

# z/OSMF 2.1 Advanced Programming

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# Agenda

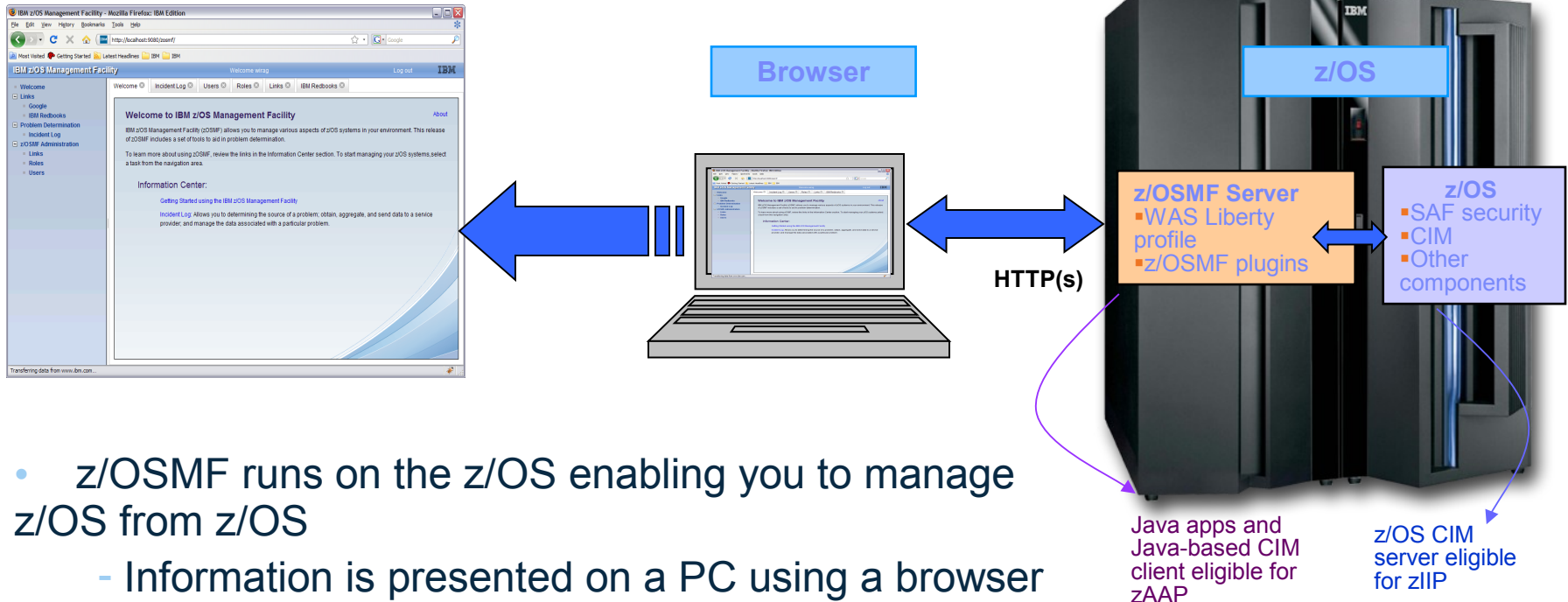
- What is z/OSMF
- What is z/OSMF Advanced Programming
- Using z/OSMF RESTful services
  - z/OS jobs service
  - z/OS data set and file service
  - Application Linking Manager interface service
  - TSO/E address space service
  - Data persistence service
  - Topology service\*\*
  - Multisystem routing service\*\*
  - z/OSMF workflow service\*\*
  - Software Management service\*\*
  - Using z/OSMF RESTful services – simple demo
  - Using z/OSMF RESTful services – Simpler than Simpler
- Summary

# What is z/OSMF

- IBM z/OS Management Facility (z/OSMF) delivers on IBM's strategy for mainframe simplification and modernization
  - The IBM z/OS Management Facility is a separate product for z/OS that provides support for a modern, Web-browser based management console for z/OS.
  - It helps system programmers more easily manage and administer a mainframe system by simplifying day to day operations and administration of a z/OS system.
  - More than just a graphical user interface, the z/OS Management Facility is intelligent, addressing the needs of a diversified skilled workforce and maximizing their productivity.
    - Automated tasks can help reduce the learning curve and improve productivity.
    - Embedded active user assistance (such as wizards) guide you through tasks and helps provide simplified operations.
- z/OSMF has a zero price for z/OS customers
- z/OSMF has its own product number and must be ordered separately

# What is z/OSMF

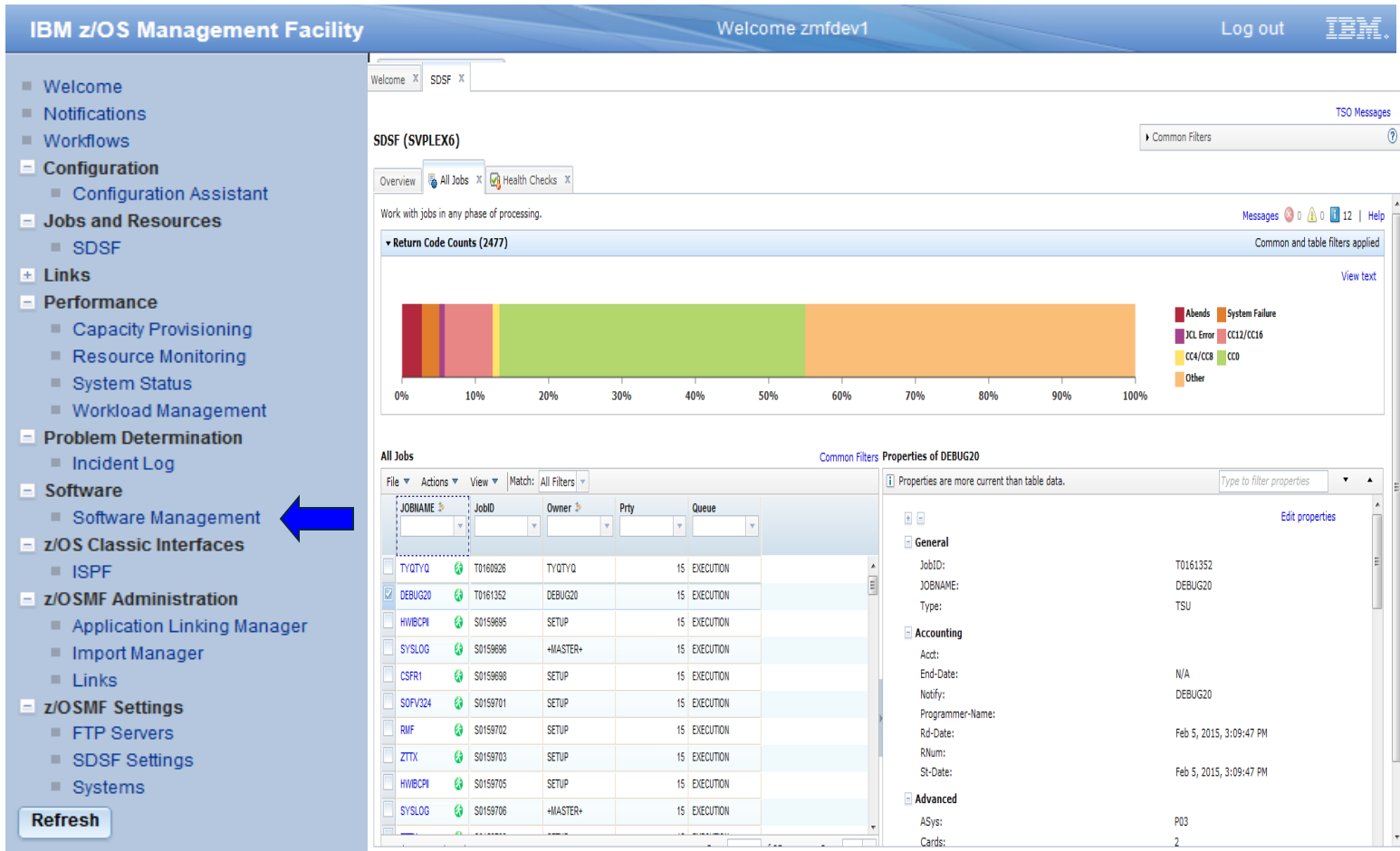
- How does z/OSMF function in the z/OS environment?



- z/OSMF runs on the z/OS enabling you to manage z/OS from z/OS
  - Information is presented on a PC using a browser
  - No client install required

# What is z/OSMF

- Gain simplification and modernization through z/OSMF plugins



**IBM z/OS Management Facility** Welcome zmfdev1 Log out IBM

Navigation Menu:

- Welcome
- Notifications
- Workflows
- Configuration
  - Configuration Assistant
- Jobs and Resources
  - SDSF
- Links
- Performance
  - Capacity Provisioning
  - Resource Monitoring
  - System Status
  - Workload Management
- Problem Determination
  - Incident Log
- Software
  - Software Management
- z/OS Classic Interfaces
  - ISPF
- z/OSMF Administration
  - Application Linking Manager
  - Import Manager
  - Links
- z/OSMF Settings
  - FTP Servers
  - SDSF Settings
  - Systems

**SDSF (SVPLEX6)**

Overview | All Jobs | Health Checks

Work with jobs in any phase of processing.

Return Code Counts (2477)

Common and table filters applied

View text

Abends System Failure  
JCL Error CC12/CC16  
CC4/CC8 CCO  
Other

**All Jobs**

Common Filters Properties of DEBUG20

JOBNAME	JobID	Owner	Prio	Queue
TYQTYQ	T0160926	TYQTYQ	15	EXECUTION
DEBUG20	T0161352	DEBUG20	15	EXECUTION
HWBCPI	S0159695	SETUP	15	EXECUTION
SYSLOG	S0159696	+MASTER+	15	EXECUTION
CSFR1	S0159698	SETUP	15	EXECUTION
SOPV324	S0159701	SETUP	15	EXECUTION
RMF	S0159702	SETUP	15	EXECUTION
ZTX	S0159703	SETUP	15	EXECUTION
HWBCPI	S0159705	SETUP	15	EXECUTION
SYSLOG	S0159706	+MASTER+	15	EXECUTION

**Properties of DEBUG20**

Properties are more current than table data.

Type to filter properties

Edit properties

**General**

JobID: T0161352  
JOBNAME: DEBUG20  
Type: TSU

**Accounting**

Acct: N/A  
End-Date: N/A  
Notify: DEBUG20  
Programmer-Name: Feb 5, 2015, 3:09:47 PM  
Rd-Date: Feb 5, 2015, 3:09:47 PM  
RNum: Feb 5, 2015, 3:09:47 PM  
St-Date: Feb 5, 2015, 3:09:47 PM

**Advanced**

ASys: P03  
Cards: 2

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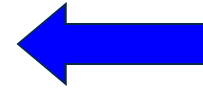
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# What is z/OSMF

## What's more?

# Agenda

- What is z/OSMF
- What is z/OSMF Advanced Programming
- Using z/OSMF RESTful services
  - z/OS jobs service
  - z/OS data set and file service
  - Application Linking Manager interface service
  - TSO/E address space service
  - Data persistence service
  - Topology service\*\*
  - Multisystem routing service\*\*
  - z/OSMF workflow service\*\*
  - Software Management service\*\*
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# What is z/OSMF Advanced Programming

- In addition to z/OSMF plugins with modern UI and simplified task, z/OSMF also provides services and facilities to help you write programs.
- z/OSMF Advanced Programming includes:
  - Using z/OSMF RESTful services
  - Develop workflow
  - Create your own z/OSMF plugins
- This session focus on “Using z/OSMF RESTful services”. Please refer to <IBM z/OS Management Facility Programming Guide>\* for more details about “Develop workflow” and “Create your own z/OSMF plugins”.

\* The latest order number of V2R1 is “SA32-1066-02”

# What is z/OSMF Advanced Programming

- Why would I need “z/OSMF RESTful services”
  - Representational State Transfer (REST) is a software architecture style. RESTful web service:
    - Has gained widespread acceptance across the Web. (Amazon, Twitter)
    - Is easy to call
    - Could be driven remotely (via HTTPS) and securely.
    - Language and platform independent.
      - Mobile (iOS and Android) platform also has strong support for calling RESTful web service.
  - z/OSMF RESTful services makes z/OS and z/OSMF more approachable.

# What is z/OSMF Advanced Programming


- Why would I need to “develop workflow”
  - z/OSMF Workflows application provides a framework supports user (workflow provider) to define a guided flow (a.k.a. workflow) through steps to accomplish a task in z/OS.
  - z/OSMF Workflows application is useful to:
    - Assist people unfamiliar with how to perform a given task, or a task that they perform rarely
    - Ensure that all tasks are performed in the right order and only when their dependencies have been met
    - Monitor and track progress toward the completion of the task in the centralized place
    - Provide a history (audit trail) of the steps performed for a task
    - Automate a workflow without the need of interaction
    - Adjust step status dynamically according to various pre-defined condition
    - Work with workflow through REST service instead of having to logon to z/OSMF UI\*\*.
  - Exploiters of workflow
    - zEDC workflow to enable zEDC on multiple systems
    - z/OS Migration workflow
    - z/OSMF Configure workflow
    - z/OSMF CA workflows

\*\* available for z/OSMF V2R1 with APAR PI32148

# What is z/OSMF Advanced Programming

- Why would I need to “create my own z/OSMF plugins”
  - z/OSMF V2R1 provides “External application support” solution enables non-z/OSMF web application (plugin) – html and/or JavaScript applications to render their UI and run in the z/OSMF browser.
  - “External application support” solution provides:
    - z/OS TSO/E address space RESTful service allows “external application” to communicate with their back-end TSO/E application which facilitates reusing existing TSO application to serve web application.
    - Data persistence RESTful service helps “external application” to manage (read/write) their persistent data in z/OS side.
    - Import Manager plugin provides the UI interface to import “external application” into z/OSMF.
  - “Create your own z/OSMF plugins” builds centralized z/OS management portal and makes developing and deploying web application more easy.

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# Using z/OSMF RESTful services

- z/OSMF provides a set of RESTful services to make z/OS and z/OSMF more approachable.
- Process overview
  - z/OSMF RESTful services can be invoked by any HTTP client application running on the z/OS local system or remote system.
  - Your application (client) issues HTTP request to the target system (z/OS).
  - z/OSMF determines if the request is valid or not. If it's valid, z/OSMF performs the requested service and return the HTTP response contains the result.
- Security consideration
  - Your client program must authenticate to z/OSMF in order to access z/OSMF RESTful services. (Certificate authentication is supported on “zOS Jobs RESTful service”\*\*)
  - Other authorization may be required for different RESTful services. Generally, your user ID requires the same authorization when performing similar operation from traditional channel such as TSO/E session. E.g. Submitting a job through “z/OS jobs RESTful service” requires that your user ID be authorized to run jobs on the system.
  - Please refer to <z/OS Management Facility Programming Guide> for details.

\*\* available for z/OSMF V2R1 with APAR PI32148

# Using z/OSMF RESTful services

- z/OSMF provides below RESTful services:
  - z/OS jobs service
  - z/OS data set and file service
  - Application Linking Manager interface service
  - TSO/E address space service
  - Data persistence service
  - Topology service\*\*
  - Multisystem routing service\*\*
  - z/OSMF workflow service\*\*
  - Software Management service\*\*

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# z/OS jobs service – API list

- z/OS jobs RESTful service is provided for working with batch jobs on a z/OS system.
- z/OS jobs RESTful service provides below operations (APIs):

Operation	Method
Obtain the status of a job.	GET
List the jobs for an owner, prefix, or job ID.	GET
List the spool files for a job.	GET
Retrieve the contents of a job spool file.	GET
Submit a job to run on z/OS.	PUT
Hold a job.	PUT
Release a job.	PUT
Change the job class.	PUT
Cancel a job.	PUT
Delete a job (cancel a job and purge its output).	DELETE



# z/OS jobs service – API example

- List the jobs for an owner, prefix or job ID
  - URL format

There are various formats of the URL for this operation:

`https://host:port/zosmf/restjobs/jobs`

`https://host:port/zosmf/restjobs/jobs?owner=owner`

`https://host:port/zosmf/restjobs/jobs?prefix=prefix*`

`https://host:port/zosmf/restjobs/jobs?owner=owner&prefix=prefix*`

`https://host:port/zosmf/restjobs/jobs?jobid=jobid`

`https://host:port/zosmf/restjobs/jobs?max-jobs=nnn`

`https://host:port/zosmf/restjobs/jobs?user-correlator=correlator`

- Expected response

On completion, the z/OS jobs REST service returns an HTTP response with an Array of matching jobs, each as a JSON job document.

# z/OS jobs service – API example

- List the jobs for an owner, prefix or job ID

- Example request

In the following example, the GET method is used to list the jobs that are owned by “IBMUSER” and have a job name prefix beginning with “TESTJOB”:

```
GET /zosmf/restjobs/jobs?owner=IBMUSER&prefix=TESTJOB* HTTP/1.1
```

- Example response

```
HTTP/1.1 200 OK
Date: Fri, 17 Jan 2014 05:39:28 +0000GMT
Content-Type: application/json
Connection: close
```

```
[
  {
    "jobid": "JOB00023", "jobname": "TESTJOB2", "subsystem": null, "owner": "IBMUSER",
    "status": "OUTPUT", "type": "JOB", "class": "A", "retcode": "CC 0000",
    "url": "https://host:port/zosmf/restjobs/jobs/TESTJOB2/JOB00023",
    "files-url": "https://host:port/zosmf/restjobs/jobs/TESTJOB2/JOB00023/files",
    "jobid": "JOB00024", "jobname": "TESTJOB3", "subsystem": null, "owner": "IBMUSER",
    "status": "OUTPUT", "type": "JOB", "class": "A", "retcode": "ABEND S000",
    "url": "https://host:port/zosmf/restjobs/jobs/TESTJOB3/JOB00024",
    "files-url": "https://host:port/zosmf/restjobs/jobs/TESTJOB3/JOB00024/files"
  }
]
```

# z/OS jobs service – API example

- Submit a job

- URL format

`https://host:port/zosmf/restjobs/jobs{/-JESB}`

- To submit a job to secondary JES, use “-JESB” in the URL
    - The job to be submitted could be included in the request body OR resided in a data set or unix file in the host z/OS system.

- Expected response

On completion, the z/OS jobs REST service returns an HTTP response with a JSON job document. The document contains information about the submitted job such as jobid, status, type, etc.

# z/OS jobs service – API example

- Submit a job

- Example request

The following request submits a job “TESTJOBX” to run on z/OS. The content of the job to be submitted is included in the request.

```
PUT /zosmf/restjobs/jobs HTTP/1.1
Content-Type: text/plain
X-IBM-Intrdr-Class: A
X-IBM-Intrdr-Recfm: F
X-IBM-Intrdr-Lrecl: 80
X-IBM-Intrdr-Mode: TEXT
```

```
//TESTJOBX JOB (),MSGCLASS=H
// EXEC PGM=IEFBR14
```

- Example response

```
HTTP/1.1 201 Created
Date: Fri, 17 Jan 2014 05:39:28 +0000GMT
Content-Type: application/json
Connection: close
```

```
{
  "jobid": "JOB00025", "jobname": "TESTJOBX", "subsystem": null, "owner": "IBMUER",
  "status": "INPUT", "type": "JOB", "class": "A", "retcode": null,
  "url": "https://host:port/zosmf/restjobs/jobs/TESTJOBX/JOB00025",
  "files-url": "https://host:port/zosmf/restjobs/jobs/TESTJOBX/JOB00025/files"
}
```

# z/OS jobs service – API exploiters

- By exploiting z/OS jobs RESTful service:
  - application could focus on implementing their own logic and be released from taking care about how to work with z/OS jobs remotely or locally
  - application can easily call these jobs API.
- Current exploiters:
  - Explorer family such as CICS Explorer, z/OS Explorer.
  - z/OSMF Software Management
  - z/OSMF SDSF UI
  - z/OSMF Workflows
  - Customer's self-developed web application

# z/OS jobs service – API exploiters

- z/OSMF Software Management plugin easily gets job management capability to manage deploy jobs (1/3)

[Software Management](#) ▶ [Deployments](#) ▶ [Deployment Checklist](#)

## Deployment Checklist

To deploy a software instance, complete the checklist.

Checklist

Progress	Step
✓	1. <a href="#">Specify the properties for this deployment.</a>
✓	2. <a href="#">Select the software instance to deploy.</a>
✓	3. <a href="#">Select the objective for this deployment.</a>
✓	4. <a href="#">Check for missing SYSMODs.</a> • <a href="#">View missing SYSMOD reports.</a>
✓	5. <a href="#">Configure this deployment.</a>
✓	6. <a href="#">Define the job settings. z/OSMF creates the deployment jobs.</a> • <a href="#">View the deployment summary.</a>
➡	7. <a href="#">Submit deployment jobs.</a>
	8. <a href="#">Specify the properties for the target software instance.</a>

Close

[Software Management](#) ▶ [Deployments](#) ▶ [Deployment Checklist](#) ▶ [Submit Deployment Jobs](#)

## Submit Deployment Jobs

Review the jobs created for this deployment, and submit the jobs in sequential order. When all the jobs are complete, you can purge the jobs.

JCL data set name: ZOSMFAD.DM.D140625.T162244.CNTL  
Target system: PEV171

Jobs

Sequence Filter	JCL Data Set Member Name Filter	Description [More   Less] Filter	System Filter
<input checked="" type="checkbox"/>	1	<a href="#">IZUD01CP</a>	Copy Data Sets: Copy the source software instance data sets to <a href="#">[More]</a>
<input type="checkbox"/>	2	<a href="#">IZUD02RN</a>	Jobs: Rename the target software instance data sets <a href="#">[More]</a>
<input type="checkbox"/>	3	<a href="#">IZUD03UC</a>	Jobs: Update the entries within the SMP/E CSI data <a href="#">[More]</a>

- View
- Submit Job
- Purge...
- Cancel...
- Override Complete

# z/OS jobs service – API exploiters

- z/OSMF Software Management plugin easily gets job management capability to manage deploy jobs (2/3)

Software Management > Deployments > Deployment Checklist > Submit Deployment Jobs

## Submit Deployment Jobs

Messages 0 0 1

**IZUD7861:** Job "IZUD01CP" ( JOB00080) has been submitted.

Review the jobs created for this deployment, and submit the jobs in sequential order. When all the jobs are complete, click **Close** to proceed to the next step in the deployment checklist.

JCL data set name: ZOSMFAD.DM.D140625.T162244.CNTL  
Target system: PEV171

Jobs

Sequence Filter	JCL Data Set Member Name Filter	Description [More   Less] Filter	System Filter	Status Filter	Messages Filter	Job Name Filter
<input type="checkbox"/> 1	IZUD01CP	Copy Data Sets: Copy the source software instance data sets to <a href="#">[More]</a>	PEV171	Submitted		IZUD01CP
<input type="checkbox"/> 2	IZUD02RN	Rename Data Sets: Rename the target software instance data sets <a href="#">[More]</a>	PEV171			
<input type="checkbox"/> 3	IZUD03UC	Update CSI Data Sets: Update the entries within the SMP/E CSI data <a href="#">[More]</a>	PEV171			



Software Management > Deployments > Deployment Checklist > Submit Deployment Jobs

## Submit Deployment Jobs

Review the jobs created for this deployment, and submit the jobs in sequential order. When all the jobs are complete, click **Close** to proceed to the next step in the deployment checklist.

JCL data set name: ZOSMFAD.DM.D140625.T162244.CNTL  
Target system: PEV171

Jobs

Sequence Filter	JCL Data Set Member Name Filter	Description [More   Less] Filter	System Filter	Status Filter
<input checked="" type="checkbox"/> 1	IZUD01CP	Copy Data Sets: Copy the source software instance data sets to <a href="#">[More]</a>	PEV171	Complete
<input type="checkbox"/> 2	IZUD02RN	Rename Data Sets: Rename the target software instance data sets <a href="#">[More]</a>	PEV171	
<input type="checkbox"/> 3	IZUD03UC	Update CSI Data Sets: Update the entries within the SMP/E CSI data <a href="#">[More]</a>	PEV171	

Context menu for Job 1:

- View
  - JCL
  - Job Output
- Submit Job
- Purge...
- Cancel...
- Override Complete

# z/OS jobs service – API exploiters

- z/OSMF Software Management plugin easily gets job management capability to manage deploy jobs (3/3)

[Software Management](#) ▶ [Deployments](#) ▶ [Deployment Checklist](#) ▶ [Submit Deployment Jobs](#) ▶ [View Job Output](#)

## View Job Output

Name: IZUD01CP ID: JOB00082 Class: A Status: Submitted Return code:

JESMSGLG JESJCL JESYSMSG SYSPRINT SYSPRINT SYSPRINT SYSPRINT

DD name:	Step name:	Procedure step name:	Dataset ID:	Class:	Record count:	Byte count:
JESMSGLG	JES2		2	A	14	524

Output (0.51 of 0.51 KB shown)

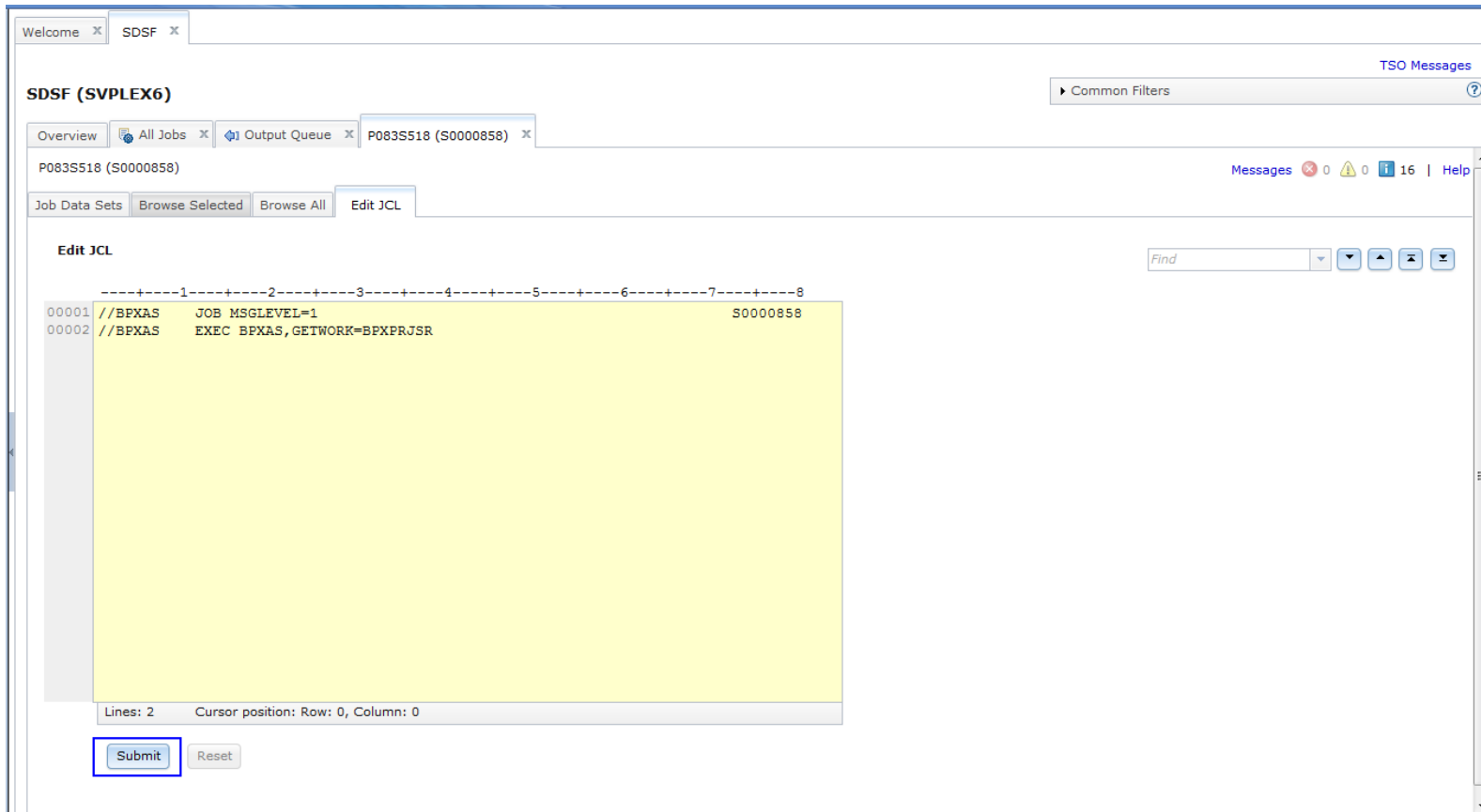
```

1      J E S 2   J O B   L O G   --   S Y S T E M   S Y 1   --   N O D E   S Y 1
0
05.04.28 JOB00082 ---- WEDNESDAY, 25 JUN 2014 ----
05.04.28 JOB00082 IRR010I USERID ZOSMFAD IS ASSIGNED TO THIS JOB.
05.04.28 JOB00082 ICH70001I ZOSMFAD LAST ACCESS AT 04:46:53 ON WEDNESDAY, JUNE 25, 2014
05.04.28 JOB00082 $HASP373 IZUD01CP STARTED - INIT 1 - CLASS A - SYS SY1
05.04.36 JOB00082 $HASP395 IZUD01CP ENDED
0----- JES2 JOB STATISTICS -----
- 25 JUN 2014 JOB EXECUTION DATE
- 102 CARDS READ
- 271 SYSOUT PRINT RECORDS
- 0 SYSOUT PUNCH RECORDS
- 14 SYSOUT SPOOL KBYTES
- 0.10 MINUTES EXECUTION TIME
  
```



# z/OS jobs service – API exploiters

- z/OSMF SDSF UI exploits “z/OS jobs RESTful service” to submit job.



Welcome x SDSF x

TSO Messages

SDSF (SVPLEX6)

Common Filters ?

Overview All Jobs x Output Queue x P083S518 (S0000858) x

P083S518 (S0000858)

Messages 0 0 16 | Help

Job Data Sets Browse Selected Browse All Edit JCL

Edit JCL

Find

```
-----1-----2-----3-----4-----5-----6-----7-----8
00001 //BPXAS JOB MSGLEVEL=1 S0000858
00002 //BPXAS EXEC BPXAS,GETWORK=BPXPRJSR
```

Lines: 2 Cursor position: Row: 0, Column: 0

Submit Reset

# z/OS data set and file service – API list

- z/OS data set and file service is provided for working with data sets and unix files on a z/OS system.
- z/OS data set and file RESTful service provides below operations (APIs):

Operation	Method
List the data sets on a z/OS system. You can filter the returned list of data set names through the specification of high-level qualifiers and wildcards.	GET
List the members of a z/OS partitioned data set (PDS or PDSE). You can filter the returned list of member names through the specification of wildcards.	GET
List the files and directories in a UNIX file path on a z/OS system.	GET
Retrieve the contents of a sequential data set, or a member of a PDS or PDSE.	GET
Retrieve the contents of a z/OS UNIX file.	GET
Write data to a sequential data set or a member of a PDS or PDSE.	PUT
Write data to a z/OS UNIX file.	PUT

# z/OS data set and file service – API example

- List the z/OS data sets on a system

- URL format

- `https://host:port/zosmf/restfiles/ds/?dslevel=filter-criteria`

- `https://host:port/zosmf/restfiles/ds/?dslevel=filter-criteria&volser=volume-serial`

- Expected response

On completion, the service returns an HTTP response, which includes a status code indicating whether your request completed. Status code 200 indicates success. A status code of 4nn or 5nn indicates that an error has occurred.

For a successful request, the HTTP response includes an array of matching data sets, each as a JSON list document.

# z/OS data set and file service – API example

- List the z/OS data sets on a system

- Example request

The following request is used to list all of the cataloged data sets that match the partial name "sys1.\*lib". That is, the data sets that have a name beginning with "sys1". and a last qualifier that ends in "lib".

```
GET https://zosmf1.yourco.com/zosmf/restfiles/ds/?dslevel=sys1.*lib HTTP/1.1
```

- Example response

```
HTTP/1.1 200 OK
Date: Wed, 23 Oct 2013 00:43:49 GMT
Content-Type: application/json
Connection: close
{ "items": [ { "dsname": "SYS1.AUXLIB" }, { "dsname": "SYS1.BDTLIB" }, { "dsname": "SYS1.CHSLIB" },
{ "dsname": "SYS1.COMDLIB" }, { "dsname": "SYS1.COBLIB" }, { "dsname": "SYS1.CSSLIB" },
{ "dsname": "SYS1.FDEFLIB" }, { "dsname": "SYS1.FONTLIB" }, { "dsname": "SYS1.FORTLIB" },
{ "dsname": "SYS1.GRSLIB" }, { "dsname": "SYS1.IMAGELIB" }, { "dsname": "SYS1.JES3LIB" },
{ "dsname": "SYS1.KANLIB" }, { "dsname": "SYS1.LINKLIB" }, { "dsname": "SYS1.LPALIB" },
{ "dsname": "SYS1.MACLIB" }, { "dsname": "SYS1.MIGLIB" }, { "dsname": "SYS1.NCPLIB" },
{ "dsname": "SYS1.NFSLIB" }, { "dsname": "SYS1.OVERLIB" }, { "dsname": "SYS1.PARMLIB" },
{ "dsname": "SYS1.PARMLIB.CB" }, { "dsname": "SYS1.PARMLIB.INSTALL" },
{ "dsname": "SYS1.PARMLIB.MSYS" }, { "dsname": "SYS1.PARMLIB.PD" }, { "dsname": "SYS1.PROCLIB" },
{ "dsname": "SYS1.PROCLIB.CB" }, { "dsname": "SYS1.PROCLIB.INSTALL" },
{ "dsname": "SYS1.PROCLIB.MSYS" }, { "dsname": "SYS1.PROCLIB.PD" },
{ "dsname": "SYS1.PROCLIB.TEST" }, { "dsname": "SYS1.PSEGLIB" }, { "dsname": "SYS1.PSPMLIB" },
{ "dsname": "SYS1.SADRYLIB" }, { "dsname": "SYS1.SAMPLIB" }, { "dsname": "SYS1.SIATLIB" },
{ "dsname": "SYS1.SICETLIB" }, { "dsname": "SYS1.SIFALIB" }, { "dsname": "SYS1.SISTCLIB" },
{ "dsname": "SYS1.SORTLIB" }, { "dsname": "SYS1.SVCLIB" }, { "dsname": "SYS1.VTAMLIB" },
{ "dsname": "SYS1.XCFLIB" } ], "returnedRows": 43 }
```

# z/OS data set and file service – API example

- Retrieve the contents of a z/OS data set or member

- URL format

For a request to retrieve data from a sequential data set:

`https://host:port/zosmf/restfiles/ds/<data-set-name>`

For a request to retrieve data from a member of a PDS or PDSE:

`https://host:port/zosmf/restfiles/ds/<data-set-name>(<member-name>)`

For a request to retrieve data from an uncataloged sequential data set:

`https://host:port/zosmf/restfiles/ds/-(volser)/<data-set-name>`

For a request to retrieve data from a member of an uncataloged PDS or PDSE:

`https://host:port/zosmf/restfiles/ds/-(volser)/<data-set-name>(<member-name>)`

- Expected response

On completion, the service returns an HTTP response, which includes a status code indicating whether your request completed. Status code 200 indicates success.

# z/OS data set and file service – API example

- Retrieve the contents of a z/OS data set or member

- Example request

The following request is used to retrieve the contents of the member SMFPRM00 in data set SYS1.PARMLIB:

```
GET https://zosmf1.yourco.com/zosmf/restfiles/ds/SYS1.PARMLIB(SMFPRM00) HTTP/1.1
```

- Example response

```
200 OK
Etag: B5C6454F783590AA8EC158D88E29EA63
Content-Type: text/plain; charset=UTF-8
Content-Language: en-US
Content-Length: 1944
Date: Fri, 07 Nov 2014 02:13:07 GMT
Connection: close

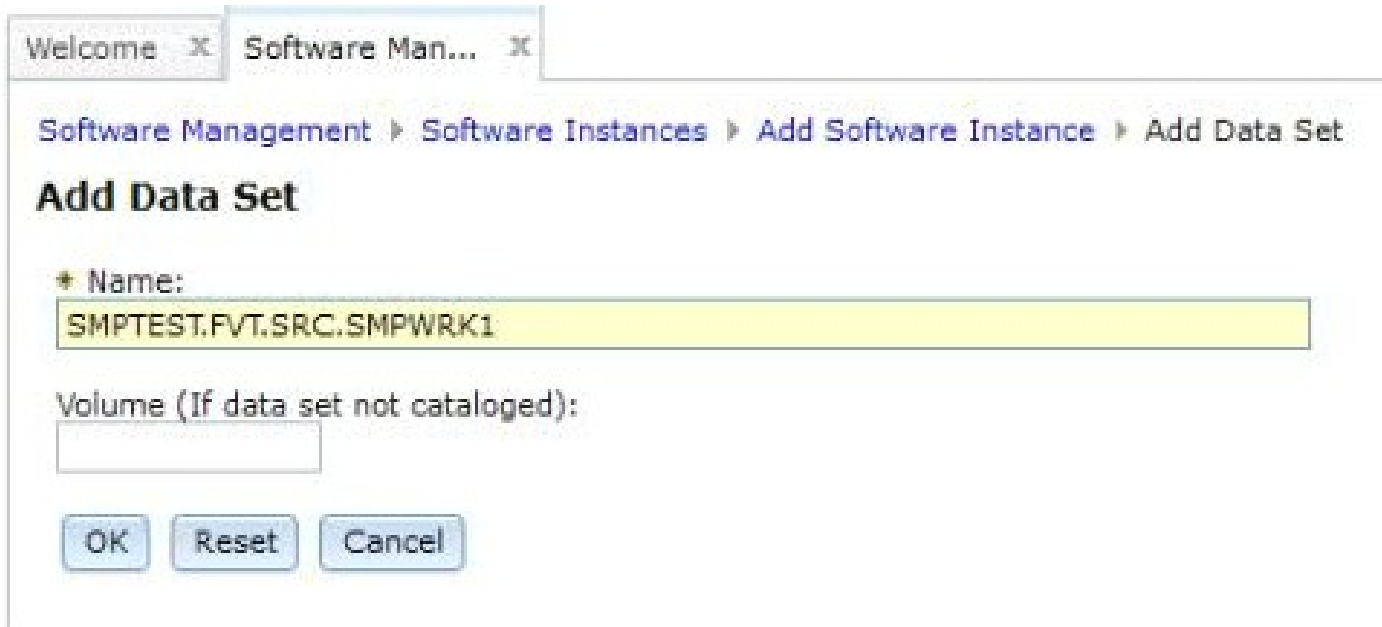
ACTIVE                /*ACTIVE SMF RECORDING*/          00010000
DSNAME(SYS1.&SMFDSN1,SYS1.&SMFDSN2, /*SMF ON 3390 */          00020000
SYS1.&SMFDSN3)          /*FT: SYSAQ3, TS: SYSAQ4 */          00030000
NOPROMPT              /*PROMPT THE OPERATOR FOR OPTIONS*/          00040000
REC(PERM)             /*TYPE 17 PERM RECORDS ONLY*/          00050000
MAXDORM(3000)         /* WRITE AN IDLE BUFFER AFTER 30 MIN*/          00060000
MEMLIMIT(256M)        /* 256M FOR 64 BIT APPS */          00061005
STATUS(003000)        /* WRITE SMF STATS AFTER HALF HOUR*/          00070000
JMT(0700)             /* INVOKE EXIT IEFUTL AFTER 7HR 00M*/          00080002
SID(&SYSNAME),         /* SYSTEM ID FOR 3084 - SINGLE IMAGE*/          00090000
LISTDSN              /* LIST DATA SET STATUS AT IPL*/          00100000
INTVAL(30)            /* INTVAL OPTION SP430 */          00110000
SYNCVAL(00)           /* SYNCVAL OPTION SP430 */          00120000
SYS(NOTYPE(19,40,92),
  EXITS(IEFU83,IEFU84,IEFACTRT,IEFUJV,IEFUJI,
        IEFUSI,IEFUTL,IEFU29),INTERVAL(010000),DETAIL)          00130001
                                                                00140000
                                                                00150000
                                                                00160000
                                                                00170000
/* WRITE ALL RECORDS AS THE SYSTEM DEFAULT, TAKE ALL KNOWN
  EXITS, NOTE: JES EXITS CONTROLLED BY JES , THERE IS NO
  DEFAULT INTERVAL RECORDS WRITTEN AND ONLY SUMMARY T32
  RECORDS AS A DEFAULT FOR TSO */          00180000
                                                                00190000
                                                                00200000
                                                                00210000
                                                                00220001
                                                                00230000
                                                                00240000
                                                                00250000
SUBSYS(STC,NOTYPE(19,40,92),
  EXITS(IEFU29,IEFU83,IEFU84,IEFUTL),
  INTERVAL(SMF,SYNC),DETAIL)          /*SP430*/          00260000
                                                                00270000
                                                                00280000
                                                                00290000
/* WRITE ALL RECORDS AS BY SYSTEM DEFAULT, TAKE ONLY THREE
  EXITS, NOTE: IEFU29 EXECUTES IN THE MASTER ASID WHICH IS A
  STC ADDRESS SPACE SO IEFU29 MUST BE ON FOR STC. USE ALL OTHER
  SYS PARAMETERS AS A DEFAULT */
```

# z/OS data set and file service – API exploiters

- By exploiting z/OS data set and file RESTful service, application could easily get the capability of managing data set and unix files remotely or locally.
- Current exploiters:
  - z/OSMF Software Management
  - Customer's self-developed web application

# z/OS data set and file service – API exploiters

- z/OSMF Software Management plugin simplifies the process of adding data set into software instance.
- Previously, user has to enter data set name manually, and, therefore, one data set at a time.



The screenshot shows a web-based interface for adding a data set. At the top, there are two tabs: 'Welcome' and 'Software Man...'. Below the tabs is a breadcrumb trail: 'Software Management > Software Instances > Add Software Instance > Add Data Set'. The main heading is 'Add Data Set'. Underneath, there is a label 'Name:' followed by a text input field containing 'SMPTTEST.FVT.SRC.SMPWRK1'. Below this is a label 'Volume (If data set not cataloged):' followed by an empty text input field. At the bottom, there are three buttons: 'OK', 'Reset', and 'Cancel'.



# z/OS data set and file service – API exploiters

- With exploiting “z/OS data set and file service”, Software Management plugin provides searching data set function. User can select multiple data sets returned by the search operation and add them once.

Software Management > Software Instances > Modify Software Instance > Add Data Set Help

## Add Data Set

To identify the data sets to be added to the software instance, specify a data set name qualifier, volume, or both, and click Search. Then, select the data sets you want to add. For valid data set name qualifiers, select [Learn more...](#)

Data set name qualifier:  Volume:  \*Maximum data sets:

Select Data Sets to Add

<input type="checkbox"/>	Data Set Name Filter	Volume Filter
<input type="checkbox"/>	JOEY.DEMO.WLMLOG1	9SX605
<input type="checkbox"/>	JOEY.DEMO.WASLOG1	9SX60A
<input type="checkbox"/>	JOEY.DEMO.USSLOG1	9SX601
<input type="checkbox"/>	JOEY.DEMO.SDSFLOG1	9SX607
<input type="checkbox"/>	JOEY.DEMO.RMMLOG1	9SX601
<input type="checkbox"/>	JOEY.DEMO.LOG1	X6TSO7
<input type="checkbox"/>	JOEY.DEMO.LDAPLOG1	9SX606
<input type="checkbox"/>	JOEY.DEMO.USSLOG1	9SX60A

Total: 11, Selected: 0

# z/OS data set and file service – API exploiters

- Build something cool by exploiting “z/OS data set and file service”:

Search for and list z/OS data sets and files.

Resource type:

☒ z/OS data sets    ☐ z/OS UNIX files

Name:

Volume:

Select or type.

Search

IBMUSER.

▲ Back

IBMUSER.HOSTS.ADDRINFO

IBMUSER.HOSTS.SITEINFO

IBMUSER.ISPFWEB.EXEC

IBMUSER.ISPFWEB.LOAD.OLD

IBMUSER.ISPFWEB.LOAD.OLD2

IBMUSER.ISPFWEB.LOAD.OLD3

IBMUSER.SPFWEB.MSGTYPES.LOAD

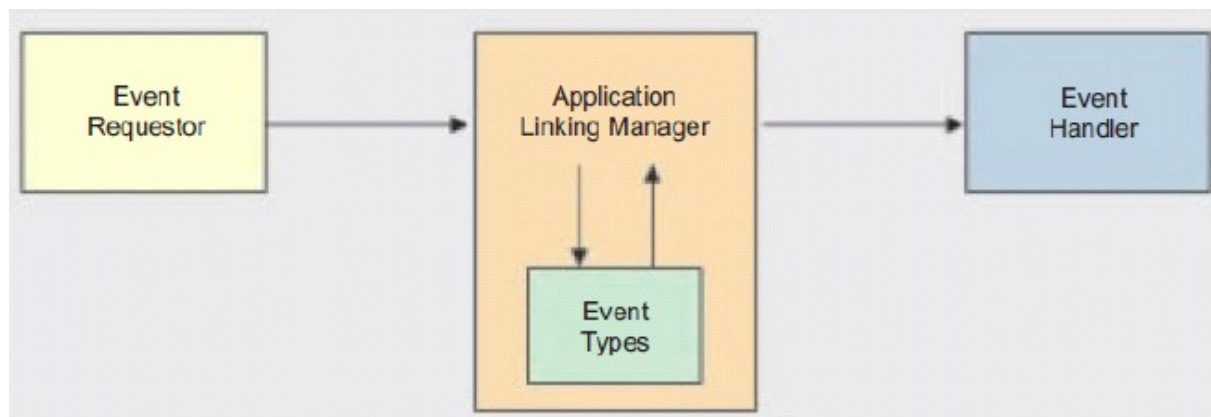
IBMUSER.SPFWEB.PANELS

IBMUSER.SPFWEB.SISPMENU

▼ Next

# Application Linking Manager service

- To perform traditional system management tasks in z/OS, you might interact with several different interfaces.
- In z/OSMF, it is possible to link or connect some of these tasks and external applications together for a smoother user experience via the Application linking Manager service.
- Key components:
  - Event Requestor: z/OSMF task or external application
  - Event: Action requested by the “Event Requestor”
  - Event type: Object that contains an “Event Requestor” to an “Event Handler”
  - Event handler: z/OSMF task or external application



# Application Linking Manager service – API list

- Application Linking Manager service provides below operations (APIs):

Operation	Method
Register an event type.	POST
Register a handler for an event type	POST
List all tasks that are eligible to be handlers	GET
List the registered handlers for an event type	GET
Unregister a handler	DELETE
Unregister an event type	DELETE

# Application Linking Manager service – API example

- Register a handler for an event type

- URL format

`https://{host}:{port}/zosmf/izual/rest/handler?eventTypeId={eventTypeId}`

Request content:

type: handler type. “INTERNAL” for z/OSMF plug-in, “EXTERNAL” for external application.

Id: Unique identifier for a launch point within the handler task or application.

applID: Identifier assigned to z/OSMF plugin

displayName: handler name

URL: URL to be used for accessing the handler.

options: indicates how the handler will be displayed when it process events.

- Expected response

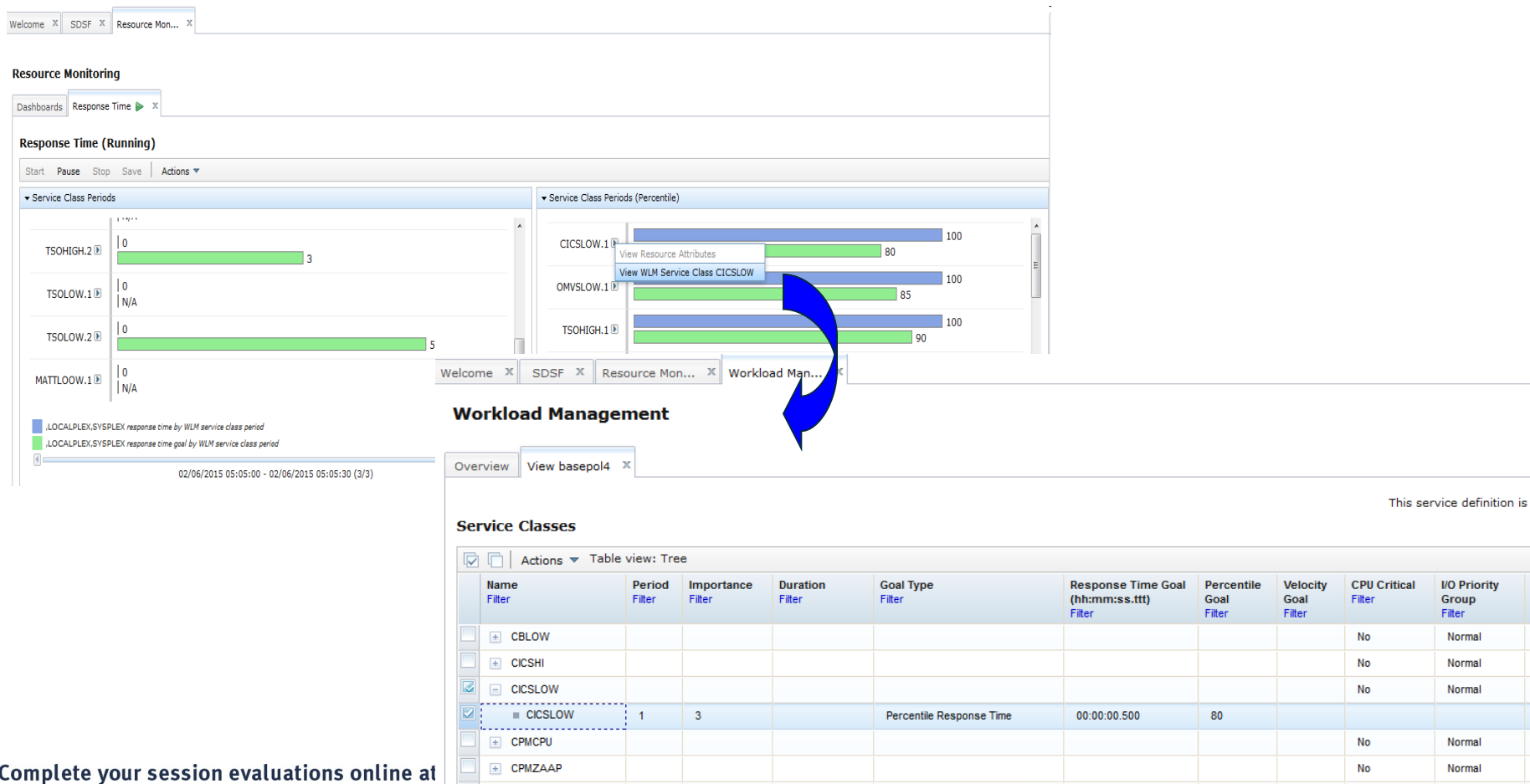
On completion, the Application Linking Manager interface returns an HTTP response, which includes a status code indicating whether your request completed. Status code 200 indicates success. A status code of 4nn or 5nn indicates that an error has occurred.

# Application Linking Manager service – API exploiters

- z/OSMF WLM plugin is used to define performance policy. z/OSMF RMF plugin is used to monitor performance. By exploiting “Application Linking Manager service”, WLM and RMF provide a smooth user experience when there is need to switch between these two plugins.
- Example of linkage between z/OSMF RMF plugin and z/OSMF WLM plugin (1/2)
  - Event Requestor: z/OSMF RMF plugin
  - Event type:  
IBM.ZOSMF.VIEW\_ACTIVE\_WLM\_SERVICE\_DEFINITION.SERVICE\_CLASS
  - Event Handler: z/OSMF WLM plugin

# Application Linking Manager service – API exploiters

- Example of linkage between z/OSMF RMF plugin and z/OSMF WLM plugin (2/2)



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# TSO/E address space service – API list

- TSO/E address space service is provided for web application (especially for external web application) to communicate with their back-end TSO/E application running on the z/OS system.
- TSO/E address space RESTful service provides below operations (APIs):

Operation	Method
Start or reconnect to a TSO/E address space	POST
Start an application on a TSO/E address space	POST
Receive messages from a TSO/E address space	GET
Receive messages from an application running in a TSO/E address space	GET
Send messages to a TSO/E address space	PUT
Send messages to an application running in a TSO/E address space	PUT
Ping a TSO/E address space	PUT
End a TSO/E address space	DELETE



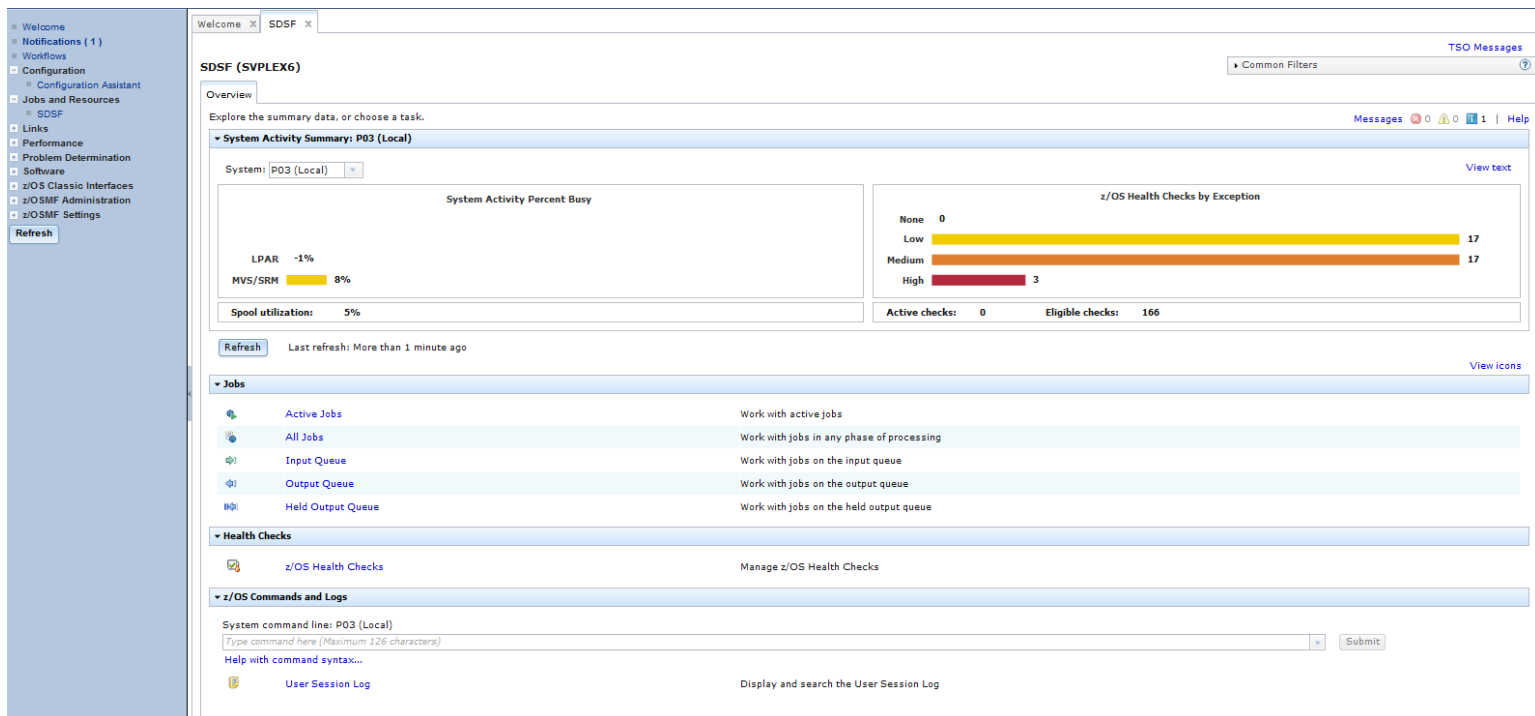
# Data persistence service – API list

- Data persistence service is provided for web application (especially for external web application) to manage their persistent data in z/OS system.
- Data persistence service provides below operations (APIs):

Operation	Method
Persist user-specific and global application data	PUT
Retrieve user-specific and global application data	GET
Delete user-specific and global application data	DELETE

# TSO/E address space service & Data persistence service – API Exploiter

- Exploiters (not only web application) could easily get the capability of communicating with TSO/E application and managing persistence data in the z/OS system such that they can focus on implementation of business logic.
- z/OS SDSF created their own z/OSMF plugin (a.k.a. external plugin) “SDSF UI” by exploiting these RESTful services.



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# Topology service\*\* – API list

- Topology RESTful service is provided for working with the groups, sysplexes and the systems that are defined to z/OSMF.
- Topology RESTful service provides below operations (APIs):

Operation	Method
List the systems defined to z/OSMF	GET
List the groups defined to z/OSMF	GET
List the systems included in a group	GET
List the sysplexes defined to z/OSMF	GET
List the systems included in a sysplex	GET

\*\* available for z/OSMF V2R1 with APAR PI32148

# Multisystem routing service\*\* – API list

- To communicate with and transfer data between systems within your enterprise, z/OSMF uses z/OSMF-to-z/OSMF communication. Multisystem routing service plays key role in the z/OSMF-to-z/OSMF model. It has the capability of:
  - Forwarding request to single remote z/OSMF instance and return the response (Basic-Proxy mode)
  - Forwarding request to a group of remote z/OSMF instances, packaging the responses and return it. (Aggregation mode)
- Multisystem routing service provides below operations (APIs):

Operation	Method
Retrieve data from one system, a list of systems, or all the systems in a group.	GET
Update data for one system, a list of systems, or all the systems in a group.	POST or PUT
Delete data from one system, a list of systems, or all the systems in a group.	DELETE
Authenticate with a secondary z/OSMF instance.	POST

\*\* available for z/OSMF V2R1 with APAR PI32148

# Topology service & Multisystem routing service

## – API Exploiter

- Exploiters could:
  - Retrieve topology information through “Topology service”
  - Manage multiple systems with only connected to primary z/OSMF which runs “Multisystem routing service”.
  - Get the aggregation capability by only specifying target systems/groups to “Multisystem routing service”.

\*\* available for z/OSMF V2R1 with APAR PI32148

# Workflow service\*\* – API list

- Workflow RESTful service allows user to create, start and manage work flow in z/OS through programmatic way instead of having to operate in z/OSMF UI.
- Workflow RESTful service provides below operations (APIs):

Operation	Method
Create a workflow	POST
Start a workflow	PUT
Lists workflows by search criteria	GET
Delete a workflow	DELETE
Cancel workflow	PUT
Retrieve workflow definition	GET

\*\* available for z/OSMF V2R1 with APAR PI32148

# Workflow service – API exploiter

- User scenario
  - Product (workflow provider) ships workflow which intends to accomplish a task in z/OS system.
  - End user of the product (or even the product itself) could build application which (remotely or locally) calls workflow RESTful service to:
    - Create workflow on demand
    - Perform the workflow to accomplish the task in an automatic way
    - Activities of performing workflow is recorded by z/OSMF workflows application for future review

# Software management service\*\* – API list

- Software management RESTful service allows a client application to interact with the z/OSMF Software Management task.
- Software management RESTful service provides below operations (APIs):

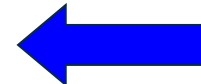
Operation	Method
List the software instances defined to z/OSMF.	GET
Retrieve the properties of a software instance.	GET
Add a new software instance.	POST

\*\* available for z/OSMF V2R1 with APAR PI32148



# Agenda

- What is z/OSMF
- What is z/OSMF Advanced Programming
- Using z/OSMF RESTful services
  - z/OS jobs service
  - z/OS data set and file service
  - Application Linking Manager interface service
  - TSO/E address space service
  - Data persistence service
  - Topology service\*\*
  - Multisystem routing service\*\*
  - z/OSMF workflow service\*\*
  - Software Management service\*\*
  - Using z/OSMF RESTful services – simple demo
  - Using z/OSMF RESTful services – Simpler than Simpler
- Summary



# Using z/OSMF RESTful services – simple demo



- Experience z/OSMF RESTful services with a simple html page (1/3)

```
<body>
  <div>
    <button id="getMyJobs" onclick="getMyJobs()">List my jobs</button>
  </div><br/>
  <hr />
  <div id="submitArea">
    <textarea id="jclArea" style="width: 400px">//TESTJOBW JOB (),MSGCLASS=H
// EXEC PGM=IEFBR14</textarea>
  </div><br/>
  <button id="subbtn" onclick="submit()">Submit a job</button><br/><br/>
  <hr/>
  <div id="getJobArea">
    <label>Job Name:</label><input id="jobname" />
    <label>Job ID:</label><input id="jobid" />
  </div><br />
  <button id="getbtn" onclick="getJobStatus()">Get job status</button><br/><br/>
  <div id="resultArea">
    <div><h4>Result:</h4></div>
    <div id="result"></div>
  </div>
</body>
</html>
```

# Using z/OSMF RESTful services – simple demo

- Experience z/OSMF RESTful services with a simple html page (2/3)

```
<head>
  <title>Demo of REST zOS Jobs service</title>
  <script type="text/javascript">
    function submit(){
      var jcl=document.getElementById("jclArea").value;
      var xhrs = new XMLHttpRequest();
      xhrs.open("PUT", "https://mvs1.centers.ihost.com/zosmf/restjobs/jobs", true);
      xhrs.setRequestHeader("Content-Type", "text/plain");
      xhrs.onreadystatechange = function (){
        if(xhrs.readyState == 4){
          document.getElementById("result").innerHTML = xhrs.responseText;
        }
      }
      xhrs.send(jcl);
    }
    function sendGetRequest(url) {
      var xhrget = new XMLHttpRequest();
      xhrget.open("GET", url, true);
      xhrget.onreadystatechange = function (){
        if(xhrget.readyState == 4){
          document.getElementById("result").innerHTML = xhrget.responseText;
        }
      }
      xhrget.send();
    }
    function getJobStatus(){
      var xhrg = new XMLHttpRequest();
      var jobname = document.getElementById("jobname").value;
      var jobid = document.getElementById("jobid").value;
      var url = "https://mvs1.centers.ihost.com/zosmf/restjobs/jobs/"+jobname+"/"+jobid;
      sendGetRequest(url);
    }
    function getMyJobs() {
      var url = "https://mvs1.centers.ihost.com/zosmf/restjobs/jobs";
      sendGetRequest(url);
    }
  </script>
</head>
```

Construct the URL

Access the RESTful service with JCL to be submitted

Construct the URL

Access the RESTful service

Construct the URL

Access the RESTful service

# Using z/OSMF RESTful services – simple demo



- Experience z/OSMF RESTful services with a simple html page (3/3)

List my jobs

---

```
//TESTJOBW JOB (),MSGCLASS=H
// EXEC PGM=IEFBRI4
```

Submit a job

Job Name:  Job ID:

Get job status

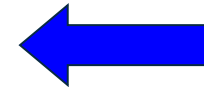
Result:

```
{ "jobname": "TESTJOBW", "retcode": "CC 0000", "subsystem": "JES2", "url": "https://mvs1.centers.ihost.com:443/zosmf/restjobs/jobs/J0027785N1.....CE96D4ED.....%3A", "status": "OUTPUT", "owner": "SHARA01", "jobid": "JOB27785", "class": "A", "job-correlator": "J0027785N1.....CE96D4ED.....", "files-url": "https://mvs1.centers.ihost.com:443/zosmf/restjobs/jobs/J0027785N1.....CE96D4ED.....%3A/files", "type": "JOB", "phase": 20, "phase-name": "Job is on the hard copy queue" }
```



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- Summary



# Using z/OSMF RESTful services - Simpler than Simpler



- Experience z/OSMF RESTful services without the need to write any code:

What you need are just:

- Valid z/OSMF user id and password
  - What can I do if I don't have a z/OSMF installation?
- Firefox browser with "HttpRequester" plugin installed

Session 16656 z/OSMF  
Hands-On labs

- Example 1 – list jobs owned by your logon user

The screenshot displays the HttpRequester plugin interface within a browser. The 'Request' tab is active, showing a URL: `https://pkstp03.pok.stglabs.ibm.com:1035/zosmf/restjobs/jobs`. The method is set to 'GET'. The 'Response' tab shows a successful GET operation with a status of '200 OK'. The response body is a JSON object containing job details for 'DEBUG20'. The 'Headers' tab at the bottom shows various response headers including 'X-Powered-By', 'Content-Type', 'Content-Language', 'Transfer-Encoding', 'Date', and 'Server'.

**Request**

URL: `https://pkstp03.pok.stglabs.ibm.com:1035/zosmf/restjobs/jobs`

Method: GET

**Response**

GET on `https://pkstp03.pok.stglabs.ibm.com:1035/zosmf/restjobs/jobs`

Status: 200 OK

**Response Body (JSON):**

```
{
  "jobname": "DEBUG20",
  "retcode": null,
  "subsystem": "JES2",
  "url": "https://pkstp03.pok.stglabs.ibm.com:1035/zosmf/restjobs/jobs/T0161971PKSTVS27CE7799C5.....%3A",
  "status": "ACTIVE",
  "owner": "DEBUG20",
  "jobid": "T0161971",
  "class": "TSU",
  "job-correlator": "T0161971PKSTVS27CE7799C5.....",
  "files-url": "https://pkstp03.pok.stglabs.ibm.com:1035/zosmf/restjobs/jobs/T0161971PKSTVS27CE7799C5.....%3A/files",
  "type": "TSU",
  "phase": 14,
  "phase-name": "Job is actively executing"
}
```

**Headers**

X-Powered-By	Servlet/3.0
Content-Type	application/json
Content-Language	en-US
Transfer-Encoding	chunked
Date	Fri, 06 Feb 2015 12:36:27 GMT
Server	WebSphere Application Server

# Using z/OSMF RESTful services - Simpler than Simpler



- Example 2 – list data set names matches the criteria of “SYS1.\*lib”

The screenshot displays the z/OSMF RESTful services interface. On the left, the 'Request' panel shows a GET request to the URL `/pkstp03.pok.stglabs.ibm.com:1035/zosmf/restfiles/ds/?dslevel=sys1.*lib`. The 'GET' button is highlighted. Below the request, the 'Content to Send' section shows 'Content Type' as 'application/json' and 'Content Options' as 'Base64' and 'Parameter Body'. The 'Response' panel on the right shows the status '200 OK' and the response body in 'Text' format, which is 'Pretty format'. The response is a JSON array of data set names: `{ "items": [ { "dsname": "SYS1.BKPTLIB" }, { "dsname": "SYS1.CHSLIB" }, { "dsname": "SYS1.COMDLIB" }, { "dsname": "SYS1.COBLIB" }, { "dsname": "SYS1.COB2CLIB" }, { "dsname": "SYS1.COB2MLIB" }, { "dsname": "SYS1.COB2PLIB" }, { "dsname": "SYS1.CSSLIB" } ] }`. The 'Headers' section at the bottom shows the following information:

Headers	
X-Powered-By	Servlet/3.0
Content-Type	application/json; charset=UTF-8
Content-Language	en-US
Transfer-Encoding	chunked
Date	Fri, 06 Feb 2015 12:39:19 GMT
Server	WebSphere Application Server

# Advertisements

- Session 16656 Lab: z/OSMF Hands-On Labs - Choose Your Own – III  
Friday, March 6, 2015: 8:30 AM-9:30 AM Redwood (Sheraton Seattle)  
(If you missed the labs you can review the handouts and see how z/OSMF works)
- Possible missed opportunities (handouts available for download):
  - Session 16643 The New and Improved z/OSMF 2.1
  - Session 16801 Getting Started with z/OSMF Resource Monitoring - Hands-on Lab
  - Session 16646 Using z/OSMF Workflows for Configuration
  - Session 16659 z/OSMF User Experiences
  - Session 16654 z/OSMF 2.1 Implementation and Configuration

\*\* available for z/OSMF V2R1 with APAR PI32148


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  - z/OSMF workflow service\*\*
  - Software Management service\*\*
  - Using z/OSMF RESTful services – simple demo
  - Using z/OSMF RESTful services – Simpler than Simpler
- Summary 

# Summary

- In addition to z/OSMF plugins with modern UI and simplified task, z/OSMF also provides services and facilities to help you write programs.
- z/OSMF Advanced Programming consists of:
  - Using z/OSMF RESTful services
  - Develop workflow
  - Create your own z/OSMF plugins
- z/OSMF RESTful services make z/OS and z/OSMF more approachable:
  - z/OS jobs service
  - z/OS data set and file service
  - Application Linking Manager interface service
  - TSO/E address space service
  - Data persistence service
  - Topology service\*\*
  - Multisystem routing service\*\*
  - z/OSMF workflow service\*\*
  - Software Management service\*\*

\*\* available for z/OSMF V2R1 with APAR PI32148

# Thank You



Complete your session evaluations online at [www.SHARE.org/Seattle-Eval](http://www.SHARE.org/Seattle-Eval)

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# Appendix

- z/OSMF Home Page

<http://www-03.ibm.com/systems/z/os/zos/features/zosmf/index.html>

- z/OSMF V2R1 Programming Guide

[http://www-01.ibm.com/support/knowledgecenter/SSLTBW\\_2.1.0/com.ibm.zos.v2r1.izua700/toc.htm](http://www-01.ibm.com/support/knowledgecenter/SSLTBW_2.1.0/com.ibm.zos.v2r1.izua700/toc.htm)