

IBM Education Assistance for z/OS V2R2

Item: zFS Monitoring Enhancements

Element/Component: RMF



Agenda

- Trademarks
- Presentation Objectives
- Overview
- Usage & Invocation
- Migration & Coexistence Considerations
- Presentation Summary
- Appendix



Trademarks

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



Presentation Objectives

- Explain purpose and usage of RMF z/OS V2R2 zFS Monitoring Enhancements
- RMF zFS Monitoring Enhancements introduces three new Monitor III Sysplex reports with z/OS Distributed File system (zFS) data.
- The reports allow to keep track of sysplex-wide z/OS Distributed File system (zFS) usage and analyse short-term performance.
- RMF Distributed Data Server (DDS) supports the new sysplex-wide metrics to allow performance analysis of zFS by DDS API exploiters.



Overview

- Problem Statement / Need Addressed
 - Existing RMF Monitor III single system reports ZFSSUM and ZFSACT offered no possibility to monitor details of zFS related to sysplex awareness of zFS file systems.
 - Some customers observed performance problems when gathering zFS performance data.
- Solution
 - Provide new RMF Monitor III Sysplex reports with detailed and aggregated zFS data for various aspects of zFS performance analysis.
 - The new reports are: ZFSOVW (wait and cache statistics), ZFSFS (file system statistics), ZFSKN (zFS kernel statistics).
 - RMF utilizes new zFS APIs to gather zFS performance data.
- Benefit / Value
 - RMF online monitoring can be used to identify performance problems related to zFS distributed file systems.



Usage & Invocation: RMF Monitor III Data Gatherer Option

- Users can control whether they want Monitor III to collect zFS activity data by specifying the data gathering option

ZFS | NOZFS

- Default value ZFS is set in shipped PARMLIB member ERBRMF04

```

/*****
/* NAME:          ERBRMF04
/* DESCRIPTION:  PARMLIB MEMBER WITH RMF MONITOR III GATHERER OPTIONS
/*              (ALL OPTIONS ARE SET TO DEFAULTS)
/*****
CYCLE(1000)          /* SAMPLE EVERY SECOND (1000 MSEC)
DATASET(STOP)        /* NO DATASET SUPPORT
DATASET(NOSWITCH)    /* APPEND TO LAST NON-FULL DATASET
DATASET(WHOLD(7))    /* CONTROLS BUFFER PAGES IN STORAGE
MINTIME(100)         /* LENGTH OF MINTIME
NOOPTIONS            /* DO NOT DISPLAY OPTIONS
RESOURCE(*JES2,JES2) /* SPECIFIES JES STARTED TASK NAME
NOSTOP              /* RUN UNTIL OPERATOR ISSUES STOP
SYNC(00)            /* MINTIME SYNCHRONIZATION
.....
VSAMRLS             /* ACTIVATE VSAM RLS GATHERING
OPD                 /* ACTIVATE OMVS PROCESS DATA GATHERING
PCIE                /* ACTIVATE PCIE DATA GATHERING
ZFS                /* ACTIVATE ZFS DATA GATHERING
NOSGSPACE           /* NO STORAGE GROUP SPACE GATHERING
NOLOCK              /* NO LOCK DATA GATHERING

```



Usage & Invocation: RMF Monitor III zFS Sysplex Reports

- To request the Monitor III ZFSOVW, ZFSFS and ZFSKN reports select 'S' from the Primary Menu, then select option 13, 14 or 15 from the Sysplex Report Selection Menu.
- Alternatively, enter one of these commands:
ZFSOVW or ZFO, ZFSFS or ZFF, ZFSKN or ZFK

```

RMF Sysplex Report Selection Menu

Enter selection number or command for desired report.

Sysplex Reports
 1 SYSSUM      Sysplex performance summary          (SUM)
 2 SYSRTD      Response time distribution            (RTD)
 3 SYSWKM      Work Manager delays                   (WKM)
 4 SYSENQ      Sysplex-wide Enqueue delays           (ES)
 5 CFOVER      Coupling Facility overview            (CO)
 6 CFSYS       Coupling Facility systems             (CS)
 7 CFACT       Coupling Facility activity            (CA)
 8 CACHSUM     Cache summary                          (CAS)
 9 CACHDET     Cache detail                          (CAD)
10 RLSSC       VSAM RLS activity by storage class    (RLS)
11 RLSDS       VSAM RLS activity by data set         (RLD)
12 RLSLRU      VSAM LRU overview                    (RLL)
13 ZFSOVW      zFS Overview                          (ZFO)
14 ZFSFS       zFS File System                      (ZFF)
15 ZFSKN       zFS Kernel                          (ZFK)

Data Index
 D DSINDEX     Data index                          (DI)
  
```

Usage & Invocation: RMF Monitor III ZFSOVW Report

- The Monitor III ZFSOVW report provides a summary of zFS activity, wait percentages and cache statistics on the current sysplex. This helps to discover bottlenecks and tune cache behaviour.

Session B - [32 x 80]

File Edit View Communication Actions Window Help

Host: PKSTHUB2.POK,STGLABS.IBM Port: 23 LU Name: Disconnect

RMF V2R2 zFS Overview - UTCPLXCB Line 1 of 4

Samples: 100 Systems: 8 Date: 02/27/15 Time: 14.57.00 Range: 60 Sec

System	-----Wait%-----			----- Cache Activity -----							
	I/O	Lock	Sleep	---User---		--Vnode--		-Metadata-			
				Rate	Hit%	Rate	Hit%	Rate	Hit%	Rate	Hit%
CB8A	9.7	2.2	0.8	48.03	55.1	1239	85.2	3508	96.0		
CB8C	100	0.7	100	402.7	86.5	1906	94.0	469.5	98.2		
CB86	8.0	----	32.8	130.4	99.9	870.6	91.7	328.5	99.1		
CB89	20.9	81.4	15.6	88.42	29.1	1215	87.3	2299	88.7		



Usage & Invocation: RMF Monitor III ZFSOVW – Fields

Field Heading	Meaning
System	Name of the system running zFS.
Wait%	<p>The following Wait percentages are reported:</p> <p>I/O Percentage of time that zFS requests had to wait for I/O completion.</p> <p>Lock Percentage of time that zFS requests had to wait for locks.</p> <p>Sleep Percentage of time that zFS requests had to wait for events.</p> <p>Dashes (----) in these fields indicate that RMF is unable to calculate a reasonable value.</p>
Cache Activity section	
User	<p>The user file cache is for caching regular user files that are larger than 7K. The measured statistics have the following meanings:</p> <p>Rate Total number of read and write requests per second made to the user file cache.</p> <p>Hit% Percentage of read and write requests to the user file cache that completed without accessing the DASDs.</p>
Vnode	<p>The vnode cache is used to hold virtual inodes. An inode is a data structure related to a file in the file system, holding information about the file's user and group ownership, access mode and type.</p> <p>The measured statistics have the following meanings:</p> <p>Rate Number of read and write requests per second made to the vnode cache.</p> <p>Hit% Percentage of read and write requests to the vnode cache that completed without accessing the DASDs.</p>
Metadata	<p>The metadata cache is used for file system metadata and for files smaller than 7K. It resides in the primary z/FS address space.</p> <p>The measured statistics have the following meanings:</p> <p>Rate Number of read and write requests per second made to the metadata cache.</p> <p>Hit% Percentage of read and write requests to the metadata cache that completed without accessing the DASDs.</p>



Usage & Invocation: RMF Monitor III ZFSOVW – I/O Data Pop-up

- The Monitor III ZFSOVW – I/O data pop-up panel displays a breakdown of I/O requests into three major request types.

```
RMF V2R2      zFS Overview      - UTCPLXCB      Line 1 of 4
Samples: 100   Systems: 8      Date: 02/27/15   Time: 14.57.00   Range: 60   Sec
----- Cache Activity -----
zFS Overview - I/O Details by Type
The following details are available for system CB8A
Press Enter to return to the Report panel.
Count Waits Cancl Merge  Type
1440  1356      0      0  FILE SYSTEM METADATA
  78     0      0      0  LOG FILE
1046  1013      0      0  USER FILE DATA
```



Usage & Invocation: RMF Monitor III ZFSOVW – User Cache Pop-up

- The Monitor III ZFSOVW – User cache pop-up panel displays details of the user file cache activity. In zFS, the user file cache is used to cache all “regular” files.

```

RMF V2R2      zFS Overview      - UTCPLXCB      Line 1 of 4
Samples: 100   Systems: 8      Date: 02/27/15   Time: 14.57.00   Range: 60   Sec
----- Cache Activity -----
Sys
CB8      zFS Overview - User Cache Details
CB8      The following details are available for system CB86
CB8      Press Enter to return to the Report panel.
CB8      Size           :      1632M      Storage fixed :  NO
CB8      Total Pages    :      15.6M
CB8      Free Pages     :      1506M
CB8      Segments       :           0

----- Read -----      ----- Write -----
Rate  Hit%  Dly%  Async      Rate  Hit%  Dly%  Sched      Read%  Dly%
Rate                                     Rate
1.700  95.1   0.0  1.200      1.700   100   0.0  57.38      1.3   0.0

----- Misc -----
Page Reclaim Writes :      0
Fsyncs               :      3
    
```

Usage & Invocation: RMF Mon III ZFSOVW – Vnode Cache Pop-up

- The Monitor III ZFSOVW – Vnode cache pop-up panel displays details of the Vnode cache activity. This zFS cache operates on vnodes, the data structure to represent file system objects.

```

RMF V2R2      zFS Overview      - UTCPLXCB      Line 1 of 4
Samples: 100   Systems: 8        Date: 02/27/15   Time: 14.57.00   Range: 60   Sec
----- Cache Activity -----
Sys
      zFS Overview - Vnode Cache Details

CB8  The following details are available for system CB8C
CB8  Press Enter to return to the Report panel.
CB8
CB8  Size :      32768

----- Vnodes -----
      Total      Size      Vnodes      Ext.#      Ext.Size      Open      Held
      35860      224      32768      816      34      5600

----- Requests -----
      Total      Rate      Hit%      Alloc      Delete
      114358      1906      94.0      0      3420

```



Usage & Invocation: RMF Mon III ZFSOVW – Metadata Cache Pop-up

The Monitor III ZFSOVW – Metadata cache pop-up panel displays details of the Metadata cache activity. This zFS cache contains all file system metadata, e.g. directory contents and file status information.

```
RMF V2R2      zFS Overview      - UTCPLXCB      Line 1 of 4
Samples: 100    Systems: 8      Date: 02/27/15    Time: 14.57.00    Range: 60    Sec
----- Cache Activity -----
Sys
zFS Overview - Metadata Cache Details
The following details are available for system CB89
Press Enter to return to the Report panel.
Size      :      1024M      Storage fixed : YES
Buffers   :      131K
----- Requests -----      ----- Misc -----
      Total   Rate   Hit%      Updates      : 72497
      137969   2299   88.7      Partial Writes :      0
```



Usage & Invocation: RMF Monitor III ZFSFS Report

- The Monitor III ZFSFS report provides detailed measurements of zFS activity on the basis of single file systems. This helps to monitor performance and capacity limits of file systems.

Session B - [32 x 80]

File Edit View Communication Actions Window Help

Host: PK5THUB2.POK.STGLAB5.IBM Port: 23 LU Name: Disconnect

RMF V2R2 zFS File System - UTCPLXCB Line 483 of 500

Samples: 100 Systems: 8 Date: 03/02/15 Time: 05.35.00 Range: 60 Sec

File System Name	System	Owner	Mode	Size	Usg%	I/O Rate	Resp Time	Read %	XCF Rate
OS390AT.THRASH5.ZFS	*ALL			1166M	52.2	1248	16.05	93.3	135.3
OS390AT.ZFS.AXXON	*ALL				0.0	0.000	0.000	0.0	0.000
OS390AT.ZFS.EMURPHY	*ALL			14M	3.6	0.000	0.000	0.0	0.000
OS390AT.ZFS.JIMOD	*ALL				0.0	0.000	0.000	0.0	0.000
OS390AT.ZFS.MEGA	*ALL				0.0	0.000	0.000	0.0	0.000
PRINTSRV.CB8B.ZFS	*ALL				0.0	0.000	0.000	0.0	0.000
PRINTSRV.CB88.ZFS	*ALL				0.0	0.000	0.000	0.0	0.000
SVTTEST.ZFS.JES2DJC.RAWGRPS	*ALL			354M	19.2	0.000	0.000	0.0	0.000
TPNSFSD.ZFS	*ALL				0.0	0.000	0.000	0.0	0.000

Usage & Invocation: RMF Monitor III ZFSFS - Fields

Field Heading	Meaning
File System Name	File system name.
System	Name of the system connected to the file system. In the first data line for a file system, the name is '*ALL' to indicate that this line shows the SYSPLEX view of the data rather than a single system view.
Owner	Name of owning system.
Mode	Mount mode of the file system. Possible values are: RW mounted in read-write mode. RO mounted in read-only mode. NM not mounted. QS not available because the aggregate is quiesced. The mount mode is followed by an S if the file system is using zFS sysplex sharing (RWSHARE).
Size	Maximum logical size of the file system (in Bytes).
Usg%	Percentage of currently used space by the file system.
I/O Rate	The rate of read and write requests per second (directory and file) made by applications to this file system.
Resp Time	Average response time in milliseconds for read and write requests made by applications to this file system.
Read%	Percentage of read operations contained in 'I/O Rate'.
XCF Rate	The rate of read and write XCF calls per second to the server.



Usage & Invocation: RMF Mon III ZFSFS – File System Details Pop-up

- The Monitor III ZFSFS – File System Details pop-up panel displays the details of a single file system's activity on one system of the sysplex.

```

                                zFS File System Details
-
File System Name : OS390AT.THRASH5.ZFS
Mount
Point : /thrashmegazfs5

System : CB8A                      Owner : CB8A                      Mode : RW S

----- Read -----
--- Appl --- --- XCF ---      Aggr
Rate  Resp  Rate  Resp      Rate
Time  Time
145.6  0.981  0.000  0.000    278K

Vnodes                : 4981
Open objects          : 0
User cache 4k pages   : 220

ENOSPC errors         : 0
XCF comm. failures    : 0

----- Write -----
--- Appl --- --- XCF ---      Aggr
Rate  Resp  Rate  Resp      Rate
Time  Time
16.38  232.8  0.000  0.000    433K

USS held vnodes       : 163
Tokens                : 103
Metadata cache 8k pages : 121K

Disk I/O error        : 0
Cancelled operations   : 0

Press Enter to return to the Report panel.
    
```



Usage & Invocation: RMF Monitor III ZFSFS - Report Options

- The contents of the Monitor III ZFSFS report can be tailored by report options (invoke with RO command on ZFSFS panel).
- Example: Detailed statistics for one file systems

RMF zFS File System Report Options Line 279 of 287

Change or verify parameters. To exit press END.
Changes will apply to the ZFSFS report.

Name ==> OS390AT.THRASH5_ZFS
ALL or one of the available zFS file systems below

Detail ==> YES
Show single system data (YES or NO) in ZFSFS report

Available zFS File Systems

OMVS22.ZFS.VAR.WBEM.CMRS22.CB8A
OMVS22.ZFS.VAR.WBEM.CMRS22.CB8C
OMVS22.ZFS.VAR.WBEM.CMRS22.CB86
OMVS22.ZFS.VAR.WBEM.CMRS22.CB89
OS390AT.THRASH5_ZFS
OS390AT.THRASH5_ZFS
OS390AT.THRASH5_ZFS
PRINTSRV.
PRINTSRV.

RMF V2R2 zFS File System - UTCPLXCB Line 1 of 6

Samples: 60 Systems: 8 Date: 03/03/15 Time: 07.14.00 Range: 60 Sec

File System Name	System	Owner	Mode	Size	Usg%	I/O Rate	Resp Time	Read %	XCF Rate
OS390AT.THRASH5.ZFS									
*ALL				1166M	54.8	881.3	14.29	72.2	134.1
CB8A	CB8A		RW S	1166M	54.8	8.200	120.5	83.9	0.000
CB8C	CB8A		RW S		0.0	273.8	14.16	59.5	46.43
CB86	CB8A		RW S		0.0	279.3	14.38	59.9	46.65
CB89	CB8A		RW S		0.0	320.1	11.60	93.6	41.05

Usage & Invocation: RMF Monitor III ZFSFS - Report Options (2)

- Example: Using ALL for 'Name' and Details=YES, complete information for all file systems on all systems is provided.

Session B - [32 x 80]

File Edit View Communication Actions Window Help

Host: PKSTHUB2.POK.STGLABS.IBM Port: 23 LU Name: Disconnect

RMF V2R2 zFS File System - UTCPLXCB Line 1446 of 1500

Samples: 100 Systems: 8 Date: 03/02/15 Time: 05.35.00 Range: 60 Sec

File System Name	System	Owner	Mode	Size	Usg%	I/O Rate	Resp Time	Read %	XCF Rate
OS390AT.THRASH5.ZFS	CB89	CB89	RW S	1341M	74.1	606.6	5.199	96.2	0.000
	*ALL			1166M	52.2	1248	16.05	93.3	135.3
	CB8A	CB8A	RW S	1166M	52.2	162.0	24.43	89.9	0.000
	CB8C	CB8A	RW S		0.0	374.9	9.614	93.8	46.73
	CB86	CB8A	RW S		0.0	379.9	10.46	93.7	47.50
	CB89	CB8A	RW S		0.0	330.9	25.66	93.8	41.10
OS390AT.ZFS.AXXON	*ALL				0.0	0.000	0.000	0.0	0.000
	CB8A	CB8D	RW S		0.0	0.000	0.000	0.0	0.000
	CB8C	CB8D	RW S		0.0	0.000	0.000	0.0	0.000
	CB86	CB8D	RW S		0.0	0.000	0.000	0.0	0.000
	CB89	CB8D	RW S		0.0	0.000	0.000	0.0	0.000
OS390AT.ZFS.EMURPHY	*ALL			14M	3.6	0.000	0.000	0.0	0.000
	CB8A	CB8A	RW S	14M	3.6	0.000	0.000	0.0	0.000
	CB8C	CB8A	RW S		0.0	0.000	0.000	0.0	0.000
	CB86	CB8A	RW S		0.0	0.000	0.000	0.0	0.000
	CB89	CB8A	RW S		0.0	0.000	0.000	0.0	0.000

Usage & Invocation: RMF Monitor III ZFSKN Report

- The Monitor III ZFSKN report provides measurements counting the calls made to zFS from z/OS UNIX and the average response time of zFS requests.

Session B - [32 x 80]

File Edit View Communication Actions Window Help

Host: PK5THUB2.POK.STGLAB5.IBM Port: 23 LU Name: Disconnect

RMF V2R2 zFS Kernel - UTCPLXCB Line 1 of 4

Samples: 100 Systems: 8 Date: 02/27/15 Time: 14.54.00 Range: 60 Sec

System Name	Request Rate		XCF Rate		Response Time	
	Local	Remote	Local	Remote	Local	Remote
CB8A	285.8	468.3	0.083	25.22	3438	1989
CB8C	63.43	2196	0.000	173.1	19.00	4261
CB86	98.17	590.5	0.000	79.82	870.0	7811
CB89	837.9	528.4	0.000	52.53	324.0	7084



Usage & Invocation: RMF Monitor III ZFSKN - Fields

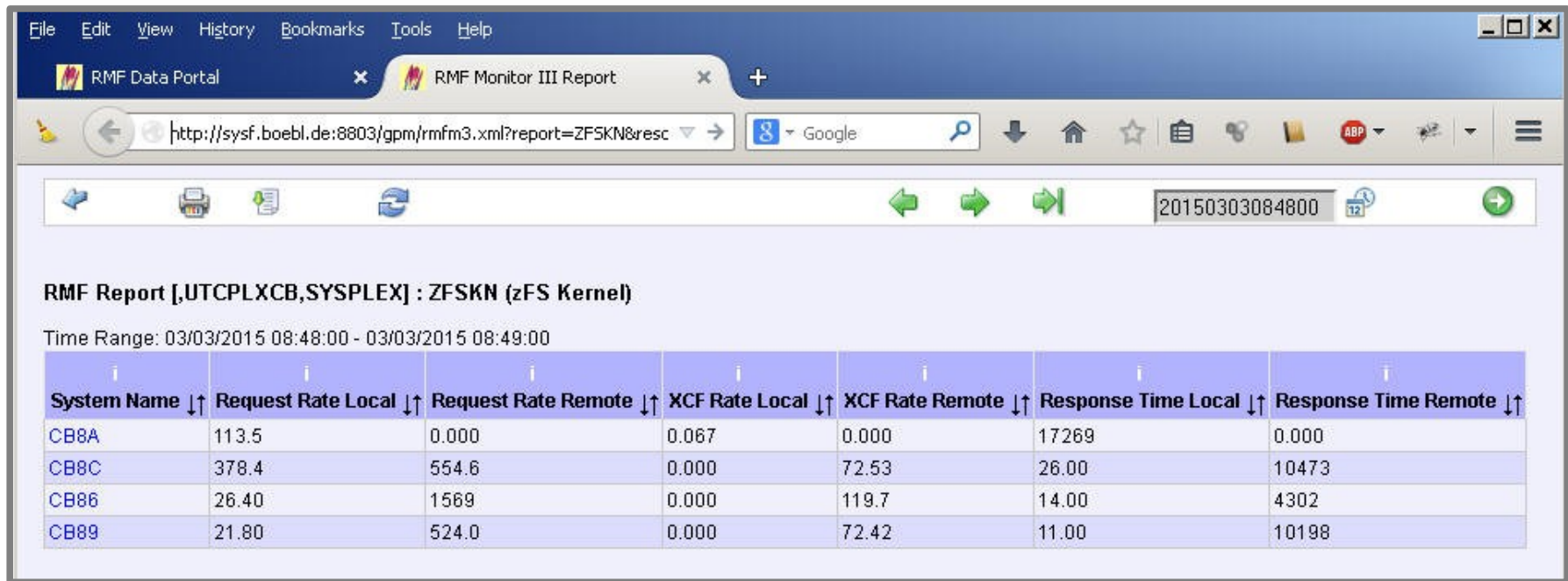
Field Heading	Meaning
System Name	Name of the system running zFS. In the context of requests against file systems, this is the name of the requesting system.
Request Rate	Rate of zFS requests during the report interval for file systems which are locally and remotely owned. A file system is locally owned if the requesting system is also the owner of the file system. It is remotely owned if the owner of the file system is not the requesting system.
XCF Rate	Rate of zFS requests during the report interval requiring data from another system via XCF, both for locally and remotely owned file systems.
Response Time	Average time in milliseconds required for the completion of the zFS requests during the report interval for locally and remotely owned file systems.



Usage & Invocation: RMF DDS Full Report Support

- Alternatively to ISPF, the browser based version of ZFSOVW, ZFSFS and ZFSKN can be requested from the RMF Distributed Data Server (DDS) by using the following URL (example is for ZFSKN):

[http://sysf.boebl.de:8803/gpm/rmfm3.xml?report=ZFSKN&resource=",,SYSPLEX"](http://sysf.boebl.de:8803/gpm/rmfm3.xml?report=ZFSKN&resource=)



RMF Report [,UTCPLXCB,SYSPLEX] : ZFSKN (zFS Kernel)

Time Range: 03/03/2015 08:48:00 - 03/03/2015 08:49:00

System Name	Request Rate Local	Request Rate Remote	XCF Rate Local	XCF Rate Remote	Response Time Local	Response Time Remote
CB8A	113.5	0.000	0.067	0.000	17269	0.000
CB8C	378.4	554.6	0.000	72.53	26.00	10473
CB86	26.40	1569	0.000	119.7	14.00	4302
CB89	21.80	524.0	0.000	72.42	11.00	10198



Usage & Invocation: RMF DDS zFS Metrics

- All performance metrics from the new zFS sysplex reports are added to the ZFS resource in the DDS and are promoted to the SYSPLEX resource as well.

RMF Data Portal for z/OS Home Explore Overview My View

Available metrics for: **SYSF,OMVS.SYSF.ZOSMF.ZFS,AGGREGATE**

Metric description	Help	Id
% read (in I/O rate)	Explanation	8D4FE0
% space used	Explanation	8D5010
% used space	Explanation	8D2AE0
# cancelled operations	Explanation	8D5040
# disk I/O errors	Explanation	8D5070
# open objects	Explanation	8D50A0
# tokens	Explanation	8D50D0
# vnodes	Explanation	8D5100
# ENOSPC errors	Explanation	8D5130
# USS held vnodes	Explanation	8D5160
# XCF communication failures	Explanation	8D5190
# 4K pages in user cache	Explanation	8D51C0
# 8K pages in metadata cache	Explanation	8D51F0
aggregate read rate	Explanation	8D5220
aggregate write rate	Explanation	8D5250
application read rate	Explanation	8D5280
application read response time	Explanation	8D52B0

RMF Data Portal for z/OS Home Explore Overview My View

Full RMF Reports:

CACHDET	CACHSUM	CFACT	CFOVER	CFSYS	SPACED	SPACEG	SYSSUM	XCFCGROUP	XCFOVW
XCFSYS	ZFSFS	ZFSKN	ZFSOVW						

Available metrics for: **,SYSDPLEX,SYSPLEX**

by aggregate		
% read (in I/O rate) (sysplex) by aggregate	Explanation	8D4FF0
% read (in I/O rate) by aggregate	Explanation	8D5000
% space used (sysplex) by aggregate	Explanation	8D5020
% space used by aggregate	Explanation	8D5030
# cancelled operations (sysplex) by aggregate	Explanation	8D5050
# cancelled operations by aggregate	Explanation	8D5060
# disk I/O errors (sysplex) by aggregate	Explanation	8D5080
# disk I/O errors by aggregate	Explanation	8D5090

(Example is for AGGREGATE resource, a child of ZFS)

Migration & Coexistence Considerations

- The RMF Monitor III data gatherer option default changed with V2R2 from NOZFS to ZFS.

If you do not want to gather zFS activity data, you have to switch from ZFS to NOZFS when you use the shipped PARMLIB member ERBRMF04.

- The single system RMF Monitor III zFS reports ZFSSUM and ZFSACT are no longer being maintained. To monitor zFS activity, the new reports ZFSOVW, ZFSFS and ZFSKN have to be used.



Presentation Summary

- The new Monitor III zFS Reports ZFSOVW, ZFSFS and ZFSKN present detailed sysplex-wide zFS file system usage statistics.
- The reports are available as new standard ISPF reports in a Monitor III Reporter session.
- Alternatively, the browser based version of the reports can be requested from the RMF Distributed Data Server (DDS).
- All metrics contained in the reports can be selected as individual metrics for continuous monitoring from the following applications:
 - RMF Data Portal for z/OS
 - z/OSMF Resource Monitoring



Appendix

- RMF website: www.ibm.com/systems/z/os/zos/features/rmf
 - Product information, newsletters, presentations, etc.
 - Downloads
 - RMF Spreadsheet Reporter
 - RMF Postprocessor XML Toolkit
 - RMF PM Java Edition
- RMF email address: rmf@de.ibm.com
- Documentation and news:
 - *RMF Report Analysis*, SC34-2665
 - *RMF User's Guide*, SC34-2664
 - PDF files can be downloaded from:
www.ibm.com/systems/z/os/zos/bkserv

