



Manage SR-PCE and NSO Providers

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Manage Providers

Cisco Crosswork Optimization Engine communicates with SR-PCE and NSO providers. Cisco Crosswork Optimization Engine stores the provider connectivity details and makes that information available to applications. For more information on provider functions, see [Get Started](#).



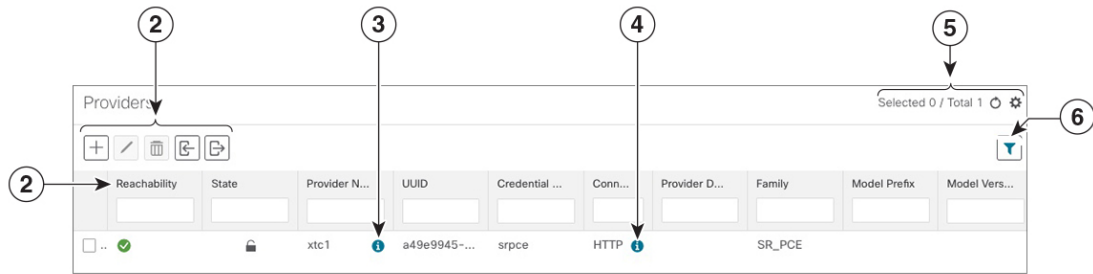
Note You may see other providers on the UI that do not apply to Cisco Crosswork Optimization Engine. Other Cisco Crosswork Network Automation applications use these providers.

From the **Providers** window, you can add a new provider, update the settings configured for an existing provider, and delete a particular provider. To open this window, choose **Admin > Providers**.



Note Wait until the application responds between performing a succession of updates. For example, adding, deleting, then readding providers in a short time. Topology services may not receive these changes if you perform these actions too quickly. However, if you find that topology is out of sync, restart the topology service. See [Control Cisco Crosswork Network Automation Applications and Services](#).

Figure 1: Providers window



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Item	Description
1	The icon shown next to the provider in this column indicates the provider's Reachability . For more information, see Reachability and Operational State .
2	Click to add a provider. See Add Cisco SR-PCE Providers, on page 3 .
	Click to edit the settings for the selected provider. See Edit Providers, on page 18 .
	Click to delete the selected provider. See Delete Providers, on page 19 .
	Click to import new providers or update existing providers from a CSV file. You can also download a CSV file template by clicking this icon. The template includes sample data that you can use as a guide for building your own CSV file. See Import Providers, on page 15 .
	Click to export a provider to a CSV file. See Export Providers, on page 19 .
3	Click next to the provider in the Provider Name column to open the Properties for pop-up window, showing the details of any startup session key/value pairs for the provider.
4	Click next to the provider in the Connectivity Type column to open the Connectivity Details pop-up window, showing the protocol, IP, and other connection information for the provider.
5	Click to refresh the Providers window.
	Click to choose the columns to make visible in the Providers window (see Set, Sort and Filter Table Data).
6	Click to set filter criteria on one or more columns in the Providers window.
	Click the Clear Filter link to clear any filter criteria you may have set.

Add Cisco SR-PCE Providers

Cisco Segment Routing Path Computation Elements (Cisco SR-PCE) providers supply device discovery, management, configuration-maintenance and route-calculation services to Cisco Crosswork Optimization Engine. At least one SR-PCE provider is required in order to learn and discover SR policies, Layer 3 links, and devices. You have the option to configure a second SR-PCE as a backup. Both SR-PCE devices must be connected to the same network as Cisco Crosswork Optimization Engine does not support managing more than one domain.



Note To enable Cisco Crosswork Optimization Engine access to an SR-PCE as an SDN controller on the management domain, SR-PCE needs to be added as a provider.


Follow the steps below to add (through the UI) up to two instances of Cisco SR-PCE as providers for Cisco Crosswork Optimization Engine.

Before you begin

You will need to:

- Create a credential profile for the Cisco SR-PCE provider (see [Create Credential Profiles](#)). This should be a basic HTTP text-authentication credential (currently, MD5 authentication is not supported). If the Cisco SR-PCE server you are adding does not require authentication, you must still supply a credential profile for the provider, but it can be any profile that does not use the HTTP protocol.
- Know the name you want to assign to the Cisco SR-PCE provider. This is usually the DNS hostname of the Cisco SR-PCE server.
- Know the Cisco SR-PCE server IP address.
- Know the interface you want to use to communicate between Cisco Crosswork Optimization Engine server and Cisco SR-PCE.
- Determine whether you want to auto-onboard the devices that Cisco SR-PCE discovers and, if so, whether you want the new devices to have their management status set to **off**, **managed** or **unmanaged** when added. For more information, see [Auto-Onboard Property Descriptions, on page 5](#).
- If you plan to auto-onboard devices that the Cisco SR-PCE provider discovers, and set them to a managed state when they are added to the database:
 - Assign an existing credential profile for communication with the new managed devices.
 - The credential profile must be configured with an SNMP protocol.
- For high availability, ensure that you set up two separate Cisco SR-PCE providers with unique names and IP addresses, but with matching configurations (see [Multiple Cisco SR-PCE HA Pairs, on page 6](#)).

Step 1 From the main menu, choose **Admin > Providers**.

Step 2 Click .

Step 3 Enter the following values for the Cisco SR-PCE provider fields:

a) Required fields:

- **Provider Name:** Name of the SR-PCE provider that will be used in Cisco Crosswork Optimization Engine.
- **Credential Profile:** Select the previously created Cisco SR-PCE credential profile.
- **Family:** Select **SR_PCE**. All other options should be ignored.
- **Protocol:** Select **HTTP** and enter **8080**.
- **IP Address/ Subnet Mask:** Enter the IP address (IPv4 or IPv6) and subnet mask of the server.
- **Port:** Enter **8080** for the port number.
- **Provider Properties:** Enter one of the following key/value pairs in the first set of fields (see [About Adding Devices](#) and [Auto-Onboard Property Descriptions, on page 5](#)):

Property Key	Value
auto-onboard	off Note Use this option if you plan to manually (via UI or CSV import) enter all of your network devices.
auto-onboard	unmanaged
auto-onboard	managed Note This option is only supported on IPv4 deployments. If you enable this option for an IPv6 deployment, devices will still register as unmanaged in the inventory.
device-profile	The name of a credential profile that contains SNMP credentials for all the new devices. Note This field is necessary only if auto-onboard is set to managed or unmanaged .
outgoing-interface	eth1 Note You have to set this only if you want to enable Cisco Crosswork Optimization Engine access to SR-PCE via the data network interface when using the two NIC configuration.

b) Optional values:

- **Timeout:** The amount of time (in seconds) to wait before timing out the connection to the SR-PCE server. The default is 30 seconds.

Step 4 When you have completed entries in all of the required fields, click **Save** to add the SR-PCE provider.

- Step 5** Confirm that the SR-PCE provider shows a green Reachability status without any errors. You can also view the Events window to see if the provider has been configured correctly.
- Step 6** Repeat this process for each SR-PCE provider.



Note It is not recommended to modify auto-onboard options (**managed/unmanaged/off**) once set. If you need to modify them, do the following:

1. Delete the provider and wait until deletion confirmation is displayed in the Events page.
2. Re-add the provider with the updated auto-onboard option.
3. Confirm the provider has been added with the correct auto-onboard option in the Events page.

What to do next

- If you entered the **auto-onboard/off** pair, navigate to **Device Management > Devices** to add a devices (see [Import Devices](#)).
- If you opted to automatically onboard devices, navigate to **Device Management > Devices** to view the device list. To add more node information such as geographical location details, export the device list (.csv), update it, and import it back. If geographical location data is missing, you will only be able to see device topology using the logical map.

Auto-Onboard Property Descriptions

The following table describes auto-onboard property provider fields.

Field	Description
off	If this option is enabled, you add or import devices manually (typically using a .csv file). When devices are discovered, the device data is recorded in the Cisco SR-PCE database, but is not registered in Crosswork Optimization Engine Inventory Management database.
unmanaged	If this option is enabled, all devices that Cisco SR-PCE discovers will be registered in the Cisco Crosswork Optimization Engine Inventory Management database, with their configured state set to unmanaged . SNMP polling will be disabled for these devices, and no management IP information will be included. To get these devices into the managed state later, you will need to either edit them via the UI or export them to a CSV make modifications and then import the updated CSV.
managed	This option is only available for IPv4 deployments. If this option is enabled, all devices that Cisco SR-PCE discovers will be registered in the Cisco Crosswork Optimization Engine Inventory Management database, with their configured state set to managed . SNMP polling will be enabled for these devices, and Cisco SR-PCE will also report the management IP address (Router ID). The devices will be added with the credential profile associated with the device-profile key in the SR-PCE provider configuration (see Add Cisco SR-PCE Providers, on page 3). Note If you enable this option for an IPv6 deployment, devices will still register as unmanaged in the inventory.



Note If **managed** or **unmanaged** options are set and you want to delete a device later, you must do one of the following:

- Reconfigure and remove the devices from the network before deleting the device from Cisco Crosswork Optimization Engine. This avoids Cisco Crosswork Optimization Engine from rediscovering and adding the device back to Cisco Crosswork Optimization Engine.
- Set auto-onboard to **off**, and then delete the device from Cisco Crosswork Optimization Engine. However, doing so will not allow Cisco Crosswork Optimization Engine to detect or auto-onboard any new devices in the network.

Cisco SR-PCE Reachability Issues

You can find reachability issues raised in the Events table and reachability status in the **Providers** window (see [Get Provider Details, on page 17](#)). If the SR-PCE goes down, all links in the topology will display with the last known state since the SR-PCE cannot send any notification updates. When the SR-PCE becomes reachable again, a message will show in the **Events** table (🔔) that SR-PCE is reconnected and the topology will be updated accordingly. If you find that the SR-PCE goes down for an extended amount of time, it is not syncing, updates are not happening, then delete the SR-PCE and add it back (when connectivity returns) using the UI:

1. Execute the following command:

```
# process restart pce_server
```

2. From the UI, navigate to **Admin > Providers** and delete the SR-PCE provider and then add it back again.

You can also troubleshoot reachability as follows:

-
- Step 1** Check device credentials.
- Step 2** Ping the provider host.
- Step 3** Attempt a connection using the protocols specified in the connectivity settings for the provider. For an SR-PCE provider, it is typically HTTP and port 8080.
- ```
curl --raw -vN "http://<hostname or ip-address>:8080/topology/subscribe/txt"
curl --raw -vN "http://<username>:<password>@"
```
- Step 4** Check your firewall setting and network configuration.
- Step 5** Check the Cisco SR-PCE host or intervening devices for Access Control List settings that might limit who can connect.
- 

## Multiple Cisco SR-PCE HA Pairs

You can set up to three Cisco SR-PCE HA pairs (total of six SR-PCEs) to ensure high availability (HA). Each HA pair of Cisco SR-PCE providers must have matching configurations, supporting the same network topology. In HA, if the primary SR-PCE becomes unreachable, Cisco Crosswork Optimization Engine uses the secondary SR-PCE to discover the network topology. If this pair fails, then the next HA pair takes over and so forth.

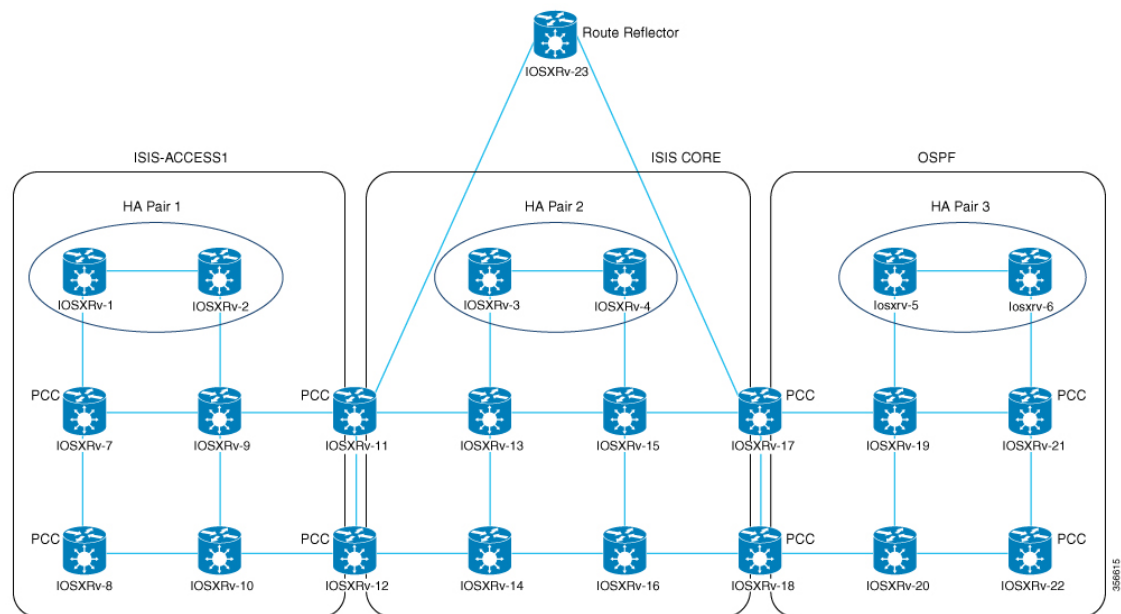
The network topology will continue to be updated correctly and you can view SR-PCE connectivity events in the Events table ( ).

### Multiple HA Pairs

In the case of multiple SR-PCE HA pairs, each SR-PCE pair sees the same topology but manages and only knows about tunnels created from its Path Computation Clients (PCCs). In the figure below, note the following:

- HA Pair 1—PCE iosxrv-1 and iosxrv-2 provisions and discovers *only* tunnels whose headends are iosxrv-7 and iosxrv-8. Note that iosxrv-9 and iosxrv-10 are not PCC routers.
- HA Pair 2—PCE iosxrv-3 and iosxrv-4 provisions and discovers *only* tunnels whose headends are iosxrv-11, iosxrv-12, iosxrv-17, and iosxrv-18. Note that iosxrv-13, iosxrv-14, iosxrv-15, and iosxrv-16 are not PCC routers.
- HA Pair 3—PCE iosxrv-5 and iosxrv-6 provisions and discovers *only* about tunnels whose headends are iosxrv-21, and iosxrv-22. Note that iosxrv-19, and iosxrv-20 are not PCC routers.

**Figure 2: Sample 3 HA Pair Topology**



### Configure HA

The following configurations must be done to enable each pair of HA Cisco SR-PCE providers to be added in Cisco Crosswork Optimization Engine.



**Note** There must be resilient IPv4 connectivity between both SR-PCEs to enable HA. The PCE IP address of the other SR-PCE should be reachable by the peer at all times.

Issue the following commands on *each* of the Cisco SR-PCE devices:

Enable the interface:

```
interface <interface><slot>/<port>
ipv4 address <sync-link-interface-ip-address> <subnet-mask>
no shut
```

Enable HA:

```
pce rest sibling ipv4 <other-node-pce-address>
```

Establish a sync link between the two SR-PCEs:

```
router static
address-family ipv4 unicast
<other-node-pce-ip-address>/<subnet-mask-length> <remote-sync-link-ip-address>
```

(Optional) # pce segment-routing traffic-eng peer ipv4 <other-node-pce-ip-address>

It should be entered for each PCC and not for other PCE nodes.

Issue the following command on the PCC:

For SR Policies: # segment-routing traffic-eng pcc redundancy pcc-centric

For RSVP-TE Tunnels: # mpls traffic-eng pce stateful-client redundancy pcc-centric

### Confirm Sibling SR-PCE Configuration

From the SR-PCE, enter the `show tcp brief` command to verify synchronization between SR-PCEs in HA are intact:

```
#show tcp brief | include <remote-SR-PCE-router-id>
```

Confirm that following information is correct:

| Local Address                          | Foreign Address                         | State |
|----------------------------------------|-----------------------------------------|-------|
| <local-SR-PCE-router-id>:8080          | <remote-SR-PCE-router-id>:<any-port-id> | ESTAB |
| <local-SR-PCE-router-id>:<any-port-id> | <remote-SR-PCE-router-id>:8080          | ESTAB |

For example:

```
RP/0/0/CPU0:iosxrv-1#sh tcp brief | i 192.168.0.2:
Mon Jun 22 18:43:09.044 UTC
0x153af340 0x60000000 0 0 192.168.0.1:47230 192.168.0.2:8080 ESTAB
0x153aaa6c 0x60000000 0 0 192.168.0.1:8080 192.168.0.2:16765 ESTAB
```

In this example, 192.168.0.2 is the remote SR-PCE IP.

### SR-PCE Delegation

Depending on where an SR policy is created, the following SR-PCE delegation occurs:

- SR-PCE initiated—Policies configured on a PCE. SR policies are delegated back to the source SR-PCE.



#### Note

- The policy can be PCE initiated even if it is created using the UI, but in that case it is not configured explicitly on SR-PCE.
- RSVP-TE tunnels cannot be configured directly on a PCE.



- PCC initiated—An SR policy or RSVP-TE tunnel that is configured directly on a device. The SR-PCE configured with the lowest precedence is the delegated SR-PCE. If precedence is not set, then SR-PCE with the lowest PCE IP address is the delegated SR-PCE. The following configuration example, shows that **10.0.0.1** is assigned a precedence value of 10 and will be the delegated SR-PCE.

```
segment-routing
 traffic-eng
 pcc
 source-address ipv4 10.0.0.2
 pce address ipv4 10.0.0.1
 precedence 10
 !
 pce address ipv4 10.0.0.8
 precedence 20
 !
 report-all
 redundancy pcc-centric
```

For RSVP-TE Tunnel:

```
mpls traffic-eng
 interface GigabitEthernet0/0/0/0
 !
 interface GigabitEthernet0/0/0/1
 !
 interface GigabitEthernet0/0/0/2
 !
 pce
 peer source ipv4 192.168.0.02
 peer ipv4 192.168.0.9
 precedence 10
 !
 peer ipv4 192.168.0.10
 precedence 20
 !
 stateful-client
 instantiation
 report
 redundancy pcc-centric
 autoroute-announce
 !
 !
 auto-tunnel pcc
 tunnel-id min 1000 max 5000
```

- Cisco Crosswork Optimization Engine SR-PCE initiated—An SR policy that is configured using Cisco Crosswork Optimization Engine. SR-PCE delegation is random per policy.




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**Note** Only SR policies or RSVP-TE tunnels created by Cisco Crosswork Optimization Engine can be modified or deleted by Cisco Crosswork Optimization Engine.

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### HA Notes and Limitations

- It is assumed that all PCCs are PCEP connected to both SR-PCEs.
- When an SR-PCE is disconnected only from Cisco Crosswork Optimization Engine, the following occur:
  - SR-PCE delegation assignments remain, but the SR-PCE that has been disconnected will not appear in Cisco Crosswork Optimization Engine.

- You are not able to modify Cisco Crosswork Optimization Engine SR-PCE initiated SR policies if the disconnected SR-PCE is the delegated PCE.
- After an SR-PCE reloads, do the following:
  1. Execute the following command:
 

```
process restart pce_server
```
  2. From the UI, navigate to **Admin** > **Providers**, remove and then add the provider again.
- In some cases, when an SR policy that was created via the UI is automatically deleted (intentional and expected) from Cisco Crosswork Optimization Engine, a warning message does not appear. For example, if the source PCC is reloaded, the UI created SR policy disappears and the user is not informed.
- In an extreme case where one SR-PCE fails on all links (to PCCs/topology devices) except the up-link to Cisco Crosswork Optimization Engine, then topology information will not be accurate in Cisco Crosswork Optimization Engine. When this happens, fix the connectivity issue or delete both SR-PCEs from the Provider page and re-add the one that is reachable.

## SR-PCE Configuration Examples

The following configurations are *examples* to guide you in a multiple SR-PCE setup for HA. Please modify accordingly.

### Sample redundant SR-PCE configuration (on PCE)

```
pce
 address ipv4 192.168.0.7
 rest
 sibling ipv4 192.168.0.6
```

### Sample redundant SR-PCE Configuration (PCC)

```
segment-routing
 traffic-eng
 pcc
 source-address ipv4 192.0.2.1
 pce address ipv4 192.0.2.6
 precedence 200
 !
 pce address ipv4 192.0.2.7
 precedence 100
 !
 report-all
 redundancy pcc-centric
```

### Sample redundant SR-PCE Configuration (on PCC) for RSVP-TE




---

**Note** Loopback0 represents the TE router ID.

---

```
ipv4 unnumbered mpls traffic-eng Loopback0
!
mpls traffic-eng
```

```

pce
peer source ipv4 209.165.255.1
peer ipv4 209.165.0.6
 precedence 200
!
peer ipv4 209.165.0.7
 precedence 100
!
stateful-client
 instantiation
 report
 redundancy pcc-centric
 autoroute-announce
!
!
auto-tunnel pcc
 tunnel-id min 1000 max 1999
!
!

```

### **Sample SR-TM Configuration**

```

telemetry model-driven
 destination-group crosswork
 address-family ipv4 198.18.1.219 port 9010
 encoding self-describing-gpb
 protocol tcp
 !
!
sensor-group SRTM
 sensor-path Cisco-IOS-XR-infra-tc-oper:traffic-collector/afs/af/counters/tunnels
 sensor-path
Cisco-IOS-XR-infra-tc-oper:traffic-collector/vrf-table/default-vrf/afs/af/counters/prefixes

!
subscription OE
 sensor-group-id SRTM sample-interval 60000
 destination-id crosswork
 source-interface Loopback0
!
traffic-collector
 interface GigabitEthernet0/0/0/3
 !
 statistics
 history-size 10

```



**Note** The destination address uses the southbound data interface (eth1) address of the Cisco Crosswork Data Gateway VM.

It is required to push sensor path on telemetry configuration via NSO to get prefix and tunnel counters. It is assumed that the Traffic Collector has been configured with all the traffic ingress interface. This configuration is needed for demands in the Bandwidth on Demand and Bandwidth Optimization function packs to work.

### **Telemetry Sensor Path**

```

sensor-path Cisco-IOS-XR-infra-tc-oper:traffic-collector/afs/af/counters/tunnels/tunnel
sensor-path
Cisco-IOS-XR-infra-tc-oper:traffic-collector/vrf-table/default-vrf/afs/af/counters/prefixes/prefix

```

### Telemetry configuration pushed by Cisco Crosswork Optimization Engine to all the headend routers via NSO

```
telemetry model-driven
destination-group CW_43dc8a5ea99529715899b4f5218408a785e40fce
vrf default
address-family ipv4 172.19.68.206 port 31500
encoding self-describing-gpb
protocol tcp
!
!
destination-group CW_4b3c69a200668b0a8dc155caff295645c684a8f8
vrf default
address-family ipv4 172.19.68.206 port 31500
encoding self-describing-gpb
protocol tcp
!
!
sensor-group CW_43dc8a5ea99529715899b4f5218408a785e40fce
sensor-path Cisco-IOS-XR-infra-tc-oper:traffic-collector/afs/af/counters/tunnels/tunnel
!
sensor-group CW_4b3c69a200668b0a8dc155caff295645c684a8f8
sensor-path Cisco-IOS-XR-infra-tc-oper:traffic-collector/vrf-table/default-vrf/afs/af/counters/prefixes/prefix
!
subscription CW_43dc8a5ea99529715899b4f5218408a785e40fce
sensor-group-id CW_43dc8a5ea99529715899b4f5218408a785e40fce sample-interval 300000
destination-id CW_43dc8a5ea99529715899b4f5218408a785e40fce
!
subscription CW_4b3c69a200668b0a8dc155caff295645c684a8f8
sensor-group-id CW_4b3c69a200668b0a8dc155caff295645c684a8f8 sample-interval 300000
destination-id CW_4b3c69a200668b0a8dc155caff295645c684a8f8
!
!
```

### Traffic Collector configurations (all Ingress traffic interface to be added below in the Traffic Collector)

```
RP/0/RSP0/CPU0:PE1-ASR9k#sh running-config traffic-collector
Fri May 22 01:14:35.845 PDT
traffic-collector
interface GigabitEthernet0/0/0/0
!
statistics
history-size 1
collection-interval 1
history-timeout 1
history-minute-timeout
!
!
```

### Add BGP neighbor next-hop-self for all the prefix (to show TM rate counters)

```
bgp router-id 5.5.5.5
address-family ipv4 unicast
network 5.5.5.5/32
redistribute static
!
address-family link-state link-state
!
neighbor 1.1.1.1
remote-as 65000
update-source Loopback0
address-family ipv4 unicast
next-hop-self
!
!
```

### Traffic collector tunnel and prefix counters

```

RP/0/RSP0/CPU0:PE1-ASR9k#show traffic-collector ipv4 counters prefix
Fri May 22 01:13:51.458 PDT
Prefix Label Base rate TM rate State
 (Bytes/sec) (Bytes/sec)

1.1.1.1/32 650001 3 0 Active
2.2.2.2/32 650002 3 0 Active
3.3.3.3/32 650003 6 0 Active
4.4.4.4/32 650004 1 0 Active
6.6.6.6/32 650200 6326338 6326234 Active
7.7.7.7/32 650007 62763285 62764006 Active
8.8.8.8/32 650008 31129168 31130488 Active
9.9.9.9/32 650009 1 0 Active
10.10.10.10/32 650010 1 0 Active
RP/0/RSP0/CPU0:PE1-ASR9k#stt
RP/0/RSP0/CPU0:PE1-ASR9k#show traffic-collector ipv4 counters tunnel
Fri May 22 01:13:52.169 PDT
RP/0/RSP0/CPU0:PE1-ASR9k#]

```

## Path Computation Client (PCC) Support

PCCs can support delegation and reporting of both RSVP-TE tunnels and SR policies to SR-PCE. In order for both to be supported on the same PCC, two separate PCEP connections must be established with the SR-PCEs. Each PCEP connection must have a distinct source IP address (Loopback) on the PCC.

The following is a Cisco IOS-XR configuration example of PCEP connections for RSVP-TE, where 192.168.0.2 is the PCEP session source IP for RSVP-TE tunnels delegated and reported to SR-PCE. It is a loopback address on the router. Two SR-PCEs are configured for PCEP sessions, where the first will be preferred for delegation of RSVP-TE tunnels due to precedence. Auto-tunnel PCC is configured with a range of tunnel IDs that will be used for assignment to PCE-initiated RSVP-TE tunnels like those created in Crosswork Optimization Engine.

```

mpls traffic-eng
interface GigabitEthernet0/0/0/2
admin-weight 1
!
interface GigabitEthernet0/0/0/3
admin-weight 1
 pce
 peer source ipv4 192.168.0.2
 peer ipv4 192.168.0.1
 precedence 10
 !
 peer ipv4 192.168.0.8
 precedence 11
 !
 stateful-client
 instantiation
 report
 !
 !
 auto-tunnel pcc
 tunnel-id min 10 max 1000
!
!
ipv4 unnumbered mpls traffic-eng Loopback0

rsvp
interface GigabitEthernet0/0/0/2
bandwidth 1000000

```

```
!
interface GigabitEthernet0/0/0/3
bandwidth 1000000
!
!
```

## Add Cisco NSO Providers

Cisco Network Services Orchestrator (Cisco NSO) providers supply device management and configuration maintenance services to Cisco Crosswork Optimization Engine.

Follow the steps below to add (through the UI) a Cisco NSO provider for Cisco Crosswork Optimization Engine. You can also add providers using CSV files (see [Import Providers, on page 15](#)).

### Before you begin

You will need to:

- Create a credential profile for the Cisco NSO provider (see [Create Credential Profiles](#)).
- Know the name you want to assign to the Cisco NSO provider.
- Know the Cisco NSO NED device models and driver versions used in your topology.



**Note** You can find the Cisco NSO and NED versions using the `version` and `package-version` commands, as shown in the below examples:

```
nso@nso-virtual-machine:~$ ncs --version
5.2.03

admin@ncs> show packages package package-version
NAME PACKAGE VERSION

cisco-iosxr-cli-7.13 7.13.9
```

- Know the Cisco NSO server IP address and hostname.
- Confirm Cisco NSO device configurations (see [Sample Configuration for Devices in Cisco NSO](#)).

**Step 1** From the main menu, choose **Admin > Providers**.

**Step 2** Click .

**Step 3** Enter the following values for the Cisco NSO provider fields:

a) Required fields:

- **Provider Name:** Enter a name for the provider that will be used in Cisco Crosswork Optimization Engine.
- **Credential Profile:** Select the previously created Cisco NSO credential profile.
- **Family:** Select **NSO**.

- **Device Key:** Select the method that Cisco NSO uses to identify devices uniquely. This will serve as the way Cisco Crosswork Optimization Engine maps the device to Cisco NSO. Choices are: **NONE**, **INVENTORY\_ID**, or **HOST\_NAME**.
- Under Connection Type(s), **Protocol:** Select the protocol that Cisco Crosswork Optimization Engine will use to connect to the provider. **NETCONF** is usually preferred.
- **IP Address/Subnet Mask:** Enter the IP address (IPv4 or IPv6) and subnet mask of the Cisco NSO server.
- **Port:** Enter the port to use to connect to the Cisco NSO server. The default is **2022**.
- **Model:** Select the model (**Cisco-IOS-XR**, **Cisco-NX-OS**, or **Cisco-IOS-XE**) from the drop-down list and enter its associated NED driver version. Add a model for each type of device that will be used in the topology. If you have more than one, select **+** to add another supported model.
- **Version:** Enter the NED software version installed for the device model in NSO.

For more information on fields, see [Import Providers, on page 15](#).

b) Optional values:

- **Timeout:** The amount of time (in seconds) to wait before timing out the connection to the Cisco NSO server. The default is 30 seconds.


**Step 4** When you have completed entries in all of the required fields, click **Save** to add Cisco NSO as a provider.

## Import Providers

Complete the steps below to create a CSV file that specifies providers and then import it into Cisco Crosswork Optimization Engine.

Importing providers from a CSV file adds any providers not already in the database, and updates any providers with the same name as an imported provider. For this reason, it is a good idea to export a backup copy of all your current providers before an import (see [Export Providers, on page 19](#)).

**Step 1** From the main menu, choose **Admin > Providers**.

**Step 2** Click  to open the **Import CSV File** dialog box.

**Step 3** If you have not already created a provider CSV file to import:

- Click the **Download sample 'Provider template (\*.csv)' file** link and save the CSV file template to a local storage resource.
- Open the template using your preferred tool. Begin adding rows to the file, one row for each provider.

Use a semicolon to separate multiple entries in the same field. Use two semicolons with no space between them to indicate that you are leaving the field blank. When you separate entries with semicolons, the order in which you enter values is important. For example, if you enter **SSH ; SNMP ; NETCONF ; TELNET** in the **connectivity\_type** field and you enter **22 ; 161 ; 830 ; 23** in the **connectivity\_port** field, the order of entry determines the mapping between the two fields:

- SSH: port 22

- SNMP: port 161
- NETCONF: port 830
- Telnet: port 23

| Field                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Required or Optional                                                                                      |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Provider Name</b>           | Enter the name for the provider that will be used in Crosswork Optimization Engine. For example: <b>MySRPCE</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Required                                                                                                  |
| <b>Connectivity Type</b>       | Enter the name of the protocol that Crosswork Optimization Engine will use to connect to the provider. For example:<br><b>ROBOT_MSVC_TRANS_HTTP</b> = HTTP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Required                                                                                                  |
| <b>Connectivity IP</b>         | Enter the IP address (IPv4 or IPv6) of the provider.<br><br><b>Note</b> When using an IPv6 address, please note the following: <ul style="list-style-type: none"> <li>• In the Properties column, do not set the auto-onboard property to <b>auto-onboard:managed</b>.</li> <li>• The auto-onboard property is automatically set to <b>unmanaged</b>.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                | Required                                                                                                  |
| <b>Connectivity Port</b>       | Enter the port number to use to connect to the provider's server.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Required                                                                                                  |
| <b>Connectivity Timeout</b>    | Enter the amount of time (in seconds) to wait before the connection to the provider times out. The default is 30 seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Optional                                                                                                  |
| <b>Credential Profile Name</b> | Enter the name of the credential profile that Crosswork Optimization Engine will use to connect to the provider. This profile must already exist in the system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Required                                                                                                  |
| <b>Provider Device Key</b>     | Enter the enum value corresponding to the key that the Cisco NSO provider uses to identify devices uniquely. This will serve as the way Crosswork Optimization Engine maps the device to the Cisco NSO provider. Valid values are: <ul style="list-style-type: none"> <li>• <b>ROBOT_PROVDEVKEY_HOST_NAME</b>—If you are using the device hostname as the device ID within NSO, this value must match the hostname that is specified for the device in the inventory.</li> <li>• <b>ROBOT_PROVDEVKEY_NODE_IP</b>—Use this enum value if the NSO device identifier is the IP address for the Node IP value in the CSV file.</li> <li>• <b>ROBOT_PROVDEVKEY_INVENTORY_ID</b>—Use this enum value if the inventory ID is the device identifier for NSO.</li> </ul> | This entry is only required if you are creating or updating a Cisco NSO provider. Otherwise, leave blank. |
| <b>Family</b>                  | Enter <b>ROBOT_PROVIDER_SR_PCE</b> or <b>ROBOT_PROVIDER_SR_NSO</b> . Do not choose other options as they are reserved for use by other Cisco Network Automation applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Required                                                                                                  |



| Field                | Description                                                                                                                                                                                                                                                                                                                                                                                                              | Required or Optional                                                                                         |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Model Prefix</b>  | If you are adding a Cisco NSO provider: Select the model prefix that matches the NED CLI used by the NSO server. Valid entries are: <b>Cisco-IOS-XR</b> , <b>Cisco-NX-OS</b> , <b>Cisco-IOS-XE</b> .<br><br>For telemetry, only Cisco-IOS-XR is supported.                                                                                                                                                               | Required for Cisco NSO providers only                                                                        |
| <b>Model Version</b> | If you adding a Cisco NSO provider: Enter the Cisco NSO NED driver version used on the server.                                                                                                                                                                                                                                                                                                                           | Required for Cisco NSO providers only                                                                        |
| <b>Properties</b>    | Enter the Cisco SR-PCE appropriate auto-onboard entries:<br><br><code>auto-onboard:&lt;auto-onboard-property&gt;;</code><br><code>device-profile:&lt;SRPCECredentialProfileName&gt;</code><br><br>. For example:<br><b>auto-onboard:managed;device-profile:cisco</b><br><br>When using IPv6 connectivity, do not set<br><b>auto-onboard:managed</b> .<br><br>See <a href="#">Add Cisco SR-PCE Providers, on page 3</a> . | This entry is only required if you are creating or updating a Cisco SR-PCE provider. Otherwise, leave blank. |

Be sure to delete the sample data rows before saving the file, or they will be imported along with the data you want. The column header row can stay, as it is ignored during import.

c) When you are finished, save the new CSV file.

**Step 4** Click **Browse** to navigate to the CSV file you just created and then click **Open** to select it.

**Step 5** With the CSV file selected, click **Import**.

The provider information you imported should now be displayed in the **Providers** window.

**Step 6** Resolve any errors reported during the import and check provider details to confirm connection.

## Get Provider Details

Use the **Providers** window to get details about your providers and to check on their reachability.

**Step 1** From the main menu, choose **Admin > Providers**.

For each provider configured in Cisco Crosswork Optimization Engine, the **Providers** window lists information such as the provider's name, universally unique identifier (UUID), associated credential profile, device key, and more, as shown in the figure below.

Figure 3: Providers Window

| Rea...                   | Provide... | UUID                       | Credenti... | Connecti... | Provider D... | Family         | Model Prefix | Model Version |
|--------------------------|------------|----------------------------|-------------|-------------|---------------|----------------|--------------|---------------|
| <input type="checkbox"/> | xtc-CE2    | 5841cb3d-92b6-312c-8b7...  | XTC1-CE2    | HTTP        |               | SR_PCE         |              |               |
| <input type="checkbox"/> | xtc-CE4    | 313b3a98-36e8-3ec1-90b...  | XTC1-CE2    | HTTP        |               | SR_PCE         |              |               |
| <input type="checkbox"/> | NSO179     | de20c619-55e8-3f70-84f1... | NSO-Cred    | NETCONF     | NODE_IP       | NSO            | Cisco-IOS-XR | 6.6.2         |
| <input type="checkbox"/> | Syslog     | 6e9a49a1-1054-3758-85c...  | syslog      | SSH         |               | SYSLOG_STOR... |              |               |

**Step 2** The icons in the **Reachability** column indicate whether a provider is reachable via the listed connectivity protocols. For a description of each icon and its meaning, see [Reachability and Operational State](#).

Cisco Crosswork Optimization Engine checks provider reachability immediately after a provider is added or modified. Other than these events, Cisco Crosswork Optimization Engine checks SR-PCE reachability about every 10 seconds.

**Step 3** Get additional details for any provider, as follows:

- In the **Provider Name** column, click the to view provider-specific key/value properties.
- In the **Connectivity Type** column, click the to view detailed connectivity information for the provider, such as provider-specific protocol, IP format, IP address, port, and timeout information.
- When you are finished, click to close the details window.

If you are running into Cisco SR-PCE reachability problems, see [Cisco SR-PCE Reachability Issues, on page 6](#).

## Edit Providers

When editing provider settings, be aware that a provider can be mapped to many devices, even thousands of devices in a large network.



### Note

- Before making any changes to a provider configuration you should be certain that you understand the full impact of the change. If you are unsure about the potential risk of making a change, contact Cisco services for guidance.
- See [Add Cisco SR-PCE Providers, on page 3](#) before modifying an SR-PCE provider. There are additional steps that must be done when editing an SR-PCE provider.

Before editing any provider, it is always good practice to export a CSV backup of the providers you want to change (see [Export Providers, on page 19](#)).

**Step 1** From the main menu, choose **Admin > Providers**.

**Step 2** In the **Providers** window, choose the provider you want to update and click .



- Step 3** Make the necessary changes and then click **Save**.
- Step 4** Resolve any errors and confirm provider reachability.
- 

## Delete Providers

Follow the steps below to delete a provider.

You are alerted when you try to delete a provider that is associated with one or more devices or credential profiles.

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- Step 1** Export a backup CSV file containing the provider you plan to delete (see [Export Providers, on page 19](#)).
- Step 2** (Optional) Check whether any devices are mapped to the provider and change the provider before deletion.
- From the main menu, choose . The **Network Devices** tab is displayed by default.
  - In the **Network Devices** window, enter the obsolete provider name in the **Search** field.
  - Check the check box for the device that is mapped to the obsolete provider, and click .
  - Choose a different provider from the **Provider** drop-down list.
  - Click **Save**.
- Step 3** Delete the provider as follows:
- From the main menu, choose **Admin > Providers**.
  - In the **Providers** window, choose the provider(s) that you want to delete and click .
  - In the confirmation dialog box, click **Delete**.
- 


## Export Providers

You can quickly export provider data to a CSV file. This is a handy way to keep backup copies of your provider information.



**Note** You cannot edit a CSV file and then re-import it to update existing providers.

---

- Step 1** From the main menu, choose **Admin > Providers**.
- Step 2** (Optional) In the **Providers** window, filter the provider list as needed.
- Step 3** Check the check boxes for the providers you want to export. Check the check box at the top of the column to select all the providers for export.
- Step 4** Click . Depending on your browser, you will be prompted to select a path and file name to use when saving the CSV file, or to open it immediately.
-

