263	0	979,730	1
SCM PAGING BLOCKS	TOTAL	AVAILABLE	BAD	IN-USE	
-----	-----	-----	-----	-----	
MIN	4,194,304	1	0	4,193,341	
MAX	8,388,608	4,195,267	0	4,194,303	
AVG	6,291,456	599,728	0	4,193,762	

**Added 16 GB SCM**

## PAGE DATA SET ACTIVITY

SYSTEM ID WSYB

DATE 08/06/2013

INTERVAL 00.59.966

TIME 17.16.00

CYCLE 1.000 SECONDS

NUMBER OF SAMPLES = 60

PAGE DATA SET AND SCM USAGE

PAGE SPACE TYPE	VOLUME SERIAL	DEV NUM	DEVICE TYPE	SLOTS ALLOC	---- SLOTS MIN	USED MAX	--- AVG	BAD SLOTS	% IN USE	PAGE TRANS TIME	PAGES IO REQ	V XFER'D O	I DATA SET NAME
...													
LOCAL	WPAGB1	321B	33903	413999	153678	160811	160497	0	3.33	0.000	125	9,336 Y	WSYB.PAGE.LOCAL1
LOCAL	WPAGB2	331B	33903	413999	159113	167073	166729	0	1.67	0.000	98	11,563 Y	WSYB.PAGE.LOCAL2
LOCAL	WPAGB3	321D	33903	593999	156653	162474	162165	0	1.67	0.000	133	9,321 Y	WSYB.PAGE.LOCAL3
LOCAL	WPAGB4	331D	33903	593999	161624	171020	170511	0	1.67	0.000	100	11,152 Y	WSYB.PAGE.LOCAL4
LOCAL	WPAGB5	321F	33903	593999	153147	159604	159358	0	1.67	0.000	190	8,800 Y	WSYB.PAGE.LOCAL5
LOCAL	WPAGB6	331F	33903	593999	157892	165486	165166	0	1.67	0.000	145	9,170 Y	WSYB.PAGE.LOCAL6
<b>SCM</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>8389K</b>	<b>4193K</b>	<b>4194K</b>	<b>4194K</b>	<b>0</b>	<b>0.00</b>	<b>0.000</b>	<b>906</b>	<b>2,477</b>	<b>N/A</b>

Tested SVCDUMP times with paging to flash memory

Dumped the WebSphere Application Server address spaces (5.5 GB)

Compare the SVCDUMP times with and without flash memory

```
IEA045I AN SVC DUMP HAS STARTED AT TIME=16.52.58 DATE=12/11/2012
FOR ASIDS(0010,004E,004F,0050,0051,0052,0053,0054,0055,0056)
QUIESCE = YES
IEA794I SVC DUMP HAS CAPTURED:
DUMPID=001 REQUESTED BY JOB (*MASTER*)
DUMP TITLE=WITH FLASH WEBSPHERE SERVERS WSYA
IEF196I IGD17070I DATA SET SYS1.DUMP.D121211.T165258.WSYA.S00001
IEF196I ALLOCATED SUCCESSFULLY WITH 4 STRIPE(S).
IEF196I IGD101I SMS ALLOCATED TO DDNAME (SYS00002)
...
IEA611I COMPLETE DUMP ON SYS1.DUMP.D121211.T165258.WSYA.S00001
DUMPID=001 REQUESTED BY JOB (*MASTER*)
FOR ASIDS(0010,004E,004F,0050,0051,0052,0053,0054,0055,0056,0027)
```

# SVCDUMP Results



Test Info	IEA045I Dump start	IEA7904I Captured	IEA611I Complete	Capture Time – Sec.	Total Time Seconds
WSYA No Flash	15:53:32	15:54:42	15:55:44	70	132
WSYB No Flash	15:58:08	15:59:02	16:00:02	54	114
WSYA Flash	16:52:58	16:53:11	16:53:58	13	60
WSYB Flash	16:55:34	16:55:51	16:56:39	17	65



# Flash Memory Experiences

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HMC Manage Flash Allocation panel easy to navigate

Procedure to dynamically add and remove Flash memory is straight forward and uses familiar operator commands

Ability of Flash memory to handle a surprise paging spike avoiding auxiliary storage shortage

Our testing showed Flash memory reduced the SVC DUMP non-dispatchability and capture times

IBM Flash Express feature is designed to improve business application availability and performance

Reduce latency and provide large capacity for paging

- ◆ Ability to handle paging spikes
- ◆ Reduced time to capture data for SVCDUMPs

Dynamically add and remove Flash memory on z/OS system

Provides additional options for configuring paging space

# References

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- [z/OS MVS Initialization and Tuning Guide, SA22-7591](#)
- [z/OS MVS Initialization and Tuning Reference, SA22-7592](#)
- [z/OS MVS System Commands, SA22-7627](#)
- [IBM zEnterprise EC12 Technical Guide, SG24-8049](#)
- <http://www-03.ibm.com/systems/z/os/zos/downloads/#RSME>  
RSM Enablement Offering for z/OS Release 13