Workload Management (WLM) Update for IBM z and IBM z/OS SRM Lock Contention Relief and More

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Agenda

- New Default for CPENABLE
- Java Usage Metrics
- SRM Lock Contention Reduction
- WLM Resilience Actions
- z/OSMF WLM Policy Advisor
- AI-powered WLM Batch Initiator Management

NEW DEFAULT FOR CPENABLE

New Default for CPENABLE

z/OS 2.5 and below	z/OS 3.1	z/OS 3.2
Default: CPENABLE=(0,0)	Default: CPENABLE=(0,0)	Default: CPENABLE=SYSTEM
Recommendation: (5,15) since z14	Recommendation: SYSTEM SYSTEM was introduced with z/OS 3.1 and resolves to the optimal value for each hardware level	Recommendation = Default = SYSTEM

New Default for CPENABLE

- The frequency at which WLM/SRM monitors the number of logical processors enabled for I/O interrupts is lowered from 20 to 2 seconds.
- The minimum number of CPs enabled for I/O interrupts is raised from one to two, if possible.

Migration Considerations

ZOSMIG32_WLM_OPT_CPENABLE

Description:

Checks low and high thresholds applied by OPT parameter CPENABLE in the active IEAOPTxx parmlib member.

Reason for check:

Starting in z/OS 3.2, the default value of OPT parameter CPENABLE is changed from (0,0) to SYSTEM. CPENABLE=(0,0) enables all logical processors of the system for I/O, while CPENABLE=SYSTEM dynamically manages the number of I/O enabled logical processors.

To prepare for this change, consider applying CPENABLE=SYSTEM to automatically use suitable low and high thresholds according to the CPC model the LPAR is running on. This removes the need to update the parameter with a hardware migration. If you have installation specific requirements to enable all logical processors for I/O, specify CPENABLE=(0,0) explicitly since it is no longer the default in z/OS 3.2.

z/OS release the check applies to:

z/OS 2.5 and 3.1

Parameters accepted:

No.

User override of IBM values:

The following sample shows the defaults for customizable values for this check. Use this sample to make permanent check customizations in an HZSPRMxx parmlib member used at IBM Health Checker for z/OS startup. If you just want a one-time only update to the check defaults, omit the first line (ADDREPLACE POLICY) and use the UPDATE statement on a MODIFY *hzsproc* command. Note that using non-POLICY UPDATEs in HZSPRMxx can lead to unexpected results and is, therefore, not recommended.

You can copy and modify the following example to override the check defaults:

```
ADDREPLACE POLICY[(policyname)] [STATEMENT(name)]
UPDATE
CHECK(IBMWLM,ZOSMIG32_WLM_OPT_CPENABLE),
INTERVAL(ONETIME),
SEVERITY(LOW),
INACTIVE,
DATE('date_of_the_change')
REASON('Your reason for making the update.')
```

- Migration check **ZOSMIG32_WLM_OPT_CPENABLE** is provided.
- This is a **one-time** check to support clients when preparing their migration to z/OS 3.2 from either 2.5 or 3.1.
- As with any other migration checks, the check is added as **inactivate**.
- The migration check is provided by **APAR OA67733** for z/OS 2.5 and 3.1.

New Health Check WLM_OPT_PARM_CPENABLE

- Activated by default
- Runs each time CPENABLE changes as result of a SET OPT command
- Checks low and high thresholds set by OPT parameter CPENABLE in the active IEAOPTxx parmlib member
- If settings other than the IBM-recommended values are desired, the following parameters can be specified to define the installation-specific low and high CPENABLE threshold values:
  - PARM('THRESHOLD_LOW(value),THRESHOLD_HIGH(value)')
- Messages IWMH110I and IWMH111I indicate a successful check
- Messages IWMH112E and IWMH113E indicate an unsuccessful check

JAVA USAGE METRICS

OA65426 Java Usage Instrumentation

- WLM tracks the Java consumption on zIIP at system level, at address space level and for enclaves in unweighted SUs
- New fields are added to
  - Resources Manager Control Table Extension 3 (IRARMCTZ)
  - Request Address Space Data Parameter List (IRARASD)
  - SMF type 99 subtype 1
- SYSEVENTs REQASD and REQFASD provide an address space's Java consumption in new fields in the Request Address Space Data parameter list IRARASD
- Releases supported: z/OS 2.5 and above

Offset	Name	Length	Format	Description
0 (0)	RMCTZ	1328	STRUCTURE	Resources Manager Control Table Extension 3
...				
64 (40)	RMCTZ_ZIIP_INFO	32	CHARACTER	System resource manager (SRM) system-wide view of zIIP consumption since IPL or policy change
64 (40)	RMCTZ_SUS_ZIIP	8	UNSIGNED	Total unweighted zIIP-eligible service units spent on zIIP
72 (48)	RMCTZ_SUS_ZIIP_ON_CP	8	UNSIGNED	Total unweighted zIIP-eligible service units spent on CP
80 (50)	RMCTZ_SUS_JAVA_ON_ZIIP	8	UNSIGNED	Total unweighted zIIP-eligible Java service units spent on zIIP
88 (58)	RMCTZ_SUS_JAVA_ON_CP	8	UNSIGNED	Total unweighted zIIP-eligible Java service units spent on CP
96 (60)	RMCTZ_UNUSED	160	CHARACTER	Reserved
...				

Offset	Name	Length	Format	Description
0 (0)	RASD	272	STRUCTURE	Request Address Space Data Parameter List
...				
240 (F0)	RASDOUT8	32	CHARACTER	RASD output fields version 8
240 (F0)	RASDENCJAVAONZIIP	8	BIT(64)	Accumulated zIIP time of Java work of completed independent enclaves owned by this A/S (STCK format)
248 (F8)	RASDDEPENCJAVAONZIIP	8	BIT(64)	Accumulated zIIP time of Java work of completed dependent enclaves owned by this A/S (STCK format)
256 (100)	RASDENCJAVAONCP	8	BIT(64)	Accumulated time of zIIP eligible Java work of completed independent enclaves owned by this A/S which is executed on CPs (STCK format)
264 (108)	RASDDEPENCJAVAONCP	8	BIT(64)	Accumulated time of zIIP eligible Java work of completed dependent enclaves owned by this A/S which is executed on CPs (STCK format)
272 (110)	RASDEND8	0	CHARACTER	End for version 8
272 (110)	RASDEND	0	CHARACTER	End of RASD

Java Usage Metrics SMF 70 Records

Type: SMF record type 70 subtype 1 (CPU Activity)

Section: CPU Control Data Section

Offsets		Name	Len	Format	Description
…					
364	16C	SMF70NVCR*	4	binary	Nominal model variable capacity rating […]
368	170	SMF70ZSU_on_zIIP	8	binary	Unweighted zIIP-eligible service units spent on zIIP for the entire system
376	178	SMF70ZSU_on_CP	8	binary	Unweighted zIIP-eligible service units spent on CP for the entire system
384	180	SMF70JSU_on_zIIP	8	binary	Unweighted zIIP-eligible Java service units spent on zIIP for the entire system
392	188	SMF70JSU_on_CP	8	binary	Unweighted zIIP-eligible Java service units spent on CP for the entire system
400	190	SMF70CPE_LO	2	binary	Low threshold value of OPT parameter CPENABLE
402	192	SMF70CPE_HI	2	binary	High threshold value of OPT parameter CPENABLE

Java Usage Metrics SMF 99 Records

Type: SMF record type 99 subtype 1 (System Level Data)

Change: New fields in SMF99 subtype 1 Software Licensing SMF99_S1_SL_MAP

```
SMF99_zIIP_Info – System resource manager (SRM) system-wide view of zIIP consumption since IPL
or policy change
    SMF99_SUs_zIIP           Total unweighted zIIP-eligible service units spent on zIIP
    SMF99_SUs_zIIP_on_CP     Total unweighted zIIP-eligible service units spent on CP
    SMF99_SUs_Java_on_zIIP   Total unweighted zIIP-eligible Java service units spent on zIIP
    SMF99_SUs_Java_on_CP     Total unweighted zIIP-eligible Java service units spent on CP
```

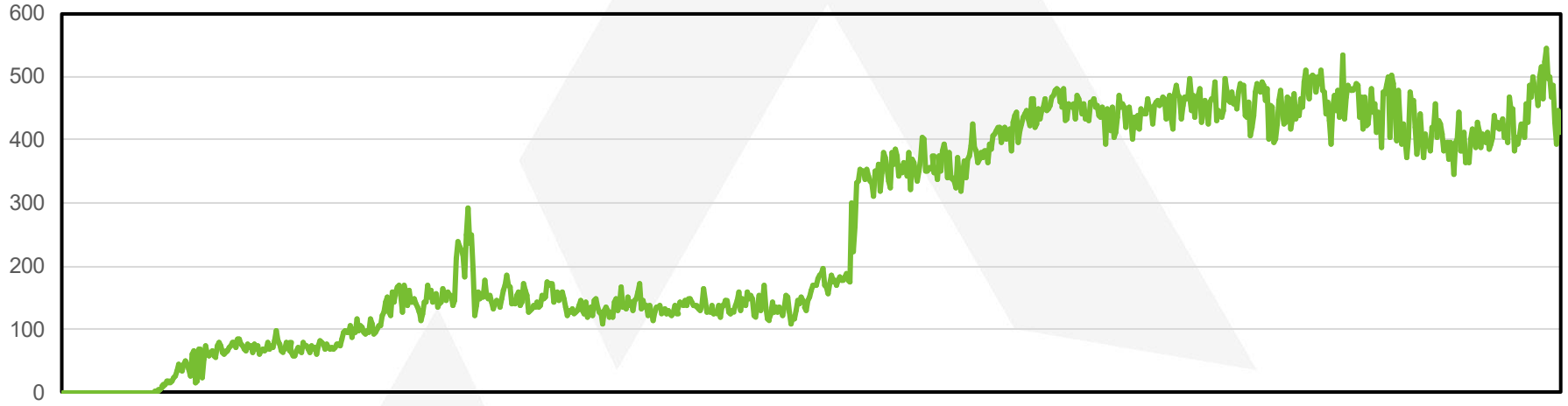
SRM LOCK CONTENTION REDUCTION

SRM Lock Contention Reduction

- SRM services and timed algorithms run concurrently serialized with the SRM lock.
- Large systems with many enclaves experience substantial SRM lock contention, leading to significant workload delays.
- We achieved a major reduction in SRM lock usage for workloads with large numbers of enclaves.

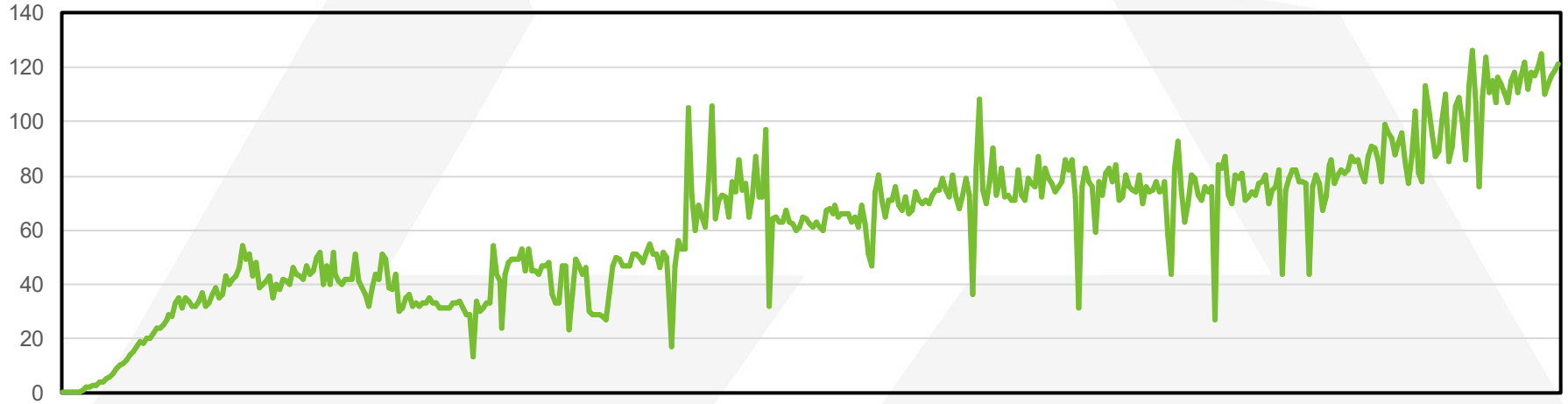
Improvements Achieved on a Large Test System

Before:



500 µs

After:



120 µs

Test Szenario With 15,000 Enclaves Per Second

	RunID	D241114D	D241114E	Delta
Report class DDFIRWW	ENDED	953167	939679	-1.4%
	ENDED/S	15886.12	15661.32	-1.4%
	CPU	718.834	700.075	-2.6%
	IIP	428.015	418.396	-2.2%
	CP CPU/tran (MS)	0.3051	0.2998	-1.8%
	IIP/tran (MS)	0.4490	0.4453	-0.8%
Report class DIST	CPU	29.045	21.858	-24.7%
	SRB	2.699	2.85	5.6%
	IIP	0.241	0.255	5.8%
	CP CPU/tran (MS)	0.0305	0.0233	-23.7%
	IIP/tran (MS)	0.0003	0.0003	7.3%
CPU activity 16cp+8zIIP	CP UTIL%	59.57	56.5	-5.2%
	zIIP UTIL%	79.53	78.89	-0.8%
	Avg UTIL%	66.22	63.96	-3.4%
	ITR	23988.70	24484.84	2.1%

Without the change | With the change

Workload about the same

It looks like the reduced SRM spinning leads to 24% less CPU consumption in the DIST address space

23.7% less CP CPU per transaction

Internal throughput rate went up, could be even higher with more enclaves

WLM RESILIENCY ACTIONS

New Health Check WLM_SCLASS_SYSSTC

- Dynamic severity check for CPU consumption of SYSSTC.
- Runs periodically – default is every minute.
- Triggers console message if SYSSTC exceeds one of the specified threshold percentages.

```
********************************* TOP OF DATA **************************
CHECK(IBMWLM,WLM_SCLASS_SYSSTC)
SYSPLEX:    PLEX1     SYSTEM: SYS1
START TIME: 11/19/2024 08:54:27.959883
CHECK DATE: 20240425  CHECK SEVERITY: MEDIUM-DYNAMIC
VERBOSE MODE: YES
CHECK PARM: THRESHOLD_LOW(20%),THRESHOLD_MED(40%),THRESHOLD_HIGH(60%)


* High Severity Exception *

IWMH104I CPU consumption in SYSSTC service class is 93%. The high
threshold of 60% is reached.

  Explanation:  CHECK(IBMWLM,WLM_SCLASS_SYSSTC) determined that the CPU
    consumption in service class SYSSTC has reached one of the threshold
    levels supplied.

    Address spaces in the SYSSTC service class are kept at a very high
    dispatching priority. Not all work is appropriate for SYSSTC
    because, if the work is CPU intensive, it could use a high amount of
    processor cycles, which could cause CPU delays for other important
    work in the system. Only trusted work that is not going to use a lot
    of CPU but requires fast CPU access and absolutely needs a higher
    dispatch priority than other work is appropriate for WLM service
    class SYSSTC.

    Refer to the end of this check report for a list of address spaces
    in the SYSSTC service class.

  System Action:  Processing continues.

  Operator Response:  Notify the system programmer.
```

```
  System Programmer Response:  Use diagnostic tools (such as the
    Resource Monitoring Facility) to help determine the CPU consumption
    of all address spaces assigned to the SYSSTC service class. Verify
    that the address space(s) are appropriate for SYSSTC. If not,
    consider using the RESET command to change the service class of the
    address space or to quiesce it. Also, update your WLM service
    definition to assign a service class of lower importance.

  Problem Determination:  N/A

  Source:  Workload Manager (WLM)

  Reference Documentation:  N/A

  Automation:  N/A

  Check Reason:  Monitors CPU consumption of work in service class
    SYSSTC.


Address spaces in the SYSSTC service class:

Name       ASID   CPU%
SOAKSYS2   0027   37.81
SOAKSYS1   002E   18.57
SOAKSY01   0069   10.31
SOAKSY02   0032   8.53
SOAKSY03   0028   6.75
SOAKSY04   0025   4.60
SOAKSY05   006B   2.41
SOAKSY06   006C   1.95
SOAKSY07   006D   1.48
SOAKSY08   006E   1.00
SOAKSY09   006F   0.50
SDSFAUX    0011   0.01
IGVDGNPP   002B   0.50

END TIME: 11/19/2024 08:54:27.964521  STATUS: EXCEPTION-HIGH
```

New Messages IWMH103I, IWMH104I

Threshold exceeded	
VERBOSE(YES)	VERBOSE(NO)
List all address spaces in SYSSTC which consume CPU at the end of the check report	List only up to 10 top CPU consuming address spaces in SYSSTC

```
CHECK(IBMWLM,WLM_SCLASS_SYSSTC)
SYSPLEX: PLEX1 SYSTEM: SYS1
START TIME: 08/28/2024 08:47:20.195675
CHECK DATE: 20240425 CHECK SEVERITY: MEDIUM-DYNAMIC
CHECK PARM: THRESHOLD_LOW(20%),THRESHOLD_MED(40%),THRESHOLD_HIGH(60%)

IWMH103I CPU consumption in SYSSTC service class is 2%. The low threshold of 20% is not
reached. No action is required.

END TIME: 08/28/2024 08:47:20.195800 STATUS: SUCCESSFUL
```

```
CHECK PARM: THRESHOLD_LOW(20%),THRESHOLD_MED(40%),THRESHOLD_HIGH(60%)

* Low Severity Exception *

IWMH104I CPU consumption in SYSSTC service class is 21%. The low threshold of 20%
is reached.

Explanation:

CHECK(IBMWLM,WLM_SCLASS_SYSSTC) determined that the CPU consumption in service
class SYSSTC has reached one of the threshold levels supplied.

Address spaces in the SYSSTC service class are kept at a very high dispatching
priority. Not all work is appropriate for SYSSTC because, if the work is CPU
intensive, it could use a high amount of processor cycles, which could cause CPU
delays for other important work in the system. Only trusted work that is not
going to use a lot of CPU but requires fast CPU access and absolutely needs a
higher dispatch priority than other work is appropriate for WLM service class
SYSSTC.

Refer to the end of this check report for a list of address spaces in the SYSSTC
service class.

System action: The system continues processing.

Operator response: Notify the system programmer.

System programmer response:  Use diagnostic tools (such as the Resource
Monitoring Facility) to help determine the CPU consumption of all address spaces
assigned to the SYSSTC service class. Verify that the address space(s) are
appropriate for SYSSTC. If not, consider using the RESET command to change the
service class of the address space or to quiesce it. Also, update your WLM
service definition to assign a service class of lower importance.

Problem Determination: N/A

Source: WLM

Reference Documentation: N/A

Automation: N/A

Check Reason: Monitors CPU consumption of work in service class SYSSTC.

Address spaces in the SYSSTC service class:

Name       ASID   CPU%
BGXOSYS1   0032   9.83
BGXOSYS2   006A   5.59
SDSF       0030   1.59
JES2       002C   1.20
ZFS        0035   0.60
VTAM       0024   0.31
TCPIP      0033   0.30
SDSFAUX    0026   0.20
ZTTX       0022   0.16
AXR        0018   0.10

END TIME: 08/28/2024 08:47:20.195800 STATUS: EXCEPTION-MED
```

WLM_SCLASS_SYSSTC Parameters

- At least one threshold parameter is required to indicate a threshold of CPU consumption in WLM service class SYSSTC.
- Specify the threshold as a percentage of the system's total CPU time.
- This check supports dynamic severity settings.The severity of the exception is based on the provided corresponding thresholds.

```
PARM('[THRESHOLD_LOW(value%)]
     [,THRESHOLD_MED(value%)]
     [,THRESHOLD_HIGH(value%)]')
```

Defaults: THRESHOLD_LOW(20%), THRESHOLD_MED(40%), THRESHOLD_HIGH(60%)

WLM_SCLASS_SYSSTC User Overrides

- You can customize the check in a HZSPRMxx parmlib member.
- For a one-time update to the check defaults, omit the ADDREPLACE POLICY statement and issue an UPDATE using the MODIFY hzsproc command.
- Omitting the ADDREPLACE POLICY in HZSPRMxx can lead to unexpected results and is therefore not recommended.

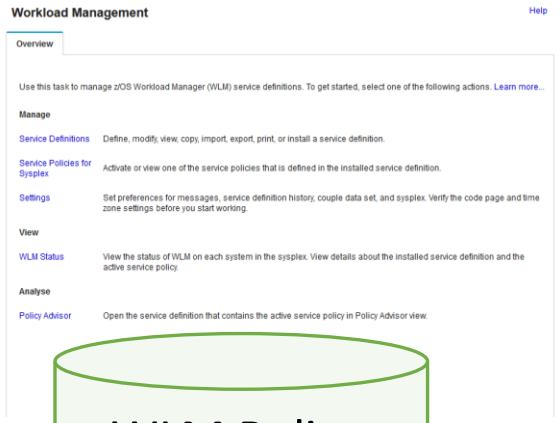
```
ADDREPLACE POLICY[(policyname)] [STATEMENT(name)]
UPDATE
CHECK(IBMWLM,WLM_SCLASS_SYSSTC),
ACTIVE,
VERBOSE(NO),
INTERVAL(00:01),
SEVERITY(LOW),
PARM('THRESHOLD_LOW(30%),THRESHOLD_MED(50%),THRESHOLD_HIGH(70%)'),
DATE('date_of_the_change'),
REASON('Your reason for making the update')
```

Installation and Dependencies

- Available for z/OS 2.5 and above.
- The PTFs for the following APAR must be installed:
  - OA66312 - UJ96671, UJ96675
- No toleration support required for z/OS 2.3 and 2.4.
- This check is inactive by default. To use this check, you must activate it.

Z/OSMF WLM POLICY ADVISOR

The Idea



WLM Policy

Performance Data (SMF)

z/OSMF WLM Policy Advisor

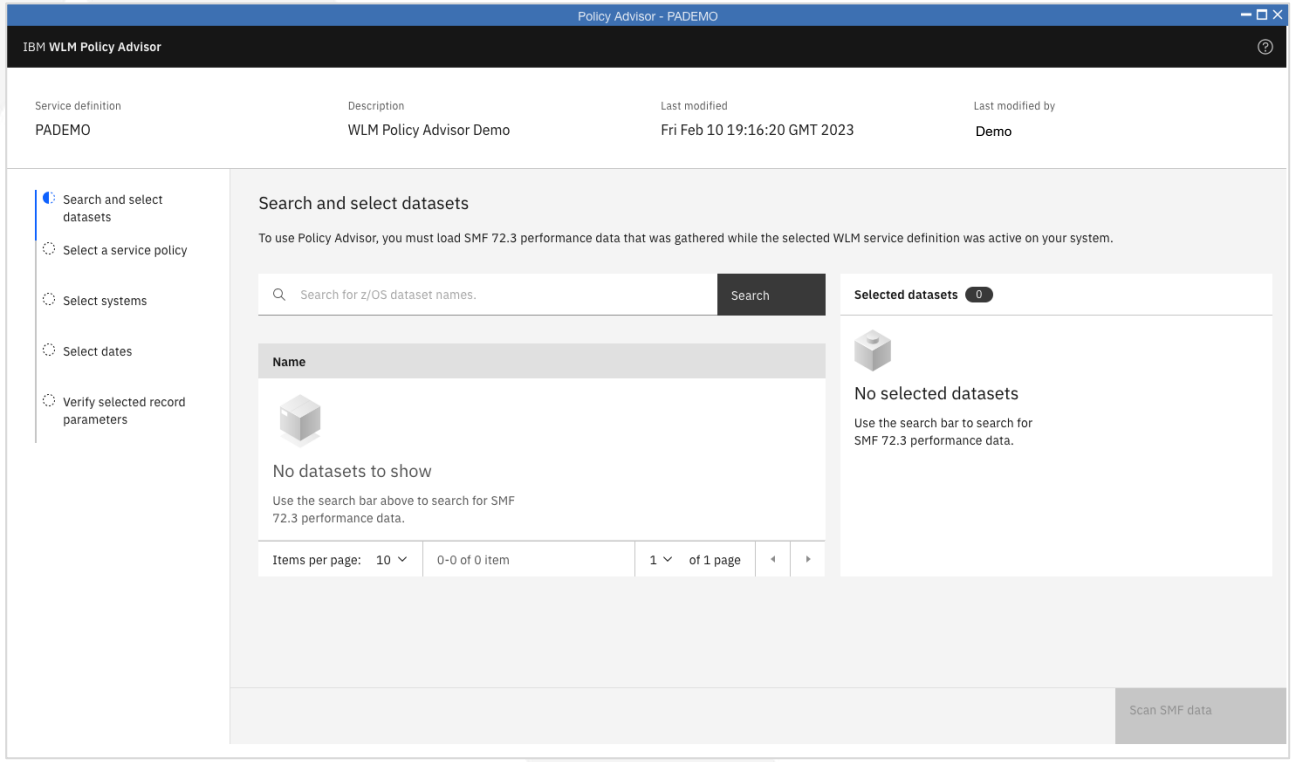
Service policy info

Checked rules / warnings

Performance graphs

z/OSMF WLM Policy Advisor 3.2 – What Is New

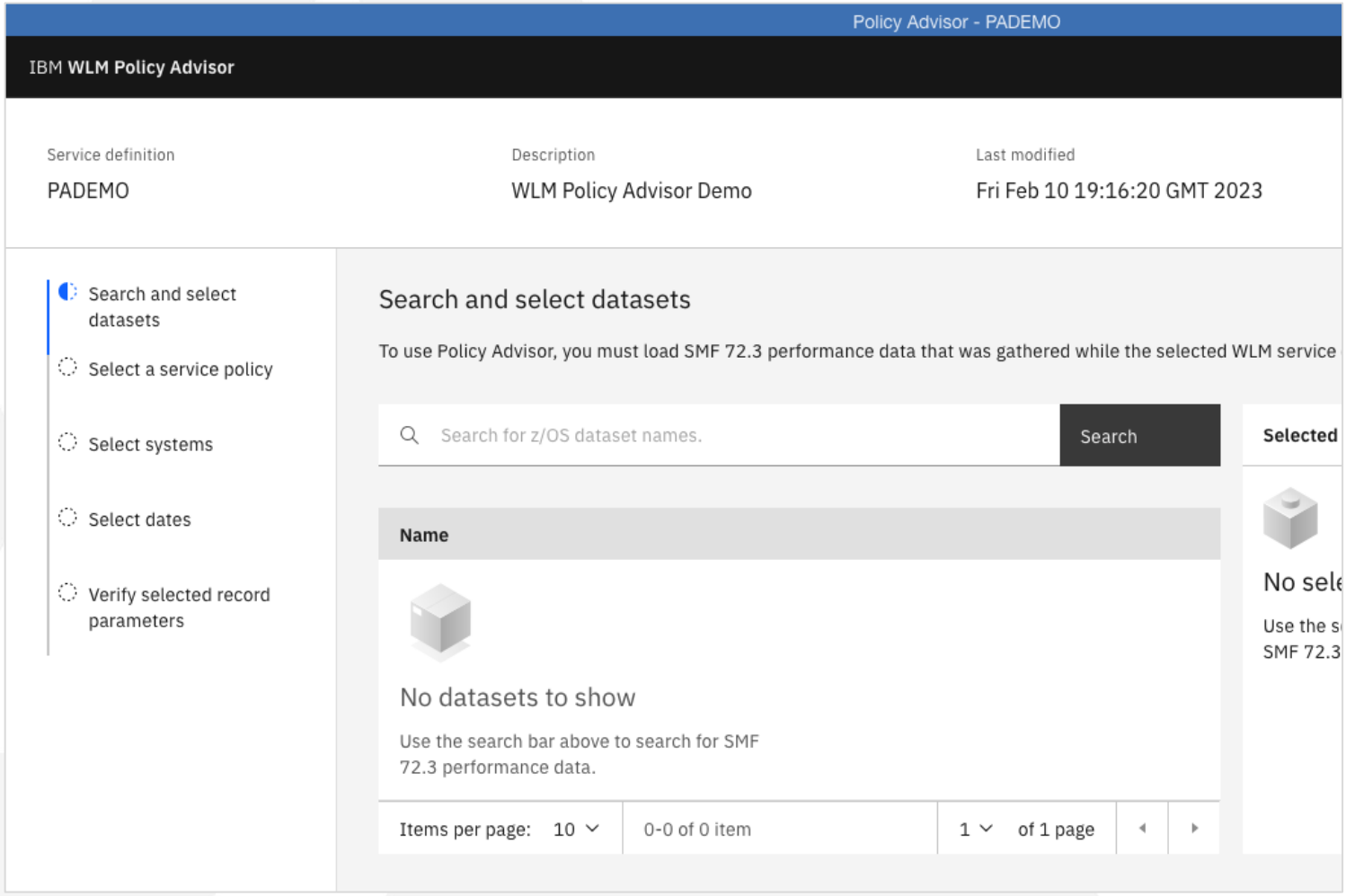
- The WLM Policy Advisor User Interface is re-designed with z/OS 3.2
- Enhancements to the existing z/OSMF WLM Policy Advisor:
  - Improved **workflow** to select and load SMF data
  - **Overview page** with summary of all relevant findings. Drill down options are available for detailed analysis
  - Better **user experience** with improved navigation and charts to help users understand the findings
  - **Suggestions** are generated for the analyzed service definition to help improve system performance and resilience



z/OSMF WLM Policy Advisor – New Workflow

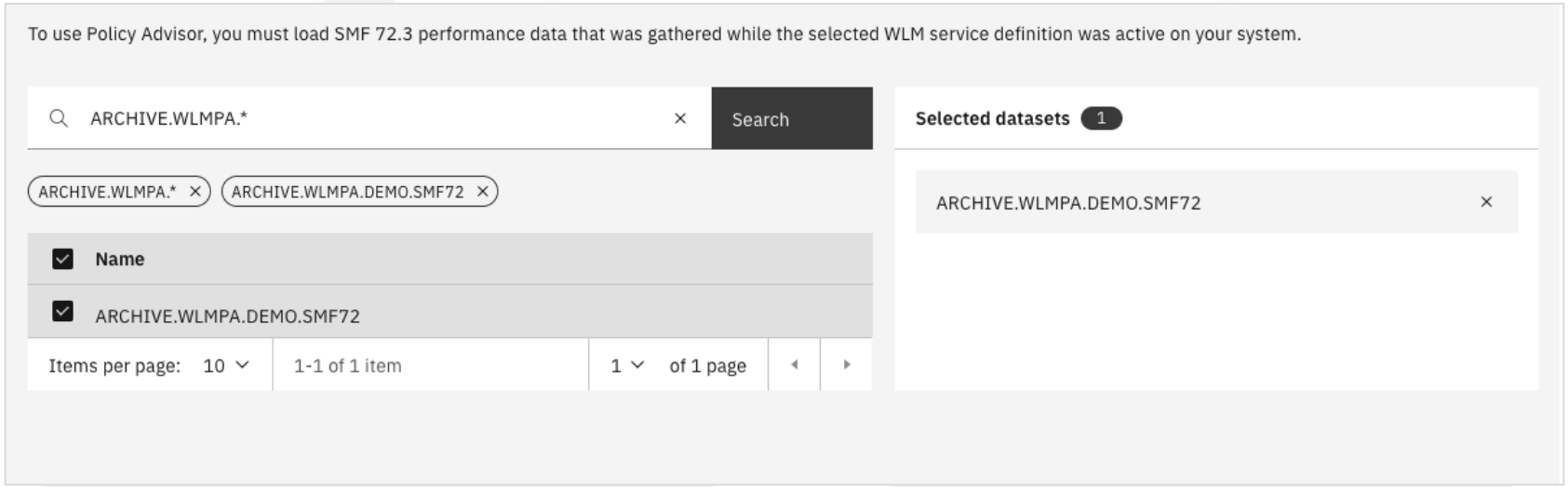
The new SMF data loading workflow:

1. Search and select SMF 72.3 data sets
2. Select a service policy
3. Select a subset of systems
4. Select a subset of dates
5. Verify your selected parameters



Step 1: Select SMF Datasets I

- Search for your datasets containing SMF type 72 subtype 3 performance data
- The user can select **any number** of datasets from the list
- Selected datasets will appear next to the search area

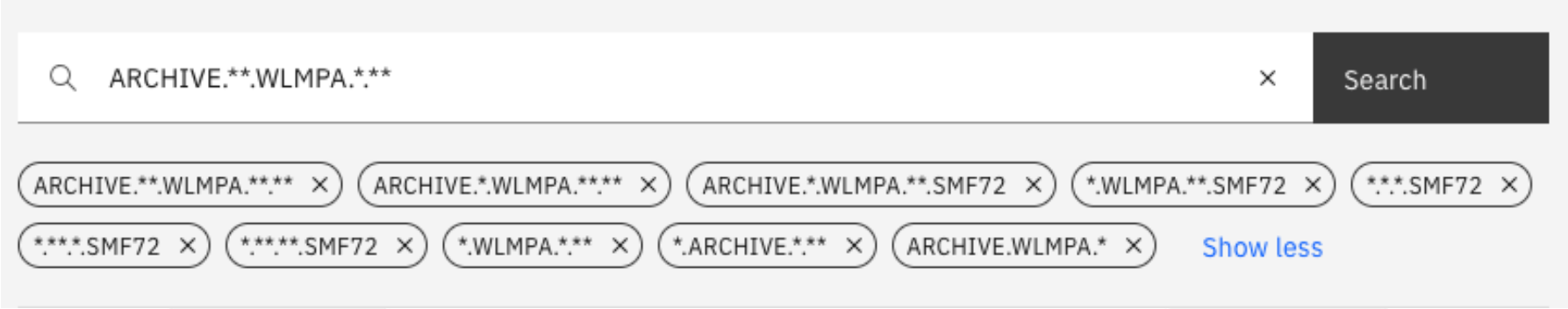


Step 1: Select SMF Datasets II

- Dataset search bar now supports partial data set names:
  - One or more high-level qualifiers or name segments
  - One or more wildcard symbols: percent sign (%), asterisk (*), or double asterisk (**)
  - A percent sign is a single character wildcard.
  - An asterisk is any number of characters within a qualifier.
  - A double asterisk is any number of characters within any number of lower-level qualifiers.

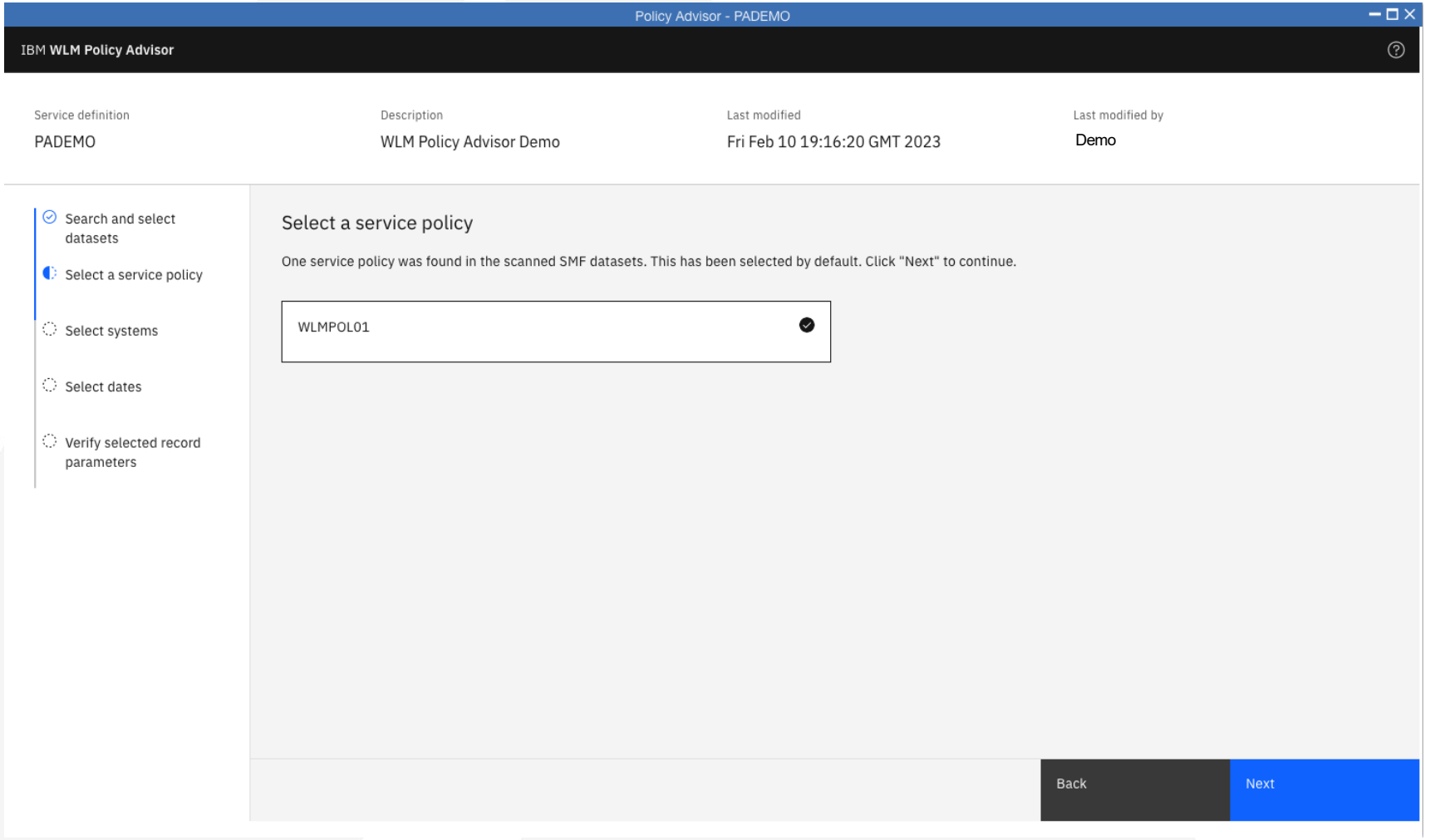
Step 1: Select SMF Datasets III

Search terms (up to 10) are made persistent for the currently logged in z/OSMF user.



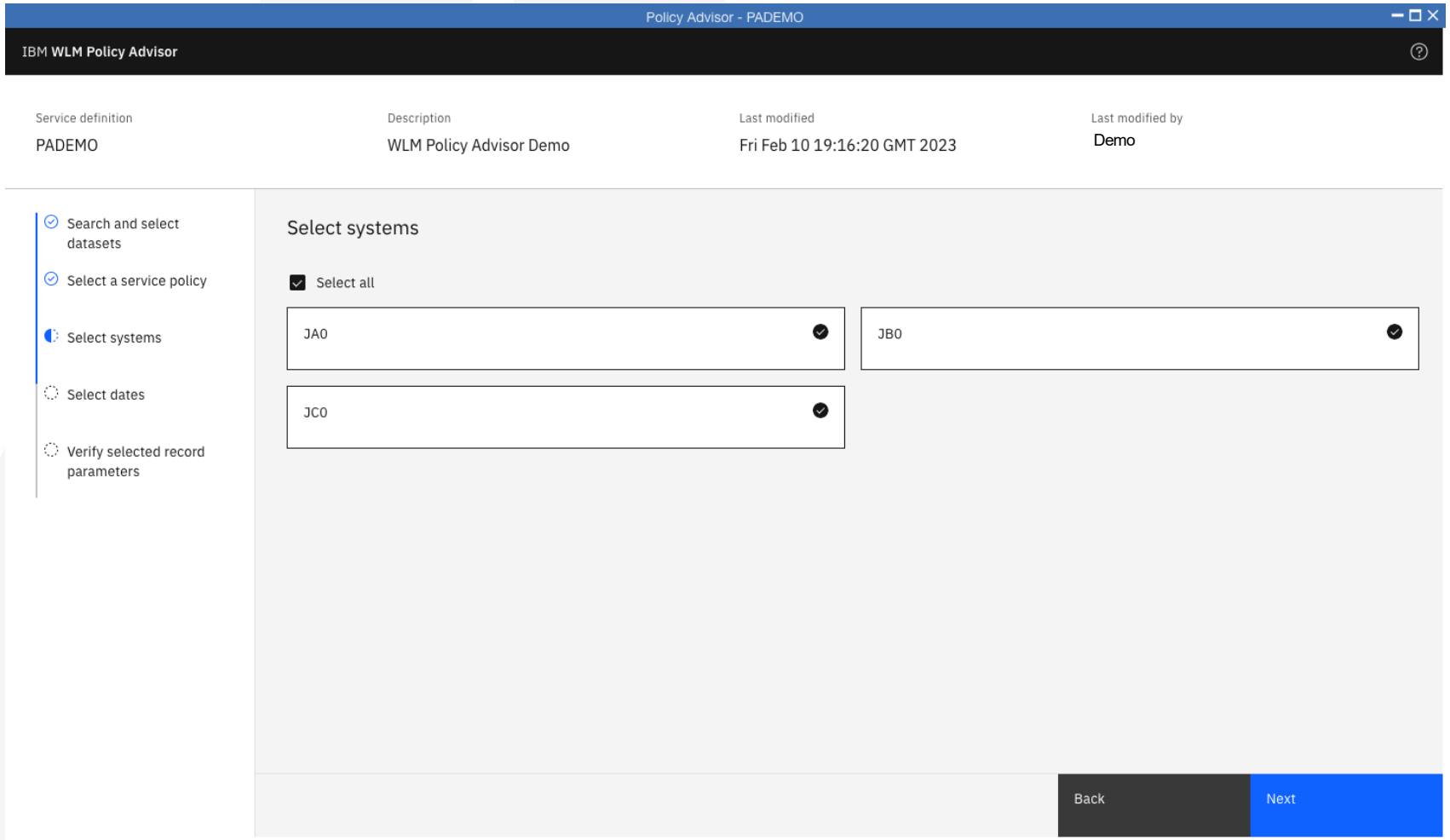
Step 2: Select WLM Policy

Only policies that are present in the service definition AND the selected dataset(s) will be available.



Step 3: Select any number of Systems

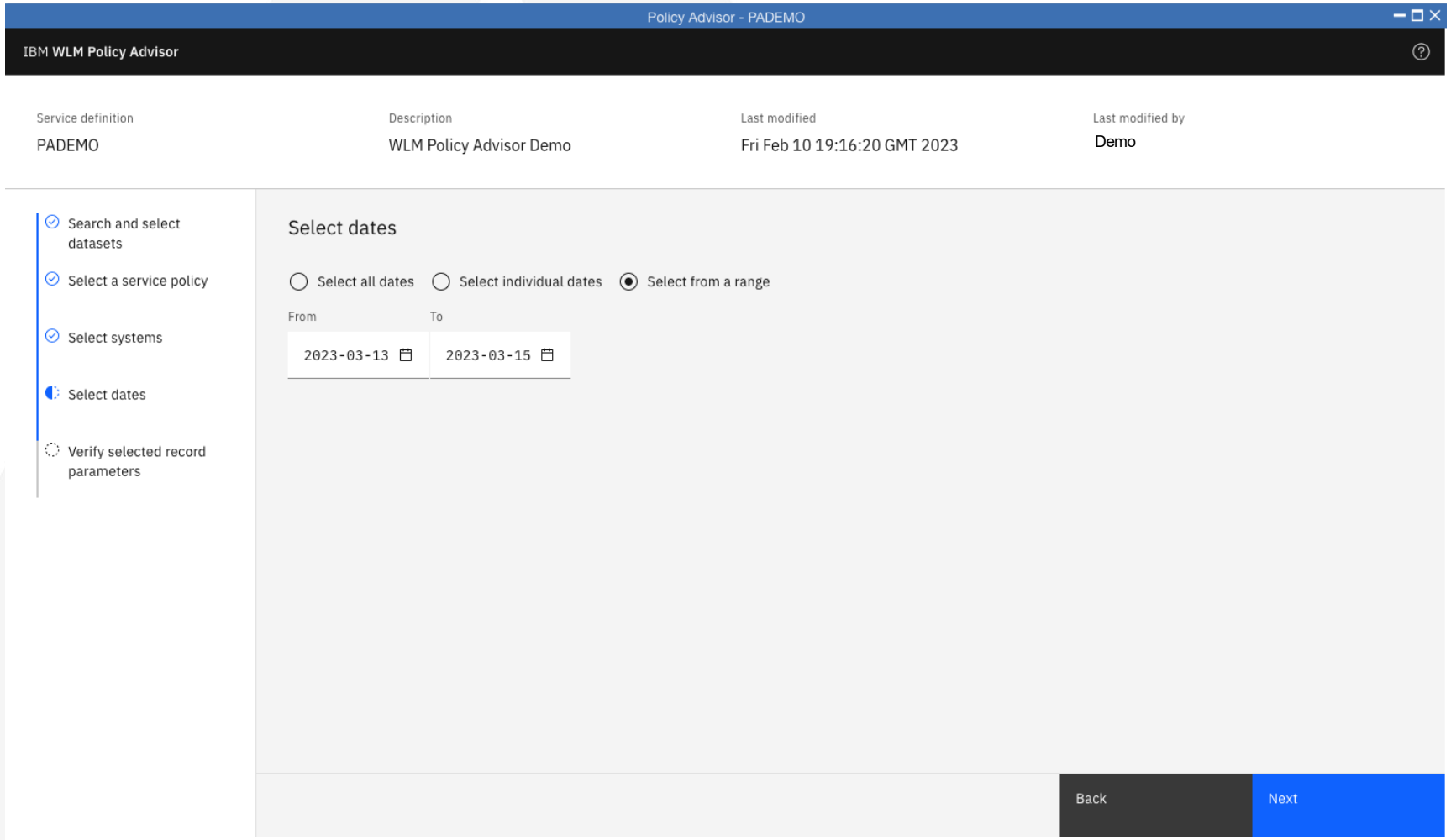
All systems are pre-selected.



Step 4: Select a Date Range

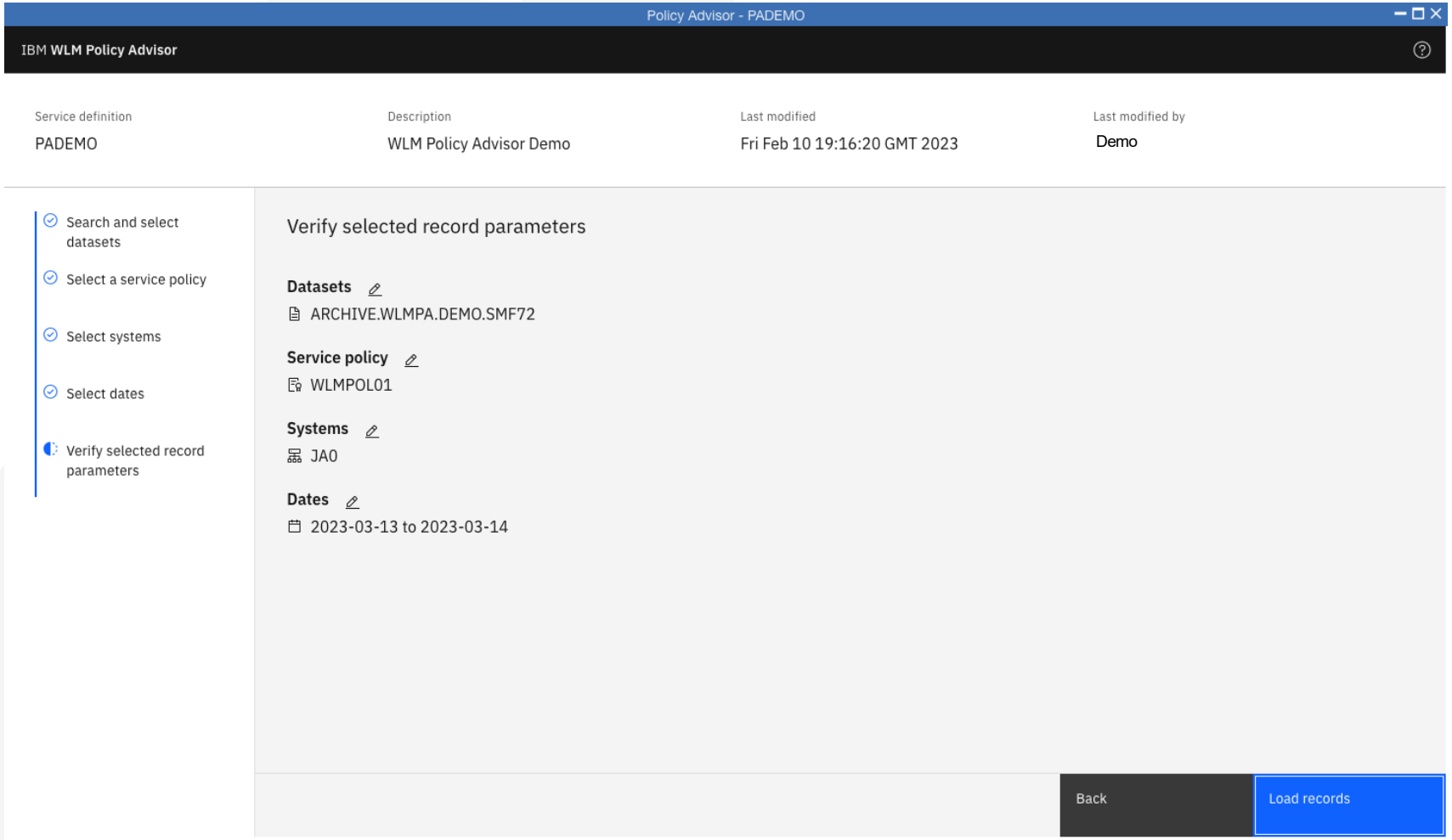
Three options:

- All dates
- Individual dates
- Select from a range



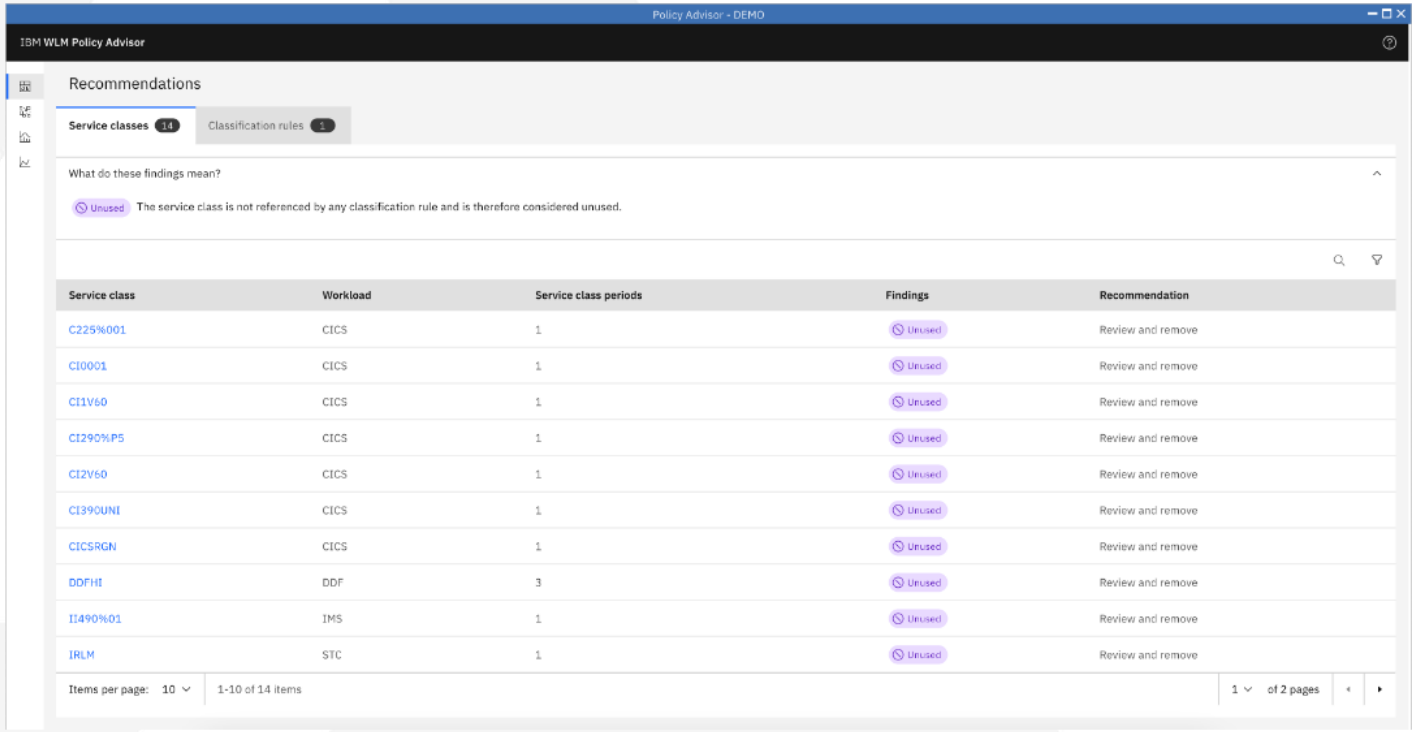
Step 5: Verify Selected Record Parameters

- The final step shows a summary of your selection.
- At any time, you may go back to a previous step and change the selection made.



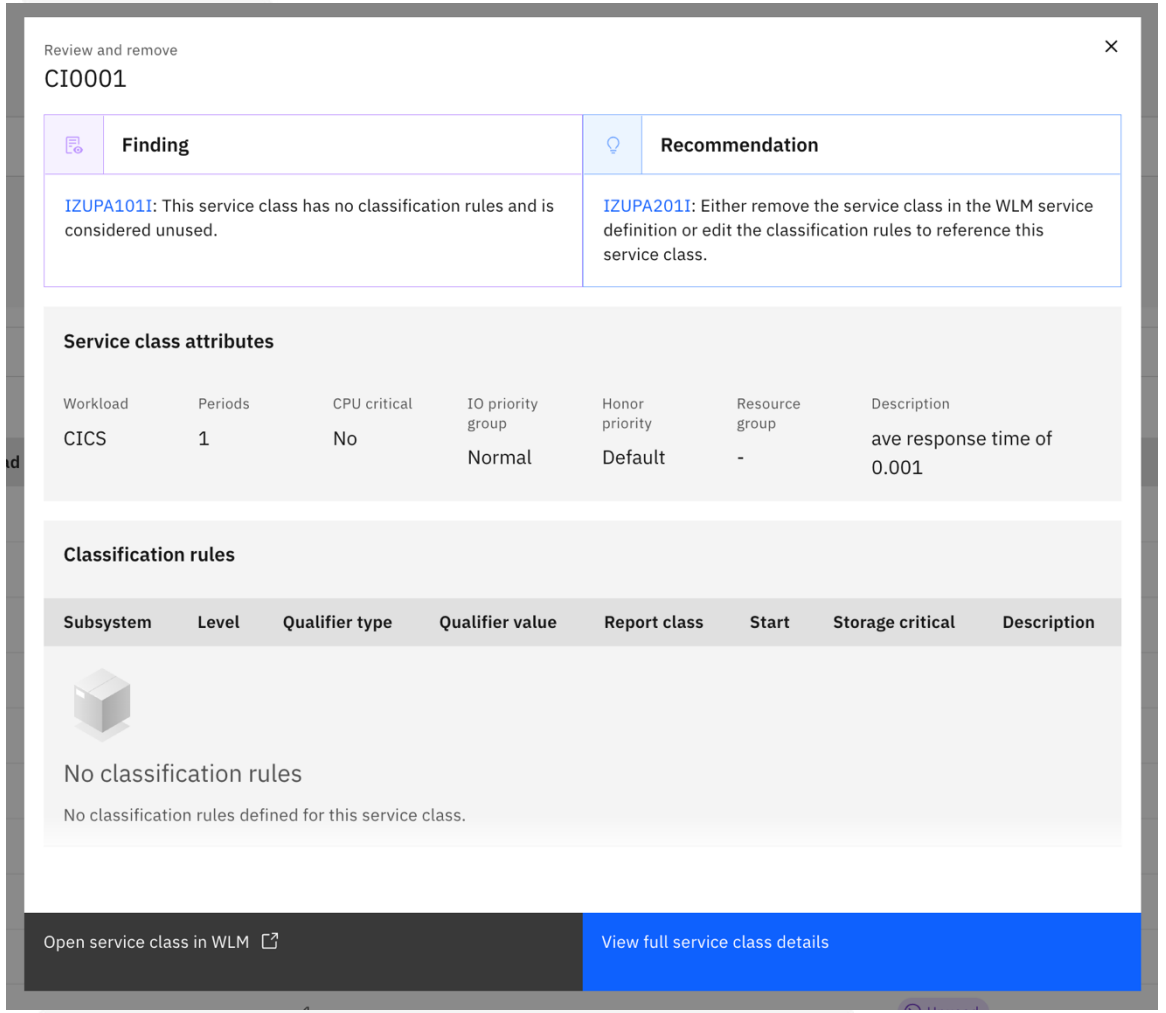
New Overview Page – Service Classes

- On the “Service classes” tab a table lists all findings related to service classes, for example:
  - **Unused** – No classification rule classifies work into those service classes.



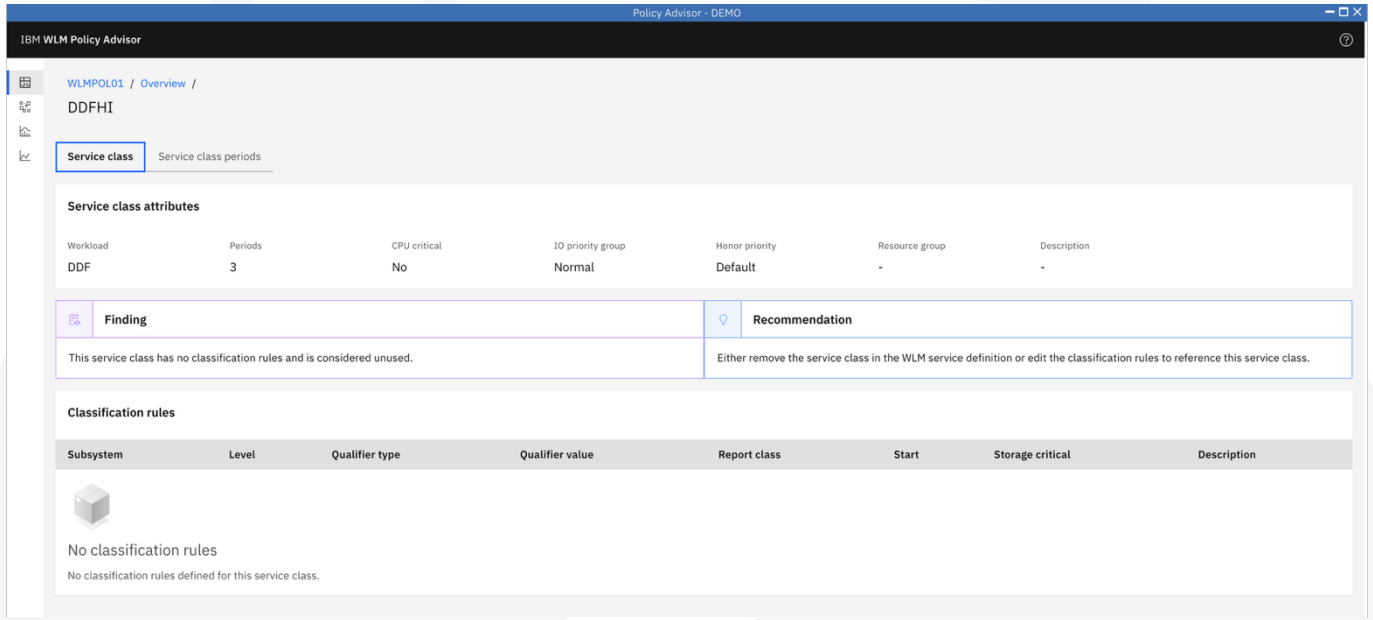
New Overview Page – Service Classes Unused Dialog

- Dialog opens when clicking on “Review and remove”
- Short description of the service class
- Option to open service class in z/OSMF WLM task or have a more detailed look in the Policy Advisor



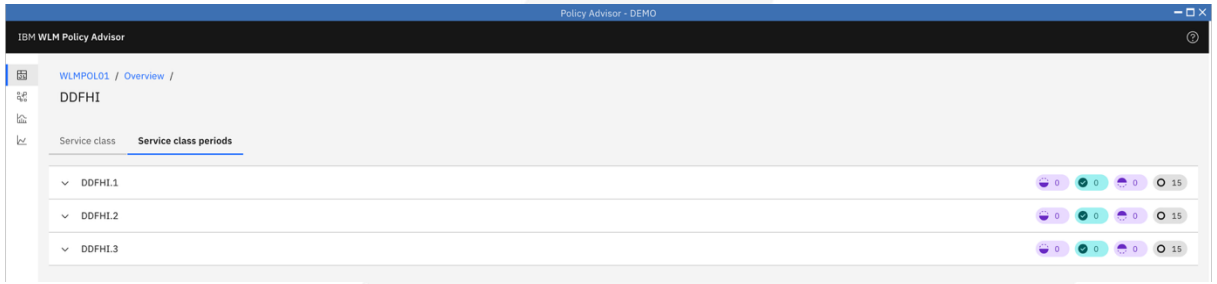
New Overview Page – Service Class Details I

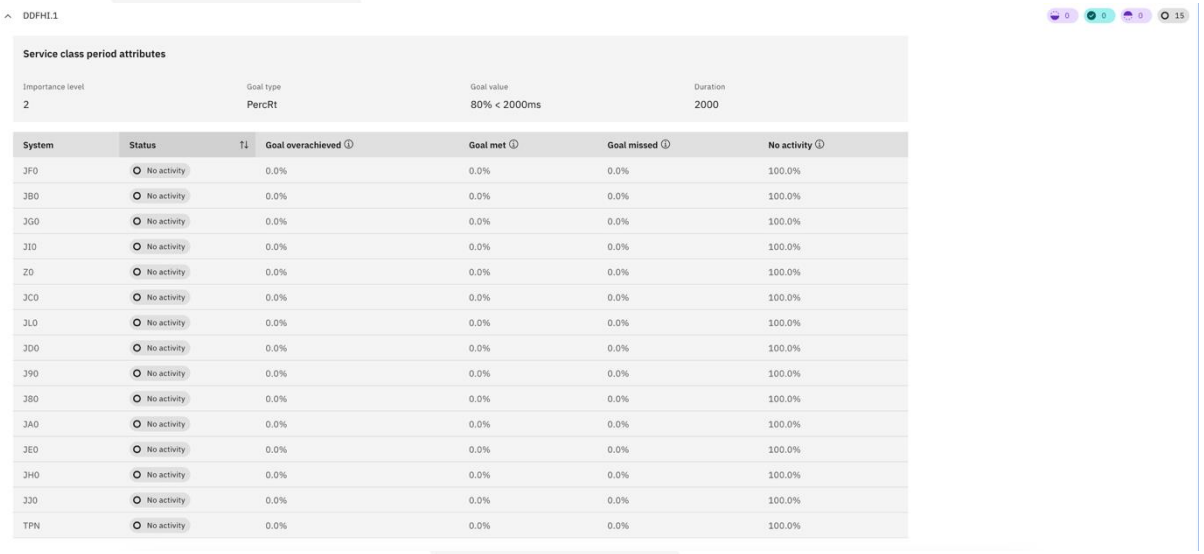
- To get more details about a service class and its periods you can click on the service class name in the table on the service class tab.
- On the service class details page, you then find information about the defined attributes and classification rules of this service class.



New Overview Page – Service Class Details II

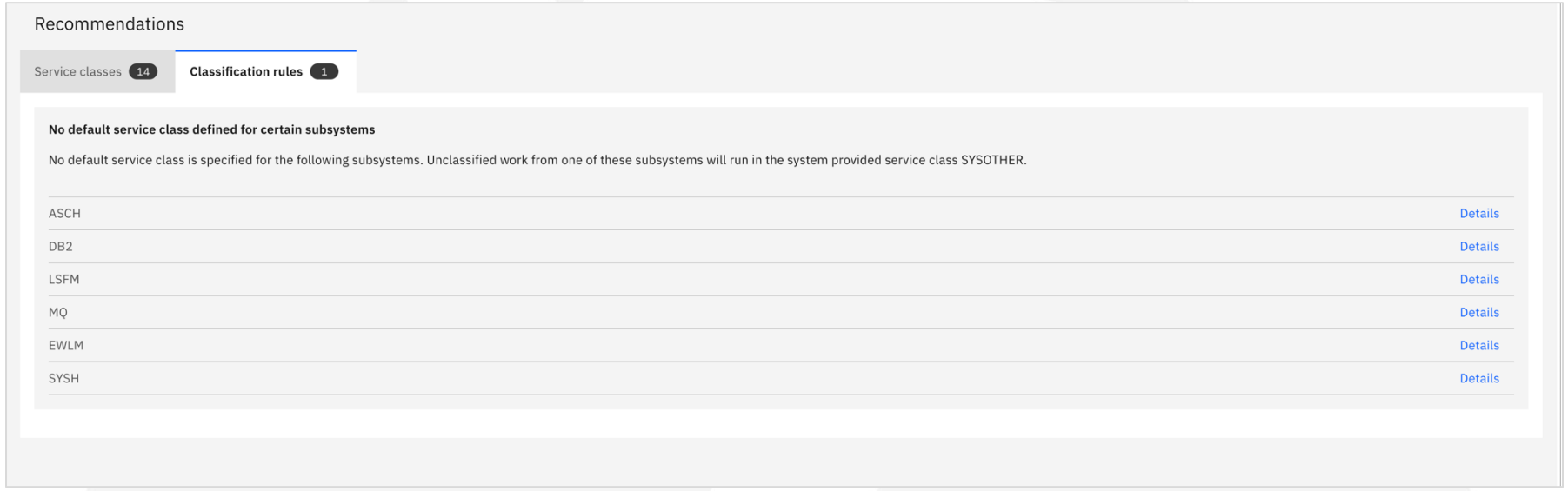
- The “service class periods” tab lists all periods and their status on each system.
- Status is derived from the percentage of time a service class period has spent in a certain PI range.
- Statuses are:
  - **Overachieved** – PI less than 0.8
  - **Goal met** – PI between 0.8 and 1.2
  - **Goal missed** – PI more than 1.2
  - **No activity** – PI of zero and no usings





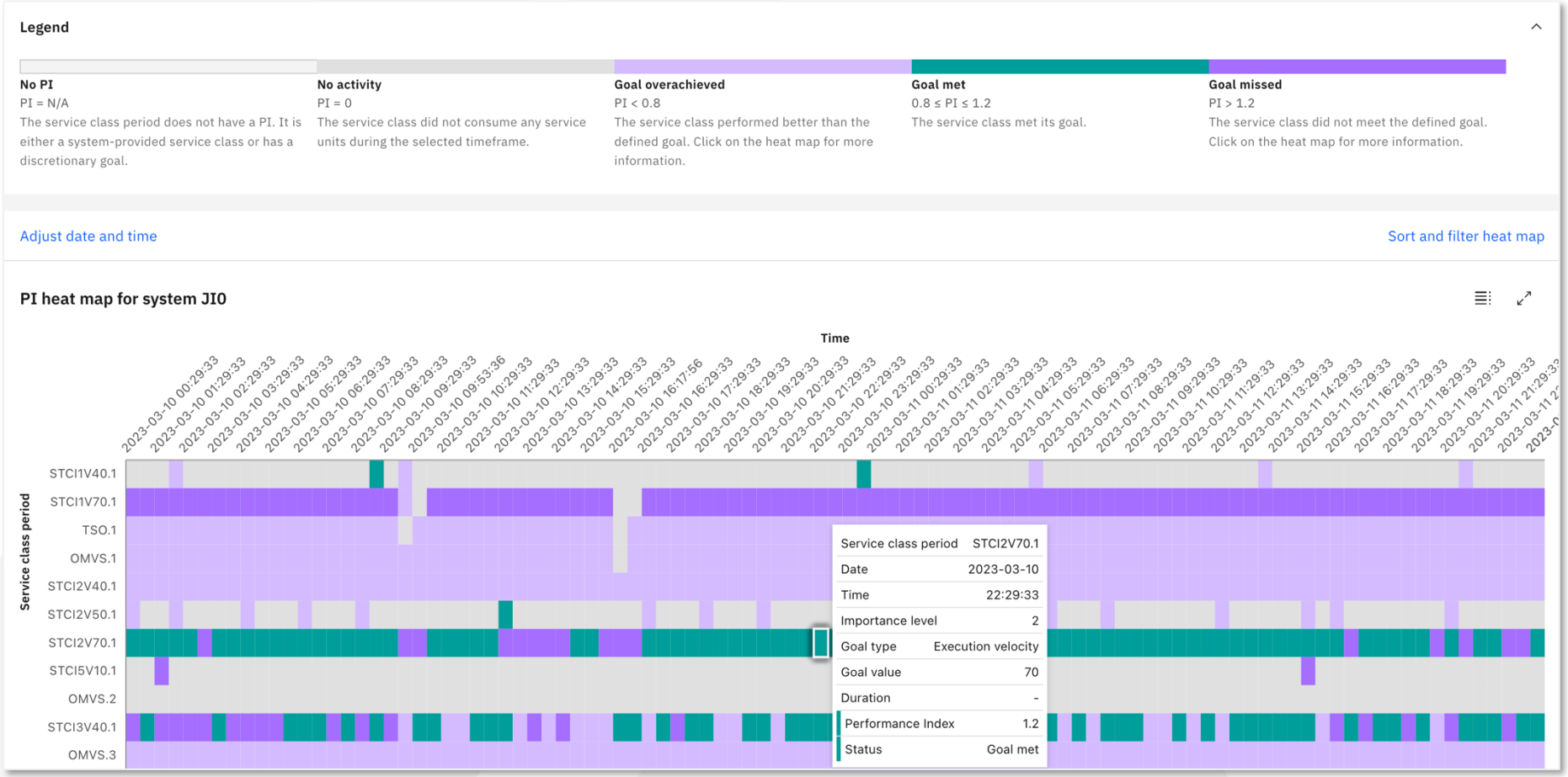
New Overview Page – Classification Rules

- On the “Classification rules” tab you can see various best practice checks:
  - Missing default service classes for subsystems
  - Workload running in default service class SYSOTHER



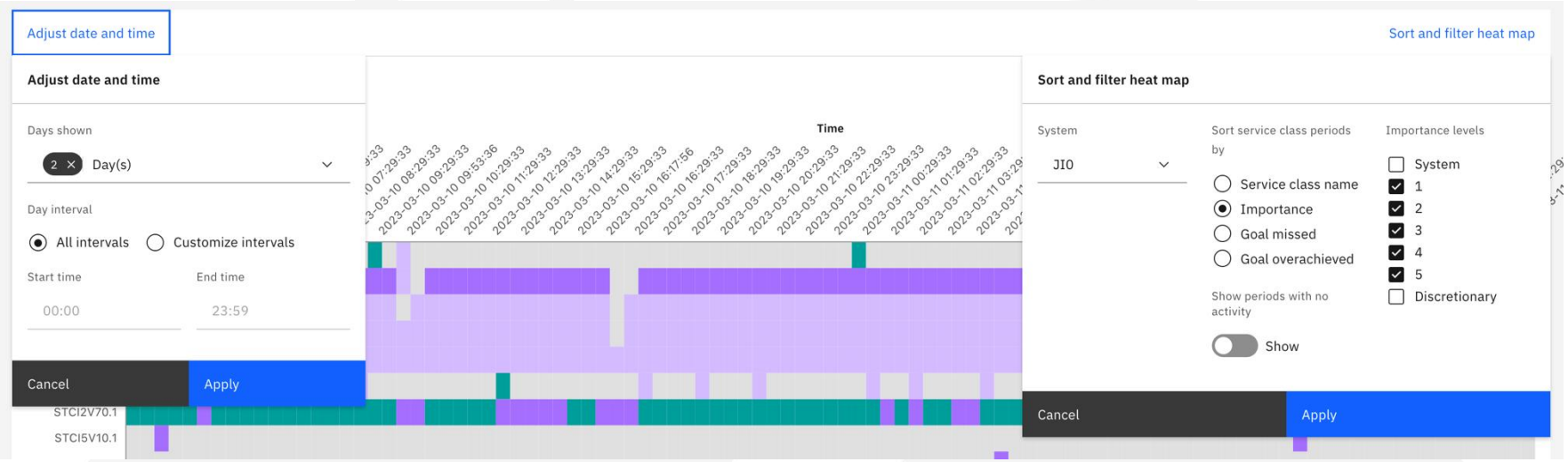
Performance Index I

- On the Performance Index page of the Policy Advisor, examine how service class periods are performing over time.



Performance Index II

- Filter by time, importance and systems to investigate the performance of your workload.
- Sort service class periods alphabetically, by importance level or their goal fulfillment.

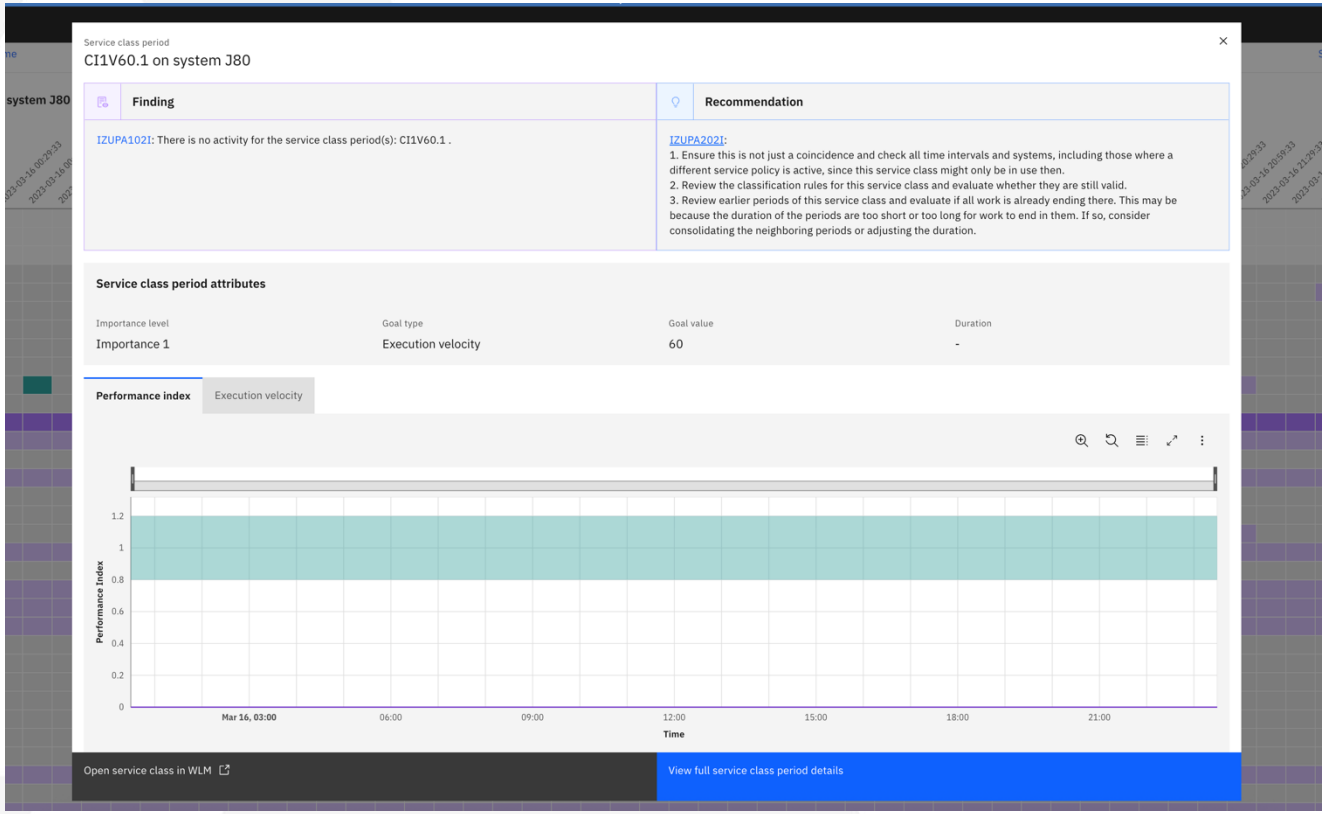


- Click on any colored tile within the heatmap to drill down…

Performance Index III

…and get further information about performance index and goal fulfillment.

- “Open service class in WLM” to jump back to the z/OSMF WLM task, in case you want to modify this service class.
- “View full service class period details” to navigate to the service class details page.

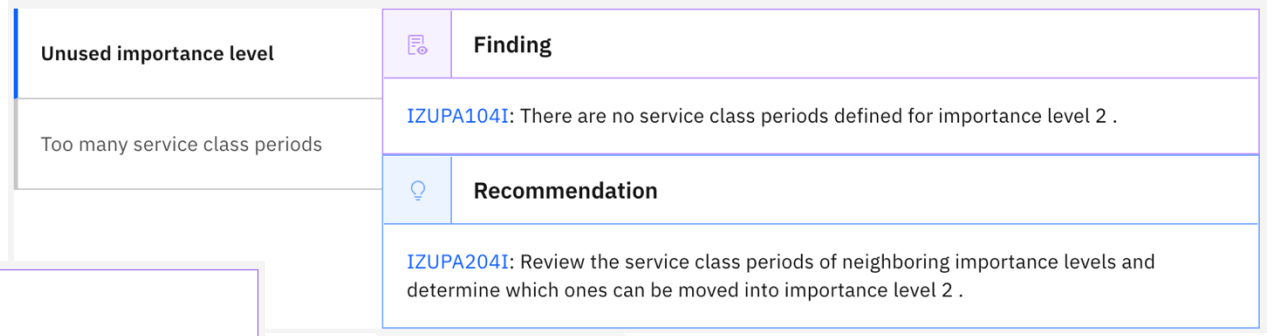


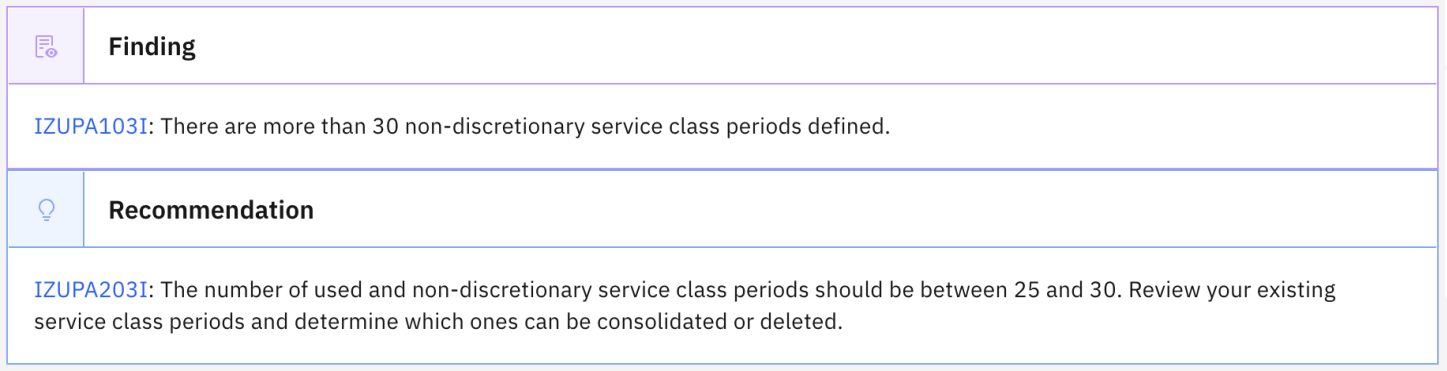
Performance Index IV

On the Performance Index overlay window you will find charts displaying performance index and execution velocity over time.

Findings and Recommendations

- Shows finding and recommendation next to each other.
- Recommendations can contain simple best practices or a step-by-step guide of what else need to be checked before concluding.
- Multiple findings are divided into tabs.



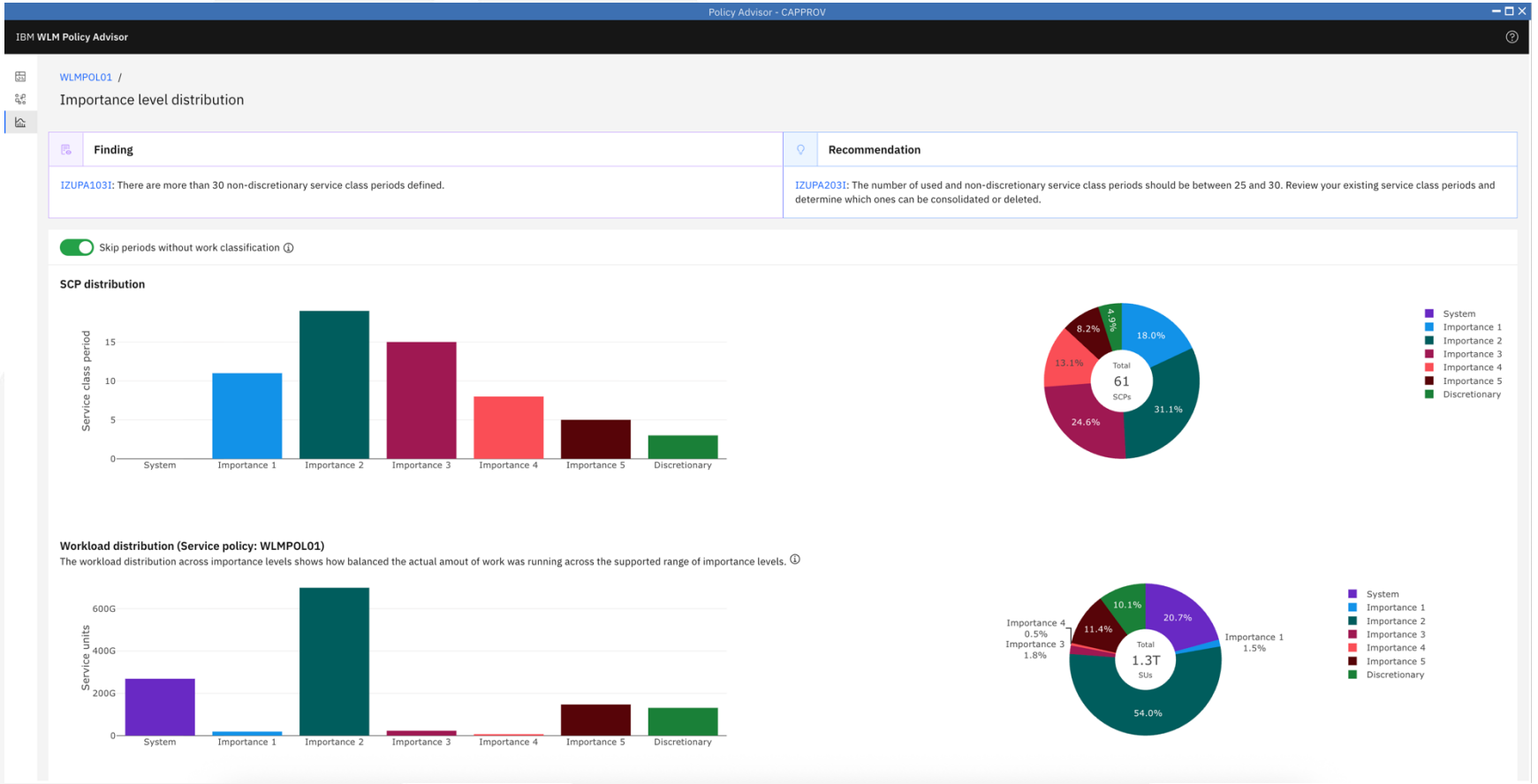


Importance

Examine the distribution of

1. Service class periods
2. Workload

across importance levels



Installation and Dependencies

- Available for z/OS 3.1 and above
- The PTFs for the following APARs must be installed
  - z/OS 3.2: PH66084
  - z/OS 3.1: PH61663

AI-POWERED WLM BATCH INITIATOR MANAGEMENT

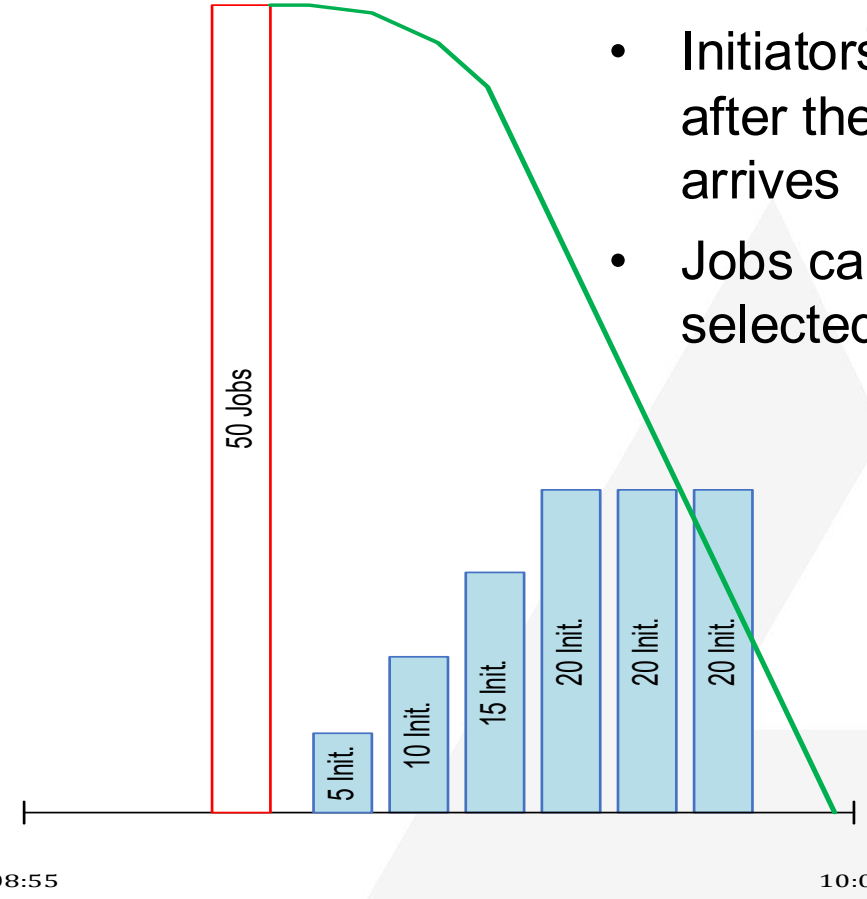
AI-powered WLM Batch Initiator Management

- AI solution infused into the operating system
- Augment Workload Manager to optimize the management of batch workloads
- Intelligently predict upcoming batch workload and react by allocating an appropriate number of WLM batch initiators
- Use your SMF 99.2 data to train an AI model for your specific environment

AI-powered WLM Batch Initiator Management

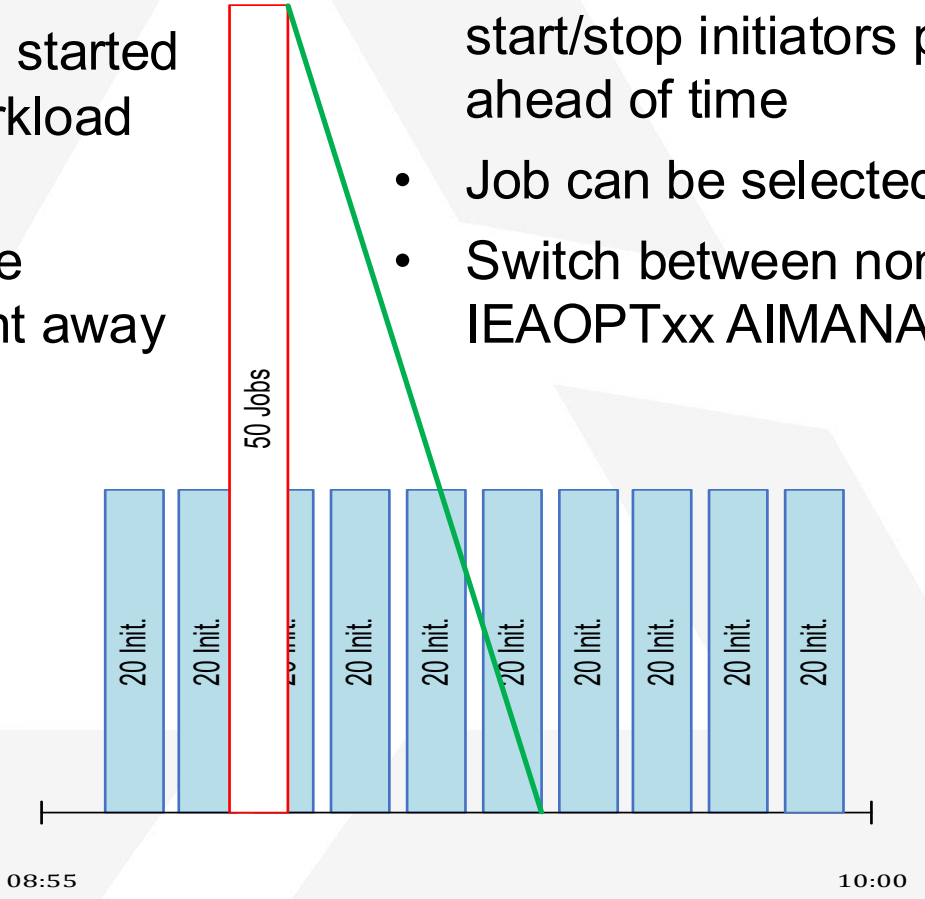
Today:

- Reactive mode
- Initiators are started after the workload arrives
- Jobs can't be selected right away



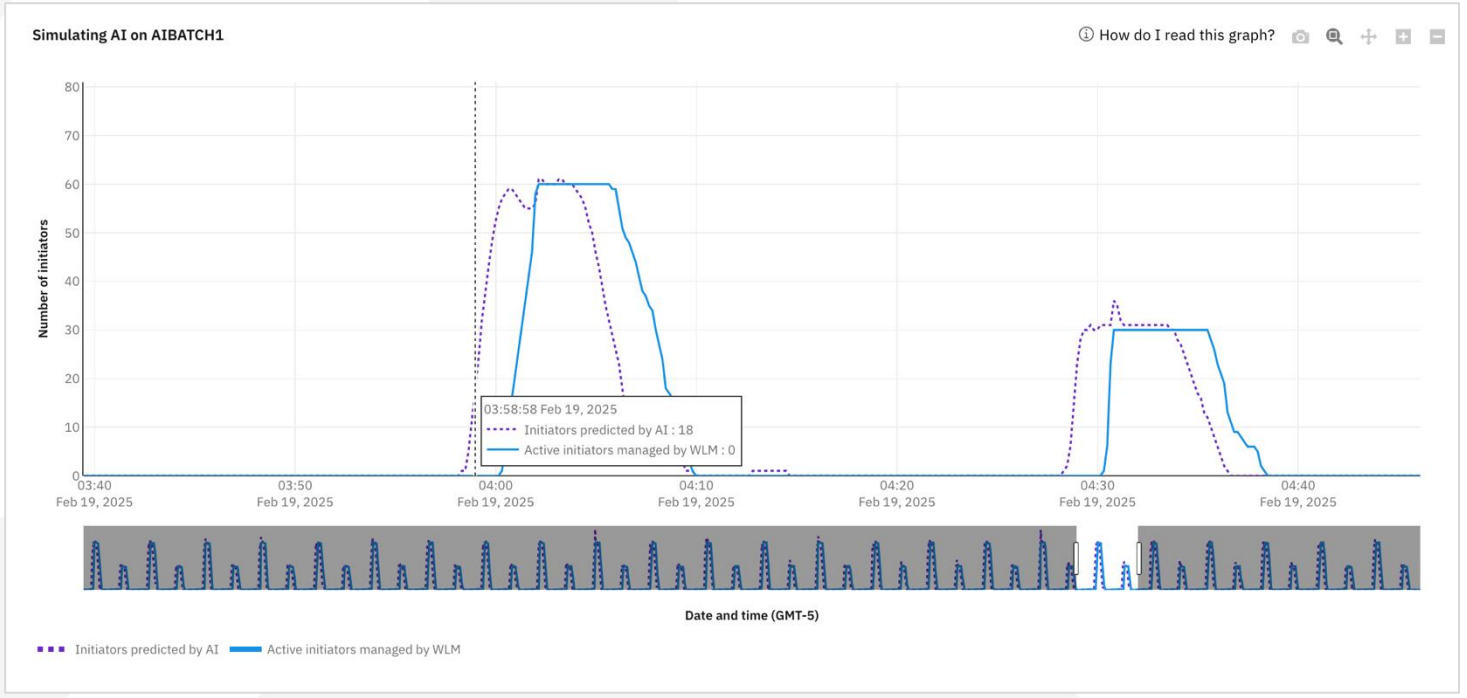
AI-powered WLM Batch Initiator Management:

- Workload forecast from AI allows WLM to start/stop initiators proactively two minutes ahead of time
- Job can be selected right away
- Switch between non-AI and AI mode IEAOPTxx AIMANAGEMENT=YES|NO



z/OSMF AICI Simulation Visualization

- AI-powered WLM Batch Initiator Management offers a simulation mode. AI predictions for service classes are generated but not used by WLM.
- The z/OSMF AI Control Interface (AICI) provides a visualization that compares the number of active batch initiators managed by WLM to the initiators predicted by the AI.
- Available on z/OS 3.1, as soon as the PTF for APAR PH56709 is installed.



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SHARE Sessions

AI infused z/OS: Overview and Updates
Anastasiia Didkovska, Steve Partlow
Salon 14
Thursday 9:15am

z/OS Workload Management: More Information

- z/OS WLM GitHub: https://github.com/IBM/IBM-Z-zOS/tree/master/zOS-WLM
- z/OS MVS documentation:
  - z/OS MVS Planning: Workload Management: https://www.ibm.com/docs/en/SSLTBW_3.2.0/pdf/ieaw100_v3r2.pdf
  - z/OS MVS Programming: Workload Management Services: https://www.ibm.com/docs/en/SSLTBW_3.2.0/pdf/ieaw200_v3r2.pdf
- IBM Redbooks publications:
  - System Programmer's Guide to: Workload Manager: http://www.redbooks.ibm.com/abstracts/sg246472.html?Open
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