# EEM Scripts

Cisco IOS XR Embedded Event Manager (EEM) scripts are also known as event scripts that are triggered automatically in response to events on the router. An event can be any significant occurrence, not limited to errors, that has happened within the system. You can use these scripts to detect issues in the network in real time, program certain conditions in response to the event, detect and generate an action when those conditions are met, and execute policy (script) when an event is generated. The script acts in response to the events and reduces the troubleshooting time involved in resolving the issues. For example, you can enforce LACP dampening if a bundle interface has flapped 5 times in less than 30 secs, and define the script to disable the interface for 2 minutes.

You can programmatically define the event and actions separately and map them using a policy map via CLI or NETCONF RPCs. Whenever the configured event occurs, the action that is mapped to it is executed. The same event and action can be mapped to multiple policy maps. You can map the same event and action in 64 policy maps, and add a maximum of 5 different actions in a policy map.

You can create event scripts using Python 3.5 programming language. For the list of supported Python packages. You can also configure the EEM policies using Tool Command Language (TCL) scripts. To know more about TCL scripts, see *Configuring and Managing Embedded Event Manager Policies* Chapter in System Monitoring Configuration Guide.

This chapter gets you started with provisioning your Python automation scripts on the router.

**Note** This section does not delve into creating Python scripts, but assumes that you have basic understanding of Python programming language. This section will walk you through the process involved in deploying and using the scripts on the router.


- Workflow to Run Event Scripts, on page 1
- Example: Shut Inactive Bundle Interfaces Using EEM Script, on page 14


# Workflow to Run Event Scripts

Complete the following tasks to provision eem scripts:

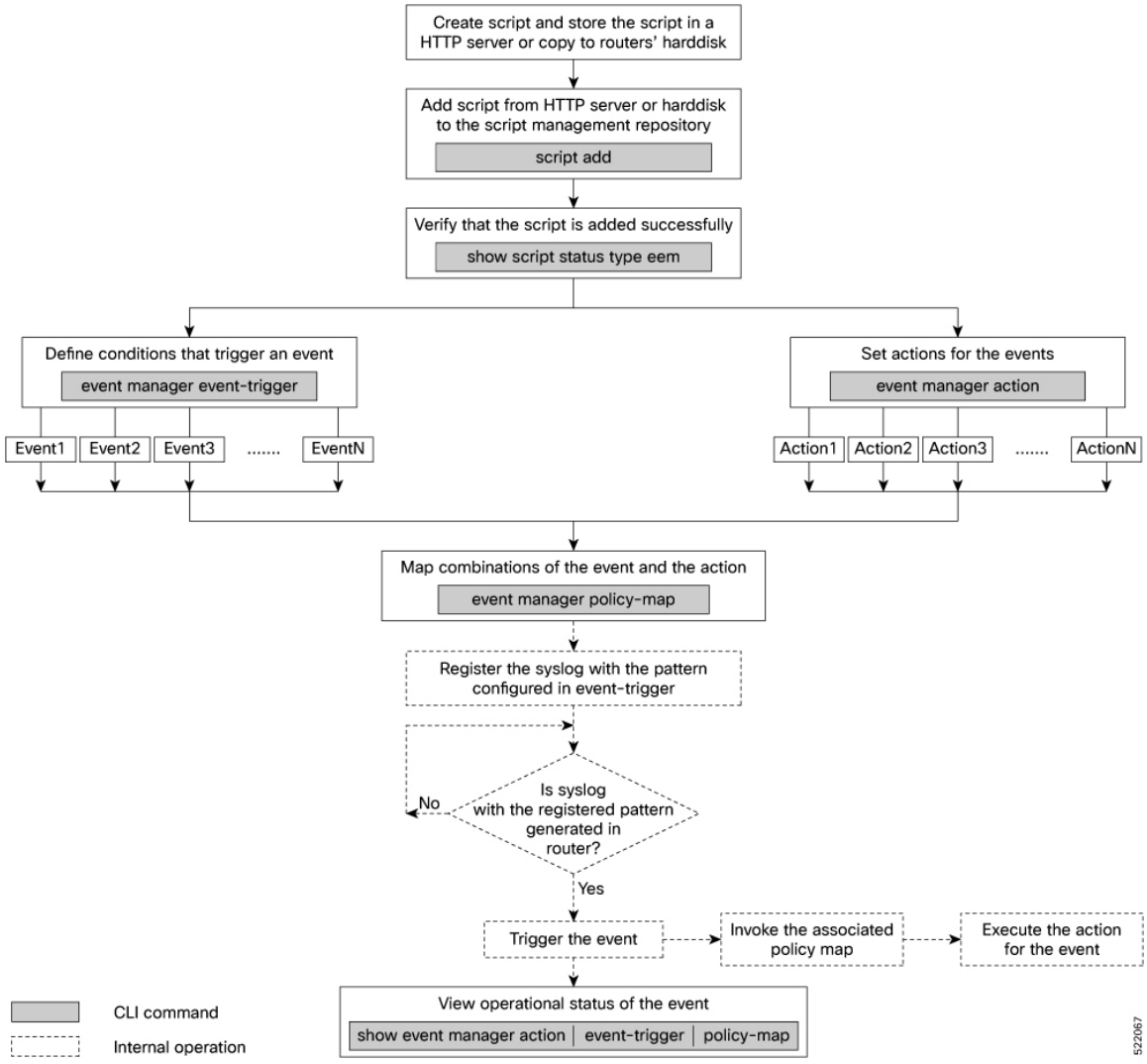
- Download the script—Store the eem script on an HTTP server or copy to the harddisk of the router. Add the eem script from the HTTP server or harddisk to the script management repository on the router using the **script add eem** command.

- Define events—Configure the events with the trigger conditions using the **event manager event-trigger** command.
- Define actions to the events—Setup the actions that must be performed in response to an event using **event manager action** command.
- Create policy map—Put together the events and the actions in a policy map using **event manager policy-map** command.

**Note** An eem script is invoked automatically when the event occurs. With the event, the event-trigger invokes the corresponding policy-map to implement the actions in response to the event.

- View operational status of the event—Retrieve the operational data using the **show event-manager action | event-trigger | policy-map** command.

The following image shows a workflow diagram representing the steps involved in using an event script:




The following sections cover the steps to run event scripts:

1. Download the Script to the Router
2. Define Trigger Conditions for an Event
3. Create Actions for Events
4. Create a Policy Map of Events and Actions
5. View Operational Status of Event Scripts

# Download the Script to the Router

To manage the scripts, you must add the scripts to the script management repository on the router. A subdirectory is created for each script type. By default, this repository stores the downloaded scripts in the appropriate subdirectory based on script type.

| Script Type | Download Location |
|---|---|
| config | harddisk:/mirror/script-mgmt/config |
| exec | harddisk:/mirror/script-mgmt/exec |
| process | harddisk:/mirror/script-mgmt/process |
| eem | harddisk:/mirror/script-mgmt/eem |

The scripts are added to the script management repository using two methods:

- **Method 1:** Add script from a server
- **Method 2:** Copy script from external repository to harddisk using **scp** or **copy** command

In this section, you learn how to add `eem-script.py` script to the script management repository.

### Procedure

**Step 1** Add the script to the script management repository on the router using one of the two options:

- **Add Script From a Server**

  Add the script from a configured HTTP server or the harddisk location in the router.

  ```
  Router#script add eem <script-location> <script.py>
  ```

  The following example shows a process script `eem-script.py` downloaded from an external repository `http://192.0.2.0/scripts`:

  ```
  Router#script add eem http://192.0.2.0/scripts eem-script.py
  Fri Aug 20 05:03:40.791 UTC
  eem-script.py has been added to the script repository
  ```

  You can add a maximum of 10 scripts simultaneously.

  ```
  Router#script add eem <script-location> <script1.py> <script2.py> ... <script10.py>
  ```

  You can also specify the checksum value while downloading the script. This value ensures that the file being copied is genuine. You can fetch the checksum of the script from the server from where you are downloading the script. However, specifying checksum while downloading the script is optional.

  ```
  Router#script add eem http://192.0.2.0/scripts eem-script.py checksum SHA256 <checksum-value>
  ```

  For multiple scripts, use the following syntax to specify the checksum:

  ```
  Router#script add eem http://192.0.2.0/scripts <script1.py> <script1-checksum> <script2.py>
  <script2-checksum>
  ... <script10.py> <script10-checksum>
  ```

  If you specify the checksum for one script, you must specify the checksum for all the scripts that you download.

  **Note**
  Only SHA256 checksum is supported.

- **Copy the Script from an External Repository**

  You can copy the script from the external repository to the routers' harddisk and then add the script to the script management repository.

**a.** Copy the script from a remote location to harddisk using scp or copy command.

```
Router#scp userx@192.0.2.0:/scripts/eem-script.py /harddisk:/
```

**b.** Add the script from the harddisk to the script management repository.

```
Router#script add eem /harddisk:/ eem-script.py
Fri Aug 20 05:03:40.791 UTC
eem-script.py has been added to the script repository
```

**Step 2** Verify that the scripts are downloaded to the script management repository on the router.

**Example:**

```
Router#show script status
Wed Aug 25 23:10:50.453 UTC
=============================================================================================
 Name               | Type     | Status           | Last Action | Action Time
---------------------------------------------------------------------------------------------
 eem-script.py      | eem      | Config Checksum  | NEW         | Tue Aug 24 10:44:53 2021
=============================================================================================
```

Script `eem-script.py` is copied to `harddisk:/mirror/script-mgmt/eem` directory on the router.

# Define Trigger Conditions for an Event

You define the event, and create a set of instructions that trigger a match to this event. You can create multiple events.

### Before you begin

Ensure that the script is added to the script management repository..

### Procedure

**Step 1** Register the event.

**Example:**

```
Router(config)#event manager event-trigger eventT10
```

You can configure more options to trigger an event:

| Keyword | Description |
|---|---|
| occurrence | Number of occurrences before the event is raised.<br>**Note**<br>The **occurrence** keyword is supported only for syslog events. |
| period | Time interval during which configured occurrence should take place.<br>**Note**<br>The **period** keyword is supported only for syslog events. |

| Keyword | Description |
|---|---|
| type | Configure the type of event.<br>**Note**<br>In Cisco IOS XR Release 7.3.2, you can configure only syslog events.<br>• Rate limit—Configure rate limit in seconds or milliseconds. After the event is triggered, the event trigger does not happen even if the event occurs any number of times, till this time has elapsed.<br>• Syslog—Configure syslog pattern, severity.<br>• Timer—Configure watch dog timer in seconds; cron timer as a text string with five fields separated by a space.<br>• Track—Configure event-trigger for track (object tracking), track state (`UP`, `DOWN`, or `ANY`). If event-trigger is configured for track state `UP`, then it gets triggered when the track state changes from `DOWN` to `UP`, and vice-versa.<br>• Telemetry—Define events based on telemetry data. With this feature, you can perform the following operations:<br>**a.** Monitor any operational state such as interface status, and trigger an action when the state changes to a specific value.<br>**b.** Monitor any counter or statistics in an operational data, and trigger an action when it reaches a threshold.<br>**c.** Monitor rate of change of any operational attribute, and trigger an action based on threshold.<br>**Note**<br>exact match supported on string and threshold or rate limit is supported only for integer type telemetry data<br>Configure sensor path for exact match, threshold or rate depending on the telemetry data type. The exact match is supported on string data type, and threshold and rate limit is supported only for interger data type. Use the following command to verify the sensor path or query before configuring the event trigger.<br>`Router#event manager telemetry sensor-path <sensor-path> json-query <query>`<br>It is mandatory to enable model-driven telemetry using the command:<br>`Router#telemetry model-driven` |

**Step 2** Configure the type for the event.

- Syslog:

```
Router(config)#event manager event-trigger eventT10 type syslog pattern
"L2-BM-6-ACTIVE"
```

  For syslog, set the pattern to match. In this example, the pattern `L2-BM-6-ACTIVE` is the match value. If a syslog is generated on the router with a pattern that matches this configured pattern, the event gets triggered.
- Timer:

Watchdog timer—

```
Router(config)#event manager event-trigger  <event-name>
 type timer watchdog value <countdown-timer-value-in-seconds>
```

Cron timer—

```
Router(config)#event manager event-trigger <event-name>
 type timer cron cron-entry "<cron string>"
```

- Track:

```
Router(config)#event manager event-trigger <event-name>
 type track name <track-name> status {up | down | any}
```

- Telemetry:

Match criteria as exact-match—

```
Router(config)#event manager event-trigger <event-name>
 query json-path <query> match-criteria exact-match value <value>
 type telemetry sensor-path <telemetry-sensor-path>
sample-interval <sample-interval-in-seconds>
```

Match criteria as threshold—

```
Router(config)#event manager event-trigger <event-name> query
json-path <query> match-criteria threshold {equal-to | greater-equal-to |
greater-than | less-equal-to | less-than| not-equal-to} <value>
type telemetry sensor-path <telemetry-sensor-path> sample-interval <sample-interval-in-seconds>
```

Match criteria as rate—

```
Router(config)#event manager event-trigger <event-name>
 query json-path <query> match-criteria rate direction {any | decreasing | increasing}
value {equal-to| greater-equal-to | greater-than | less-equal-to | less-than | not-equal-to}
<value>
 type telemetry sensor-path <telemetry-sensor-path> sample-interval <sample-interval-in-seconds>>
```

### Example

**Example:** The following example shows the configuration for syslog event type. If severity is configured, the event gets triggered only if both the syslog severity and the syslog pattern match with the syslog generated on the router. If severity is not configured, it is set to `all`, where only pattern match is considered for the event to trigger.

```
Router(config)#event manager event-trigger eventT10
 type syslog pattern "<pattern-to-match>" severity <value>
```

```
Router(config)#event manager event-trigger eventT10
rate-limit seconds <time-in-seconds>
type syslog pattern "<pattern-to-match>" severity <value>
```

The severity values are:

```
alert      Syslog priority 1
critical   Syslog priority 2
debug      Syslog priority 7 (lowest)
emergency  Syslog priority 0 (highest)
error      Syslog priority 3
```

```
info       Syslog priority 6
notice     Syslog priority 5
warning    Syslog priority 4
```

The following example shows a syslog pattern `L2-BM-6-ACTIVE` with severity value critical:

```
Router(config)#event manager event-trigger eventT10
 type syslog pattern "L2-BM-6-ACTIVE" severity info
```

The event gets triggered, if both the syslog pattern `L2-BM-6-ACTIVE` and severity value `info` match.

# Create Actions for Events

Define the actions that must be taken when an event occurs.

### Before you begin

Ensure that the following prerequisites are met before you configure the action:

- Define Trigger Conditions for an Event, on page 5

### Procedure

**Step 1** Set the event action.

**Example:**

```
Router(config)#event manager action action1
```

**Step 2** Define the type of action. For example, the action is a Python script.

**Example:**

```
Router(config)#event manager action action1 type script action1.py
```

**Step 3** Configure the maximum run time of the script for the event.

**Example:**

```
Router(config)#event manager action action1 type script action1.py maxrun seconds 30
```

The default value is 20 seconds.

**Step 4** Configure the checksum for the script. This configuration is mandatory. Every script is associated with a checksum hash value. This value ensures the integrity of the script, and that the script is not tampered. The checksum is a string of numbers and letters that act as a fingerprint for script.

a) Retrieve the SHA256 checksum hash value for the script from the IOS XR Linux bash shell.

**Example:**

```
Router#run
[node0_RP0_CPU0:~]$sha256sum /harddisk:/mirror/script-mgmt/eem/action1.py
407ce32678a5fc4b0ad49e83acad6453ad1d47e8dad9501cf139daa75d53e3dd
/harddisk:/mirror/script-mgmt/eem/action1.py
```

b) Configure the checksum for the script.

**Example:**

```
Router(config)#event manager action action1 type script action1.py checksum
sha256 407ce32678a5fc4b0ad49e83acad6453ad1d47e8dad9501cf139daa75d53e3dd
```

**Step 5** Enter the username for the script to execute.

**Example:**

```
Router(config)#event manager action action1 username eem_user
```

**Note**
If you load the event manager action commands using configuration files, for example, by using the **load harddisk:config.txt** command, you must make sure that the commands in the configuration files are properly indented and aligned with the running configuration.

In this example, the **username eem** and **type script** commands in the **config.txt** configuration file are properly indented and aligned with the running configuration.

```
event manager action action_all
 username eem
 type script script-name eem.py Marx seconds 7200 checksum
sha256fb2e1f7c4b135c296abb7149cf5fb96f052d3876c35a8422d44f78b9b6d3e452
!
```

# Create a Policy Map of Events and Actions

***Table 1: Feature History Table***

| Feature Name | Release Information | Description |
|---|---|---|
| Add Multiple Events In a Policy Map With a Single EEM Script | Release 25.1.1 | Introduced in this release on: Fixed Systems (8700 [ASIC: K100], 8010 [ASIC: A100])(select variants only*)<br>*This feature is supported on:<br>• 8712-MOD-M<br>• 8011-4G24Y4H-I |
| Add Multiple Events In a Policy Map With a Single EEM Script | Release 7.5.1 | With this feature, you can add multiple events to a policy map with boolean (AND or OR) correlation. EEM triggers the script when the correlation defined in the policy map for the events is true. Using EEM scripts, you can create a logical correlation of events in the policy map and configure multiple actions for detectors such as timer, object-tracking, and telemetry events via sensor path. |

Create a policy to map events and actions. You can configure a policy that associates multiple actions with an event or use the same action with different events. The policy can be triggered if an event or multiple events occur at a specified number of times within a specified period of time. The `occurrence` and `period` are optional parameters. You can add multiple events to a policy-map with boolean (AND or OR) correlation. EEM triggers the script when correlation defined in the policy-map for the events is true. For example, a multi-event policy-map for `event1` and `event2` with `event1 AND event2` boolean operation is triggered only when both `event1` and `event2` are true.

### Before you begin

Ensure that the following prerequisites are met before you create a policy map:

- Define Trigger Conditions for an Event, on page 5
- Create Actions for Events, on page 8

### Procedure

**Step 1** Create a policy map.

**Example:**

```
Router(config)#event manager policy-map policy1
```

```
Router(config)#event manager policy-map policy1
 trigger multi-event ["(<event1> AND <event2>) AND (<event3> OR <event4>)" |
 occurrence <count> | period <time in seconds>]
```

**Note**
Ensure that the operations when configuring multiple events are within double quotes `""`.

where,

- occurrence: Specifies the number of times the total correlation occurs before an EEM event is raised. If occurrence is not specified, the policy-map gets triggered on every occurrence of the event. The occurance vale ranges from 1 to 32. An occurrence that is configured with multiple events is considered as only one occurrence if the boolean logic operations becomes true.
- period: Time interval in seconds, during which the event occurs. The period must be an integer number between 1 to 429496729 seconds.

**Step 2** Define the action that must be implemeted when the event occurs. Maximum of 5 actions can be mapped to a policy map.

**Example:**

```
Router(config-policy-map)#action action1
```

**Step 3** Configure the name of the event or multiple events to trigger the policy-map.

**Example:**

```
Router(config-policy-map)#trigger event event10
```

The following example shows the policy-map for multiple events:

```
event manager policy-map policy001
 trigger multi-event "event1 OR (event4 AND event2)"
 period 60
```

```
 action action2
 occurrence 2
!
```

# Authorize Event Manager

### Before you begin

Ensure that the following prerequisites are met before you authorize a event manager:

- Ensure to give appropriate clearances to the exec script to make it effective.
- In router configuration, ensure the username configured under "event manager action" should match an existing user.

### Procedure

Run the AAA configuration for legacy EEM and next generation EEM scripts:

**Example:**

```
Router(config)#aaa authorization eventmanager {default | list-name} {none | local | group {tacacs+
| radius | group-name}}
```

**Example:**

With this command, the event manager task will be authorized using local authentication configured on the router for the default list

```
Router(config)#aaa authorization eventmanager default local
```

**Note**
Additionally, regular authentication methods are needed for exec and login.

**OR**

Using `tacacs+` authentication, the following commands authorize exec commands and authenticate logins on the default list and fallback to local if `tacacs+` server is unreachable:

**Example:**

```
Router(config-policy-map)#aaa authorization exec default group tacacs+ local
Router(config-policy-map)#aaa authentication login default group tacacs+ local
```

**Note**
For more information about configuring AAA authorization, see the *System Security Configuration Guide*.

# View Operational Status of Event Scripts

Retrieve the operational status of events, actions and policy maps.

### Before you begin

Ensure that the following prerequisites are met before you trigger the event:

- Define Trigger Conditions for an Event, on page 5
- Create Actions for Events, on page 8
- Create a Policy Map of Events and Actions, on page 9

### Procedure

**Step 1** Run the **show event manager event-trigger all** command to view the summary of basic data of all events that are configured.

**Example:**

```
Router#show event manager event-trigger all
Tue Aug 24 14:47:35.803 IST
Thu May 20 20:41:03.690 UTC
No. Name    esid   Type    Occurs  Period  Trigger-Count Policy-Count Status
1   event1  1008   syslog  2       1800    4             1            active
2   event2  1009   syslog  2       1800    4             1            active
3   event3  1010   syslog  2       1800    4             1            active
4   event4  1011   syslog  2       1800    4             1            active
5   event5  1012   syslog  2       1800    4             1            active
6   event6  1013   syslog  2       1800    4             1            active
7   event7  1014   syslog  2       1800    4             1            active
8   event8  1015   syslog  2       1800    4             1            active
9   event9  1016   syslog  2       1800    4             1            active
```

Use the **show event manager event-trigger all detailed** command to view the details about the match criteria that you configured, severity level, policies mapped to the events and so on.

Use the **show event manager event-trigger <event-name> detailed** command to view the details about the individual events.

```
Router#show event manager event-trigger event1 detailed
Fri Nov 19 04:21:45.558 UTC

Event trigger name: event1
Event esid: 107
Event type: timer
Event occurrence: NA
Event period: NA
Event rate-limit: NA
Event triggered count: 12861
Event policy reg count: 1
Event status: active
Timer type: watchdog
Timer value: 10

Policy mapping info
1    event1                     policy1
```

**Step 2** Run the **show event manager policy-map all** command to view the summary of all the configured policy maps.

**Example:**

```
Router#show event manager policy-map all
Tue Aug 24 14:48:52.153 IST
```

```
No. Name      Occurs   period    Trigger-Count     Status
1   policy1   NA       NA        1                 active
2   policy2   NA       NA        1                 active
3   policy3   NA       NA        1                 active
4   policy4   NA       NA        1                 active
```

Use the **show event manager policy-map all detailed** command to view the details about mapping of associated events and actions in the policy maps.

```
Router#show event manager policy-map policy1 all detailed
Fri Nov 19 11:35:40.282 UTC

Policy name: policy1
Policy occurrence: 3
Policy period: 120
Policy triggered count: 0
Policy status: active
Multi event policy: FALSE

Events mapped to the policy
No.       Name                          Status
1         event2                        active

Actions mapped to the policy
No.       Name                          Checksum
1         action1                       SHA256
```

Use the **show event manager policy-map <policy-map-name> detailed** command to view the details about the individual policy maps.

```
Router#show event manager policy-map policy1 detailed
Fri Nov 19 11:05:38.828 UTC

Policy name: policy1
Policy occurrence: 2
Policy period: 60
Policy triggered count: 0
Policy status: active
Multi event policy: TRUE
Multi event string : "event1 OR (event4 AND event2)"
Current Correlation State : FALSE

Events mapped to the policy
No.       Name                          Status         Corr Status    Reset time(sec)
1         event1                        active         0              0
2         event2                        active         0              0
3         event4                        active         0              0

Actions mapped to the policy
No.       Name                          Checksum
1         action2                       SHA256
```

**Step 3** Run the **show event manager action <action-name> detailed** commad to view the details of an action.

**Example:**

```
Router#show event manager action action1 detailed
Tue Aug 24 16:05:44.298 UTC

Action name: action1
Action type: script
EEM Script name: event_script_1.py
Action triggered count: 1
Action policy count: 1
Username: eem_user
```

```
Checksum: 407ce32678a5fc4b0ad49e83acad6453ad1d47e8dad9501cf139daa75d53e3dd
Last execution status: Success

Policy mapping info
1    action1                       policy1
```

Use the **show event manager action all** and **show event manager action all detailed** command to view the summary and details about all the configured actions.

# Example: Shut Inactive Bundle Interfaces Using EEM Script

In this example, you use an EEM event to look for a syslog message and trigger a Python script. The script does two things:

- Triggers an event on the interface inactive log as part of Bundle-Ether1, and shuts down the interface.
- Runs the **show tech-support bundles** command to collect debug data.

### Procedure

**Step 1** Create an eem script `event_script_action_bundle_shut.py`. Store the script on an HTTP server or copy the script to the harddisk of the router.

**Example:**

```
from iosxr.xrcli.xrcli_helper import *
from cisco.script_mgmt import xrlog

logger = xrlog.getScriptLogger('sample_script')
syslog = xrlog.getSysLogger('sample_script')
helper = XrcliHelper(debug = True)

syslog.info('Execution of event manager action script event_script_action_bundle_shut.py started')

config = """interface Bundle-Ether1
shutdown"""

cmd = "show tech-support bundles"

if __name__ == '__main__':
  res = helper.xr_apply_config_string(config)
  if res['status'] == 'success':
     syslog.info('OPS_EVENT_SCRIPT_ACTION : Configuration succeeded')
  else:
     syslog.error('OPS_EVENT_SCRIPT_ACTION : Configuration failed')

  res = helper.xrcli_exec(cmd)
  if res['status'] == 'success':
     syslog.info('OPS_EVENT_SCRIPT_ACTION : show tech started')
  else:
     syslog.error('OPS_EVENT_SCRIPT_ACTION : show tech failed')

  syslog.info('Execution of event manager action script event_script_action_bundle_shut.py ended')
```

**Step 2** Add the script from HTTP server or harddisk to the script management repository..

**Step 3** After the configured type matches the syslog pattern, the script is triggered in response to the detected event. You can view the running configuration for the event manager.

**Example:**

```
Router#show running-config event manager
Mon Aug 30 06:23:32.974 UTC
event manager action action1
 username eem_user
  type script script-name eem_script_bundle_shut.py maxrun seconds 600 checksum sha256
2386d8f71b2d6f6f6e77a7a39d3b4d38cca07f9eaf2a4de7cd40c1b027a4e248
!
event manager policy-map policy1
 trigger event event1
  action action1
!
 event manager event-trigger event1
  type syslog pattern "%L2-BM-6-ACTIVE : FortyGigE0/0/0/13 is no longer Active as part of Bundle-Ether1"
!
```