RMF Development Edition

z/OS
Resource Measurement Facility

The RMF2WTO Secret

From Exceptions to Console Messages

August, 10th 2009

This presentation describes how to setup RMF in order to generate console messages in case an RMF monitored metric exceeds a certain threshold

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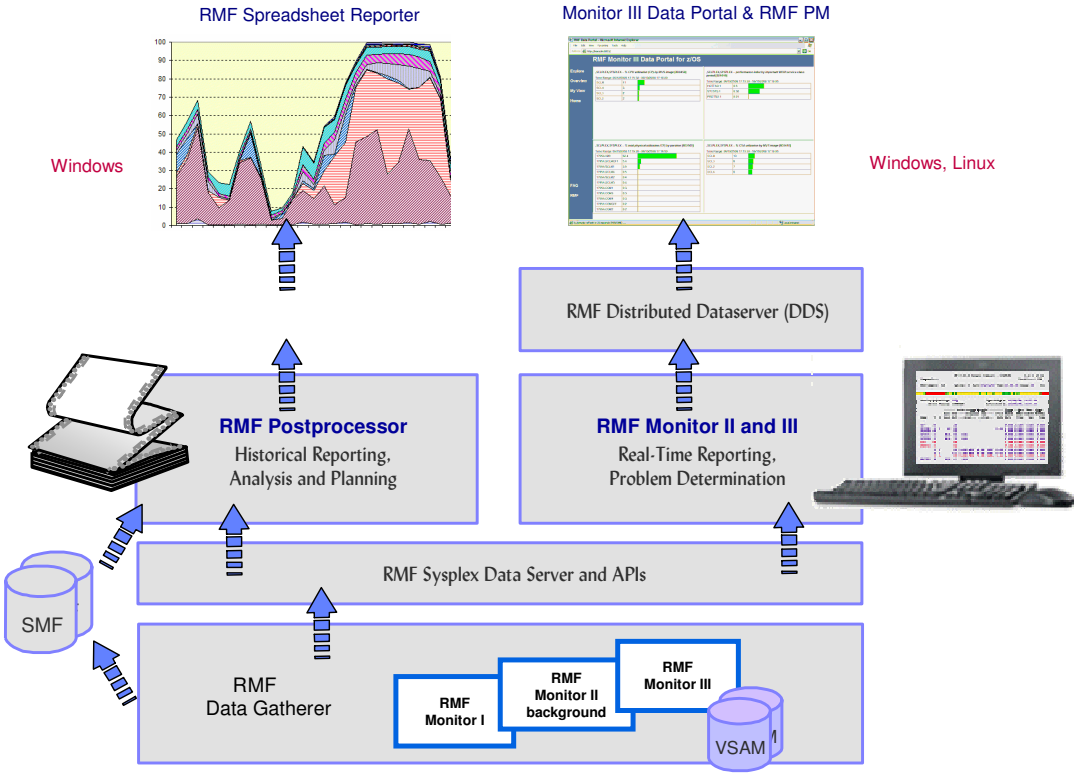
Agenda

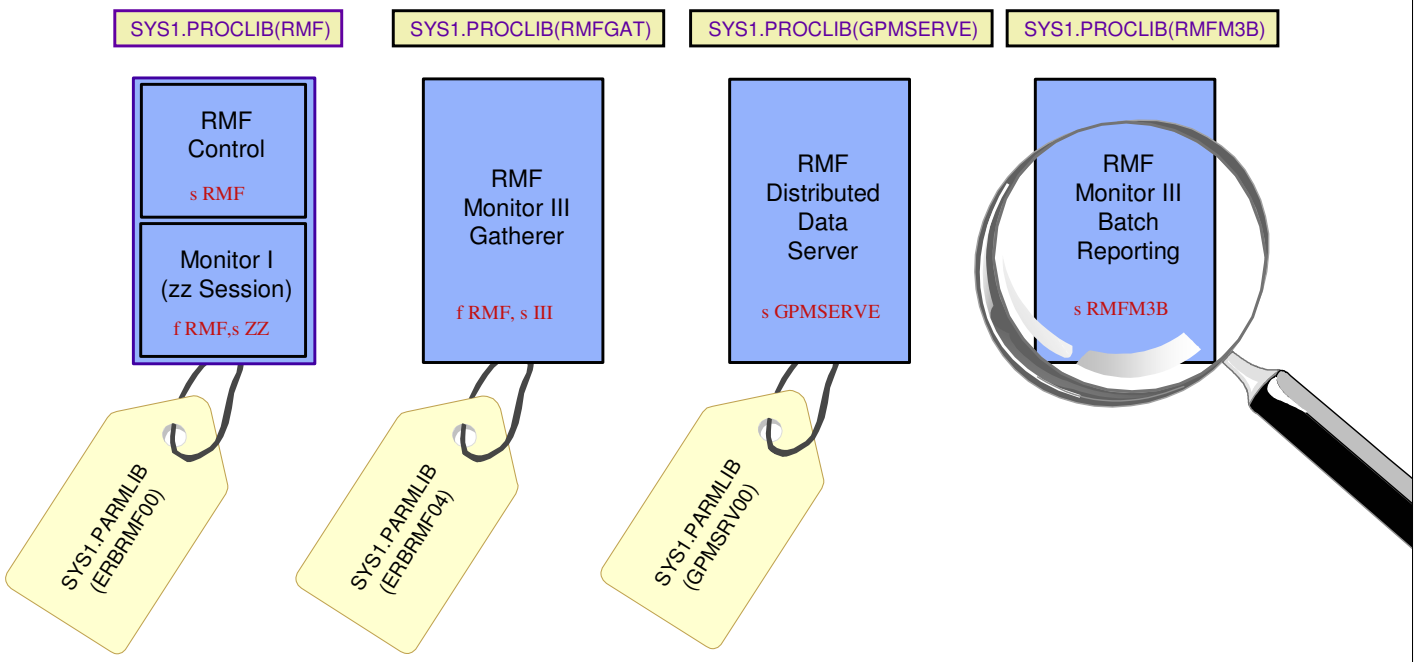
- Product Overview
- Monitor III Batch Reporting
  - JCL & Components
  - Setup the Batch Job
  - Cloning of Report Options
- The Workflow Exception Report (WFEX)
  - Report Content
  - Exception Definitions
- Monitor III Reporter Phase Concept
  - Phase 3 User Interception
  - Report Table Scanning
  - Generation of Console Messages
- Examples

RMF Product Overview



- z/OS Resource Measurement Facility (RMF) is an optional priced feature of z/OS. It supports installations in performance analysis, capacity planning, and problem determination. For these disciplines, different kinds of data collectors are needed:
  - Monitor I long term data collector for all types of resources and workloads. The SMF data collected by Monitor I is mostly used for capacity planning and performance analysis
  - Monitor II snap shot data collector for address space states and resource usage. A subset of Monitor II data is also displayed by the IBM SDSF product
  - Monitor III short-term data collector for problem determination, workflow delay monitoring and goal attainment supervision. This data is also used by the RMF PM Java Client and the RMF Monitor III Data Portal
- Data collected by all three gatherers can be saved persistently for later reporting (SMF receords or Monitor III VSAM datasets)
- While Monitor II and Monitor III are realtime reporters, the RMF Postprocessor is the historical reporting function for Monitor I data

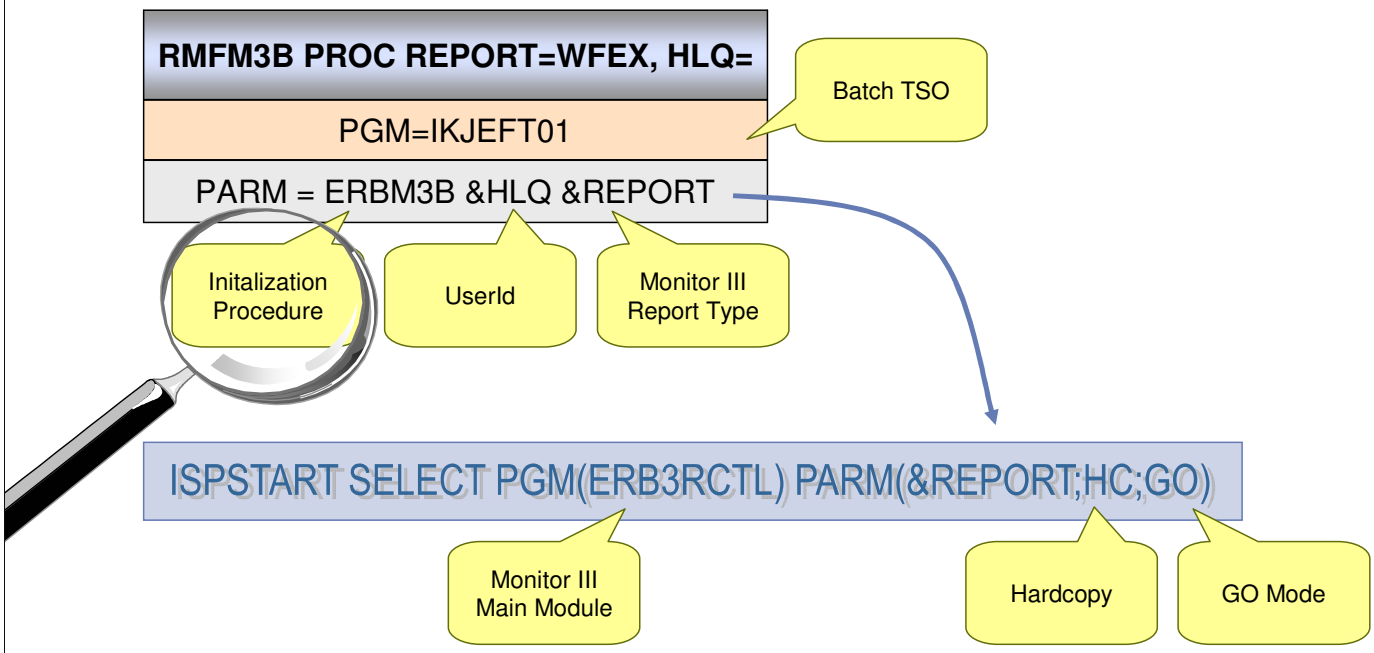
RMF Address Spaces



In order to make all RMF functions working, a couple of address spaces have to be activated:

- RMF is the root address space. It is required for any further activities
- The Monitor I gatherer is a subtask in the RMF address space. It is started immediately together with RMF (by default) or later by means of the modify command
- RMFGAT is the Monitor III data gatherer. It cannot be started as standalone address space. Like Monitor I, it can only be activated with the modify command. Within a sysplex, one instance per system is needed for RMFGAT
- The RMF Distributed Data Server is the data source for the RMF Performance Monitoring java client and the Monitor III Data Portal. Only one instance is needed per sysplex
- RMFM3B is needed for the generation of console messages in case a certain threshold is exceeded

Monitor III Batch Reporting



- Once RMFM3B has been started the utility IKJEFT01 receives control and builts up a standard batch TSO environment
- During the START command, a high level qualifier and the requested Monitor III report type can be specified. Please note, that just one report type can be specified per RMFM3B instance. In case you need multiple report types you can create corresponding RMFM3B clones.
- The TSO batch utility instantly passes control to the initialization procedure ERBM3B which has the following resposibilties:
  - Builds up an ISPF environment
  - Invokes the Monitor III main reporter module ERB3RCTL with three parameters:
    - Requested report type
    - Hardcopy=ON
    - Start report session in GO mode
- The batch report session will create now one Monitor III WFEX report for each interval resp. Mintime. The report output is written either to SYSOUT or to an exclusive dataset, which can be specified with the Monitor III session options

Monitor III Batch Reporting...

- Standard Libraries
  - ISPF (Default Prefix=SYS1)
  - RMF (Default Prefix=SYS1)
- User Libraries
  - &HLQ..RMFM3B.SERBCLS (for customized procedures)
  - &HLQ..RMFM3B.ISPTABLE (for cloned M III options)

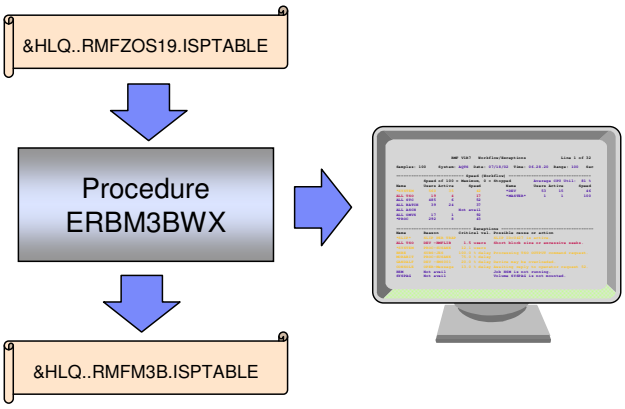
RMFM3B PROC RMF=SYS1,ISPF=SYS1

```
//SYSPROC  DD DISP=SHR,DSN=&HLQ..RMFM3B.SERBCLS
//         DD DISP=SHR,DSN=&RMF..SERBCLS
//         DD DISP=SHR,DSN=&ISPF..SISPEXEC
//         DD DISP=SHR,DSN=&ISPF..SISPCLIB
//ISPPLIB  DD DISP=SHR,DSN=&ISPF..SISPPENU
//         DD DISP=SHR,DSN=&RMF..SERBPENU
//ISPSLIB  DD DISP=SHR,DSN=&ISPF..SISPSENU
//ISPMLIB  DD DISP=SHR,DSN=&ISPF..SISPMENU
//         DD DISP=SHR,DSN=&RMF..SERBMENU
//ISPTLIB  DD DISP=SHR,DSN=&ISPF..SISPTENU
//         DD DISP=SHR,DSN=*.ALLOC.ERBPHDS3
//         DD DISP=SHR,DSN=&HLQ..RMFM3B.ISPTABLE
//         DD DISP=SHR,DSN=&RMF..SERBTENU
//         DD DISP=SHR,DSN=&RMF..SERBT
//ISPTABL  DD DISP=SHR,DSN=*.ALLOC.ERBPHDS3
```

Use Procedure ERBM3BWX for the Cloning

- The Procedure RMFM3B basically works with the standard RMF and ISPF libraries
- Just two additional libraries have to be provided resp. preallocated by the user before RMFM3B can be activated:
  - One library containing the customized procedures to control the threshold processing
  - Another library containing the Monitor III option table clones. Procedure ERBM3BWX ist provided for the cloning process

Monitor III Batch Reporting...



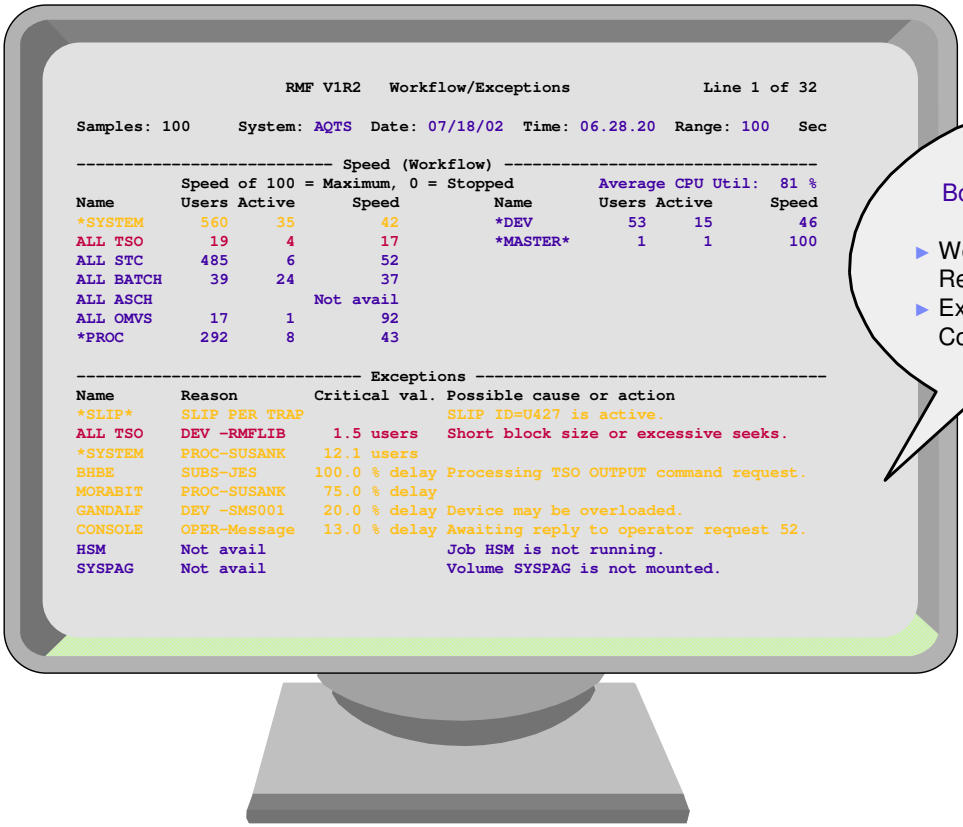
It is recommended to work with cloned reporting tables. Otherwise the tables must be shared between TSO & Batch sessions

Procedure ERBM3BWX:

- Initializes Monitor III Reporter Environment
- Invokes the Workflow Exception Report (WFEX)
- Let's you define your Exception criteria
- Let's you specify your session options (SO command), e.g. the hardcopy output dataset
- Creates the table clones (on exit)

- Procedure ERBM3BWX is designed to make the Monitor III Batch setup to a plain sailing.
- Once the procedure is started, the Monitor III Workflow Exception Report comes up. Type RO (=Report Options) in the command line and you can select between a rich set of exception criteria. Whenever an exception criteria is met, a corresponding message line is generated in the lower half of the WFEX report. Later on you can decide, whether you want this line be displayed on the operator console as well.
- Additionally, you can use the Monitor III interactive session to review and change your global session options for your batch driven reporting (SO command). Probably you want to specify an exclusive dataset for your hardcopy output or you might adjust the length of your reporting intervals (=Mintime)
- On exit, your specifications are saved to the table dataset &HLQ..RMFM3B.ISPTABLE. This is exactly the same name, which is used by the RMFM3B Started Task

Workflow Exception Report



Bottleneck Detection at a Glance !

- Workflow for Groups and Resources
- Exception Lines for individual Conditions

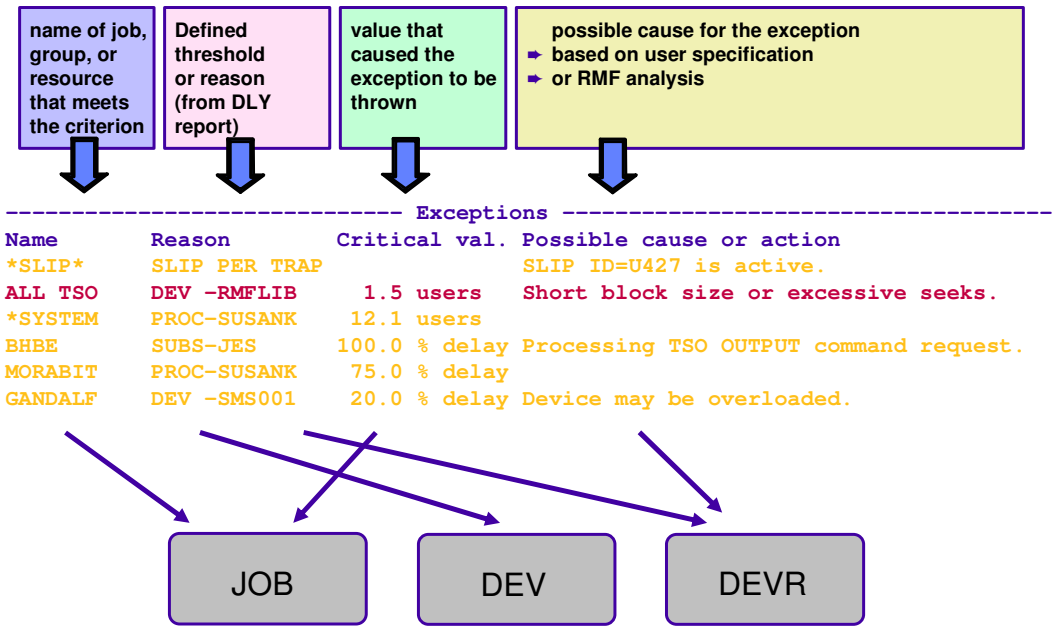
The Monitor III Workflow Exception Report consists of two independent sections:

- The *Workflow* section provides an overview about groups of work, individual address spaces or resources
  - Worflow is reported as Speed (using samples/(using samples + delay samples)
  - Users
    - For type group or address space: average number found, regardless of their state (including idle)
    - For type resource: total number of address spaces found at least one time using or delayed for the resource (single state)
  - Active
    - For type group or address space: average number found using or delayed for a resource
    - For type resource: average number of address spaces found using or delayed for the resource (single state)
- The *Exceptions* section displays alerts when critical thresholds are exceeded

The content of both sections can be customized individually:

- For the *Workflow* section, up to 14 candidates for continuous display of workflow can be selected
- For the *Exceptions* section, alerts for almost all Monitor III metrics (as well as combination of metrics) can be defined

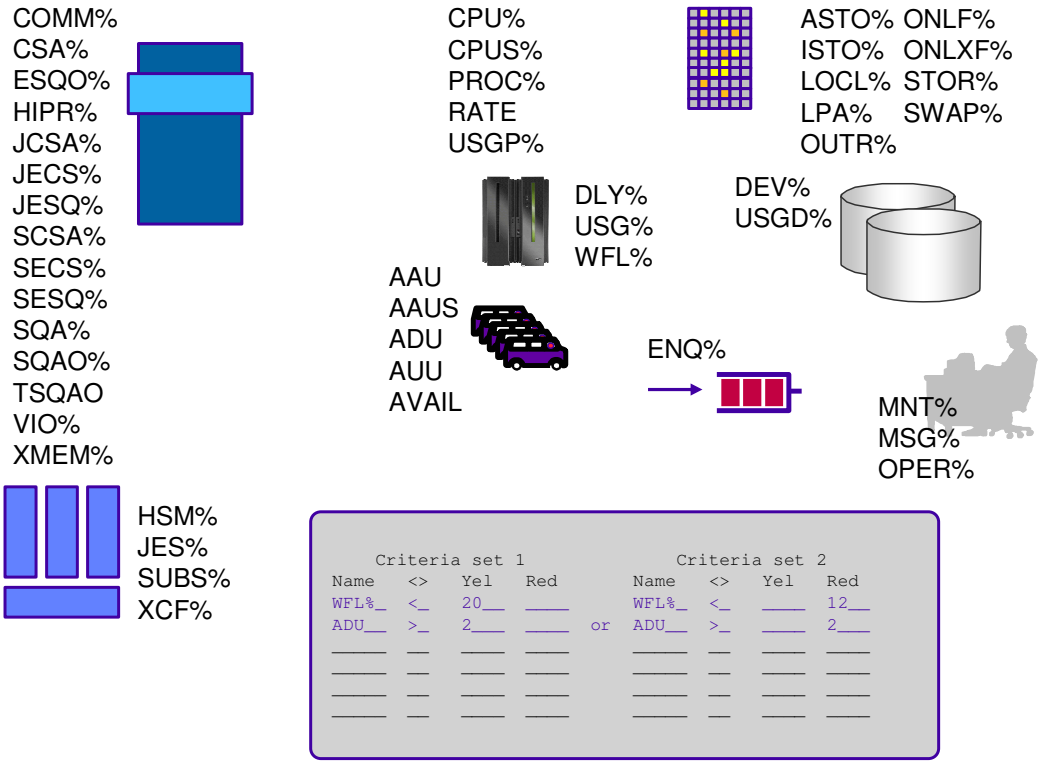
Exception Lines: Content



The exception lines in the WFEX report consist of the following columns:

- Name column:
  - Default content: name of job, group or resource
  - Optional content: label specified by the user
- Reason column: displays the defined exception criterion or in case of EX_ANY the reason (same than in the DELAY report)
- Critical val. column: displays the actual value which caused the exception
- Cause or action column
  - Default content: explanation based on best practices of RMF
  - Optional content: text specified by the user

Exception Criteria: Examples



For the definition of exception criteria, the user can choose from a rich set of conditions related to all existing hard- and software resources:

- Virtual Storage (e.g. % overall CSA usage or usage for a specific job)
- Processor (e.g. CPU utilization or using%, delay%)
- Real Storage (e.g. online frames)
- Device (e.g. using%, delay%)
- Jobs, Group of Jobs: active, delayed or using users (also applicable for resources)
- ENQ
- Operator

Exception criteria can be combined by means of criteria sets:

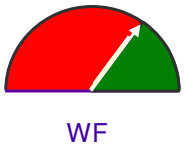
- Up to 5 criteria with AND condition
- UP to 3 criteria sets with OR condition

Exception Specification

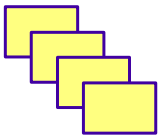
WFEX Options (RO)

```
Class       ===>  STC___
Qualifier   ===>  ________
Indicator   ===>  EX-ANY____
Label       ===>  __________
Alert       ===>  NONE_
Text        ===>  __________
```

- Object
  - Class
  - Qualifier
- Exception Indication
  - Indicator Type
- Object Name (optional)
  - Label
- Alert (optional)
  - Alert Type
- Reason
  - Text



WF



EX-ANY

EX-AVG

EX-GROUP

not found

EX-UNAVAIL

e.g. MONITOR3

e.g. Blink or Beep

New exceptions can be defined by means of the RO command in the WFEX report. The following categories can be specified:

- Exception object in terms of a class and an optional qualifier (for objects JOB, DEV, SRVCLASS). Valid classes are:
  - SYSTEM (all address spaces)
  - BATCH, STC, TSO, SRVCLS (groups of address spaces)
  - JOB (specific address space, qualifier required)
  - PROC, DEV, STOR (resources)
- Exception scope or indicator:
  - WF: monitors just workflow, no exception lines
  - EX-ANY: for objects of the type group the threshold is checked agains all instances (generates multiple exception lines)
  - EX-AVG: the threshold is checked against the group average
  - EX-GROUP: the threshold is checked against all instances (generates just one summary line for the group)
- Name (optional)
  - Overrides the default in the name colums
  - It is ignored in favour of the instance names for EX-ANY
- Alert: Blink, beep or none
- Reason : Overrides best practices of RMF explanation

Specify Exceptions: Example

```
Class       ===>  STC___
Qualifier   ===>  _________
Indicator   ===>  EX-GROUP__
Label       ===>  ___________
Alert       ===>  NONE_
Text        ===>  ___________

    Criteria set 1
Name    <>    Yel    Red
CPU%_   >_    _____  0.1_
```

```
Class       ===>  STC___
Qualifier   ===>  _________
Indicator   ===>  EX-ANY____
Label       ===>  ___________
Alert       ===>  NONE_
Text        ===>  ___________

    Criteria set 1
Name    <>    Yel    Red
CPU%_   >_    0.1_   _____
```

```
---------- Exceptions ----------

Name        Reason          Critical v
ALL STC     CPU% > 0.1        0.4 %
GRS         CPU% > 0.1        0.1 %
HZSPROC     CPU% > 0.1        0.2 %
OMEGHUBT    CPU% > 0.1        0.2 %
RMFGAT      CPU% > 0.1        0.3 %
WLM         CPU% > 0.1        0.4 %
```

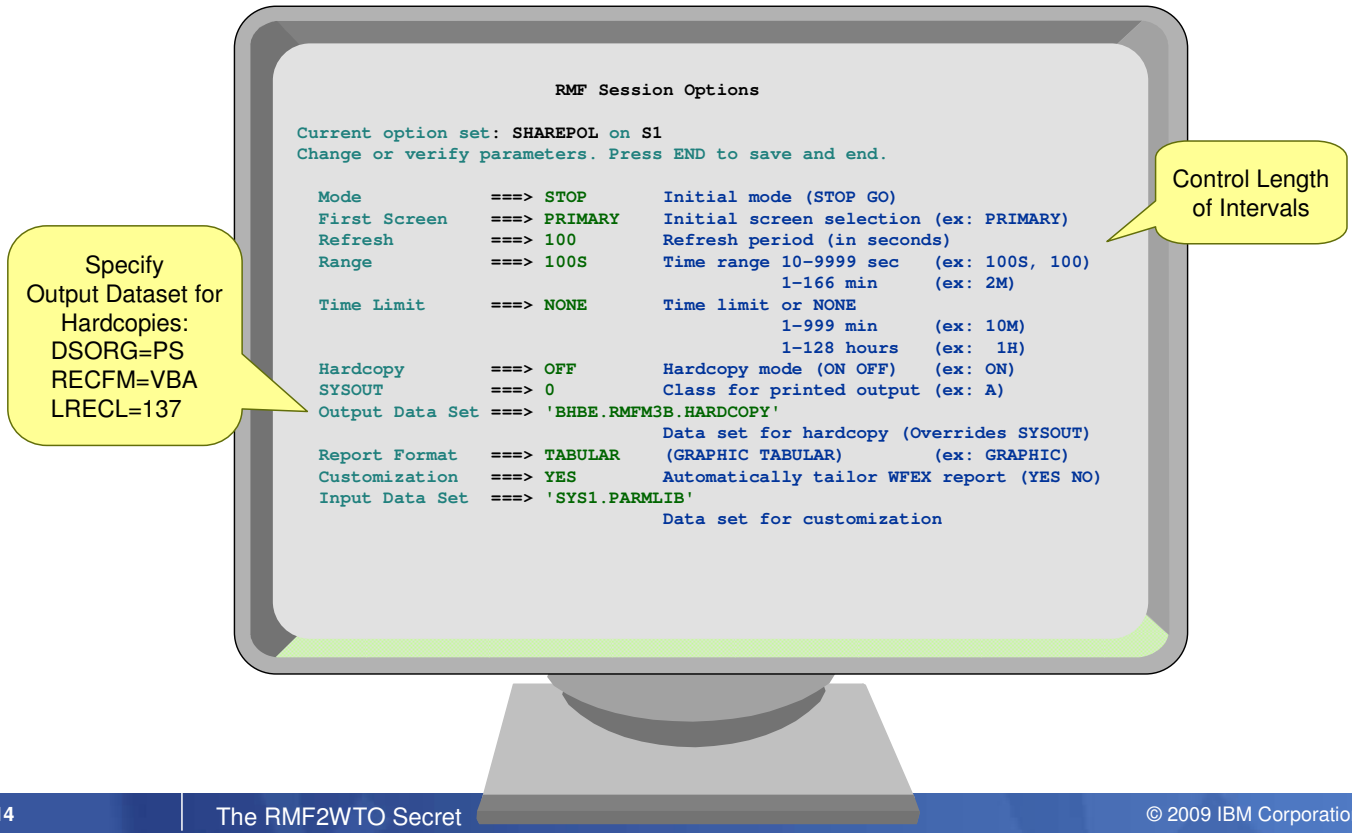
EX-GROUP: One summary exception line for the entire group

EX-ANY: One exception line per matching instance

Now let us define some simple exceptions:

- We want to monitor the CPU consumption (criterion name = CPU%) of all address spaces belonging to the class STC:
  - Generate one generic red exception line when the TCB% + SRB% for at least one address space exceeds the specified threshold (EX-GROUP)
  - Generate one yellow exception line for EACH address space which exceeds the specified limit (EX-ANY)
- We want to monitor the overall volume activity rate (criterion name = DAR) and figure out critical candidates with the highest utilization (Class = DEV)
  - Generate one generic red exception line when the overall volume activity exceeds the specified threshold (EX-AVG)
  - Generate one yellow exception line for each volume which exceeds the specified limit (EX-ANY)

Specify Session Options



Once you have completed your exception definitions, take a look a the global Monitor III Session Options.

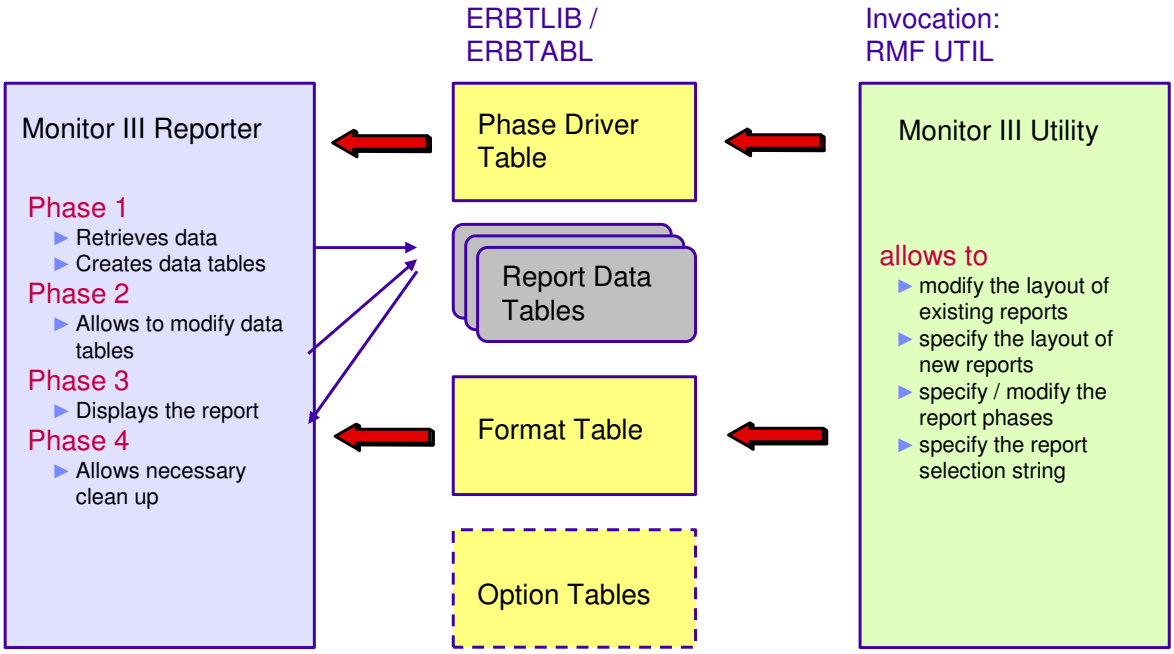
Type the command SO for the Session Options panel.

- If you want to set a longer period for the reporting intervals, you can adjust the Range parameter for your batch session
- By default, hardcopy reports are witten to a SYSOUT class. However, the specification of an Output Data Set allows you to assign an exclusive dataset for your report printouts

What else?

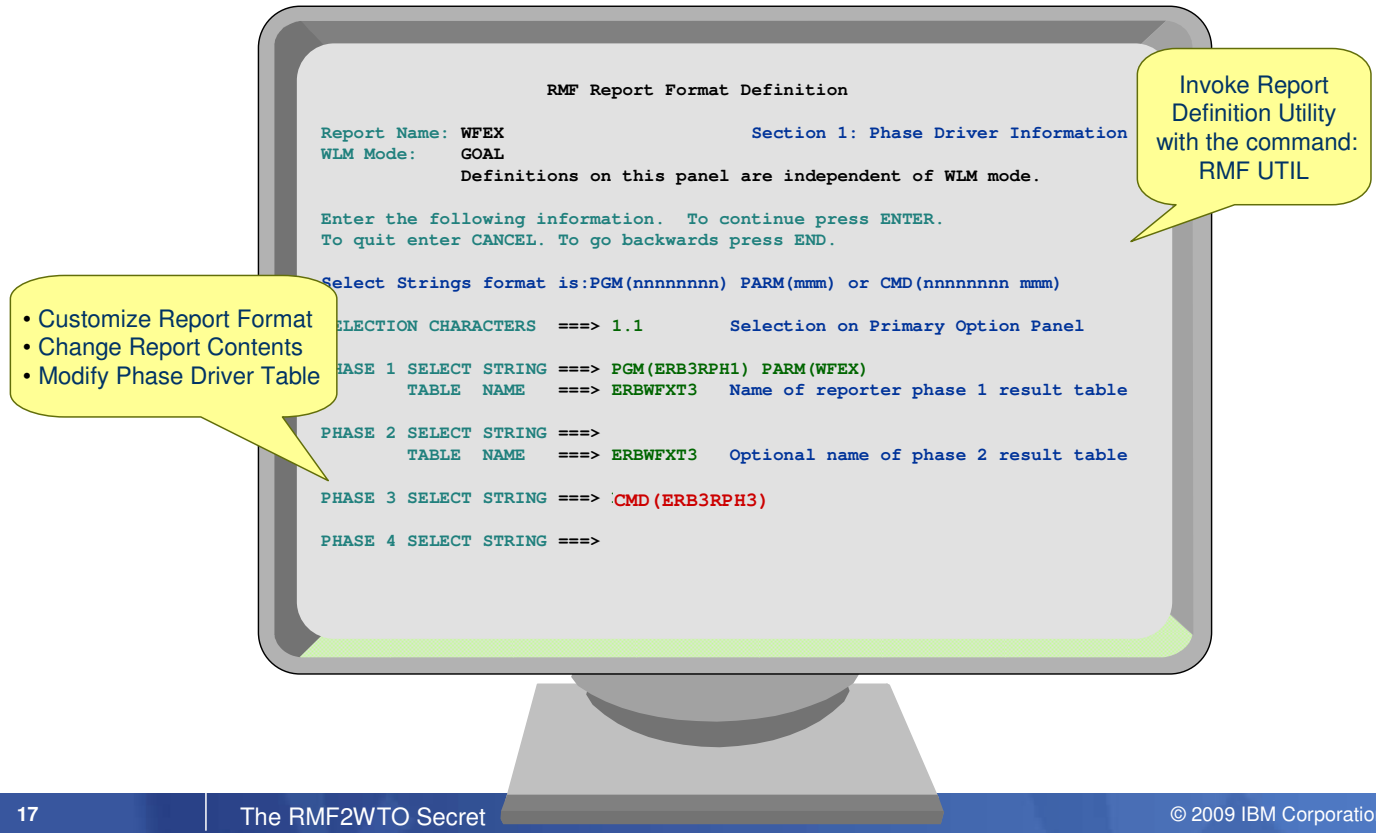
- We have completed the setup so far:
  - All datasets for the batch session are allocated
  - We have defined our exception criteria
  - We have specified our session options
- We still don‘t know:
  - What else is needed to redirect the exception lines to the console? Nothing !!
  - Can we assign individual message id‘s? Yes !!
  - Can we monitor metrics contained in other reports than the WFEX report? Yes !!

Monitor III Reporting Phases



- The creation of a standard Monitor III report is accomplished by means of 4 phases
- The Phase Driver Table ERBPHDS3 determines the command which is executed in each phase
- The user can plugin in anyone of the phases through a slight modification of the Phase Driver Table
- The Monitor III Batch exploits this mechanism by intercepting the display phases for all reports: now procedure ERB3RPH3 receives control in phase 3
- Technically spoken, the string PGM(ERB3RDSP) is exchanged against the string CMD(ERB3RPH3) in the phase driver table
- Once ERB3RPH3 receives control, any desired action can be taken, depending on the values found in the report data tables

Monitor III Report Definition Utility



When you have invoked the Monitor III Report Definition Utility ERBRMFU, you are prompted for the report type that you want to customize.

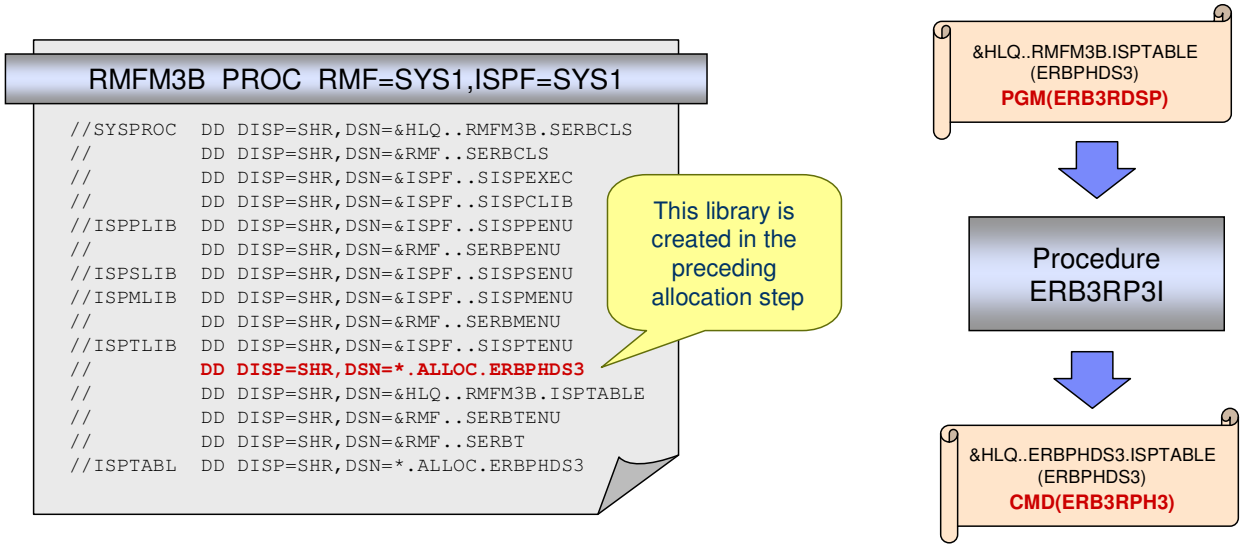
Then the first panel allows you to modify the phase driver table:

- This can be useful, if you want to make changes or extensions at the data tables created in phase 1. In this case you can specify your own module or procedure which should be called in phase 2
- In order to redirect our exception lines from the WFEX report to the console, we just need a small phase 3 modification: Instead of the call to the display module ERB3RDSP, we specify our own phase 3 exit procedure ERB3RPH3. This procedure is already provided by RMF and can basically remain unchanged

Phase Driver Table Modifications

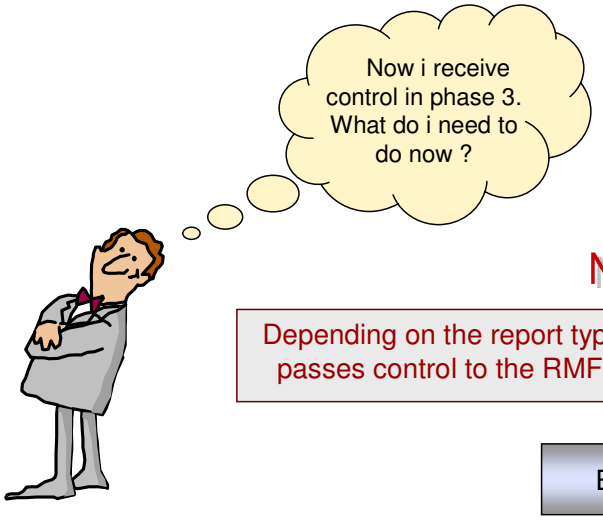
Procedure ERB3RP3I (“Phase 3 Installer“)

- Is automatically called during the Monitor III batch address space initialization by the main module ERBM3B (PGM=IKJEFT01, PARM=ERBM3B)
- Makes the modifications for the exit module ERB3RPH3 in the phase driver table
- Copies the modified phase driver table to &HLQ.ERBPHDS3.ISPTABLE



- The report definition utility ERBRMFU can be used to make the necessary modifications to the phase driver table (pass control to ERB3RPH3 instead of the standard report display)
- However this work is not needed in the Monitor III batch environment. Everything is performed automatically: The Phase 3 Installer ERB3RP3I is called during the Monitor III batch address space initialization by the main module ERBM3B. As result, a copy of the modified phase driver table is stored to the library &HLQ..ERBPHDS3.ISPTABLE. This library is at position number one in the RMF table library concatenation ISPTLIB for the Monitor III reporting session

Phase III Opportunities

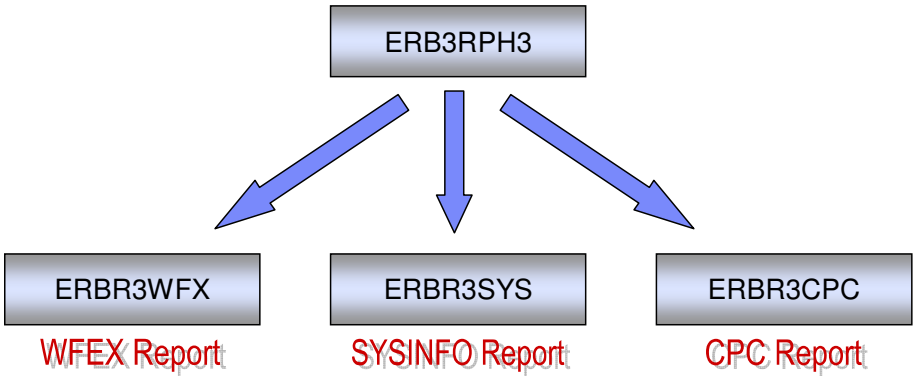



```
RMFM3B  PROC  RMF=SYS1,ISPF=SYS1
//SYSPROC  DD DISP=SHR,DSN=&HLQ..RMFM3B.SERBCLS
//           DD DISP=SHR,DSN=&RMF..SE
//           DD DISP=SHR,DSN=&ISPF..SI
//           DD DISP=SHR,DSN=&ISPF.
```

Use this library for modifications of the RMF supplied procedures

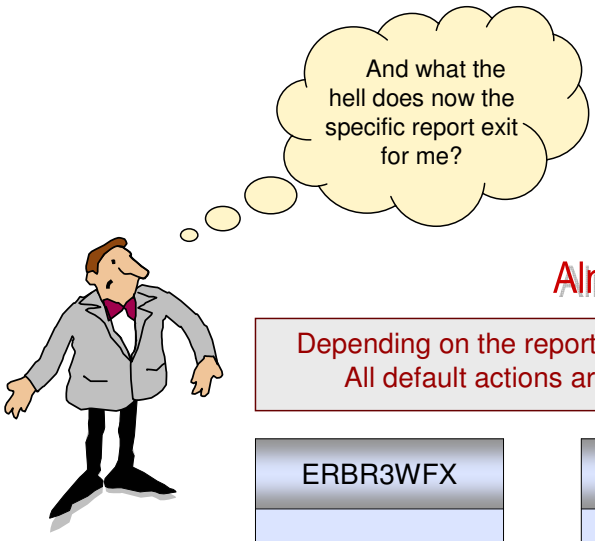
Nothing !!

Depending on the report type the generic exit module ERB3RPH3 passes control to the RMF supplied specific report exit modules



- When you have specified WFEX, SYSINFO or CPC as report type for your batch session no further action is needed. The generic exit module ERB3RPH3 is nothing else than a gateway which passes control to report specific exit modules that are supplied by RMF as well.
- In case your batch session creates an alternate report type you can simply add one line of code to ERB3RPH3 where the control is passed to your personal report exit module. This module should reside in your procedure library &HLQ..RMFM3B.SERBCLS. It is recommended that you simply copy one of the RMF supplied exit module and use it as pattern

Phase 3 Opportunities...



Almost Everything !!

Depending on the report type various default actions are provided.
All default actions are associated with a console message.

ERBR3WFX	ERBR3SYS	ERBR3CPC
Counts the number of exception lines from the WFEX report and issues a console message which displays the number of exceptions	Checks whether the total CPU utilization is higher than 90%. If yes, issues a console message which displays the actual CPU utilization	Checks whether WLM initiated capping (softcap) is currently active. If yes, issues a console message which displays the current capping %. If no, issues a console message which displays the remaining time until potential softcap starts
WFEX Report	SYSINFO Report	CPC Report

Default Actions

- RMF delivers the library SYS1.SERBCLS, which contains REXX procedures with default actions and alternate actions for the WFEX, SYSINFO and CPC Report
- All procedures perform a scan of their associated report tables. Based on the scan results, message id's are assigned and messages are sent to the operator console

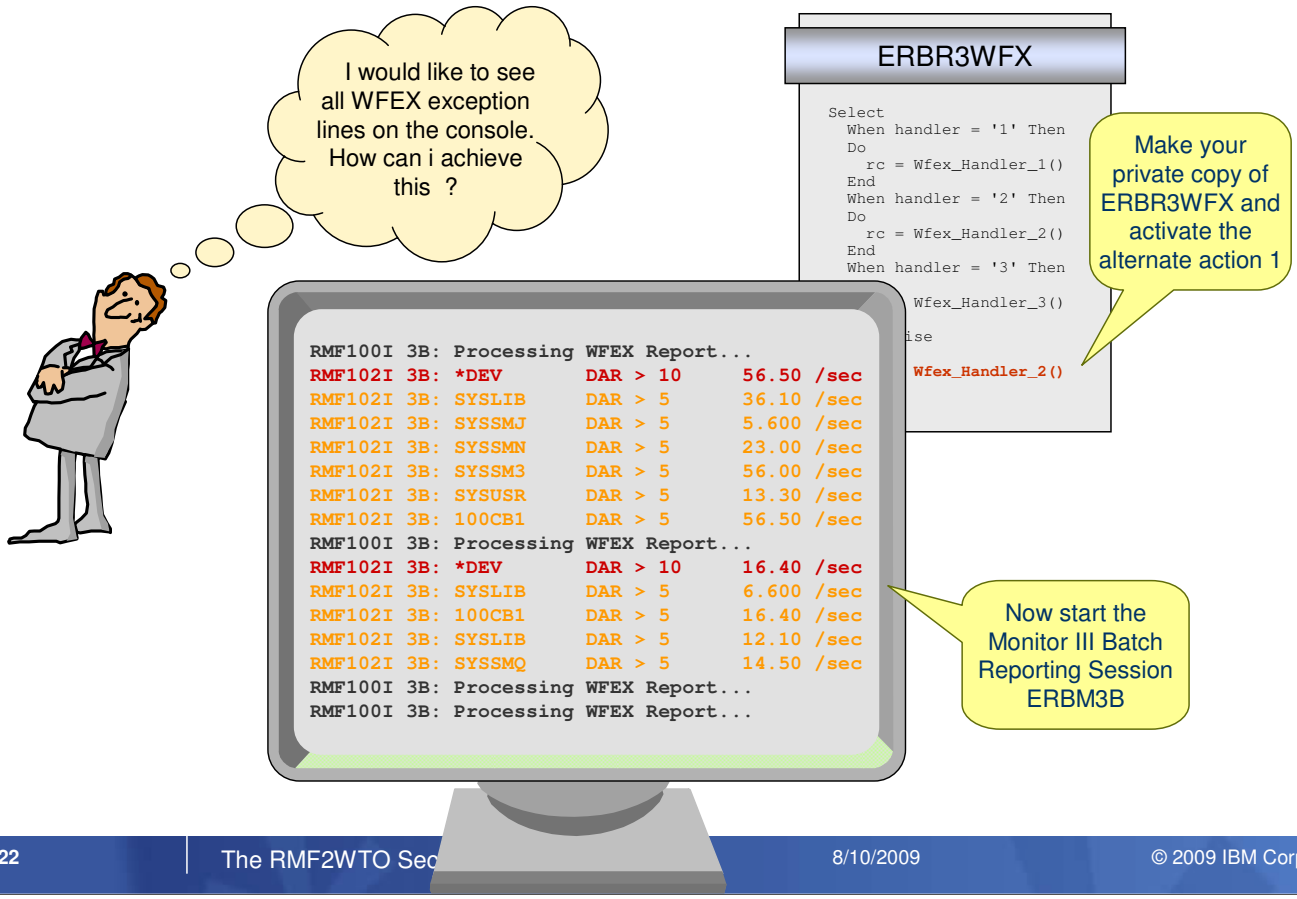
Phase 3 Opportunities...

	ERBR3WFX	ERBR3SYS	ERBR3CPC
Default Actions	Counts the number of exception lines from the WFEX report and issues a console message which displays the number of exceptions	Checks whether the total CPU utilization is higher than 90%. If yes, issues a console message which displays the actual CPU utilization	Checks whether WLM initiated capping (softcap) is currently active. If yes, issues a console message which displays the current capping %. If no, issues a console message which displays the remaining time until potential softcap starts
Alternate Actions 1	Routes all exception lines from the WFEX report unchanged to the console	Checks the response time for a specific WLM group agains a user specified threshold. Issues a console message which displays the actual response time in case the threshold is met	Checks the MSU consumption of all LPARs against a user specified threshold. Issues a console message with the actual MSU consumption for the LPARs that are exceeding the limit
Alternate Actions 2	Checks the system wide CPU utilization as well as the ECSA usage against user specified thresholds. Issues a console message which displays the actual values in case the thresholds are met	n/a	n/a
	WFEX Report	SYSINFO Report	CPC Report

This action performs a scan of the report table header

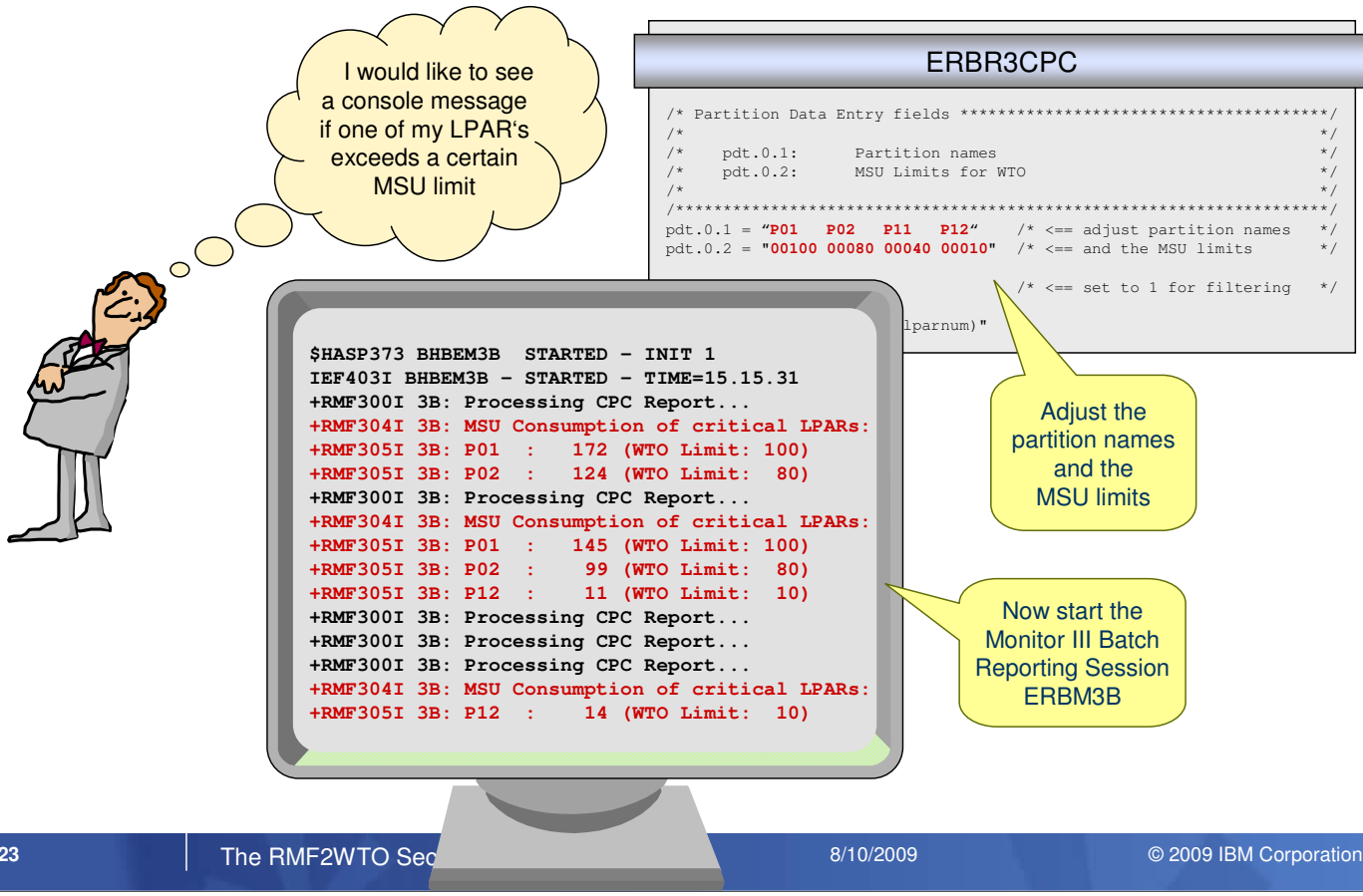
This action performs a scan through all report table rows

Phase III Opportunities: Example 1



- It's fairly easy to change the behaviour of the RMF supplied exits. Alternate subroutines can be activated or thresholds can be customized within a few minutes!
- In case you want to see all WFEX exception lines on the console, you can simply activate the alternate subroutine Wfex_Handler_2 within the exit module ERBR3WFX
- Once you have now started the Monitor III Batch Report Session ERBM3B, the exception lines from the WFEX Report are displayed at the console as well

Phase III Opportunities: Example 2



- It's fairly easy to change the behaviour of the RMF supplied exits. Alternate subroutines can be activated or thresholds can be customized within a few minutes!
- In case you want to control whether partition exceeds a certain MSU limit you can simply specify your thresholds in subroutine Cpc_Handler_2 within exit module ERBR3CPC
- Once you have now started the Monitor III Batch Report Session ERBM3B, console messages are generated for all partitions that exceed their specified limit

Questions & Answers

From the REXX procedures, how do the messages reach the console?

The messages are passed to the RMF supplied load module ERBCSWTO. The module is invoked via standard ISPF linkage: SELECT PGM(ERBCSWTO) PARM(msg)

How can i customize the text of a message?

The message text is generated and stored to a standard variable within the REXX procedures. As a matter of course you can assemble your own messages by means of corresponding adaptions in the REXX code.

Can i assign my own message id‘s?

Yes. In the same way than the message text can be customized, you can assign any message id to a specific event.

How can i react to a certain message?

Once the messages appear on the console, of course you can take an appropriate action. However, this is outside the scope of RMF.
You might either use the z/OS standard Message Processing Facility (parmlib member MPFLSTxx) or a more sophisticated z/OS automation product (e.g. Tivoli System Automation)

Information and Tools

RMF homepage: www.ibm.com/servers/eserver/zseries/zos/rmf/

- Product information, newsletters, presentations, ...
- Downloads
  - Spreadsheet Reporter
  - RMF PM Java Edition
  - RMF data collector for Linux

RMF email address: rmf@de.ibm.com

Documentation and news:

- RMF Performance Management Guide, SC33-7992
- RMF Report Analysis, SC33-7991
- RMF User's Guide, SC33-7990
- Latest version of PDF files can be downloaded from:

www.ibm.com/systems/z/os/zos/bkserv/r10pdf/#rmf

RMF Redbook !!!