z/OS V2.5 IBM Education Assistant

Solution Name: Predictive Failure Analysis (PFA) Exhaustion Check for JES2 Resources

Solution Element(s): BCP PFA

August 2021

Agenda

- Trademarks

- Objectives

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Trademarks

- See url http://www.ibm.com/legal/copytrade.shtml for a list of trademarks.
- Additional Trademarks:
  - None

Objectives

- Discuss the new PFA_JES2_RESOURCE_EXHAUSTION Check
  - Alerts your system operators of *potential future exhaustion* of JES2 resources so that they can take action before it impacts your business!

Overview

- Who (Audience)
  - Systems operators, systems programmers

- What (Solution)
  - Created a new PFA check to track usage trends of the following JES2 resources:
    - TGS (SPOOL Track Groups)
    - JQE (Job Queue Elements)
    - JOE (Job Output Elements)
    - BERT (Control Block Extensions)
  - If potential future exhaustion is detected based on the modeled trend of the current usage into the future for any of these resources, PFA will issue a health check exception and a report with sufficient data to investigate the problem and take appropriate action.

- Wow (Benefit / Value, Need Addressed)
  - Assists in avoiding outages related to JES2 resource exhaustion.
  - This check is different from the $HASP050 messages which indicate that a JES2 resource shortage exists. It detects the potential for future exhaustion based on the current trends.

Usage & Invocation – slide 1 of 6

- PFA uses a JES2 SSI 71 invocation to obtain the JES2 resource limits information
  - This is similar to the $D LIMITS JES2 command new in V2R4.
  - PFA tracks only the JES2 non-privileged space.
  - The SSI 71 invocation uses the IAZLIMD parameter list.

- Usage tips:
  - The check exception report:
    - Has resource(s) in exception marked with *
    - Shows a description of which command and keyword to use to increase the capacity of that resource
  - The check uses IBM Health Checker for z/OS dynamic severity capabilities
    - Severity of exception changes based on the number of minutes projected until exhaustion occurs
    - Dynamic severity parameters are configurable
  - Use COMP% to adjust the sensitivity of check
    - Defines the percentage of capacity for which exhaustion occurs.
    - Default = 100% (the total capacity). Lower COMP% to get exceptions earlier.
  - This check cannot detect rapid growth that occurs on a machine-time scale such as within a collection interval.

- This check and the PFA_JES_SPOOL_USAGE check do not overlap!
  - This new check is looking for *exhaustion* of the four JES2 resources
  - PFA_JES_SPOOL_USAGE is looking for *damaged address spaces* by detecting when an address space has an abnormal increase in track groups.

- The check's report
    1. Shows exception message at the top
    2. Reminds you to look at new diagnostic actions in the "Operator Response" section of the message at the bottom of the report.
    3. Contains section headings to group information
    4. Shows additional information from JES2 by resource type and by count and rate, where applicable.
    5. Designates resources in danger of exhaustion with an asterisk.
    6. Shows which address spaces might be causing the exception if modeled by PFA.
    7. Shows command and keyword to use to increase the resource capacity.
    8. Lists recommended actions in the "Operator Response" of the exception message.

- Example scenario on next slides: A job is running that is exhausting JES2 resources

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4 and 5

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* Medium Severity Exception Issued *

One or more JES2 resources will exceed its capacity by 04/30/2021
14:37:45.

See the 'Operator Response' section of the exception message below for
recommended actions.

              JES2 Resource Exhaustion Prediction Report

Last successful model time     :  04/30/2021 13:53:07
Next model time                :  04/30/2021 14:13:07
Model interval                 :  20
Last successful collection time:  04/30/2021 13:53:29
Next collection time           :  04/30/2021 13:58:29
Collection interval            :  5

SECTION 1: JES2 RESOURCE USAGE DATA

                   Total      Current    Current    Percentage
                   Current    Prediction Capacity   of Count
Resource           Count      of Count   of Count   to
Capacity
_____   _____   _____  _____  _____
CB extensions             185        184        475        39%
Job output elements       587       2298       1400        42%
*Job queue elements       613       2330       1200        51%
Spool track groups       1207       2082       2655        45%

SECTION 2: ADDRESS SPACE DATA FOR EACH RESOURCE

CB EXTENSIONS:

   Jobs modeled by PFA that had the highest increased count of
   CB extensions:

                                  Current    Percentage
                       Current    Prediction of Total
   Job Name  Job ID    Count      of Count   Count

   _____  _____  _____   _____  _____
   J0000125  JOB01207  3651425627   UNKNOWN         1        0%
   J0000167  JOB01206  3651425625   UNKNOWN         1        0%
   J0000209  JOB01205  3651425623   UNKNOWN         1        0%
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Top consumers by count for CB extensions:

                                             Percentage
                                  Current    of Total
                                  Count      Count
Job Name   Job ID    Job Key      _____   _____
_____   _____  _____
TCS1       STC00002  3651416358          1        1%
JES2LQ1    JOB00703  3651423630          1        1%
JES2LQ2    JOB00704  3651423635          1        1%
ZFS        STC00007  3651416363          1        1%
SYSLOG     STC00008  3651416364          1        1%
INIT       STC00009  3651416365          1        1%
JES2LQ3    JOB00706  3651423641          1        1%
WELLIE0    TSU00015  3651416407          1        1%
J0000145   JOB01286  3651425945          1        1%
J0000194   JOB01287  3651425947          1        1%
J0000244   JOB01289  3651425957          1        1%
SDSF23     STC00003  3651416359          1        1%

   Refer to the z/OS JES2 Commands manual section for the $T CKPTSPACE
   command and the BERTNUM= keyword(s) for information concerning
   increasing the capacity of CB extensions.

JOB OUTPUT ELEMENTS:

   Top consumers by count for Job output elements:

   Current      Percentage
                                  Current    Rate Per   of Total
   Job Name  Job ID    Job Key    Count      Minute     Count

   _____  _____  _____   _____  _____  _____
   J0000001  JOB00705  3651423640         1     0.000         0%
   J0000001  JOB00707  3651423647         1     0.000         0%
   J0000002  JOB00708  3651423649         1     0.000         0%
   J0000001  JOB00709  3651423656         1     0.000         0%
   J0000002  JOB00710  3651423659         1     0.000         0%
   J0000003  JOB00711  3651423660         1     0.000         0%
   J0000004  JOB00712  3651423668         1     0.000         0%
   J0000003  JOB00713  3651423670         1     0.000         0%
   J0000002  JOB00714  3651423672         1     0.000         0%
   J0000005  JOB00715  3651423678         1     0.000         0%

   Refer to the z/OS JES2 Commands manual section for the $T OUTDEF
   command and the JOENUM= keyword(s) for information concerning
   increasing the capacity of Job output elements
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*JOB QUEUE ELEMENTS:

  Jobs modeled by PFA that had the highest increased rate of
  Job queue elements:

                                            Current
                                Current     Prediction
  Job Name   Job ID    Job Key  Rate        of Rate
  _____   _____  _____  _____   _____
  JES2LQ1    JOB00703  3651423630   6.291      9.255
  JES2LQ2    JOB00704  3651423635   5.324      5.505
  JES2LQ3    JOB00706  3651423641   3.993      9.226
  WELLIE0    TSU00015  3651416407   0.073      0.090

  Top consumers by rate for Job queue elements:

                                Current
                                Rate Per
  Job Name   Job ID    Job Key  Minute
  _____   _____  _____  _____
  JES2LQ1    JOB00703  3651423630   6.291
  JES2LQ2    JOB00704  3651423635   5.324
  JES2LQ3    JOB00706  3651423641   3.993
  WELLIE0    TSU00015  3651416407   0.073

  Refer to the z/OS JES2 Commands manual section for the $T JOBDEF
  command and the JOBNUM= keyword(s) for information concerning
  increasing the capacity of Job queue elements.
```

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SPOOL TRACK GROUPS:

  Top consumers by count for Spool track groups:

                                          Current     Percentage
                                Current   Rate Per    of Total
  Job Name  Job ID    Job Key   Count     Minute      Count
  _____  _____  _____  _____  _____    _____
  SYSLOG    STC00008  3651416364      10    0.222          1%
  SDSF23    STC00003  3651416359       3    0.037          0%
  J0000001  JOB00707  3651423647       2    0.000          0%
  J0000002  JOB00708  3651423649       2    0.000          0%
  J0000001  JOB00709  3651423656       2    0.000          0%
  J0000002  JOB00710  3651423659       2    0.000          0%
  J0000003  JOB00711  3651423660       2    0.000          0%
  J0000004  JOB00712  3651423668       2    0.000          0%
  J0000003  JOB00713  3651423670       2    0.000          0%
  J0000002  JOB00714  3651423672       2    0.000          0%
  J0000005  JOB00715  3651423678       2    0.000          0%
  J0000004  JOB00716  3651423682       2    0.000          0%
  J0000006  JOB00717  3651423687       2    0.000          0%
  J0000003  JOB00718  3651423688       2    0.000          0%
  J0000005  JOB00719  3651423694       2    0.000          0%
  J0000007  JOB00720  3651423697       2    0.000          0%
  J0000004  JOB00721  3651423703       2    0.000          0%
  J0000006  JOB00722  3651423706       2    0.000          0%
  J0000008  JOB00723  3651423707       2    0.000          0%
  J0000009  JOB00724  3651423716       2    0.000          0%


  Top consumers by rate for Spool track groups:

                                          Current     Percentage
                                Current   Rate Per    of Total
  Job Name  Job ID    Job Key   Count     Minute      Count
  _____  _____  _____  _____  _____    _____
  SYSLOG    STC00008  3651416364      10    0.222          1%
  SDSF23    STC00003  3651416359       3    0.037          0%

  Refer to the z/OS JES2 Commands manual section for the $T SPOOLDEF
  command and the TGSPACE=ACTIVE= keyword(s) for information concerning
  increasing the capacity of Spool track groups.
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* = JES2 resources that caused the exception.

* High Severity Exception *

AIRH264E One or more JES2 resources will exceed its capacity by
10/19/2020 18:41:09.

  Explanation:  The check is looking to see if there is a potential for
    JES2 resources to be exhausted in the upcoming model interval.
    Exhaustion of JES2 resources can lead to widespread system impacts
    in jobs that are dependent upon job management services and spooled
    output.

    The model of JES2 resources for this LPAR has predicted that usage
    of one or more resources will exceed the capacity definition set by
    the user before the current model interval ends at 10/19/2020
    18:41:09. The prediction was modeled at 10/19/2020 17:45:28.

    In general, the spool track groups, BERTs, and JOE limits should be
    set high. Note that once your system runs out of spool, all other
    jobs continue to run until they need a JES2 service. At that time,
    they enter a wait for the "out of spool" condition to be resolved.

  System Action:  Subsequent runs of this check will not produce an
    operator message until new data is available.

Operator Response: ←      8

    1. Examine SECTION 1: JES2 RESOURCE USAGE DATA in the report above.
    Resources that start with an asterisk (*) have the potential to be
    exhausted in the next model interval. This report contains the total
    current usage and the predictions for each of the JES2 resources
    tracked by this check.
```

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2. Examine SECTION 2: ADDRESS SPACE DATA FOR EACH RESOURCE in the
report above. One or more resources may have caused the exception.
The resources causing the exception will have an asterisk (*) in
front of their resource names.

There will be from one to three lists shown for each resource. One
list may be the jobs modeled by PFA that may contain up to ten
consumers whose usage has increased the most. Another list may
contain up to twenty top consumers by count as identified by JES2.
Another list may contain up to twenty top consumers by rate as
identified by JES2. Address spaces in more than one list are likely
the cause of the problem.

3. Use the $D LIMITS command, if desired, which will provide
information similar to what is on the report above. If the resource
usage is consistently high such as at 90%, consider changing the
JES2 resource limits which are high. Use the command listed in the
report above for each resource that specifies how to increase the
resource capacity.

4. Create a graph of the usage for each resource in exception listed
above marked with an asterisk (*). Then, graph the top five address
spaces using the most of the resource in exception. Use these graphs
to help determine when the anomaly started and whether this is a
large consumer with a spike or creep in usage. IBM has provided
Python scripts that can be used to graph this resource usage over
time. These graphs can be very helpful in determining the root cause
of the problem. See the 'Graphing Exhaustion Data' section in z/OS
Problem Management for more details.

5. Examine SYSLOG and OPERLOG for $HASP messages which indicate that
the warning limit has been reached.

6. If the problem cannot be isolated and local guidelines allow it,
initiate an SVC dump of the jobs whose usage is increasing the most
as shown in the report.

7. To find additional recommendations, consult the z/OS Problem
Management book, Predictive Failure Analysis checks chapter,
PFA_JES2_RESOURCE_EXHAUSTION subsection, in the 'Best Practices'
topic.
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8. If the problem cannot be easily determined in a short amount of time and you want to stop all exceptions until the problem can be resolved, do one of the following:

a. Quiesce the check so that data continues to be collected, but comparisons are not performed. Quiescing the check allows the check to resume processing with no interruption of collected data once the check is reactivated. First, ensure the check will collect and model data while deactivated by setting COLLECTINACTIVE to 1 and then deactivate the check.

```
f hzsproc,update,check(IBMPFA,PFA_JES2_RESOURCE_EXHAUSTION),
parm('collectinactive(1)')

f hzsproc,deactivate,check(IBMPFA,PFA_JES2_RESOURCE_EXHAUSTION)
```

b. Change the severity of the exception so that all processing continues for this check, but exceptions are not issued by modifying the dynamic severity parameters for this check by setting these parameters so that all exceptions issued by this check use no severity. Use the command below or establish an IBM Health Checker for z/OS PARMLIB member to make the change persistent:

```
f hzsproc,update,check(IBMPFA,PFA_JES2_RESOURCE_EXHAUSTION),
parm('e_high(unused) e_med(unused) e_low(unused) e_none(max)')
```

9. After investigating the problem, if you have determined that the exception is normal operating behavior and you do not want to be alerted for similar data in the future, perform one or more of the following actions:

a. Modify this check's COMP% parameter to a higher value. This parameter indicates the percentage of the current capacity used for that value that defines exhaustion. For example, a value of 102 indicates that 102 percent of the capacity is used in the calculations using capacity rather than 100 percent and that the prediction must be at least 102 percent of the current capacity before comparisons will be performed which makes exceptions less frequent. Setting the COMP% too high might cause exhaustion problems to be undetected. Setting the COMP% too low might cause more undesired exceptions. Use the command below and specify your desired value in place of the X or establish an IBM Health Checker for z/OS PARMLIB member to make the change persistent:

```
f hzsproc,update,check(IBMPFA,PFA_JES2_RESOURCE_EXHAUSTION),
parm('comp%(X)')
```

b. Modify this check's dynamic severity parameters by using the IBM Health Checker for z/OS modify command. These parameters determine the severity of the WTO issued when this check detects the potential for future exhaustion. The severity is based on the number of minutes until exhaustion would occur with a steady increase of usage such that the severity increases the closer the system is to resource exhaustion. The number of minutes is specified in the E_HIGH, E_MED, E_LOW, and E_NONE parameters. Use the command below and specify your desired values in place of X or establish an IBM Health Checker for z/OS PARMLIB member to make the change persistent:

```
f hzsproc,update,check(IBMPFA,PFA_JES2_RESOURCE_EXHAUSTION),
parm('e_high(X) e_med(X) e_low(X) e_none(X)')
```

Interactions & Dependencies

- Interactions
  - Resources are tracked for the primary JES2 in a MAS.
  - PFA does processing for each MVS member in a SYSPLEX separately.

- Software Dependencies
  - None

- Hardware Dependencies
  - None

- Exploiters
  - None

Upgrade & Coexistence Considerations

- To exploit this solution, all systems in the sysplex must be at the new z/OS level: No

- List any toleration/coexistence APARs/PTFs: None

Installation & Configuration

- Nothing new.
    - The check is automatically added to IBM Health Checker for z/OS when PFA starts.
    - If you have not previously used PFA, see the chapter entitled *Predictive Failure Analysis overview and installation* in *z/OS Problem Management* (also listed in the Appendix of this presentation).

Summary

- Predictive Failure Analysis (PFA) has added a new check, PFA_JES2_RESOURCE_EXHAUSTION, which detects and alerts you to the potential for future exhaustion of JES2 resources.

- This check tracks usage of the JES2 resources BERTs, JOEs, JQEs, and SPOOL and predicts future usage based on the current trends.

- This check's report contains data to investigate the problem and take appropriate action to avoid outages.

Appendix

- *z/OS Problem Management* SC23-6844