z/OSMF 2.2 Advanced Programming

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Agenda

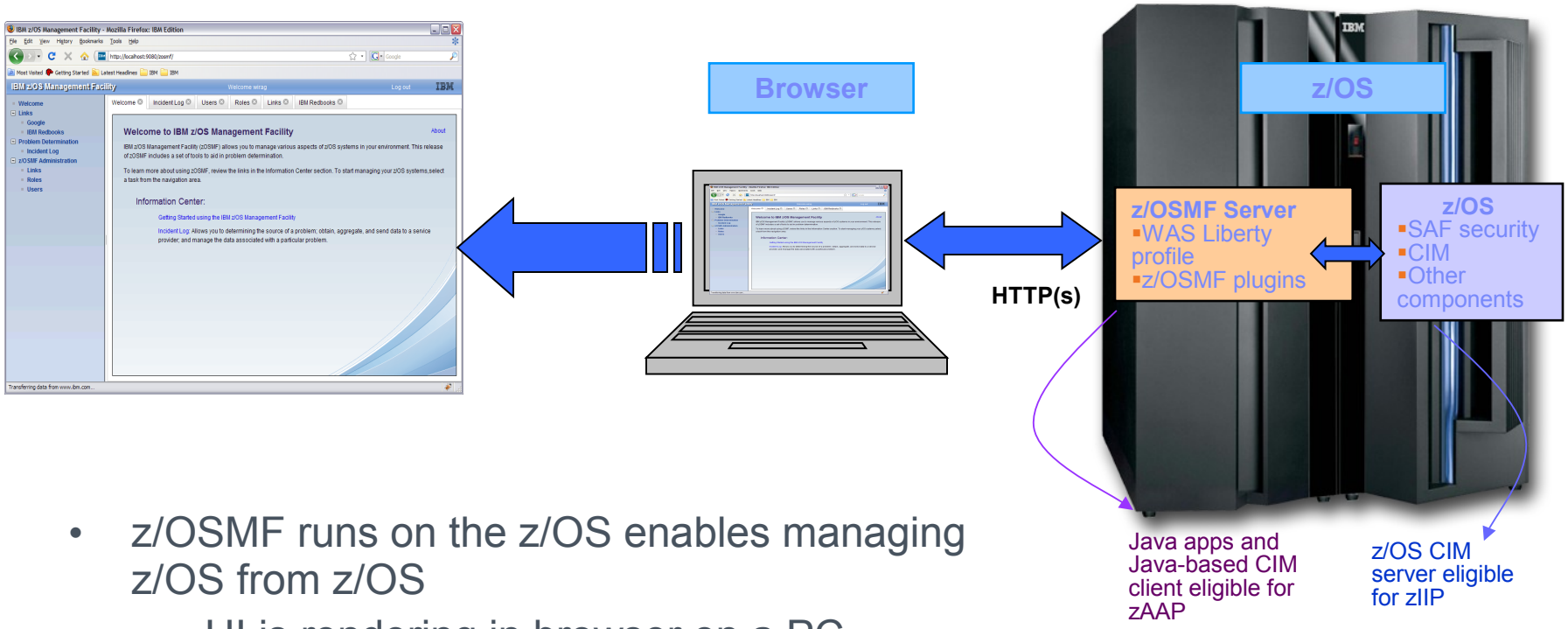
- What is z/OSMF 
- What is z/OSMF Advanced Programming
- Using z/OSMF RESTful services
  - z/OS jobs service
  - z/OS data set and file service
  - Application Linking Manager interface service
  - TSO/E address space service
  - Data persistence service
  - Application Server routing service
  - Topology 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 now a part of z/OS V2R2 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.

What is z/OSMF

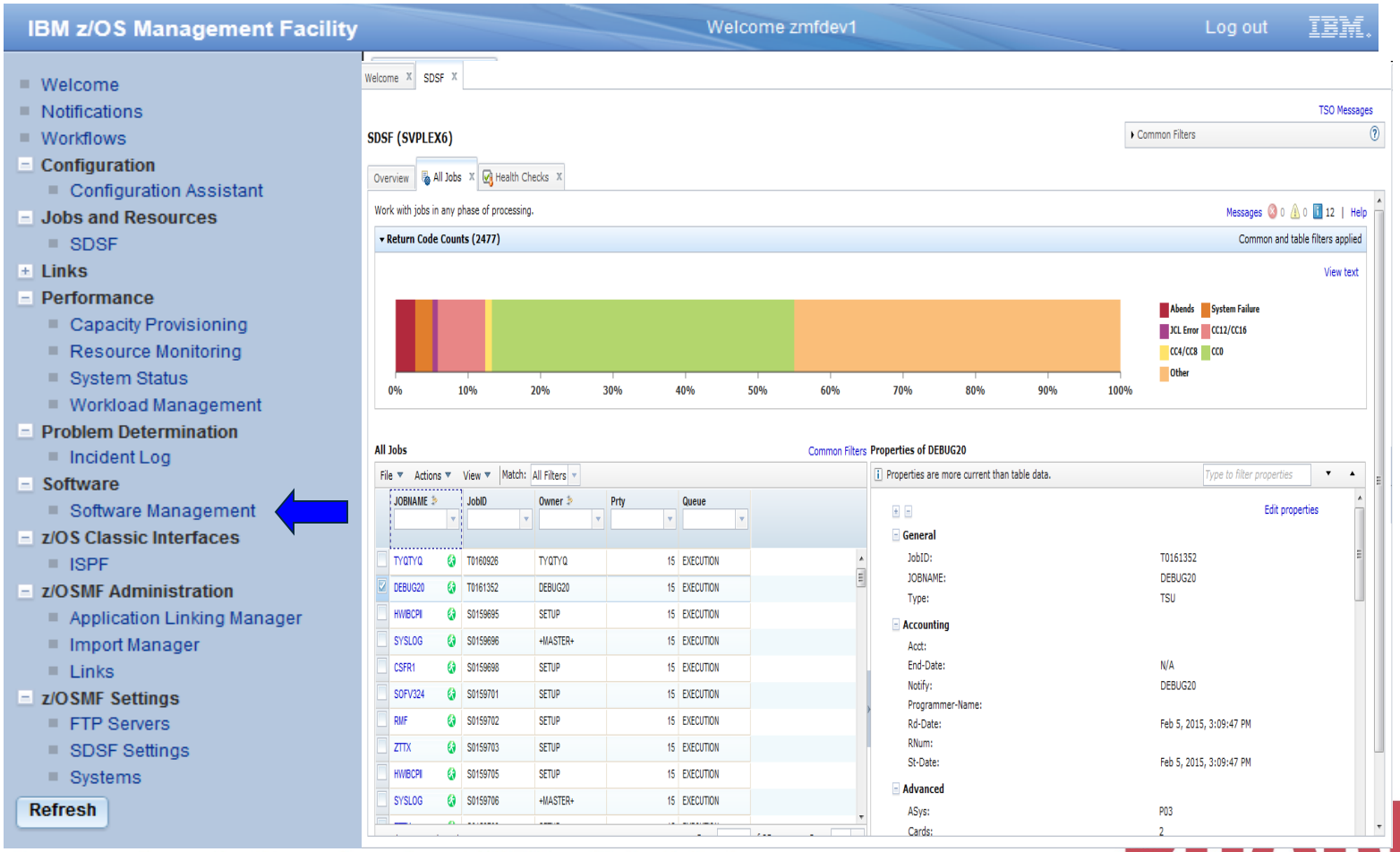
- How does z/OSMF function in the z/OS environment?



- z/OSMF runs on the z/OS enables managing z/OS from z/OS
  - UI is rendering in browser on a PC
  - No client install required

What is z/OSMF

- Gain simplification and modernization through z/OSMF plugins



What is z/OSMF

What's more?

Agenda

- What is z/OSMF
- What is z/OSMF Advanced Programming 
- Using z/OSMF RESTful services
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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”.

What is z/OSMF Advanced Programming

- Why would I need “z/OSMF RESTful services”
  - Representational State Transfer (REST) is a software architecture style. It defines constraints for designing services:
    - Client-Server (Scalability, Simplicity)
    - Stateless (Scalability, Reliability)
    - Uniform interface (Simplicity, Visibility)
      - Identification of resources
      - Manipulation of resources through representation
      - Hypermedia as the engine of application state
  - RESTful web service is based on HTTP channel and it’s lightweight:
    - Has gained widespread acceptance across the Web. (Amazon, Twitter)
    - Easy to call
    - Could be driven remotely (via HTTPS) and securely
    - Language and platform independent
  - 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 condtion
    - 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

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 returns the result.

- Security consideration
  - Authenticate to z/OSMF is required. (Certificate authentication is also supported)
  - Other authorization may be required for different RESTful services.

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
  - Application Server routing service
  - Topology service
  - Multisystem routing service
  - z/OSMF workflow service
  - Software Management service

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 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":"IBMUSER",
"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"
}
```

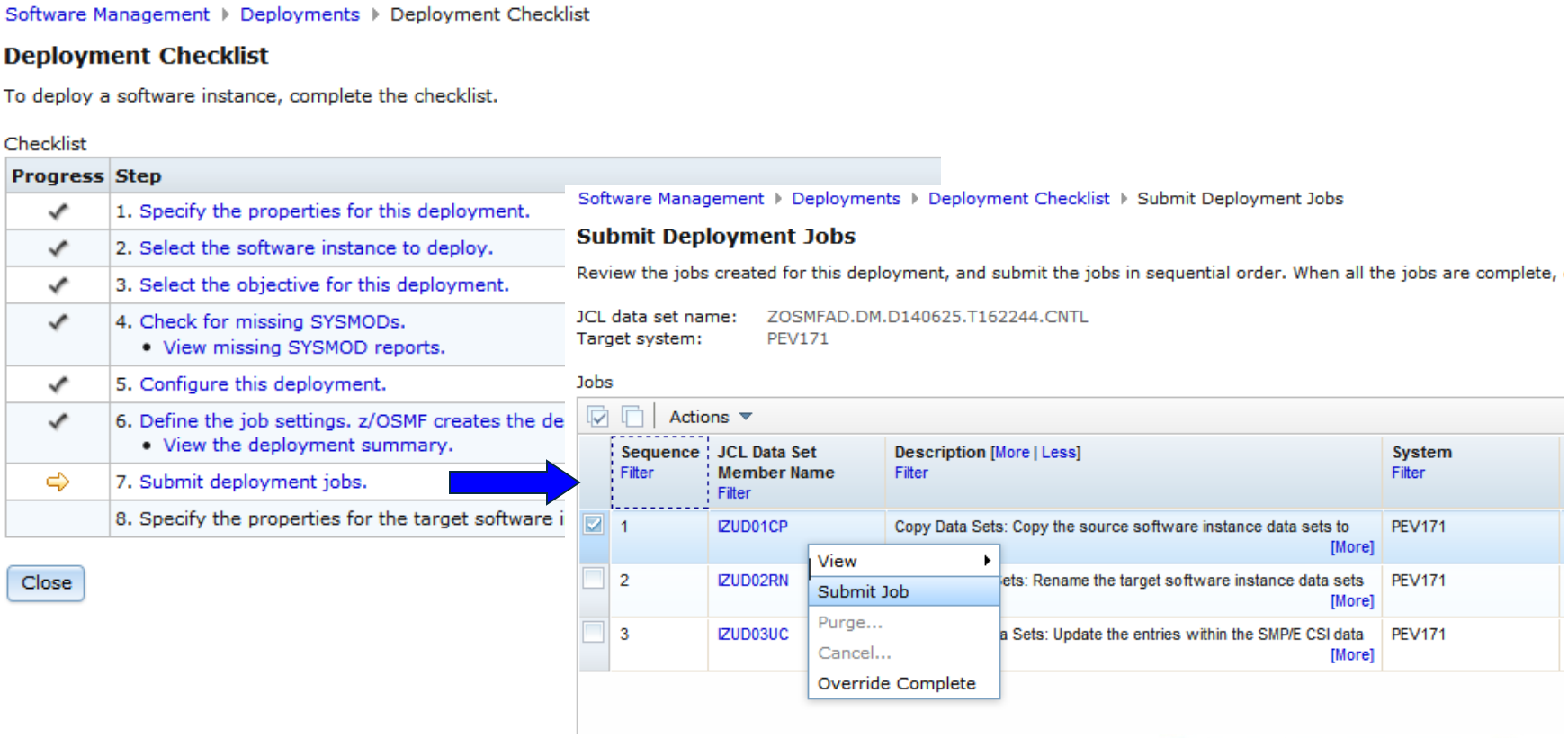
z/OS jobs service – API exploiters

- 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

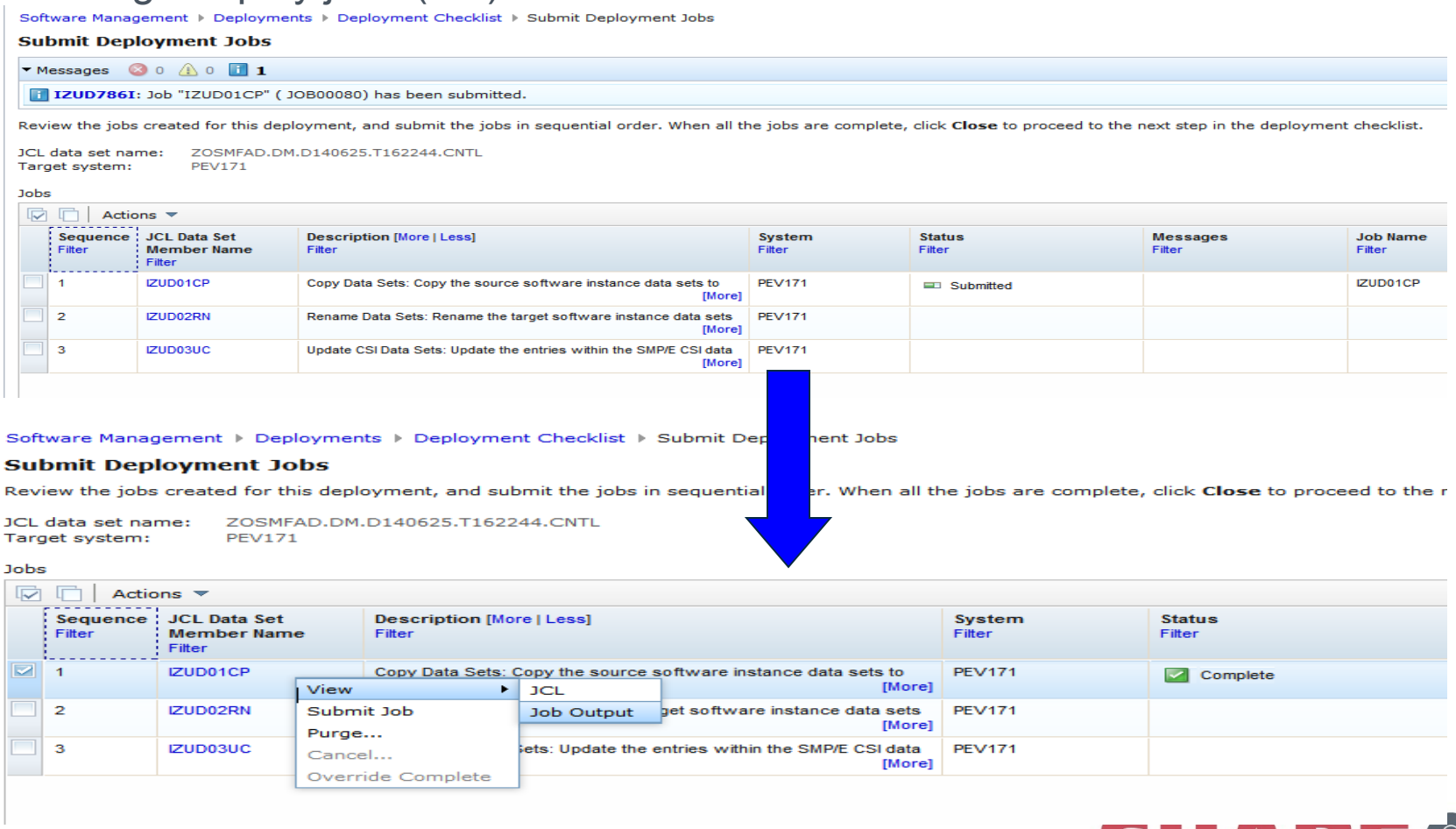
z/OS jobs service – API exploiters

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



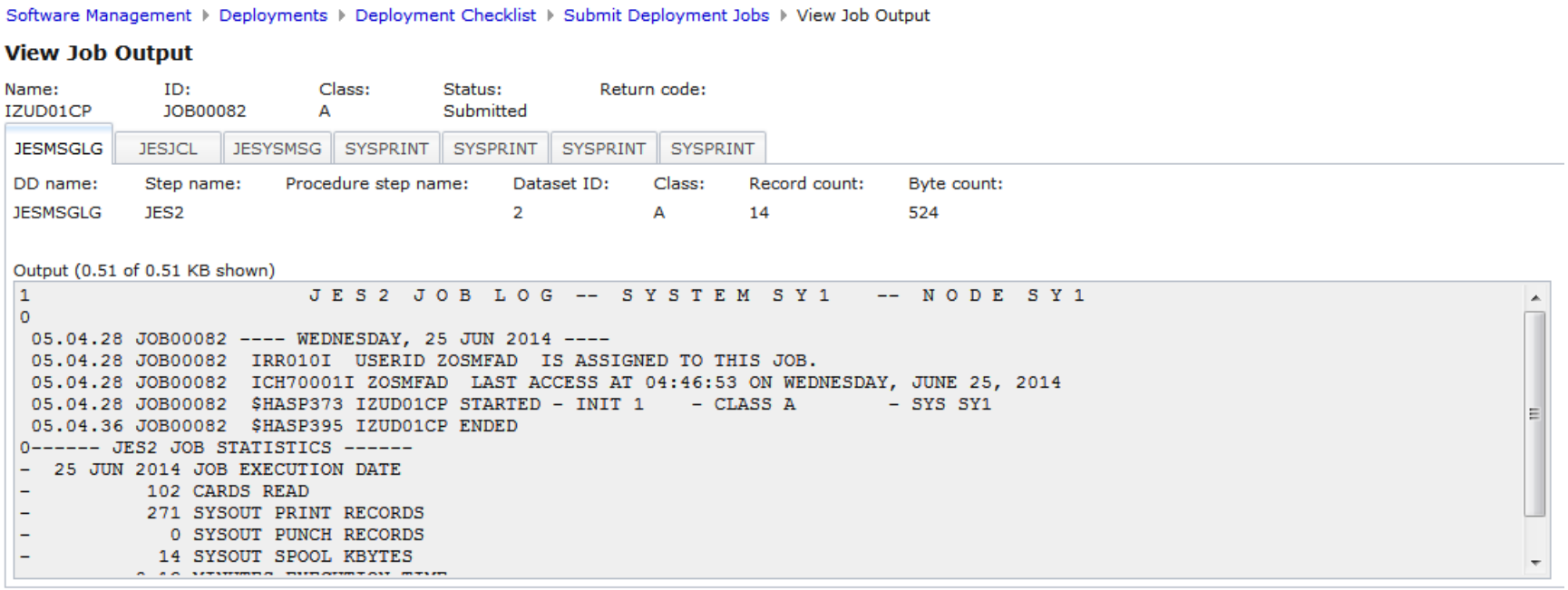
z/OS jobs service – API exploiters

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



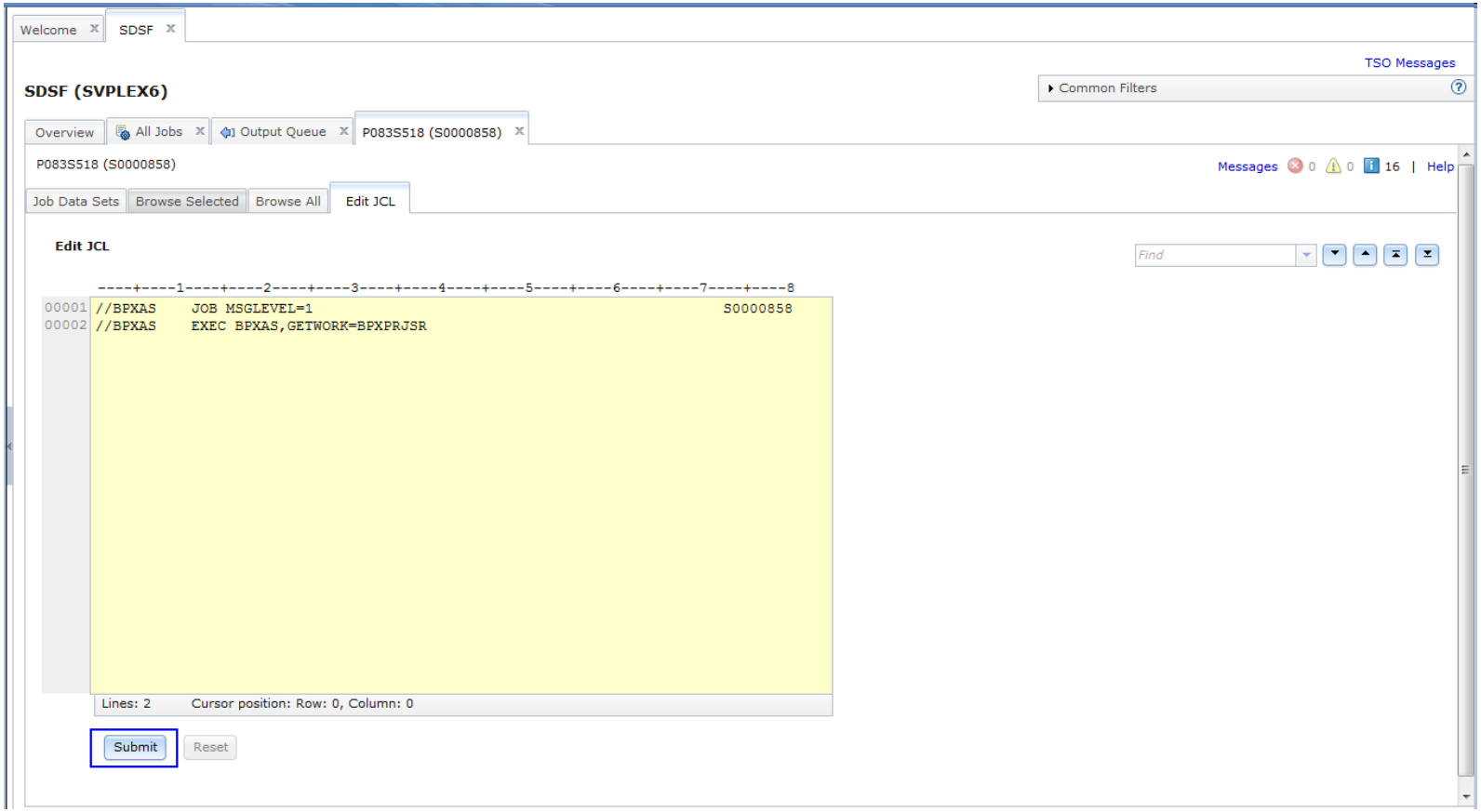
z/OS jobs service – API exploiters

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



z/OS jobs service – API exploiters

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



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.CMDLIB" }, { "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 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: B5C6454F783590AA8EC15BD88E29EA63
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
JWT(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),                                               00130001
 EXITS(IEFU83,IEFU84,IEFACTRT,IEFUJV,IEFUJI,                        00140000
          IEFUSI,IEFUTL,IEFU29),INTERVAL(010000),DETAIL)            00150000
                                                                    00160000
/* WRITE ALL RECORDS AS THE SYSTEM DEFAULT, TAKE ALL KNOWN          00170000
   EXITS, NOTE: JES EXITS CONTROLED BY JES , THERE IS NO            00180000
   DEFAULT INTERVAL RECORDS WRITTEN AND ONLY SUMMARY T32            00190000
   RECORDS AS A DEFAULT FOR TSO */                                  00200000
                                                                    00210000
SUBSYS(STC,NOTYPE(19,40,92),                                        00220001
 EXITS(IEFU29,IEFU83,IEFU84,IEFUTL),                                00230000
 INTERVAL(SMF,SYNC),DETAIL)          /*SP430*/                     00240000
                                                                    00250001
/* WRITE ALL RECORDS AS BY  SYSTEM DEFAULT, TAKE ONLY THREE         00260000
   EXITS, NOTE: IEFU29 EXECUTES IN THE MASTER ASID WHICH IS A       00270000
   STC ADDRESS SPACE SO IEFU29 MUST BE ON FOR STC. USE ALL OTHER    00280000
   SYS PARAMETERS AS A DEFAULT  */                                  00290000
```

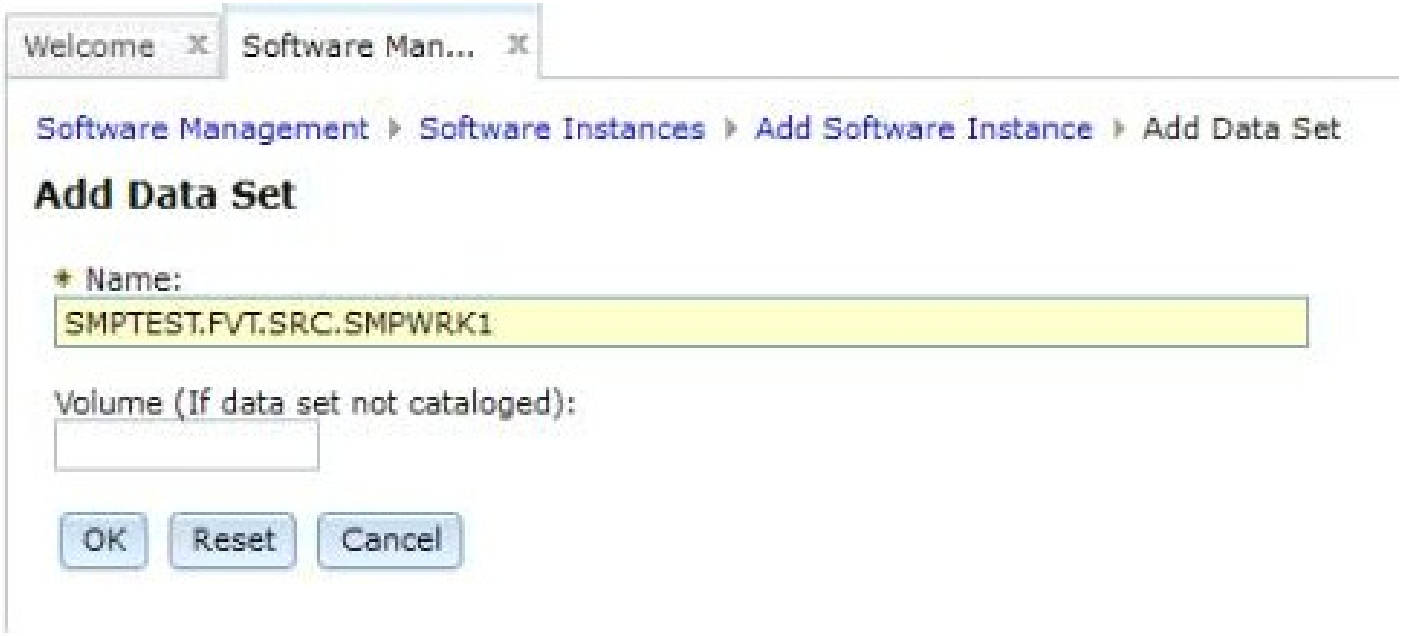
z/OS data set and file service – API exploiters

- 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

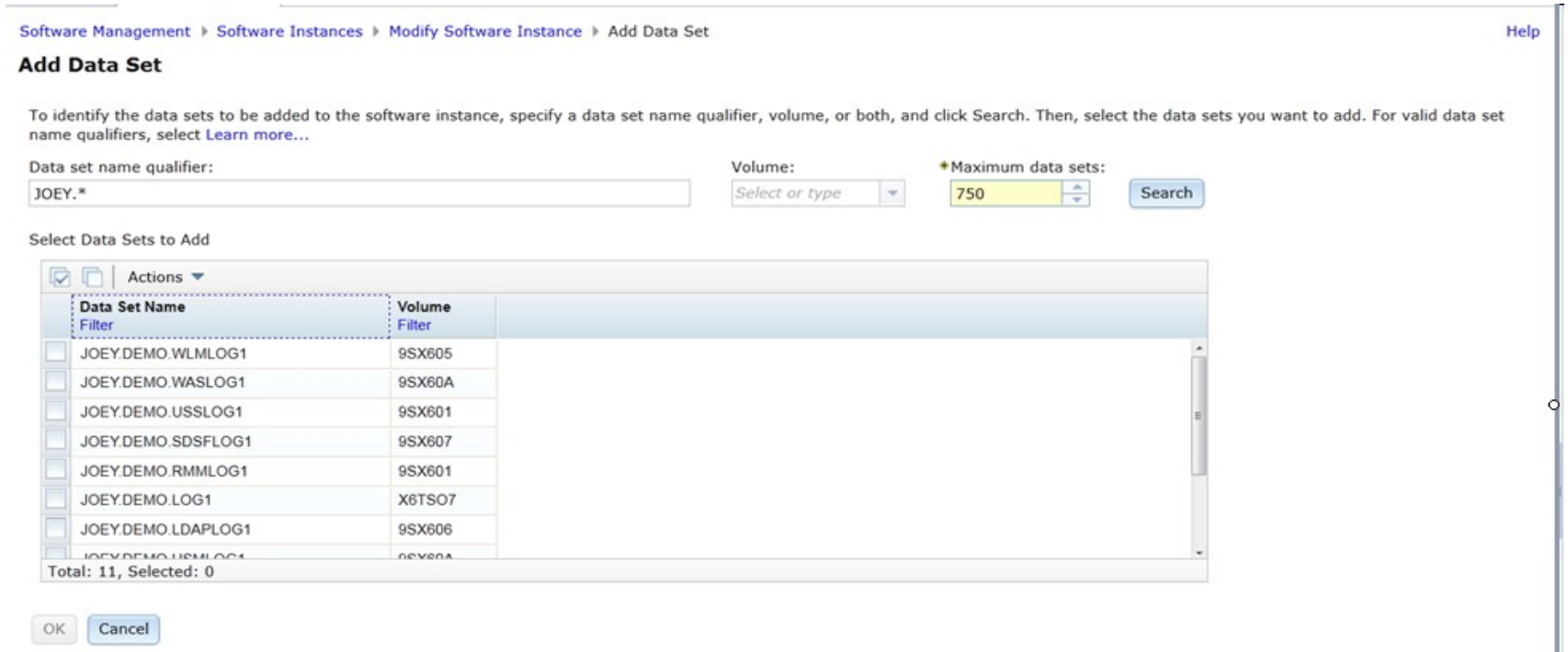
z/OS data set and file service – API exploiters

- 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.



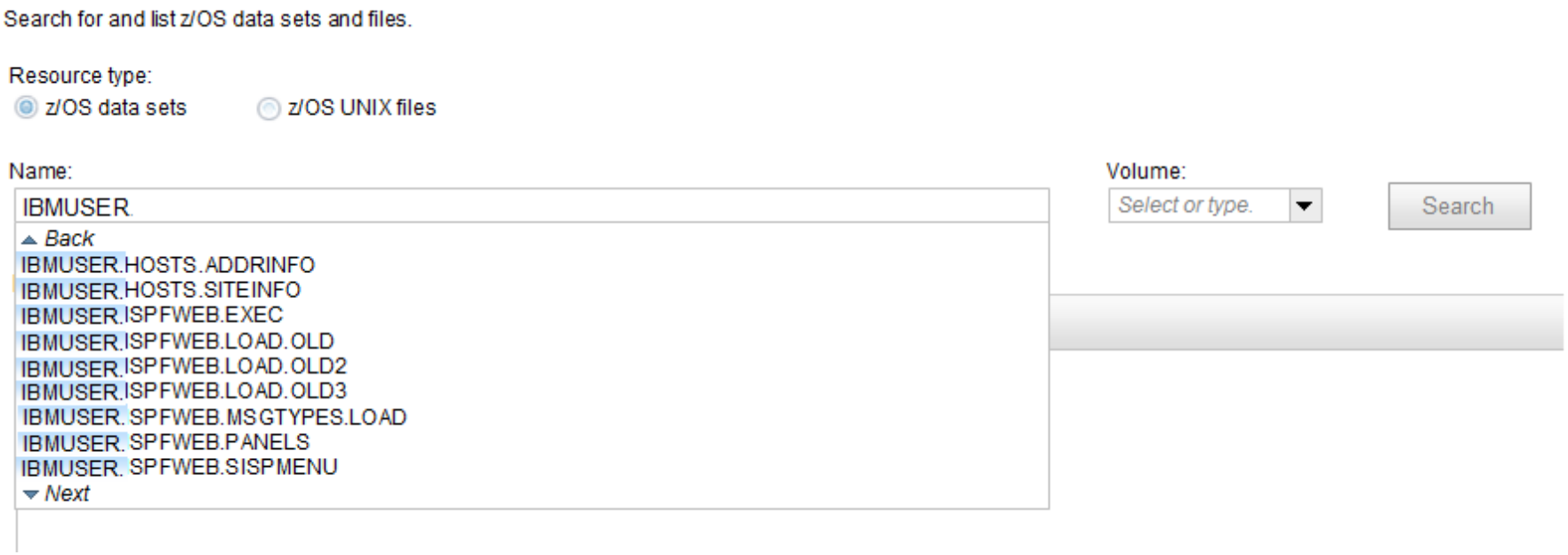
z/OS data set and file service – API exploiters

- 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.



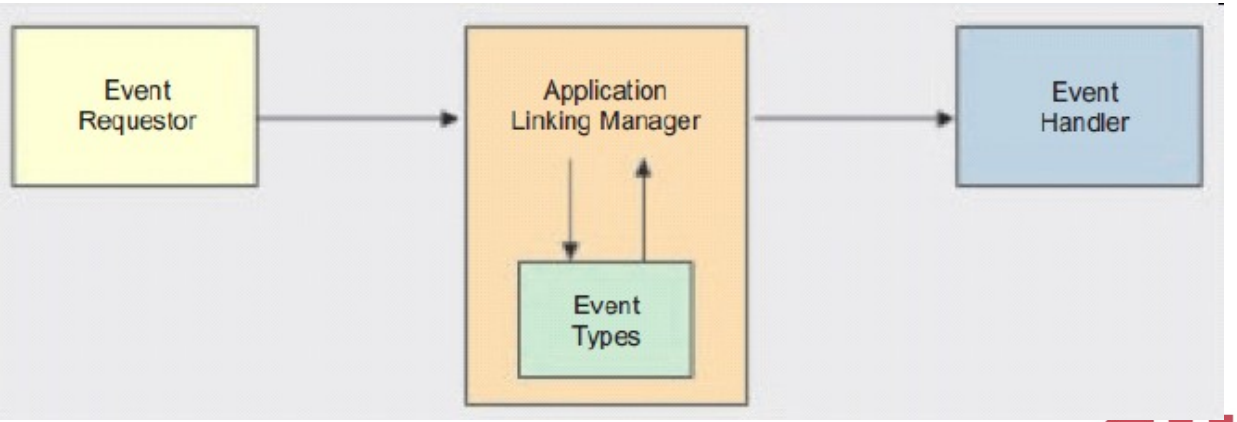
z/OS data set and file service – API exploiters

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



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, “EXTERAL” for external application.
    Id: Unique identifier for a launch point within the handler task or application.
    appIID: 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.

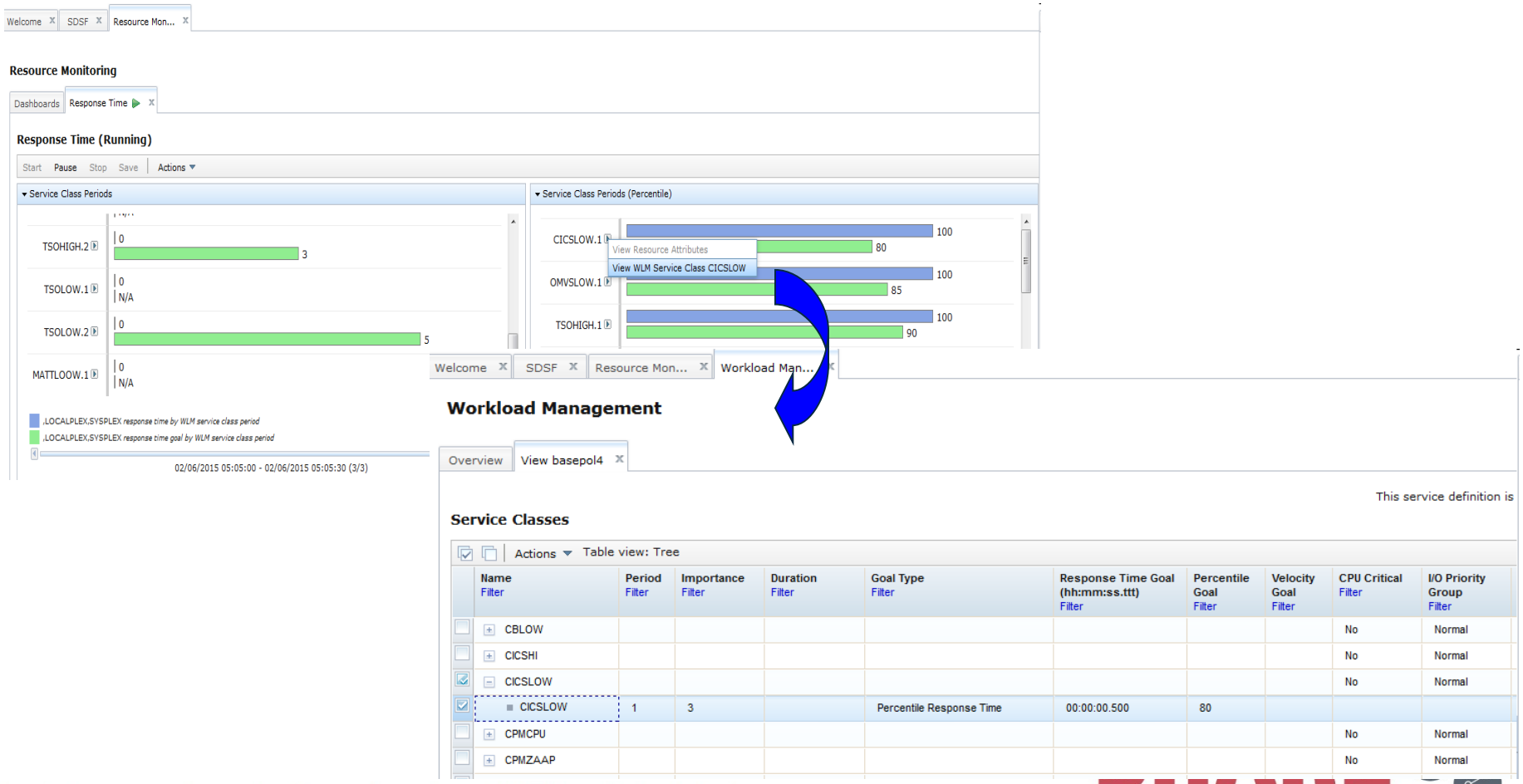
Application Linking Manager service – API exploiters

- 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)



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

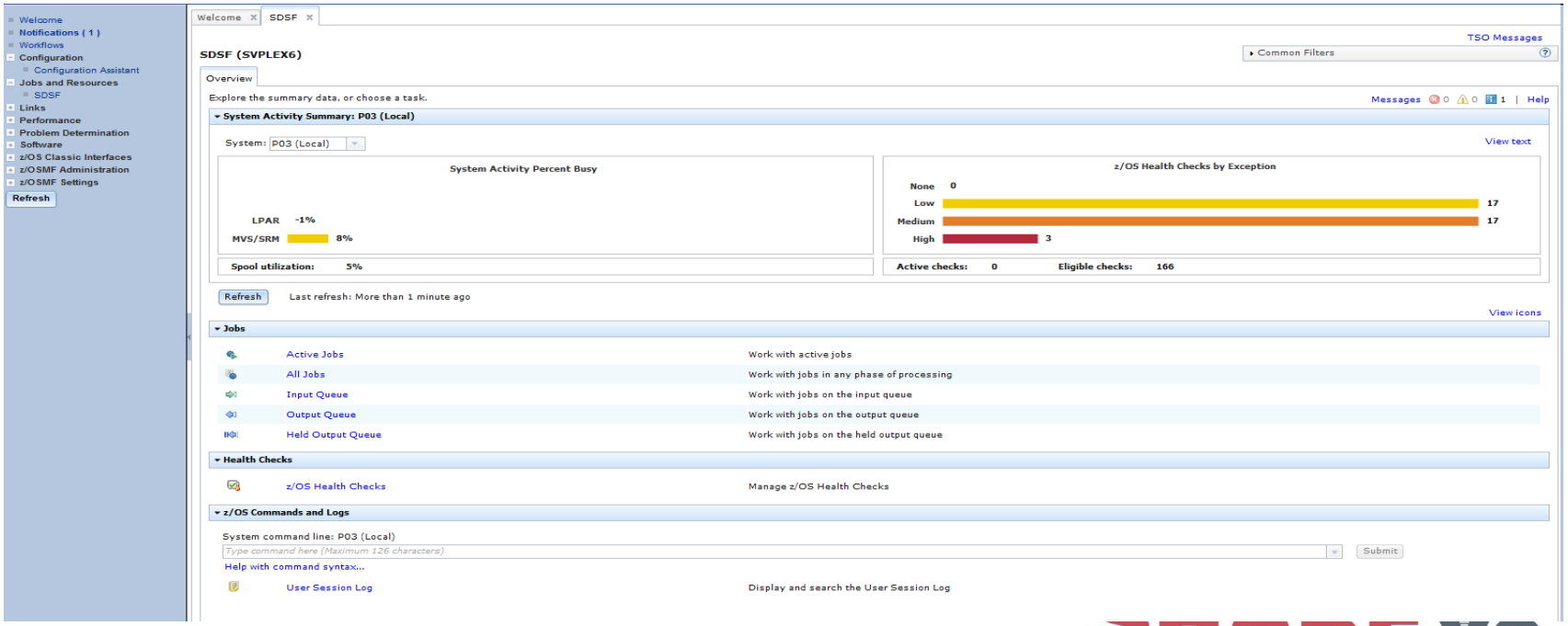
Data persistence service – API list

- 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.

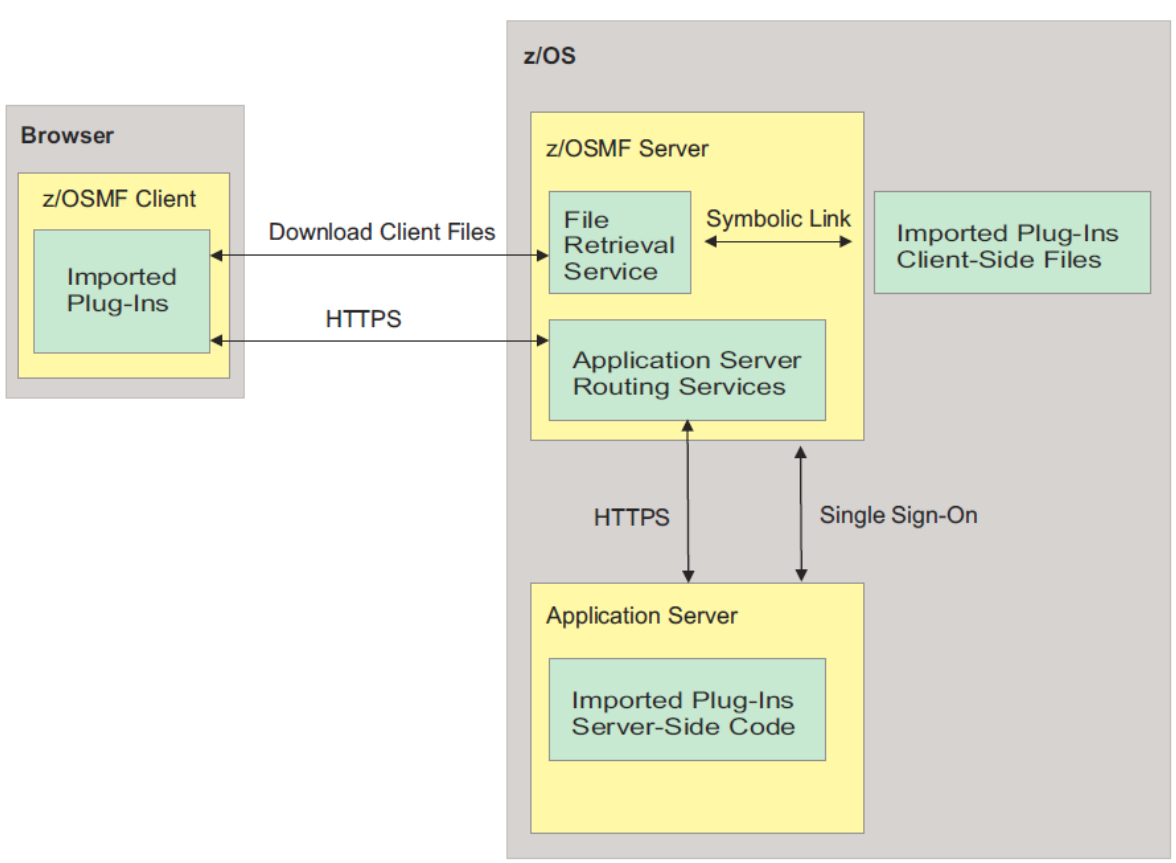


TSO/E address space service & Data persistence service – API Exploiter

- Questions:
  - What if my server-end code needs to be run in an application server?
  - Can I have my java code running in z/OSMF server?

Application server routing service – Overview

- Application server routing service supports routing requests and responses between client-side and server-side code for any z/OSMF plug-ins you created where the server-side code is hosted on an application server other than the z/OSMF server.



Complete y

Application server routing service – API list & example

- API list

Operation	Method
Retrieve data from an application server	GET
Update data for an application server	POST or PUT
Delete data from an application server	DELETE

- API example

You client-side code which is rendered in z/OSMF window is about to add *objectC* on the application server identified in system entry “appServer1”, which is defined in the z/OSMF Systems task, submit the following request:

```
POST /zosmf/externalgateway/system HTTP/1.1

Host: appname.yourco.com

{"target":"appServer1","resourcePath":"/testApp/objectC","content":{
"attribute1":"value11","attribute2":"value12","attribute3":"value13",
"attribute4":"value14","attribute5":"value15"}}
```

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

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

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 specifying target systems/groups when accessing the “Multisystem routing service”.

- z/OS V2.2 z/OSMF allows you to obtain an aggregated display of incidents across z/OSMF instances within your enterprise

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

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
List the data sets included in a software instance	GET
Load the products, features, and FMIDs for a software instance	GET
Add a new software instance.	POST
Modify the properties of a software instance	PUT
Delete a software instance	DELETE

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- What is z/OSMF
- What is z/OSMF Advanced Programming
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  - Using z/OSMF RESTful services – Simpler than Simple
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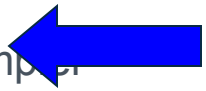

Using z/OSMF RESTful services – simple demo

- 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=IEFBR14
```

Submit a job

Job Name: TESTJOBW Job ID: JOB27785

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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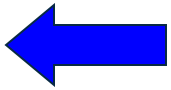
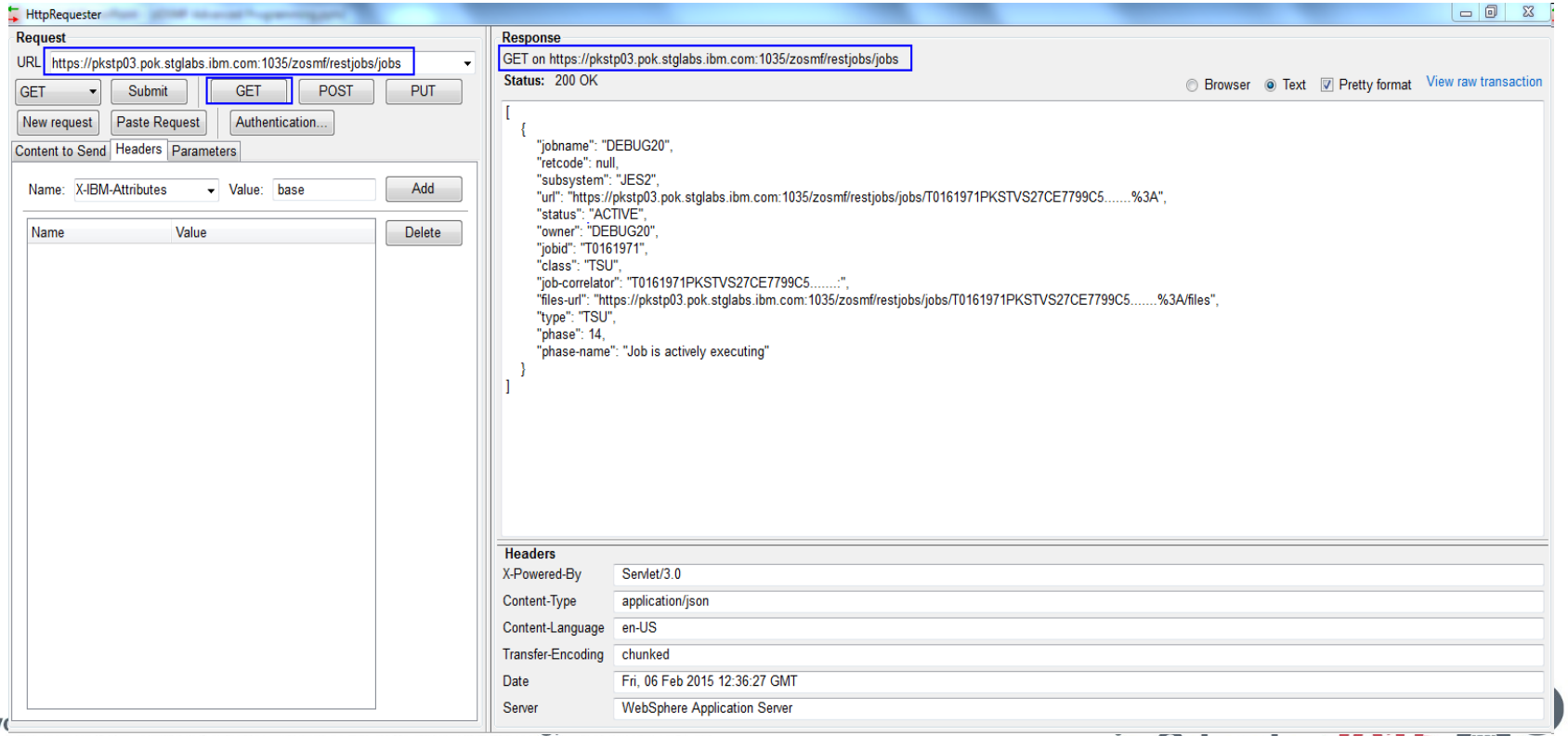


** available for z/OSMF V2R1 with APAR PI32148

Using z/OSMF RESTful services - Simpler than Simpler

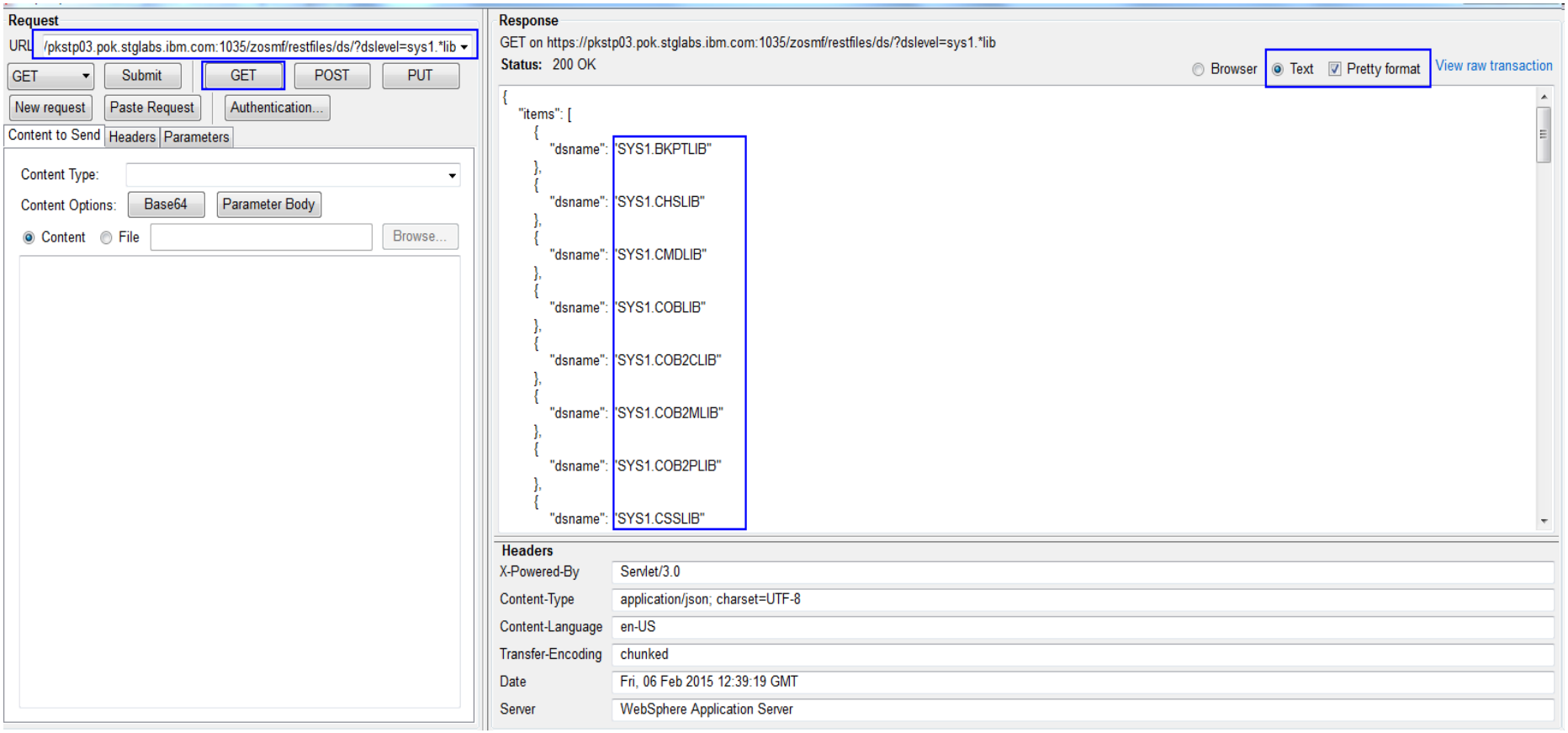
- Experience z/OSMF RESTful services without the need to write any code:

  What you need are just:
  - Valid z/OSMF user id and password
  - Firefox browser with “HttpRequester” plugin installed
- Example 1 – list jobs owned by your logon user



Using z/OSMF RESTful services - Simpler than Simpler

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



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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
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  - Topology service
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  - Software Management service

Advertisements

- Possible missed opportunities (handouts available for download):
  - Session 17795 What's new in z/OSMF 2.2?
  - Session 17236 z/OSMF 2.2 Implementation and Configuration
  - Session 17841z/OSMF Roundtable
  - Session 17422 z/OSMF Hands-on Labs - Choose Your Own I
  - Session 17909 z/OSMF Hands-on Labs - Choose Your Own - II

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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