

Network Maintenance Window

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Overview

Objective

Schedule and automate maintenance workflows with minimal network interruption and most efficient results.

Challenge

Maintenance activities typically require system downtime and temporary disruption of services. Keeping downtime and disruption to a minimum is critical but challenging. Therefore, maintenance activities must take place during a carefully calculated optimal time slot, usually when activity is at its lowest.

Solution

Cisco Crosswork Change Automation and Cisco Crosswork Health Insights are optional add-on applications that provide the functionality needed to automate the scheduling and execution of maintenance tasks. Planning the optimal time for maintenance activities can be done successfully using Cisco WAE Design to simulate "what-if" scenarios based on timed topology snapshots exported from Cisco Crosswork Network Controller using APIs.

How Does it Work?



- Using the Crosswork Network Controller APIs, you can create topology snapshots (plan files) which capture and represent topology state at a given point in time, including the IGP topology as well as interface level statistics (traffic load). For impact analysis purposes, these snapshots should be representative of a time period to be evaluated for an upcoming maintenance activity. For example, if you are planning a router upgrade at midnight on a Monday, you would take snapshots from several Mondays at midnight to evaluate typical traffic loads at this time. You can export these plan files to a central storage repository, where a library of topology plan files can be stored for a specified period of time.
- Cisco WAE Design allows you to explore "what-if" scenarios relevant to the planning of the maintenance window. For example, in the case of upgrading a router, Cisco WAE Design can simulate the resulting traffic load on the remaining devices after traffic is diverted from the device being upgraded. You can also explore the impact of deploying tactical traffic engineering policies to further optimize the topology during the maintenance window. For more information, contact your Cisco Customer Experience representative.

Additional Resources

Cisco Crosswork Change Automation and Health Insights User Guide

Cisco WAE Design documentation

Cisco Crosswork Network Automation API Documentation on Cisco Devnet

Scenario 8 – Perform a software upgrade on a provider device during a scheduled maintenance window

Scenario Context

This scenario assumes that Cisco WAE Design has been used to evaluate the impact of removing a P node from the network to perform a software upgrade during a specific timeframe. In this scenario, we will choose a predefined playbook to automate the execution of the SMU on the device, and we will schedule it to run during the predetermined maintenance window.

Assumptions and Prerequisites

- Cisco Crosswork Change Automation must be installed and running.
- You must have access to Cisco WAE Design.
- The Device Override Credentials must be set for Crosswork Network Change Automation to be functional. Go to Administration > Settings > System Settings > Network Automation.

Step 1 Download Topology Plan Files for Impact Analysis

When considering when to take down a device for maintenance so that there will be the least impact to the network, you need information about the traffic trends around that device at the targeted time. Using the Cisco Crosswork Optimization API, you can download plan files that capture a snapshot of the network topology at that time. If you download plan files at the same time over a period of time, you can use Cisco WAE Design to analyze the traffic trends. Based on this analysis, you can decide whether the impact to the network would be acceptable or not.

Refer to Cisco Crosswork Network Automation API Documentation on Cisco Devnetfor more information about the API.

The input for this scenario is as follows:

- **Step 1** Prepare the input required to download the plan file. You need to specify the version of Cisco WAE design that you will be using for analysis and the format in which you want the plan file, either txt or pln.
 - **Note** If you download the plan file as a txt file, you can view it in any text editor. If you download it as a pln file, you can open it only in Cisco WAE design.

The input for this scenario is as follows:

```
'{
   "input": {
    "version": "7.3.1",
    "format": "txt",
    }
}'
```

Step 2 Invoke the API on the Cisco Crosswork Network Controller server using the input prepared in the previous step. For example:

```
curl --location --request POST
'https://10.194.63.198:30603/crosswork/nbi/optima/v1/restconf/operations/cisco-crosswork-
optimization-engine-operations:get-plan \
--header 'Content-Type: application/yang-data+json' \
--header 'Accept: application/yang-data+json' \
--header 'Authorization: Bearer
eyJhbGciOiJIUzUxMiJ9.eyJzdWIiOiJhZG1pbiIsImlzRnJvbU5ld0xvZ2luIjoidHJ1ZSIsInBvbGljeV9pZCI6ImFkb
WluIiwiYXV0aGVudGljYXRpb25EYXRIIjoiMjAyMS0wMy0yMlQxNjozODozNy43NDY2MTZaW0dNVF0iLCJzdWNjZXNzZnV
sQXV0aGVudGljYXRpb25IYW5kbGVycyI6IIF1ZXJ5RGF0YWJhc2VBdXRoZW50aWNhdGlvbkhhbmRsZXIiLCJpc3MiOiJod
```

```
HRwOlwvXC9sb2NhbGhvc3Q6NTQ4OVwvU1NPIiwibGFzdF9uYW11Ijoic21pdGgiLCJjcmVkZW50aWFsVH1wZSI6I1VzZXJ
uYW11UGFzc3dvcmRDcmVkZW50aWFsIiwiYXVkIjoiaHR0cHM6XC9cLzEwLjE5NC42My4xOTg6MzA2MDNcL2FwcC1kYXNoY
m9hcmQiLCJhdXRoZW50aWNhdGlvbk1ldGhvZCI6IlF1ZXJ5RGF0YWJhc2VBdXRoZW50aWNhdGlvbkhhbmRsZXIiLCJsb25
nVGVybUF1dGhlbnRpY2F0aW9uUmVxdWVzdFRva2VuVXNlzCI6ImZhbHNlIiwiY2hhbmdlX3B3zCI6ImZhbHNlIiwiZXhwI
joxNjE2NDU5OTIwLCJpYXQiOjE2MTY0MzExMjAsImZpcnN0X25hbWUiOiJqb2huIiwianRpIjoiU1QtODQtOFV1WXMybEt
3R2d1Z3RIYj14MzVmTF1NTGVVRlp60URyNGpoeFcxakhsV01VYXdXSWgxbUdTd01aRC1t0Ek1S2Z0amI2ZmlWTUh1YnBYY
jBMMFZqRFc2WVppUFVUbHRpNFVpZnNUeG9aQ284WWpPWEc2V1FjS0Mwb291WjJhc3BWanMzYnA3bHo5VkhyS1BCTz15TDN
GcFRIWXRPeWJtVi1jYXMtMSJ9.Vi4k0w8KsOv5M 08zBqWochT3k9V9Pn2NjSn5ES9c5Pf-
4ds0o4kk6xuZx5 cggauiEICuUMnzmRzneST-oAuA'
--data-raw !{
  "input": {
    "version": "7.3.1",
    "format": "txt",
   ...
    }
  }
}
```

Step 3 Note the plan file content in the API response. It is encoded for security purposes and must be decoded before you can view the content.

```
{
    "cisco-crosswork-optimization-engine-operations:output": {
    "status": "accepted",
    "plan-file content": "
    PE51dHdvcms+ClByb3BlcnR5CVZhbHVlClRpdGxlCQpWZXJzaW9uCTcuMy4xCgo8TmV0d29ya09wdGlvbnM+Ck9wdGlvbg
    IWYWxlZQpFbmZvcmNlQWRqU0lETG9jYWxpemF0aW9uCVRSVUUKCjxDaXJjdWl0cz4KTmFtZQl<<<>>>0b2RlQQlJbnRlcm
    ZhY2VBCU5vZGVCCUludGVyZmFjZUIJQ2FwYWNpdHkJRGVsYXkJRGlzdMJTmV0SW50U05NUF9FcnJvcgl0ZXRJbnRTb3VyY
    2UJTmV0SW50UkUwQ1BVNW0JTmV0SW50UkUwQ1BVNWZpZXIJQWxnb3JpdGhtCVJmbGFnCU5mbGFnCVBmbGFnCUVmbGFnCVz
    mbGFnCUxmbGFnCg=="
    }
    Use a script to decode the plan file or copy the plan file content into a decoder. After decoding the plan file, you can see
    the content of the model to be used in Cisco WAE Design. It includes a full snapshot of the topology, including the
    devices, interfaces, links, LSPs, traffic levels, and other information.
```

Step 5 Open the plan file in Cisco WAE Design, simulate the device going down, and observe the impact on the network. Refer to the Cisco WAE Design documentation for more information.

Step 2 Schedule and execute the SMU by running a playbook

If the simulated impact is acceptable, you can create and schedule the change by running a playbook through Cisco Crosswork Change Automation. For this scenario, we will run a predefined playbook to install a Software Maintenance Update (SMU) on devices tagged under a certain geographic location (NY).



Note If the predefined (stock) plays and playbooks do not meet your specific needs, you can create custom plays and playbooks. To create a custom play, go to **Network Automation > Play List**, and to create a custom playbook, go to **Network Automation > Playbook List**.

Step 1 Go to Network Automation > Run Playbook

Step 4

Step 6 Based on the analysis, decide on an optimal time to execute the SMU.

Step 2 Browse the Available Playbooks list, and click the Install a SMU playbook. You can also filter using keywords to identify the playbook. Note that the playbook execution stages, supported software platform, software version, and individual play details are displayed on the right side.

O Select Playbook Select Devices	O O O Parameters Execution Policy	O Confirm
Available Playbooks Q. Search here Predefined Playbooks (33) My Playbooks All Playbooks	Install a SMU or an optional pact Last Modified: 14-Oct-2020, 1:45 AM by Cisco Software Platform: IOS XR SVersion: 1.0.0 Description: Install SMU or an optional package on a r	ckage on a router
Delete ACL based traffic steering configs	✓ Pre Maintenance (1)	✓ Maintenance (4)
Delete DSCP based traffic steering configs	1 Verify package consistency on router	2 Perform DLM node lock on device(s)
Enable/Disable traffic collector	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3 Install and nackane(s)
Install a SMU or an optional package on a router		
Interface State change for XE device		4 Install activate package(s)
Interface State change on XR		5 Install commit package(s)
Node State Snapshot		✓ Post Maintenance (1)
Prefix Set ADD/DELETE		$\boldsymbol{\delta}$ Verify package in committed list on router
Push config using NAMs		
Remove interface from Bundle Ether and delete bundle-ether		-
Cancel		Next

Step 3 Click Next to go to the next task: Select Devices. All devices tagged with City: NY will be selected for SMU installation.

Step 4 Under the City tag on the left, click **NY**. The devices tagged with NY are listed on the right and are automatically selected.

	0	•	0)	0	
	Select Playbook	Select Devices	Parameters	Executio	on Policy	Confirm	
LIST	\sim	Se	elect Device Tag 🔘 Set	lect Device Manuall	y	Allow Bu	ulk Jobs 🕐
Select Tags* Clear All	Tag Selected	NY X	1 Tags	will be resolved dy	mamically at r	untime to determine constitue	nt devices.
City	Devices with s	selected tag					T
○ TX(2)	Reachability St	Operational State	Host name	Software Pla	Provider	Unique Identifier	
O CA(3)							
NY(2)	Reachable	OK	P-BOTTOMRIGHT	IOS XR		bcc1bc0c-d1cc-493	32-90a7-30
○ WA(0)	Reachable	OK	P-TOPRIGHT	IOS XR		ce944bd2-c476-43	.91-9c47-b
Default							

Step 5 Click **Next** to go to the next task: Define Parameters.

Step 6 Edit the runtime parameters to execute the SMU playbook. Alternatively, you can upload a JSON file that contains the parameter values. The following values are used specifically for this scenario. You can change them as required:

- a. Under "verify package consistency on the device" play, set collection_type as mdt.
- b. Under "perform DLM node lock on device" play, set retry_count and retry_interval as 3 and 5s respectively.

Select Playbook Select Devices	Parameters Execution Policy Confirm
Available Playbooks Q. Search here Predefined Playbooks (33) My Playbooks All Playbooks	Install a SMU or an optional package on a router Last Modified: 14-Oct-2020, 1:45 AM by Cisco Software Platform: IOS XR SVersion: 1.0.0 Description: Install SMU or an optional package on a router.
Delete ACL based traffic steering configs Delete DSCP based traffic steering configs Enable/Disable traffic collector Install a SMU or an optional package on a router Interface State change for XE device	Pre Maintenance (1) Verify package consistency on router Perform DLM node lock on device(s) Install add package(s) Ainstall activate package(s) Sinstall commit nackage(s)
Interface State change on XR Node State Snapshot Prefix Set ADD/DELETE	Post Maintenance (1) 6 Verify package in committed list on router
Push config using NAMs Remove interface from Bundle Ether and delete bundle-ether Cancel	-

c. Under "Install add package(s)" play, set action as add, and optimize as false. Enter the <SMU package name> in item 1 and set region as NODES.

0	0	•	0	0	
Select Playbook	Select Devices	Parameters	Execution Policy	Confirm	
✓ Install add p	ackage(s) ?				d)
optimize					
false					~
Whether or not to optim	ize the package list installati	ion. If check mode is set th	ne packages list will be availabl	e as facts.	
✓ packages (?				\oplus
item 1					
xrv-9k-base-2.	0.0.144-r721.CSCuv93809x86_64.rpm				
JSON List of	SMU package names to be	installed on the router, or a	a tar containing SMU packages		
region					

The region in which the host belonds.	The	region	in	which	the	host	belonas.	
---------------------------------------	-----	--------	----	-------	-----	------	----------	--

- d. Set type as SCP, and enter values for the source, address, destination, and dlm_credential_profile.
- e. Under Install activate package(s), click the piece of paper symbol, select action, and set action to Activate.
- f. Under Install commit package(s), set action to Commit.
- **g.** Under Verify package in committed list on router, set collection_type to mdt, and enter the <SMU package name> in item 1.

- **Step 7** Click Next to go to the next task: Define Execution Policy.
- **Step 8** Select **Continuous** as the Execution mode so that the playbook will run uninterrupted with no pauses. Under Failure policy, select the action you want taken if the execution fails abort or rollback.
- **Step 9** Schedule the execution for the optimal time calculated during the impact analysis stage. Uncheck the **Run Now** option. Note the calendar and timer that are displayed to schedule pre-check and perform plays. Select the date and time for the scheduled maintenance.

0	0				•		-0
Select Playbook	Select Devices	Pa	arameters	Exec	ution Policy	Co	onfirm
Continuous Run the playbook wi interruption.	thout	Run play spec	le Stepping the Playbook at a time, and ify when to p	one I ause.	÷	Dry Run View the config changes without a commit.	uration It performing
Collect Syslog ⑦	Failu	re policy ᠀					
Yes No	0	n failure Abo	ort	\sim			
Schedule	All Schedule	d Jobs		:	Show jobs fo	r selected devic	es only
Run Now	Previous	Today	April	2021		Month	Week
Schedule Pre- check (Asia/Jerusalem)(?)	Next						Day
2021-04-09 Add date	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Increment hours Increment minutes	28				1	2	3
00 : 42 V Decrement hours V Decrement minutes	4	5	6	7	8	9	10
Schedule	11	12	13	14	15	5 16	17
2021-04-09 Add date	18	19	20	21	22	23	24
Increment hours Increment minutes 00 : 42	25	26	27	28	29	30	
Decrement hours V Decrement minutes							

Step 10 Click **Next** to go to the next task: Confirm Job.

Step 11 Review your job details. Label your job with a unique name. Click **Run Playbook**. The SMU installation is now scheduled to run in the planned maintenance window.

O Select Playbook	O	O Parameters	O Execution	Policy	Confirm	
Review your Job			La	ibel your Job	2	
Playbook	Install a SMU or an op Continuous (0) Pre Maintenance (1) Maintenance (4)	tional package on a router	Change	Name * Labels	smu_upgrd update	
	Post Maintenance (1)		- 1-	👒 up	odate X	
Tag	₩NY		Change			
<pre>"1": { "collection_type": "mdt" }, "2": { "retry_count": "3", "retry_interval": "5s" }, "3": { "optimize": false, "packages": ["xrv-9k-base-2.0.0.144-r],</pre>	-721.CSCuv93809x86_64	4.rpm"				
"region": "NODES", "repository": { "type": "SCP", "source": "/root/smus", "address": "192.168.6.1" "destination": "harddisk "dlm_credential_profile"	', ::", ': "abc"		Ŧ			
Cancel	: auc			C	Previous Run Playb	ook

Step 3 Verify the SMU install job completion status

Step 1 After the scheduled maintenance window time, go to **Network Automation > Automation Job History**. Under Job Sets, check that the job status icon on the SMU install job is Green, indicating that the scheduled job has run successfully.

Job	Sets	1/43 🔿	\$ ⟨⟩	Job Set: smu_xrv-	77993990	Ice			$\leftarrow \rightarrow \overline{\cdots} $
Actio	ins \checkmark	7	r						
	Status	Name	ld	Status Success (1)		Sob Set Tags (1)	PlayBook Title router_op_sm	u_upgrade (1)	Created By admin
\checkmark	0	smu_xrv-77993990ce	rou				•••• /		
	0	smu-597500543b	rou	All Jobs in the Set	(1)				Selected 1 / Total 1 💍 🌣
	0	smu-1543a2f3ab	rou						
	۲	sanshit-fb8f5ea027	rou	Abort Selected Abort	IIA:				T
		sanshit-d479ab4b04	rou	0	De la	E		0	
	0	show_cmd-f21c67fd4c	rou	Status	Device	Execution ID		Start Time	End Time
	0	show_cmd-ddcb5e8578	rou						
	8	show_cmd-8e811cfab4	rou	Succeeded	xrv9k-1	161366714	147-5b7e0cec-7c19-4368-b	Thu, Feb 18, 2021,	08:55:5 Thu, Feb 18, 2021, 09:20:0
	8	show_cmd-33b9c3a6bf	rou						

Step 2 Select the SMU install job. Note the Job Set details on the right side. Click the Execution ID for job details.

Playbook Install a SMU or an optional package on a router	Device xrv9k-1	SUCCEEDED 2021-feb-18, 09:20:04 (GMT -06:00)
Execution Mode		
✓ Pre Maintenance 1/1		^
1 Verify package consistency on router	Ø	\checkmark
✓ Maintenance 4/4		Even Autor Autor
2 Perform DLM node lock on device(s)	O	Events Syslog Console
3 Install add package(s)	0	GENERIC EVENT 2021-Feb-18, 09:20:04 (GMT -08:00) - Node Name : ["xrv9k-1"] - Event : ["description":"MoP job exempleted" texture: "COURT ETER"]
4 Install activate package(s)	Sector 100 (1998)	
5 Install commit package(s)	O	MOP STATUS 2021-Feb-18, 09:20:04 (GMT -08:00) Status: SUCCEEDED - Description: maintenance phase succeeded
✓ Post Maintenance 1/1		MOP TASK EVENT 2021-Feb-18, 09:20:04 (GMT -08:00) - Node Name : ["xrv9k-1"] - Task : Verify package in committed list on
6 Verify package in committed list on router	Image: A start of the start	router - Result: SUCCESS - Description: Input package(s) given are present in committed package(s)
		GENERIC EVENT 2021-Feb-18, 09:20:04 (GMT -08:00) - Node Name : ["xrv9k-1"] - Event : input package(s) given are present in committed package(s)
		NODE STATUS UPDATE 2021-Feb-18, 09:20:04 (GMT -08:00) - Node Name : ["xrv9k-1"] - Status : READY

Step 3 Double-check that the correct SMU has been installed by executing the "show install active summary" and "show install committed summary" commands on the device and checking that the SMU you installed appears in the list. Some example outputs from these commands are shown below:

```
RP/0/RP0/CPU0:CX-AA-PE4#show install active summary
1
2
    Mon Apr 12 11:09:20.198 EDT
        Active Packages: 12
3
            ncs5500-xr-6.6.3 version=6.6.3 [Boot image]
4
            ncs5500-ospf-2.0.0.0-r663
5
            ncs5500-mpls-2.1.0.0-r663
6
7
            ncs5500-eigrp-1.0.0.0-r663
            ncs5500-isis-2.2.0.0-r663
8
            ncs5500-li-1.0.0.0-r663
9
            ncs5500-mpls-te-rsvp-4.1.0.0-r663
10
            ncs5500-mcast-3.1.0.0-r663
11
            ncs5500-mgbl-3.0.0.0-r663
12
            ncs5500-k9sec-3.1.0.0-r663
13
            ncs5500-routing-4.0.0.17-r663.CSCvr43225
14
            ncs5500-mpls-te-rsvp-4.1.0.17-r663.CSCvr43225
15
16
    RP/0/RP0/CPU0:CX-AA-PE4#show install committed summary
17
18
    Mon Apr 12 11:09:27.092 EDT
        Committed Packages: 12
19
            ncs5500-xr-6.6.3 version=6.6.3 [Boot image]
20
            ncs5500-ospf-2.0.0.0-r663
21
            ncs5500-mpls-2.1.0.0-r663
22
            ncs5500-eigrp-1.0.0.0-r663
23
            ncs5500-isis-2.2.0.0-r663
24
            ncs5500-li-1.0.0.0-r663
25
            ncs5500-mpls-te-rsvp-4.1.0.0-r663
26
            ncs5500-mcast-3.1.0.0-r663
27
28
            ncs5500-mgbl-3.0.0.0-r663
            ncs5500-k9sec-3.1.0.0-r663
29
            ncs5500-routing-4.0.0.17-r663.CSCvr43225
30
            ncs5500-mpls-te-rsvp-4.1.0.17-r663.CSCvr43225
31
32
    RP/0/RP0/CPU0:CX-AA-PE4#
```

Summary and Conclusion

In this scenario we saw how to plan for a maintenance window in which to bring down a device in order to install an SMU. The goal is to cause as little impact to the traffic in the network as possible. To analyze the impact on the network, we showed how to download snapshots of the network topology (plan files) at the target time for the maintenance window. The plan files can then be analyzed using Cisco WAE design.

Assuming that the impact was acceptable, we chose a predefined playbook to install the SMU on specific devices and we scheduled it for the planned maintenance window time when there would be the least impact to the network.