z/OS 3.1 IBM Education Assistant

Solution Name (1): Notification REST call when a job completes, eliminate CIM

Solution Name (2): JES2 Job Notification URLS – Job submitted, job in execution, job complete

Solution Element(s): JES2

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Agenda

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Trademarks

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

Objectives

- In this presentation, we will introduce enhancements made to JES2, in support of the z/OSMF Jobs REST API, to send HTTP notifications as a job progresses through its life cycle.
    - In particular, dependencies on the CEA (Common Event Adapter) and CIM (Common Information Model) components have been eliminated.
    - Discuss implementation of new notification points to notify users when their jobs have reached various stages of processing.

Overview

- ## Who (Audience)
  - System programmers who wish to fully enable the z/OSMF Jobs REST interface without configuring the CEA and CIM components.
  - Providers of jobs scheduling applications, and direct users of the z/OSMF Jobs REST API, who desire more information from JES2 as a job progresses through its lifecycle.

- ## What (Solution)
  - Eliminate dependency on CEA and CIM by sending notifications directly in JES2.
  - Provide a new interface to allow users to request HTTP notifications at additional stages of a job's life cycle.

- ## Wow (Benefit / Value, Need Addressed)
  - Simplification – fewer products to install and configure.
  - More reliable and efficient delivery of notifications.
  - Easier view of a job as it progresses through its life cycle.

Overview – CIM Elimination

- Implementation of one feature of the z/OSMF Jobs REST API has changed, specifically, job completion notification via HTTP POST to the URL passed in the custom header X-IBM-Notification-URL.

- In original implementation:
  - z/OSMF passes notification URL to JES2 via JES symbol SYS_JOB_NOTIFY
  - After job completes, JES2 sends ENF 78 signal
  - ENF 78 is received by CEA. CEA extracts URL and job information from ENF 78 and builds job completion document in JSON format.
  - Finally, job completion document is sent via HTTP POST by CIM provider.

- In the new implementation:
  - z/OSMF passes notification URL to JES2 via JES symbol SYS_JOB_NOTIFY (same as before)
  - After job completes, JES2 generates job completion document in JSON format and sends it to target URL with HTTP POST using JES2 EDS (Email Delivery Services).

Overview – EDS changes

- JES2 Email Delivery Services (EDS) has been enhanced to support new type of EDS messages and two new types of EDS message queues.

- Unlike email messages that use system SSL to secure HTTPS session with the z/OSMF server, security of HTTP sessions used for job notification messages is controlled via AT-TLS policy outside of JES2.

- Since there are now more than one type of EDS message queue, new JES2 operator command, $D EDSQ, was added to display queue inventory.

- New JES2 function to deliver job notifications via HTTP is initially disabled and can be enabled at MAS level by command or JES2 initialization statement.

- New flag (ENF78_OPT_JES_HANDLED) has been added to ENF78 structure to indicate that the notification has been handled by JES2.
  - Code change in CEA coming to ignore ENF78 events that have this flag set.

Overview – Receiving and sending job notifications

- Job notification messages queued to EDS are processed by EDS and are written to SPOOL
  - Guaranteed message delivery for job completion notifications
  - Will be sent during JES2 warm start in event of a system crash
- HTTP notifications are allowed to accumulate to SPOOL and after a delay of 1 second, EDS will send all queued notifications
- When an HTTP notification cannot be sent, message is moved to a queue of "undelivered job notifications"
  - Could be due to local configuration error or target HTTP server is not active
  - $S EDS,RETRY command can be used to retry sending of undelivered job notifications
- Some errors may be considered "un-retriable" - in these cases, notifications will be dropped

Overview – Dependencies for sending notifications

- JES2 EDS rely on availability and proper configuration of a number of components
  - OMVS availability
  - TCP/IP stack availability
  - Presence of AT-TLS policies

- Until all dependencies are available, job notifications will be queued to be sent until dependencies are satisfied.

- A number of configuration events will drive EDS to attempt sending queued notifications
  - $S command
  - $S EDS or $T EDS command
  - Start of OMVS (ENF 46)
  - Start of z/OSMF (ENF 83)
  - Start of TCP/IP (ENF 80)
  - Start of AT-TLS policy agent (ENF 80)

Overview – Support for multiple stacks

- Email notifications only communicated with one target, z/OSMF server, so there was no need to configure multiple TCP/IP stacks

- With support for arbitrary notification targets, customers may wish to separate local traffic from traffic to external locations by using different TCP/IP stacks.

- To address this, support for configurable TCP/IP stack affinity was introduced – both for email message and HTTP notification messages.

- New command/initialization statement was defined:
  - $T EDS,EMAIL_STACK=<stack name>,JOBNFY_STACK=<stack_name>

- If <stack_name> is omitted, EDS will use default TCP/IP stack. Otherwise, EDS will attempt to use configured stack.

Overview – Additional Notification Points

- A new header, X-IBM-Notification-Options, has been added to the z/OSMF Jobs REST API to allow API user to specify enhanced notification options
  - A new symbol has been created, SYS_JOB_NOTIFYX, which is used by z/OSMF Jobs REST API to propagate value from header to JES2
  - Format of the header is a JSON object with a single property "events", allowing user to select additional points in processing for an HTTP notification to be sent
  - Format of "events" property is an array of strings. Supported event types are:
    - "READY" - Job went through input/conversion without any errors
    - "ACTIVE" - Job selected for execution
    - "COMPLETE" - Job entered a state where it is no longer eligible to execute
  - Specified options only affect processing of HTTP notifications. Other notification types (ENF78, email, TSO) are unaffected.

- New header must be specified in combination with existing X-IBM-Notification-URL header to specify target URL for HTTP notification

Overview – Enhanced Job Document

- Job notification document, owned by z/OSMF component, is constructed and sent when a job has reached a point in processing
    - Format of document matches the document generated by CEA and CIM components
- Additional properties have been added to the document.
    - Well-behaved applications processing this JSON document should be able to tolerate the new properties.
    - New property, "event", has been added to inform user of which job life cycle event has occurred
        - Value is either "READY", "ACTIVE", or "COMPLETE"
    - New property, "member", has been added to inform user of the JES2 member name where the job life cycle event has occurred
    - New property, "event-time", has been added to report the time when the notification was generated. Time is reported in ISO 8601 UTC format.

Usage & Invocation – Usage of z/OSMF Jobs REST API

- Example HTTP payload and headers to submit a job via the z/OSMF Jobs REST API and schedule notification to an HTTP server when the job has reached a terminal state.

```
PUT /zosmf/restjobs/jobs
Host: https://SY1.COMPANY.COM:443
Content-type: text/plain
X-IBM-Intrdr-Class: A
X-IBM-Intrdr-Recfm: F
X-IBM-Intrdr-Lrecl: 80
X-IBM-Intrdr-Mode: TEXT
X-IBM-Notification-URL: https://127.0.0.1:5000/restloop
X-IBM-Notification-Options: {"events": ["complete"]}


//MYJOB     JOB MSGLEVEL=(1,1)
//STEP1     EXEC PGM=IEFBR14
```

Usage & Invocation – Sample Job Document

- Example JSON document sent in payload of HTTP notification after a job has ended normally.

```
{
    "job-correlator": "J0000036POK.....DCEDE5A1.......:",
    "jobid": "JOB00036",
    "jobname": "MYJOB",
    "owner": "IBMUSER",
    "class": "A",
    "retcode": "CC 0000",
    "abend-code": null,
    "completion-code": 0,
    "completion-type": 1,
    "event": "COMPLETE",
    "member": "IBM1",
    "event-time": "2023-03-01T03:11:27.176755Z"
}
```

Interactions & Dependencies

- Software Dependencies
  - No dependencies on z/OSMF enhancements
    - Users may submits jobs and request notifications by defining SYS_JOB_NOTIFY and SYS_JOB_NOTIFYX symbols directly and allocating an INTRDR.

- Hardware Dependencies
  - None

- Exploiters
  - z/OSMF Jobs REST API

Upgrade & Coexistence Considerations

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

- Down-level members of JES2 MAS must have JES2 compatibility APAR OA61751 installed.

- Function has been shipped to z/OS 2.5 via continuous delivery APARs and prerequisite APARs.
  - OA61231 – CIM elimination support (JES2)
  - OA62796 – Enhanced job notification support (JES2)
  - OA62804 – IAZSYMBL interface updated to allow specification of SYS_JOB_NOTIFYX (JES common)
  - OA63581 – Allows retry of more types of undeliverable notifications (JES2)
  - PH44152 – z/OSMF Jobs REST API enhancements (z/OSMF)
  - AH47680 – Addresses a problem where readiness of TCP/IP stack cannot be detected in a single stack (INET) configuration

- If the JES2 MAS has members prior to z/OS 2.5, or z/OS 2.5 members without OA62796/OA62804 applied, ACTIVE and READY notifications may not be sent if event occurs on down-level member.

Installation & Configuration

- Configuration of JES2 EDS for email support has not changed.

- EDS support for job notifications does not require any new JES2 configuration steps
  - However, AT-TLS policy must be configured and installed into TCP/IP stack before job notifications over HTTPs can be delivered.

- From operational perspective, EDS support for job notifications functions in parallel and independently from EDS support for email.

- Initially, JES2 support for HTTP notifications is disabled. To enable, use JES2 command or initialization statement to enable the function at a MAS level
  - $T JOBDEF,HTTP_NOTIFY=ENABLED

- Before enabling job notifications, some steps may be required:
  - Change CEA and CIM configuration to make sure they will not attempt to deliver duplicate notifications.
    - Future enhancement planned for CEA to ignore ENF 78's flagged by JES2

Installation & Configuration (cont.)

- If necessary, create or modify AT-TLS policy to provide security for relevant HTTP sessions
  - If there is already an AT-TLS policy in place to cover relevant HTTP sessions from CIM provider, it can likely be reused.
  - Some filtering rules may need to be adjusted because connections will be initiated from a different address space and userid.

- Optionally, customer may take advantage of a new security check and add RACF profiles to manage ability of job submitter to request job notifications via HTTP.
  - Job submitter must have at least READ access to a JESJOBS profile with the format *JOBNFY.nodename.jobclass.jobname*
  - If submitter does not have sufficient authority, job submission is failed with security error
  - For compatibility with prior implementation, if RACF does not make a decision, job notification request is accepted.
  - By extension, this security check also affects the z/OSMF Jobs REST API.

Summary

- In this presentation, we will introduce enhancements made to JES2, in support of the z/OSMF Jobs REST API, to send HTTP notifications as a job progresses through its life cycle.

    - Dependencies on the CEA and CIM components have been removed.

    - Support for additional notification points have been added.

Appendix

- JES2 Publications
  - z/OS V3R1.0 JES2 Commands
  - z/OS V3R1.0 JES2 Initialization and Tuning Guide
  - z/OS V3R1.0 JES2 Initialization and Tuning Reference
  - z/OS V3R1.0 JES2 Installation Exits
  - z/OS V3R1.0 JES2 Messages
  - z/OS V3R1.0 MVS Using the Subsystem Interface

- z/OSMF Publications
  - z/OS V3R1.0 Management Facility Configuration Guide
  - z/OS V3R1.0 Management Facility Programming Guide