

Predictive Failure Analysis – Customer Experience

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z/OS Predictive Failure Analysis (PFA)

- Health Checker runs checks supplied by IBM, vendors or written by you to detect existing or potential problems primarily with variation from understand successful practices
- GEICO has been running Health Checker for z/OS since the prototype and the first implementation in z/OS in 2005 in z/OS 1.7 base was optional download for z/OS 1.4 to 1.6
- *We run Health Checker all the time from IPL. You should too!*
- PFA will attempt to detect problems which require analysis of history and current trends to detect. PFA can help you avoid soft failures.
- PFA was introduced with z/OS 1.10
- We run PFA all the time from IPL

z/OS Predictive Failure Analysis (PFA)

- PFA checks have been delivered in each z/OS release starting with 1.10 currently for me on 1.12 I run these
 - PFA_COMMON_STORAGE_USAGE
 - PFA_FRAMES_AND_SLOTS_USAGE
 - PFA_LOGREC_ARRIVAL_RATE
 - PFA_MESSAGE_ARRIVAL_RATE
 - PFA_SMF_ARRIVAL_RATE
- IBM plans to extend PFA over time PFA so PFA will be useful today but like Health Checker your investment will be returned with interest in the future
- PFA uses the Health Checker for z/OS infrastructure but PFA checks are different and need to be treated differently
- *“Prediction is very difficult, especially about the future”
Niels Bohr*

z/OS Predictive Failure Analysis (PFA)

- PFA is constructed largely in Java and the majority of the CPU used by PFA is eligible to run on zAAP speciality engines
- **APAR OA27495 NEW FUNCTION - ZAAP ON ZIIP ENHANCEMENT**
 - **ZZ=YES in IEASYSxx**
 - **zAAP on zIIP does not change in any way what is eligible for specialty processing just allows you to consolidate to have only one pool of specialty engines. If you have z/OS 1.11 or the PTF for APAR OA27495 applied to 1.10 or 1.9 AND you have only zIIP engines but NO zAAP engines AND you set a new operating system parameter ZZ=YES then zAAP eligible workloads will run on the zIIP alongside zIIP eligible workloads.**
- *Using zAAP on zIIP is like buying colorsafe Cheer for your washing machine and being able to mix the lights and the darks☺*

Dealing with Health Checker Exceptions

- Resolution of a Health Checker exception frequently requires other subject matter experts cooperation
- Understanding of PFA exceptions and tuning has required recurring assistance from IBM Level-2 to adjust the proper “knob” correctly
- Don’t break existing system. Health Checker is reporting a potential problem don’t make an immediate visible one trying to hurry in a change.
- Avoid persistent outstanding exceptions it will lead to 'cry wolf syndrome' and Health Checks being disregarded.
- Running Health Checker and PFA and not looking at the output does not help you☹

Identifying Exceptions

- Automate notifications from Health Checker!
- We trap **HZS*** WTO using CA-OPSMVS
 - MLWTO avoid processing same event more than once
 - Consider “normal” error HZS0011E READING THE HZSPDATA DATA SET may want to just process HZS0001I, HZS0002E, HZS0003E, HZS0004I
 - EVENTUAL exceptions are emailed
 - CRITICAL exceptions are sent by email and pager
- Most well known SPOOL browsers and MVS monitors including IOF, SDSF, SYSVIEW, TMON, provide on-line interfaces to view and manage exceptions

Sending PFA documentation to IBM

- IBM Level-2 will typically need to see the data that is causing PFA to raise an exception
- Package the directory for the exception using the PAX command in batch
- PFA component ID is 5752SCPFA useful to know when opening a PMR

```
//UNPAX EXEC PGM=IKJEFT01
//SYSTSPRT DD SYSOUT=*
//SYSEXEC DD DSN=SYS1.SBPXEXEC,DISP=SHR
//SYSTSIN DD *
  oshell cd /u/pfauser/PFA_SMF_ARRIVAL_RATE ; +
  pax -wvzf /tmp/PMR93649.499.000.BTST.AUG11.PFASAR.pax .
/*
```


Sending PFA documentation to IBM

- **FTP documentation to IBM this is an example using batch directly from z/OS but you may have different procedures**

```
//FTP EXEC PGM=FTP,PARM='(EXIT'  
//SYSPRINT DD SYSOUT=*  
//SYSIN DD *  
testcase.software.ibm.com (timeout 720 exit=12  
anonymous  
you@yoursite.com  
cd /toibm/mvs  
lcd /tmp  
SENDSITE  
binary  
put PMR93649.499.000.BTST.AUG11.PFASAR.pax  
quit  
/*
```


PFA : Installation

- **RACF userid with OMVS segment we made it unique as doc specified and it's home directory is where PFA will store historical information**
- **Initially just added /pfauser to our primary USER file system. Most groups are segregated but odd users like ekmserv and others we have just created in /u. Once PFA had been running for a while saw zFS filling up and needing to be grown i.e. IOEZ00078E zFS aggregate OMVS.BTST.U.ZFS exceeds 95% full (2140/2250)**
- **Historical collection creates LOTS of small files which add up over time so a separate USS filesystem is a good idea.**

PFA : Installation

- **z/OS 1.12 added the automatic retention of past exception data. Up to 30 snapshots of data related to past exceptions saved each in a unique directory. This can be useful historical data for support.**
- **It can also significantly increase the use of the USS file system filling it up☹ This is another good reason to segregate PFA into its own file system.**
- **IOEZ00551I Aggregate OMVS.ASYS.PFA.ZFS ran out of space.**
- **IOEZ00445E Error extending OMVS.ASYS.PFA.ZFS.**
- **You may want to setup a CRON job or manually purge EXC_* directories (example EXC_20111106182) from the exception directories. Requirement to improve the purge and control retention has been voiced to IBM**

PFA : Installation

- On each system **BEFORE** starting PFA you need to copy the PROC from SYS1.SAMPLIB(AIRPROC) to your execution PROC. I used SYS1.PROCLIB(PFA)
- On each system **BEFORE** starting PFA you need to use the supplied script to create a directory structure

```
$ cd /u/pfauser
```

```
$ su
```

```
# pwd
```

```
/u/pfauser
```

```
# sh /usr/lpp/bcp/AIRSHREP.sh
```

All existing data files and directories removed.

Successfully created the Common Storage Usage Check Directory Structure.

Successfully created the Logrec Arrival Rate Check Directory Structure.

Successfully created and populated ini file for the Common Storage Usage Check.

Successfully created and populated ini file for the Logrec Arrival Rate Check.

PFA : Installation zFS

- **Allocated zFS and mounted for PFA. Must have RACF access to PFSCCTL or UID 0 to format ZFS**
- **zSeries File System (zFS) PARMLIB(IOEPRM00) has aggrfull(90,5) and aggrgrow=on**
- **IDCAMS**
 - **DEFINE CLUSTER (NAME(OMVS.ASYS.PFA.ZFS) -
LINEAR CYL(500,500) SHAREOPTIONS(3))**
- **IOEAGFMT**
 - **PARM=('-aggregate OMVS.ASYS.PFA.ZFS -compat')**
- **MOUNT FILESYSTEM('OMVS.ASYS.PFA.ZFS')
MOUNTPOINT('/u/pfauser') TYPE(ZFS) MODE(RDWR)**
- **Don't forget to update SYS1.PARMLIB(BPXPRMxx)**
- **MOUNT FILESYSTEM('OMVS.&SYSNAME..PFA.ZFS')
MOUNTPOINT('/u/pfauser') /* ZFS for /u/pfauser */
TYPE(ZFS) /* Filesystem type ZFS */
MODE(RDWR) /* Mounted or read/write */**

z/OS Predictive Failure Analysis (PFA)

- PFA checks have had to be customized via HZSPRMxx updates to avoid spurious notifications in many cases relief later provided by APARs

```
/* Predictive Failure Analysis Checks */  
ADDREPLACE POLICY STMT(PFA2) UPDATE  
CHECK(IBMPFA,PFA_MESSAGE_ARRIVAL_RATE)  
PARM='DEBUG(0) STDDEV(16) COLLECTINT(15) MODELINT(360)  
COLLECTINACTIVE(1) TRACKEDMIN(0) EXCEPTIONMIN(5)'  
REASON('less sensitive to avoid spurious trips')  
DATE(20110221)
```

```
ADDREPLACE POLICY STMT(PFA4) UPDATE  
CHECK(IBMPFA,PFA_MESSAGE_ARRIVAL_RATE)  
PARM='DEBUG(0) STDDEV(3) COLLECTINT(15) MODELINT(720)  
COLLECTINACTIVE(1) TRACKEDMIN(0) EXCEPTIONMIN(10)'  
REASON('less sensitive to avoid spurious trips')  
DATE(20110728)
```

PFA APARs of interest

- **OA31644 LOGREC ARRIVAL RATE SPURIOUS AIRH110E MESSAGE**
- **OA34655 PFA FRAMES AND SLOTS USAGE SPURIOUS. PREDICTIVE FAILURE ANALYSIS**
- **OA34586 HIGH CPU IN PFA AFTER PTF UA50081 FOR APAR OA29963 APPLIED**
- **OA35820 PREDICTIVE FAILURE ANALYSIS. Abend0C4 RC4 AIRHMEMA.x'FF' DECIMAL 255 PERSISTENT JOBS CAUSES A LOOP IN PFA THAT OVERLAYS STORAGE**
- **OA36462 ABEND0C4 IN AIRHMEXC**
- **OA36837 PREDICTIVE FAILURE ANALYSIS (PFA) TREATS TSO USERID AS PERSISTENT JOBS IN PFA_FRAMES_AND_SLOTS_USAGE CHECK**

PFA APARs of interest

- **OA38175 PREDICTIVE FAILURE ANALYSIS ENHANCEMENT TO DETECTING EXCEPTIONS** - An enhancement to the logic in detecting exceptions in z/OS 1.13 is being rolled back. This can help with some false positive exceptions. **PTF UA63721 for 1.12**
- **OA38416 PREDICTIVE FAILURE ANALYSIS FALSE EXCEPTION JES_SPOOL_USAGE (JSU). (1.13 > only)**
- **OA38279 PREDICTIVE FAILURE ANALYSIS PFA_COMMON_STORAGE_USAGE CHECK FALSE EXCEPTION ESQA** - PFA_COMMON_STORAGE_USAGE check can issue false exceptions for ESQA if there is no conversion of ECSA to ESQA storage and PFA detects that ESQA may exceed 100% This will trigger an exception to be issued. This is not valid because ECSA can still be used and the system is not in danger of being exhausted of storage.
- **OA37801 PFA_SMF_ARRIVAL_RATE DEFAULT SETTINGS MAY CAUSE FALSE EXCEPTIONS PREDICTIVE FAILURE ANALYSIS**

AIRH109E A problem with common storage usage



-----Original Message-----

From: Enterprise Event Management

Sent: Friday, July 24, 2009 3:51 PM

To: Knutson, Sam

Subject: z/OS Health Checker BTST 24 Jul 2009 HZS0004I

CHECK|IBMPFA,PFA_COMMON_STO

z/OS Health Checker BTST 24 Jul 2009 HZS0004I

CHECK|IBMPFA,PFA_COMMON_STORAGE_USAGE|: AIRH109E A problem with common storage usage |CSA and SQA| above the line was predicted to occur by 07/24/2009 21:51:17. The current usage is higher than expected based on an evaluation of the total capacity plus the threshold, the current usage, the current prediction, and the future prediction modeled at 07/24/2009 15:51:17.

```
-----  
* EMAIL NOTIFICATION SENT FROM OPS/MVS *  
*                                     *  
* SYSTEM :BTST                       *  
*   RULE  :MSGACTN.HZSINFO           *  
*   GROUP  :SKNUTSON                 *  
*   DATE   :24 Jul 2009   TIME: 15:51:17 *  
-----
```

AIRH109E A problem with common storage usage



Session A - application LU SYSVIEWT Connected to ASYS

File Edit Font Transfer Macro Options Window Help

PA1

SYSVIEW VTAM BTST ----- VSMTRACK.SUMMARY, Common Storage Tracking
Command =====>

Formats DEFAULT CSA ECSA ESQA ORPHAN SQA
Status SRT NoLIM NoSEL NoDST NoPFX NoOWN NoUPD NoPRT NoCAP

Options SPN CALLER SUMMARY MEMSWT ADJCNVT NOTRACKSTAT UNACCT

Jobname SYSVUSER ASID 0092 Jobid STC62017

| Region | ASize | UnAlloc/Large | Alloc/Pct% | Used/Pct% | Free | Cnvrt | Sel/Pct% |
|--------|-------|---------------|------------|-----------|-------|-------|-----------|
| E-CSA | 250M | 163M 147M | 87.5M 35% | 85.8M 34% | 1.72M | -0 | 85.8M 34% |
| E-SQA | 68.3M | 0 0 | 68.3M 100% | 53.2M 78% | 15.1M | +0 | 53.2M 78% |
| SQA | 780K | 0 0 | 780K 100% | 262K 34% | 517K | +0 | 262K 34% |
| CSA | 4M | 2.98M 2.98M | 1.02M 25% | 935K 23% | 104K | -0 | 935K 23% |

| Cmd | Jobname | Jobid | ASID | EndDate | EndTime | CSA | E-CSA | SQA | E-SQA | Total | NCmp | Owner | VAB |
|-----|----------|----------|------|---------|---------|-------|-------|-------|-------|-------|------|---------|---------|
| --- | *SYSTEM* | | | | | 104K | 20.1M | 170K | 30.6M | 51M | | SYSTEM | |
| --- | CAMSM | STC62349 | 00BE | | | | 18.9M | | 296 | 18.9M | | ADDRSPC | 02E43B0 |
| --- | NET | STC61970 | 0064 | | | 36392 | 13.7M | | 1376 | 13.7M | | ADDRSPC | 02E4362 |
| --- | *MASTER* | | 0001 | | | 253K | 5.59M | 40688 | 3.45M | 9.33M | | ADDRSPC | 021FC7E |
| --- | DB2SMSTR | STC62075 | 00B8 | | | 13848 | 3.37M | 64 | 8136 | 3.39M | | ADDRSPC | 02E43BE |
| --- | DB2SDIST | STC62078 | 00BB | | | 136 | 2.61M | 64 | 1552 | 2.61M | | ADDRSPC | 02E43B9 |
| --- | SMSVSAM | | 000A | | | | 2.18M | 64 | 8704 | 2.19M | | ADDRSPC | 02E4309 |

- Good exception system is still healthy only 34% used on ECSA but a task was out of profile. Testing on test Sysplex had found new bug.
- Recycle of started task temporarily resolved the problem and CA-CCI RO10195 and CA-DATACOM PTFs RO10065 were created

PFA_LOGREC_ARRIVAL_RATE



CHECK(IBMPFA,PFA_LOGREC_ARRIVAL_RATE)
START TIME: 08/18/2009 12:03:47.499169
CHECK DATE: 20080330 CHECK SEVERITY: MEDIUM
CHECK PARM: DEBUG(0) **STDDEV(2)** COLLECTINT(60) MODELINT(360)
COLLECTINACTIVE(1)

*** Medium Severity Exception ***

The LOGREC entry arrival rate is higher than expected and could cause a system problem by

08/18/2009 17:49:35.

When the LOGREC entry rate is higher than expected, it can indicate recurring failures on the system which can eventually lead to system hang. The prediction used in the comparison was modeled at 08/18/2009 11:49:35.

PFA_LOGREC_ARRIVAL_RATE



LOGREC Arrival Rate Prediction Report

Last successful model time : 08/18/2009 11:49:35

Next model time : 08/18/2009 17:49:35

Model interval : 360

Last successful collection time: 08/18/2009 11:52:37

Next collection time : 08/18/2009 12:52:37

Collection interval : 60

| Key 0 | Key 1-7 | Key 8-15 |
|-------|---------|----------|
|-------|---------|----------|

Arrivals in last

| | | | |
|----------------------|----|-----|---|
| collection interval: | 77 | 364 | 8 |
|----------------------|----|-----|---|

Predicted rates based on...

| | | | |
|-----------------|---|---|---|
| 1 hour of data: | 9 | 0 | 5 |
|-----------------|---|---|---|

Jobs having LOGREC arrivals in last collection interval:

| Job Name | ASID | Arrivals |
|----------|------|----------|
| DSMD0D | 0205 | 438 |
| NONE-FRR | 00D0 | 1 |
| U38T20 | 0344 | 1 |

PFA_LOGREC_ARRIVAL_RATE



- **ABEND rate can vary widely and quickly**
- **Out of the box check tends to trip spuriously**
- **Remember this is saying “look at me” not I am broken**
- **Adjusted STDEV temporarily**
- **APAR OA31644 LOGREC ARRIVAL RATE SPURIOUS AIRH110E MESSAGE was the real resolution to spurious trips from this check and has been effective**

PFA Customer Experience Summary

- I run Health Checker and PFA and you should too
- There are many opportunities for new and improved PFA checks. I would like to see PFA doing global monitoring of private virtual storage use for persistent address spaces
- Please work with IBM to tune your checks to work accurately and improve PFA for everyone
- z/OS 1.12 contained some useful enhancements to PFA which will not be rolled back to previous releases
- The goal of automatically configured proactive detection failures or looming problems is laudable
- This is a hard problem and I am not sure when PFA exceptions will be sufficiently accurate to treat them as operational alerts
- *HAL: I've just picked up a fault in the AE35 unit. It's going to go 100% failure in 72 hours. 2001: A Space Odyssey (1968)*

PFA : References

- **Session 2866 IBM Experience Building Remote Checks for the IBM HEALTH CHECKER for z/OS presented at SHARE in Austin by James Caffrey**
- **Manual: [z/OS Problem Management](#) G325-2564-04 April 2009 not included in -02 on April 2009 z/OS V1R10 and Software Products DVD Collection need to obtain this from the web or a later DVD**
- **[WSC Flash WP101454](#) by Riaz Ahmad can be found on the web, www.ibm.com/support/techdocs under the category of “White Papers.”**
- **Session 2858 Health Checker: User Experience Beyond Installation presented at SHARE in Tampa by Sam Knutson and Dave Danner**
- **Session 2208 Bit Bucket x'26' presented at SHARE in Denver**

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