



Sample end-to-end configuration

Network sizing requirements

This section details the sizing requirements for a network. For a small lab installation, you need three servers with 256 GB of RAM to run Crosswork, Crosswork Network Controller, Cisco Optical Network Controller, NSO, Crosswork Hierarchical Controller, and EPNM without high availability (HA). For a production setup, calculate the total resources required using information provided in the tables.

For Cisco Crosswork, see [Plan Your Deployment](#).

For Cisco Optical Network Controller, see [Cisco Optical Network Controller 25.1.x Installation Guide](#).

Network profiles

Network profiles are defined according to network size, available services, and application features.

Network entity or feature	Lab (20%)	Production (100%)
Devices	2000	10000
Total number of interfaces	100000	650000
IGP interfaces	20000	100000
VPN Services (Layer2 and Layer3)	40000	200000
Endpoints for each VPN service	2–10	50
Total LSPs (SR policies and RSVP tunnels)	12000	60000
Number of PCEP sessions	2000	10000



Note Each SR-PCE pair can only support 2000 PCEP sessions which means only 2000 headends for lab networks and 10000 headends for production networks. While counting headends, LCM nodes must be included.

Deployment size for each network profile

This table provides recommended deployment sizing requirements based on the defined network profiles for solutions that use Cisco Crosswork Network Controller.

Package	Contents	Crosswork Data Gateway deployment	Recommended number of cluster VMs
Cisco Crosswork Network Controller Essentials	Cisco Crosswork Optimization Engine	On-Premise Standard (default): Collectors only.	When Essentials package is installed without element management functions: • three hybrid nodes When Essentials package is installed with element management functions: • three hybrid nodes and one worker node
	Cisco Crosswork Active Topology	On-Premise Standard (default): Collectors only.	
	Element Management Functions	On-Premise Standard (default): Collectors only.	
Cisco Crosswork Network Controller Advantage	Cisco Crosswork Service Health	On-Premise Extended: Collectors and offload services.	three hybrid nodes and two worker nodes
Add-on Package	Cisco Crosswork Change Automation	On-Premise Extended: Collectors and offload services.	three hybrid nodes and two worker nodes
	Cisco Crosswork Health Insights	On-Premise Extended: Collectors and offload services.	
	Cisco Crosswork Zero Touch Provisioning	On-Premise Standard (default): Collectors only.	



Note For non-production lab installations without HA, you can use one hybrid node.

VM resources

This table provides details about CPU, memory, and disk requirements for each Crosswork VM and other VMs in the deployment.

Crosswork VM	Crosswork Data Gateway	NSO	SR-PCE	Crosswork Hierarchical Controller	EPNM
<ul style="list-style-type: none"> • CPU: 12 vCPU • RAM: 96 GB • DISK: 1 TB (SSD) 	<ul style="list-style-type: none"> • CPU: 20 vCPU • RAM: 112 GB • DISK: 0.5 TB 	<ul style="list-style-type: none"> • Small Network Profile <ul style="list-style-type: none"> • CPU: 8 vCPU • RAM: 64 GB • DISK: 250 GB • Large Network Profile <ul style="list-style-type: none"> • CPU: 24 vCPU • RAM: 132 GB • DISK: 1 TB 	<ul style="list-style-type: none"> • CPU: 8 vCPU • RAM: 24 GB • DISK: 45 GB 	<ul style="list-style-type: none"> • CPU: 10 cores • RAM: 96 GB • DISK: 400 GB SSD for lab use, 3 TB SSD for production use 	<ul style="list-style-type: none"> • Professional (Small) <ul style="list-style-type: none"> • CPU: 16 vCPU • RAM: 64 GB • DISK: 2.8 TB • Extended (medium or large) <ul style="list-style-type: none"> • CPU: 24 vCPU • RAM: 128 GB • DISK: 4 TB



Note In Routed Optical Networking 2.1, Cisco Optical Network Controller and Crosswork Network Controller require different Crosswork Infrastructure versions.

The Crosswork Infrastructure Cluster for Cisco Optical Network Controller must have:

- three VMs
- 12 vCPU
- 96 GB RAM
- DISK: 1TB SSD

Cisco Optical Network Controller scale support

Cisco Optical Network Controller supports up to 500 nodes and 600 services. It can run on the same cluster and adds resources incrementally at the maximum supported scale. These requirements are included in the Crosswork VM resources table.

- [Sample configuration, on page 4](#)
- [Planning and design phase, on page 4](#)
- [Implement phase, on page 5](#)
- [Operate phase, on page 74](#)
- [Optimization phase, on page 88](#)

Sample configuration

This section details the step-by-step approach to build a new Routed Optical Networking based, 75 km fiber span to replace an existing legacy span in a two node DCI topology.

- [Planning and design phase, on page 4](#)
- [Implement phase, on page 5](#)
- [Operate phase, on page 74](#)
- [Optimization phase, on page 88](#)

Planning and design phase

The planning and design phase consists of these activities:

1. Network planning and design

Inputs needed: packet layer traffic demands, optical fiber topology, resiliency criteria, and other network constraints.

- a. WAE can be used to determine a new network build or augmentations to an existing network.
- b. After the IP network circuits have been determined, Cisco ONP evaluates the optical layer feasibility and identifies the components required to support the network.

The output for a sample configuration includes these components:

This topology uses two Cisco 8201 routers, two NCS 2006 terminal nodes equipped with NCS1K-MD-64 add/drop multiplexers, and EDFA-35 bidirectional amplifiers. The span length is 75 km. Additional ILA nodes may be required for amplification if the spans are longer.

2. Automation software resource planning

Identify the servers required for the full solution. See [Sample end-to-end configuration, on page 1](#) and [Installation requirements for Routed Optical Networking components, on page 4](#).

- a. For a lab or EFT setup, it is recommended to use three servers each with 384 GB of RAM, 32 cores, and two TB SSDs.
- b. The solution requires the use of VMware ESX 6.7 or higher.

Installation requirements for Routed Optical Networking components

The installation requirements for different Routed Optical Networking components are:

- [Cisco Optical Network Planner 5.2](#)
- [Cisco WAN Automation Engine 7.6.x](#)
- [Cisco Crosswork Cluster, Crosswork Data Gateway, and Crosswork Applications](#)

- [Cisco Optical Network Controller 3.1](#)
- [Cisco Evolved Programmable Network Manager 7.1.2](#)
- [Cisco Network Services Orchestrator 6.1.9](#)
 - [Cisco NSO Routed Optical Networking Core Function Pack 3.0.0](#)
 - [Cisco NSO Transport-SDN Function Pack Bundle 6.0](#)
 - [Cisco Network Services Orchestrator DLM Service Pack 6.0](#)
- [Cisco Crosswork Hierarchical Controller 8.0](#)
- [Cisco Crosswork Network Controller 6.0](#)

Implement phase

The implement phase involves:

1. Installation of hardware components

- a. Hardware staging or installation and initial base configuration required for management connectivity.
- b. All onboard software updates must be completed to the required revision.
- c. All associated base wiring must be completed to support the network. This includes connections between the optical elements and connections between routers and optical add/drop end-points to support Routed Optical Networking circuits using ZR and ZR+ optics. See [Deployment Topologies](#).
- d. Install Cisco Optical Site Manager to support NCS 1010 nodes. See [Install Cisco Optical Site Manager](#)

2. Installation of automation software components

- a. Complete all server hardware installation and base configuration to support the solution, including VMWare ESX if not already installed.
- b. Install the following software components to support the Routed Optical Networking solution.
 - [Cisco Optical Network Planner 5.2](#) (for optical planning)
 - [Cisco WAN Automation Engine 7.6.x](#) (for IP planning)
 - [Cisco Crosswork Cluster, Crosswork Data Gateway, and Crosswork Applications](#) (for supporting Crosswork Network Controller)
 - [Cisco Optical Network Controller 3.1](#) (for supporting optical network)
 - [Cisco Evolved Programmable Network Manager 7.1.4](#) (for managing the physical router and the optical network nodes)
 - [Cisco Network Services Orchestrator 6.1.9](#) (base installation to support RON FP)
 - [Cisco NSO Routed Optical Networking Core Function Pack 3.0](#) (for RON ML provisioning)
 - [Cisco NSO Transport-SDN Function Pack Bundle 6.0](#) (for Crosswork Network Controller SR and xVPN provisioning)

- [Cisco Network Services Orchestrator DLM Service Pack 6.0](#) (for device synchronization between Crosswork Network Controller and NSO)
- [Cisco Crosswork Hierarchical Controller 8.0](#) (for provisioning the Routed Optical Networking ML service using the Crosswork Hierarchical Controller)



Note This is required only if the Routed Optical Networking ML service is provisioned via the Crosswork Hierarchical Controller GUI.

3. Onboarding of devices

- Add devices to Cisco Optical Network Controller. See [Onboard Devices to Cisco Optical Network Controller](#).
- Add NSO, SR-PCE, and devices to Crosswork Network Controller. See [Add SR-PCE providers, NSO providers, and routers to Crosswork Network Controller, on page 7](#).
- Add routers to NSO using the IOS-XR CLI NED. See Step 3 in [Provision an ML service using NSO Routed Optical Networking CFP, on page 31](#).
- Add and configure the following Crosswork Hierarchical Controller adapters. See [Configure adapters for Routed Optical Networking in Crosswork Hierarchical Controller, on page 14](#).



Note This step is required only if the Routed Optical Networking ML service is provisioned via the Crosswork Hierarchical Controller GUI.

- Add and configure the Crosswork Network Controller adapter.
- Create or import sites in Crosswork Hierarchical Controller. See the sections, "Add Sites" and "Export and Import Sites" in the [Cisco Crosswork Hierarchical Controller Administration Guide 8.0](#).
- Add and configure the IOS-XR adapter. Create router devices in Crosswork Hierarchical Controller using the IOS-XR adapter type. After the routers are created, add the Crosswork Network Controller adapter to the router device.
- Add and configure the Cisco Optical Network Controller adapter.

4. Provisioning of services

- Ensure all device interconnections are complete.
- To provision the Routed Optical Networking ML service, use either one of the procedures:
 - Using the NSO GUI:**
 - Utilize the Routed Optical Networking FP ML services to provision and end-to-end service. See [Provision an ML service using NSO Routed Optical Networking CFP, on page 31](#).
 - Verify that the end-to-end service has been deployed by checking the NSO service deployment status using the check-sync status.

- c. Verify the router optics controller state using the CLI or in EPNM. See [Troubleshoot provisioning issues on ZR or ZR+ optics](#).
2. **Using the Crosswork Hierarchical Controller GUI:**
 - a. Utilize the Crosswork Hierarchical Controller GUI to provision and end-to-end Routed Optical Networking ML service. See *Provision a Routed Optical Networking ML service using Crosswork Hierarchical Controller*.
 - b. Verify the router optics controller state using the Link Assurance tool in Crosswork Hierarchical Controller. See Step 4 in *Provision a Routed Optical Networking ML service using Crosswork Hierarchical Controller*.

Add SR-PCE providers, NSO providers, and routers to Crosswork Network Controller

Follow these steps to add SR-PCE providers, NSO providers, and routers to Crosswork Network Controller.



Note When you add or import devices, or create providers, you need to specify the credential profile.

Procedure

- Step 1** [Log in](#) to the Crosswork user interface.
- Step 2** Choose **Device Management** > **Credential Profiles** from the main menu to create a credential profile. See [Manage Credential Profiles](#).
 - a) For the NSO credential profile, the connectivity type must be set to NETCONF and HTTPS. Optionally, HTTP can also be defined if HTTPS is not used in NSO.

Edit Profile nso ×

Profile Name * nso

Add Credential Protocols

Connectivity Type	User Name *	Password *	Confirm Password *	
NETCONF	nso	*****	*****	
HTTPS	nso	*****	*****	

[+ Add Another](#)

[Save](#) [Cancel](#)

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- b) The SR-PCE credential profile requires HTTP credentials to communicate with the SR-PCE Northbound API.

Edit Profile SR-PCE ×

Profile Name * SR-PCE

Add Credential Protocols

Connectivity Type	User Name *	Password *	Confirm Password *	
HTTP	admin	*****	*****	

[+ Add Another](#)

[Save](#) [Cancel](#)

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- c) The router credential profile requires SNMPv2 or SNMPv3 and SSH connectivity types. NETCONF is optional. Use gNMI when you configure streaming telemetry sensors on the node.

Edit Profile routers

Profile Name * routers

Add Credential Protocols

Connectivity Type	Read Community *	Write Community		
SNMPv2	*****	*****		
Connectivity Type	User Name *	Password *	Confirm Password *	
SSH	admin	*****	*****	
Enable Password				
Connectivity Type	User Name *	Password *	Confirm Password *	
NETCONF	admin	*****	*****	
Connectivity Type	User Name *	Password *	Confirm Password *	
GNMI	admin	*****	*****	

+ Add Another

Save Cancel

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Step 3 Add the providers. See [About Adding Providers](#).

- Choose **Administration > Manage Provider Access** from the main menu to add the SR-PCE or NSO provider. See [Manage Providers](#).
- Add the NSO provider. See [Add Cisco NSO Providers](#).

Select the credential profile created for NSO. Select the family as NSO. The Device Key may be set to either HOST_NAME or INVENTORY_ID, depending on the specific deployment.

This image shows the connectivity to the RESTCONF API for NSO over SSL using port 8888 and NETCONF using the default port number 2022. Since the Routed Optical Networking NSO CFP utilizes the XR CLI NED, the Cisco-IOS-XR model is not applicable and may be set to any version.

Edit Provider
✕

Provider Name * nso-58

Credential Profile * nso

Family * NSO

Device Key * HOST_NAME

Connection Type(s)

Protocol *	IP Address / Subnet Mask *	Port *	Timeout	
HTTPS	172.29.11.58 / 25	8888	60	✕
NETCONF	172.29.11.58 / 25	2022	60	✕

[+ Add Another](#)

Provider Properties

Property Key	Property Value	
forward	true	✕

[+ Add Another](#)

Model Prefix Info

Model *	Version *	
Cisco-IOS-XR	7.3.1	✕

Save
Cancel

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- c) Add the SR-PCE provider. See [Add Cisco SR-PCE Providers..](#)

Select the credential profile created for SR-PCE. Select the family type as SR_PCE. The connectivity type for SR-PCE must be HTTP. In this image, the default API port of 8080 is specified. When the Property Key, "auto-onboard" is set to a Property value, "off", Crosswork Network Controller does not automatically add nodes that are discovered via the SR-PCE IGP topology to the device inventory. Devices must be added through the Crosswork Network Controller UI or inventory API.

Edit Provider
✕

Provider Name *

Credential Profile *

Family *

Connection Type(s)

Protocol *	IP Address / Subnet Mask *	Port *	Timeout
HTTP	172.29.11.54 / 25	8080	60

[+ Add Another](#)

Provider Properties

Property Key (?)	Property Value (?)
auto-onboard	off

[+ Add Another](#)

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- Step 4** Validate communications with one or more providers. Check the reachability of the provider using [Get Provider Details](#).
- Step 5** Onboard devices. See [Add Devices Through the UI](#).
- a) The Administration State, Reachability Check, and Credential Profile are mandatory elements. The Host Name must be used if the NSO provider device key is set to the Host Name value. If the NSO provider device key is set to Inventory ID that field must be populated. The Software Type, Software Version, UUID, Serial Number, MAC address, and Product Type are filled by device discovery. Optionally, tags can be applied to the device. The GNMI encoding type can be set to JSON or PROTO.

Add New Device
✕

▼ General

Administration State* <input type="text" value="UP"/>	UUID <input type="text"/>
Reachability Check* <input type="text" value="ENABLE"/>	Serial Number <input type="text"/>
Credential Profile* <input type="text" value="routers"/>	Mac Address <input type="text"/>
Host Name <input type="text" value="ron-8201-1"/>	Capability* <input type="text" value="YANG_MDT, SNMP, GNMI"/>
Inventory ID <input type="text"/>	Tags <input type="text"/>
Software Type <input type="text"/>	Product Type <input type="text"/>
Software Version <input type="text"/>	Syslog Format <input type="text"/>

▼ Connectivity Details

Protocol *	IP Address / Subnet Mask *	Port *	Timeout	Encoding Type	
<input type="text" value="SSH"/>	<input type="text" value="172.29.11.20 / 25"/>	<input type="text" value="22"/>	<input type="text" value="60"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="SNMP"/>	<input type="text" value="172.29.11.20 / 25"/>	<input type="text" value="161"/>	<input type="text" value="60"/>	<input type="text"/>	<input type="text"/>
<input type="text" value="GNMI"/>	<input type="text" value="172.29.11.20 / 25"/>	<input type="text" value="57333"/>	<input type="text" value="60"/>	<input type="text" value="PROTO"/>	<input type="text"/>
<input type="text" value="NETCONF"/>	<input type="text" value="172.29.11.20 / 25"/>	<input type="text" value="830"/>	<input type="text" value="60"/>	<input type="text"/>	<input type="text"/>

[+ Add Another](#)

> Routing Info

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Optionally, you can enter location information. Latitude and longitude information is used to specify the node's geographic location.

Add the previously configured NSO provider as a provider for the device.

Sample end-to-end configuration

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Add New Device
✕

SNMP	172.29.11.20	/ 25	161	60			
GNMI	172.29.11.20	/ 25	57333	60	PROTO		
NETCONF	172.29.11.20	/ 25	830	60			

+ Add Another

> Routing Info

> Streaming Telemetry config

∨ Location

Building

Street

City

State

Country

Region

Zip

Latitude

Longitude

Altitude

∨ Providers and Access

Provider Family	Provider Name	Credential	Device Key
NSO	nso-58	nso	ron-8201-1

+ Add Another

Save
Cancel

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b) Attach the devices to an active Cisco Crosswork Data Gateway pool to manage them (device discovery).

Review the Data Gateways pane (see [Overview of Cisco Crosswork Data Gateway](#)). The operational state of the Cisco Crosswork Data Gateway pool to which you want to attach devices must be **Up**.


See [Attach Devices to Cisco Crosswork Data Gateway](#).

Administration / Data Gateway Management
show more


Data Gateways Pools Virtual Machines

∨ Data Gateway Metrics Summary


Operational State




Administration State



High Availability Status



Devices



Data Gateways Total 1

Name	Operational State	Administration State	High Availability Status	Pool Name	Outage History	Average Availability	VM ID	Attached Device Count	Actions
cdg-pool-1-1	Up	Up	None Planned	cdg-pool-1			cdg-soltest	13	<ul style="list-style-type: none"> Attach Devices Detach Devices Move Devices

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SR-PCE providers, NSO providers, and routers appear in Crosswork Network Controller and are ready for management and monitoring.

Configure adapters for Routed Optical Networking in Crosswork Hierarchical Controller

These adapters are needed for the Routed Optical Networking solution.

Table 1: Routed Optical Networking adapters

Adapter	Credential type
Crosswork Network Controller	HTTP (username and password)
Crosswork Network Controller Crosswork Data Gateway	HTTP (username and password)
Cisco Optical Network Controller	HTTP (username and password)
IOS-XR	SSH (username and password)



Note If Cisco Optical Network Controller and Crosswork Network Controller are on the same Crosswork cluster, use the same credential profile for both.

Before you begin

To use Crosswork Hierarchical Controller adapters, you are required to use credentials. These credentials are used for authentication when a device is assigned to an adapter. You can use the same credentials for multiple adapters.

The credentials are added under the **Services > Device Manager > Credentials** tab in the Crosswork Hierarchical Controller GUI.

Follow these steps to add the adapters:

Procedure

-
- Step 1** Choose **Services > Device Manager > Adapters** in the applications bar in Crosswork Hierarchical Controller.
- Step 2** Click **Add new adapter** to add a new adapter.
- Step 3** Enter the adapter details:
- **Adapter Type:** Select an adapter type from those available and currently installed in Crosswork Hierarchical Controller.
 - **Adapter Name:** Enter a unique name for this adapter type instance. Multiple instances of the same adapter type are allowed.
- Step 4** Select the adapter in the **Adapters** pane to configure the adapter. Configure the parameters as shown in these images.
- **Crosswork Network Controller adapter:**

Note

API version for Crosswork Network Controller must be version 2.

Figure 1: Crosswork Network Controller adapter configuration—General tab

Note

The Full Data Fetch Interval must be set to 300 seconds or higher in a production network.

These parameters must be configured for Crosswork Network Controller notifications and collection.

Figure 2: Crosswork Network Controller notifications

Figure 3: Crosswork Network Controller collection and provisioning

• **IOS-XR adapter**

Figure 4: IOS-XR adapter —General tab

The screenshot shows the 'General' tab configuration for the IOS-XR adapter. At the top, there are tabs for 'Devices', 'Events', and 'General'. Below these, there are several configuration sections:

- Logging:** A checkbox labeled 'Enabled' is checked. The 'Logging Level' is set to 'Info' via a dropdown menu.
- Polling Cycle:** A text input field contains '300'. Below it, the text 'Poll every X seconds' is visible.
- Concurrent Routers:** A text input field contains '8'. The label is 'Number of concurrent routers collected'.
- Timeout:** A text input field contains '300'. The label is 'Timeout for data persisting [sec]'.
- SSH CONFIGURATION PARAMETERS:**
 - 'Enable Tunnel' is unchecked.
 - 'Tunnel Host' is an empty text input field.
 - 'Tunnel Port' is an empty text input field.
 - 'Tunnel Credentials Key' is a dropdown menu.
 - 'Router Connect timeout' is set to '30'.
 - 'Router Command timeout' is set to '90'.
 - 'Router Command retries' is set to '1'.

Note

The Polling Cycle must be 300 seconds or higher in a production network. Concurrency can be increased. Set the Logging Level to Info when everything is working correctly.

These collection parameters must be configured. These parameters collect optical power values for the link assurance application.

Figure 5: IOS-XR adapter —General tab

The screenshot shows the 'COLLECTION PARAMETERS' section. It contains a grid of checkboxes and a text input field:

- Enable Topology Collection
- Enable Interface Stats Collection
- Enable MPLS Tunnels Collection
- IGP IS-IS Priority:
- Enable RSVP Collection
- Enable collection of optics and coherent DSP Statistics
- Enable IGP IS-IS Collection
- Enable VRF Collection
- Enable LSP Stats Collection
- Collect only IGP IS-IS seed routers
- Enable collection of optics and coherent DSP
- Use host_name.domain_name device ID format
- Enable IGP OSPF Collection
- Enable LLDP Collection
- Enable SNMP Collection
- Allow to use loopback IP as management IP
- Enable Segment Routing Collection

At the bottom, there is a note: 'Used under specific circumstances, see documentation'.

Note

Check the **Enable collection of optics and coherent DSP Statistics** parameter only when using Automation Starter Solution.

Figure 6: IOS-XR adapter —General tab

This screenshot is similar to Figure 5, showing the 'COLLECTION PARAMETERS' section. The configuration is as follows:

- Enable Topology Collection
- Enable Interface Stats Collection
- Enable MPLS Tunnels Collection
- IGP IS-IS Priority:
- Enable RSVP Collection
- Enable collection of optics and coherent DSP Statistics
- Enable IGP IS-IS Collection
- Enable VRF Collection
- Enable LSP Stats Collection
- Collect only IGP IS-IS seed routers
- Enable collection of optics and coherent DSP
- Use host_name.domain_name device ID format
- Enable IGP OSPF Collection
- Enable LLDP Collection
- Enable SNMP Collection
- Allow to use loopback IP as management IP
- Enable Segment Routing Collection

At the bottom, there is a note: 'Used under specific circumstances, see documentation'.

The status of the devices must be **ok** in the **Devices** tab after the addition and completion of a successful collection cycle.

Figure 7: IOS-XR adapter - Devices tab

Name	Status	Status Changes (Last 24 hr)	Site	Adapter(s)	Host	Port
16 ITEMS						
172.29.11.26	✓ OK	0	Monterey	cisco-xr, cnc30	172.29.11.26	22
172.29.11.41	✓ OK	0	Tucson	cisco-xr, cnc30	172.29.11.41	22
172.29.11.23	✓ OK	2	Las Vegas	cisco-xr, cnc30	172.29.11.23	22
172.29.11.40	✓ OK	0	Monterey	cisco-xr, cnc30	172.29.11.40	22
172.29.11.29	✓ OK	0	ST. George	cisco-xr, cnc30	172.29.11.29	22
172.27.227.11	✓ OK	0	Cedar City	cisco-xr, cnc30	172.27.227.11	22
172.29.11.120	✓ OK	0	Tucson	cisco-xr, cnc30	172.29.11.120	22
172.29.11.22	✓ OK	0	Morroero Palms	cisco-xr, cnc30	172.29.11.22	22
172.29.11.28	✓ OK	0	Albuquerque	cisco-xr, cnc30	172.29.11.28	22
172.29.11.24	✓ OK	0	San Diego	cisco-xr, cnc30	172.29.11.24	22
172.27.227.10	✓ OK	0	Santa Fe	cisco-xr, cnc30	172.27.227.10	22
172.29.11.30	✓ OK	0	ST. George	cisco-xr, cnc30	172.29.11.30	22
172.29.11.21	✓ OK	0	Las Vegas	cisco-xr, cnc30	172.29.11.21	22
172.29.11.27	✓ OK	2	San Luis Obispo	cisco-xr, cnc30	172.29.11.27	22
172.29.11.20	✓ OK	0	Los Angeles	cisco-xr, cnc30	172.29.11.20	22
172.29.11.25	✓ OK	0	Flagstaff	cisco-xr, cnc30	172.29.11.25	22

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To add routers to Crosswork Hierarchical Controller, click the **Managed Devices** tab and then **+ Add Device**.

Figure 8: IOS-XR adapter —add new device— General tab

172.29.11.40

General Adapters Events

Name: 172.29.11.40

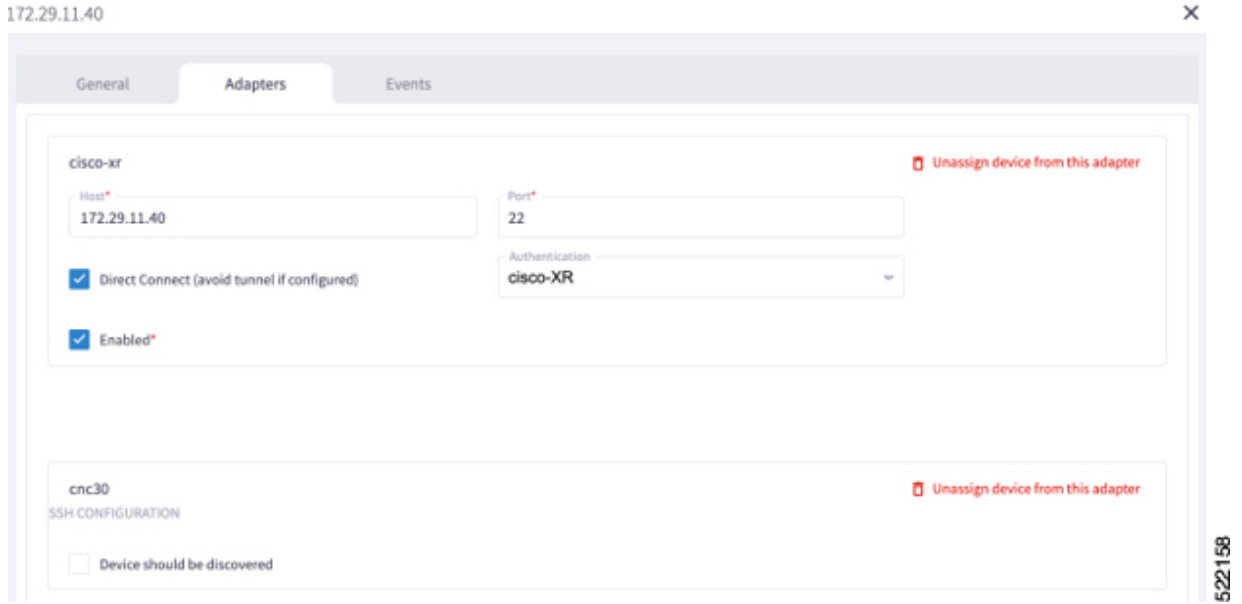
Network Element Site: Monterey

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Use the hostname+hco (ron-8201-1-hco) or the device IP address. Assign the device to a site for display in Explorer UI.

Assign both the IOS-XR adapter type and the Crosswork Network Controller adapter type to the device. Do not enable discovery for the Crosswork Network Controller adapter.

Figure 9: IOS-XR Adapter—add new device— Adapters tab

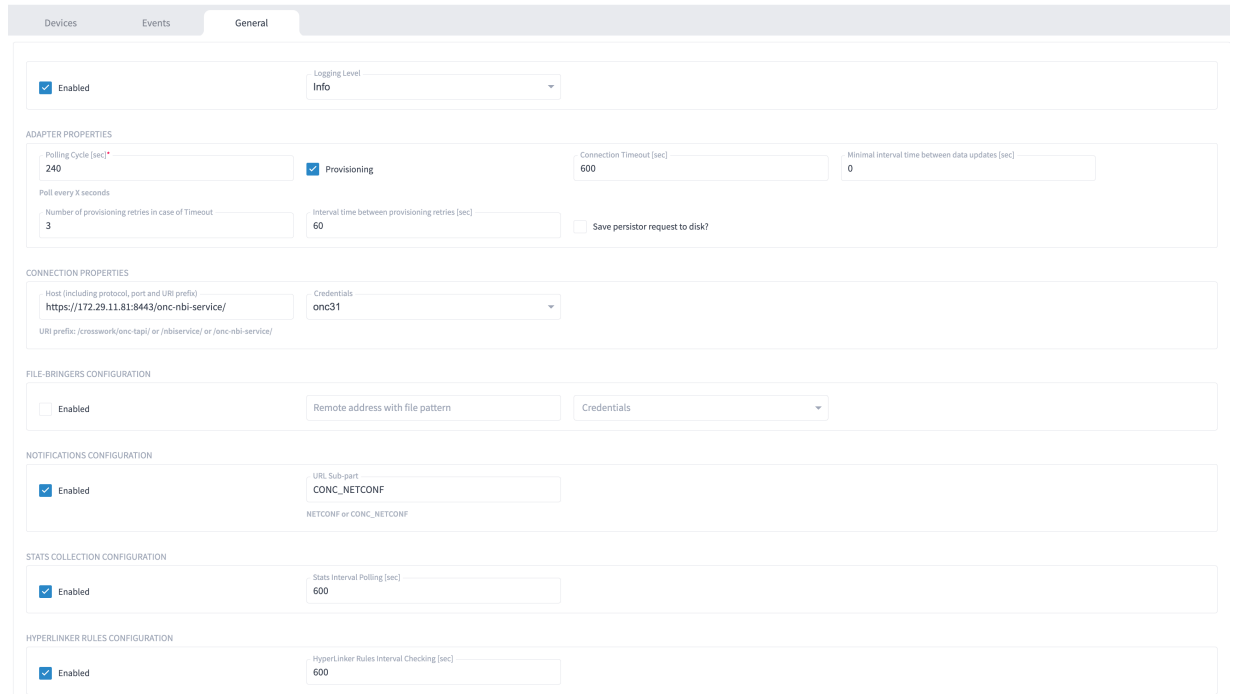


• Cisco Optical Network Controller adapter

Figure 10: Cisco Optical Network Controller adapter — General tab

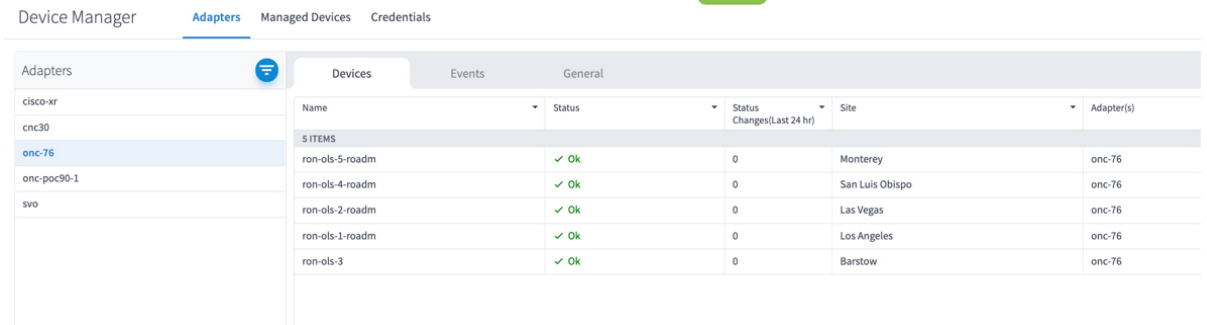
The Polling cycle must be set to 300s or higher in a production network. Polling retrieves TAPI SIPs, topology, and connectivity services.

The URL in this figure is for the Cisco Optical Network Controller 3.1.



Cisco Optical Network Controller automatically discovers optical nodes. Assign a site to the nodes to display them in the Explorer UI.

Figure 11: Cisco Optical Network Controller adapter - Devices tab

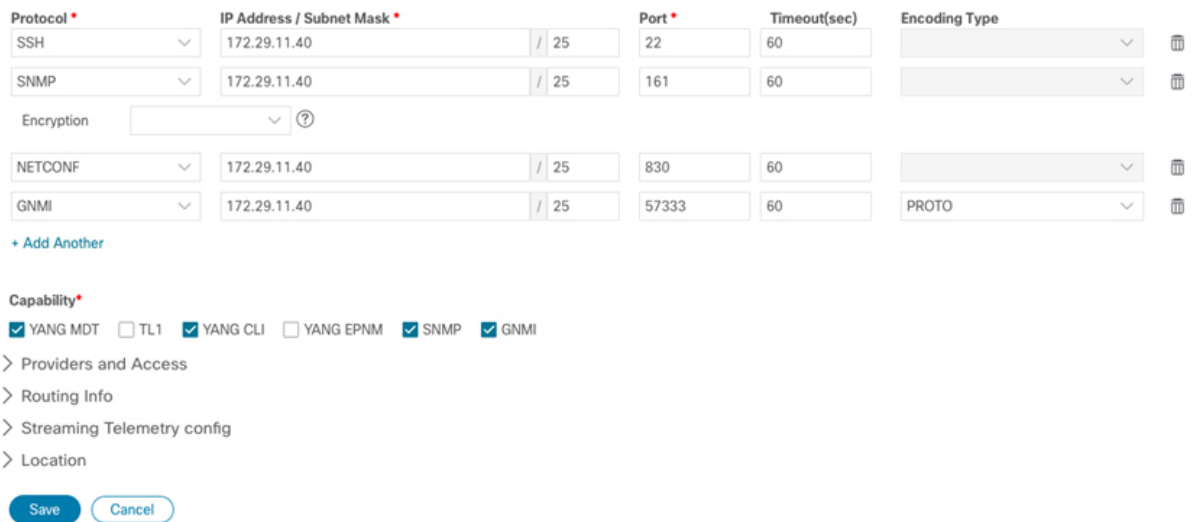


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• **Crosswork Network Controller Crosswork Data Gateway adapter**

Crosswork Network Controller Crosswork Data Gateway adapter is used to collect telemetry data through gNMI (gRPC Network Management Interface) to the router. In Crosswork Network Controller, the routers must be configured with the gNMI protocol with the encoding type set to “PROTO” and the gNMI capability enabled. In IOS XR, the routers must be configured for gRPC so that Crosswork Data Gateway can create gNMI telemetry subscriptions.

Figure 12: Crosswork Network Controller Crosswork Data Gateway adapter



The Crosswork Data Gateway adapter is configured to connect to Crosswork Network Controller controlling Crosswork Data Gateway instance. It can be the same as the Crosswork Network Controller used for the topology or a different Crosswork Network Controller. The collection parameters describe the supported telemetry collection jobs. The statistics show up in the physical interface statistics and in the Link Assurance application.

Figure 13: Crosswork Network Controller Crosswork Data Gateway adapter—General tab

Devices
Events
General

Enabled

Logging Level
Info

Collector Cadence [sec]
Collector sample cadence in seconds

Status Update Interval [sec]
NOTE: You can see missed stats errors if the interval is less than the collector cadence

CNC CONFIGURATION

GRPC LISTENER CONFIGURATION

GRPC Messages Debug Logging

NOTE: Make sure that the address is forwarded (or belonged) to the docker host NOTE: The name should be unique in the crosswork context

COLLECTION PARAMETERS

Enable Interface Counters

Threshold in percentages per device ports with no stats to report error

Enable Optics Counters: 30 Seconds

Enable Optics Counters: 15 Minutes

Enable Optics Counters: 24 Hours

Enable OTU Counters: Instant

Enable OTU Counters: 30 Seconds

Enable OTU Counters: 15 Minutes

Enable OTU Counters: 24 Hours

- The device name in Cisco Crosswork Hierarchical Controller must match the device name in Crosswork Network Controller for successful deployment. If successful, you will see Cisco Crosswork Hierarchical Controller as a new destination in Crosswork Network Controller. This is automatically set up by Cisco Crosswork Hierarchical Controller. As Crosswork Data Gateway is enabled on devices, new collection jobs are populated. A single collection job is available for each router collecting multiple KPIs.

Figure 14: Crosswork Network Controller Crosswork Data Gateway adapter - data destinations

▼ Data Destinations ⓘ

+
✎
🗑

	Destination Name	Server Type	Compression Type	Encoding	UUID
<input type="checkbox"/>	Crosswork_Kafka	📘 Kafka	snappy	gbkv	c2a8fba8-8363-3d22-b0c2-a9e449693fae
<input type="checkbox"/>	cdg-astack-pipeline	📘 gRPC	gzip	gbkv	e9b4c2ec-b2e6-4db0-a942-0402dd347a1d
<input type="checkbox"/>	netfusion_cdg	📘 gRPC	gzip	gbkv	0a088f8b-3fea-4694-a744-54c02fbdda5e

Figure 15: Crosswork Network Controller Crosswork Data Gateway adapter - collection jobs

The screenshot displays the 'Collection Jobs' page in the Crosswork Network Controller. The page shows a list of collection jobs with columns for Status, App ID, Context ID, and Action. The 'netfusion_cdg' adapter is highlighted, showing several successful collection jobs for the context 'ron-poc-8201-1'. The jobs are performed by various data gateway adapters like 'dim/ci-collector/group...', 'cw.optimatraf...', and 'cw.topo_vizualization'. A detailed view of a job is shown on the right, including its status (Successful), hostnames, device IDs, sensor data, and the last reported time.

Status	App ID	Context ID	Action
Successful	netfusion_cdg	ron-poc-8201-2	
Successful	cw.dminvmgr0	dim/ci-collector/group...	
Successful	cw.dminvmgr0	dim/ci-collector/group...	
Successful	cw.optimatraf...	cw.optimatrafcomdt-ctx	
Successful	cw.dminvmgr0	dim/snmp-collector/gro...	
Successful	cw.dminvmgr0	dim/ci-collector/group...	
Successful	cw.topo_svc	cw.toposvc.snmp	
Successful	netfusion_cdg	ron-poc-8201-1	
Successful	cw.optimatraf...	cw.optimatrafcsnmp-ctx	
Successful	cw.topo_vizualization	topo-visualization.colle...	
Degraded	cw.topo_svc	cw.toposvc.snmptraps	

• NSO adapter In Hierarchical Controller

In Hierarchical Controller 8.0 there is an embedded NSO installed when Hierarchical Controller 8.0 is installed. The NSO adapter can use the internal NSO or an external NSO instance. To provision devices using the NSO adapter, add the NSO adapter to the devices.

Use the NSO adapter when you use the [Automation starter solution and full solution](#).

Note

- If using the internal NSO, the Routed Optical Networking 3.0 Core Function Pack must be installed on the NSO instance.
- If using the internal NSO, devices must be added to that NSO, since adding them to Hierarchical Controller does not automatically onboard them into the internal NSO.

Figure 16: NSO adapter—General tab

The screenshot shows the 'NSO' adapter configuration page in the 'Adapters' section. The 'General' tab is active, showing the following configuration options:

- Enabled
- Logging Level: Debug
- Use internal nso
- Connect to an already-existing local nso instance (you may leave Server Configuration parameters empty)
- SERVER CONFIGURATION:
 - Host: []
 - Port: []
 - Timeout [sec]: []
 - Credentials: nso
- PROVISIONING PARAMETERS:
 - IP-Link create timeout: 600

Begin configuring your NSO and IOS-XR adapters.

The selected adapters are configured and ready for device assignment.

Configure SSO in Crosswork Hierarchical Controller

Enable Single Sign-On (SSO) in Crosswork Hierarchical Controller using Crosswork Network Controller as the identity provider.

Use this task when you need to configure SSO in Crosswork Hierarchical Controller with Crosswork Network Controller as Identity Provider. You can use the same SSO configuration to set up SSO for Cisco Optical Network Controller Release 3.1.

Procedure

Step 1 Configure Crosswork Hierarchical Controller.

a. Click **Settings > Security > SAML Configuration**.

Enter the required information:

- **Login URL:** Visit https://<CNC_IP_address>:<port>/crosswork/sso/idp/profile/SAML2/Redirect/SSO
- **Entity ID:** Visit https://<CNC_IP_address>/idp

- **Signing Certificate:** Copy the metadata from Crosswork Network Controller at `https://<CNC_IP_address>:<port>crosswork/sso/idp/metadata`
- **Groups Attribute Name:** Type `authenticationMethod`.

Figure 17: Crosswork Hierarchical Controller provider configuration sample

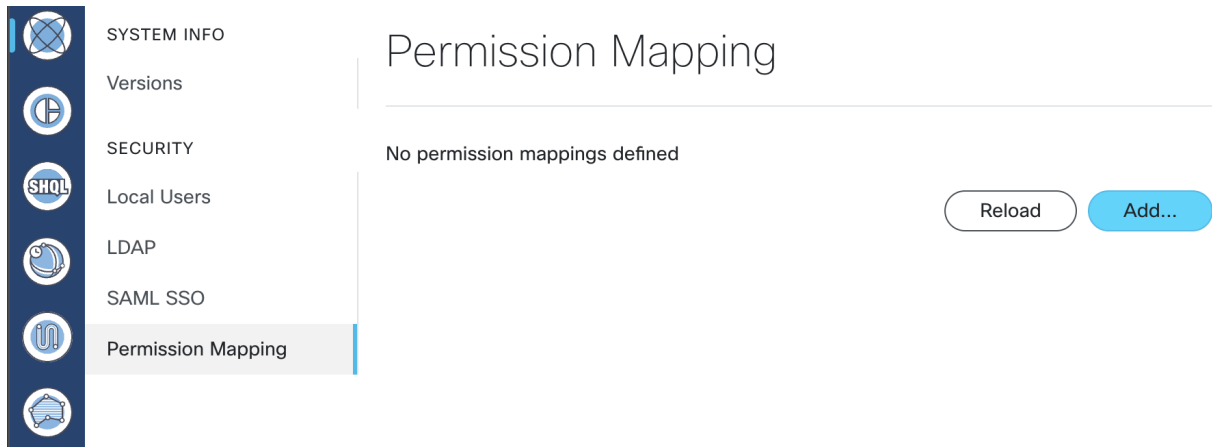
The screenshot displays the configuration page for SAML SSO. The left sidebar contains the following menu items: SYSTEM INFO, Versions, SECURITY, Local Users, LDAP, SAML SSO (highlighted), and Permission Mapping. The main configuration area is titled "SAML SSO" and includes the following settings:

- Enabled:** A toggle switch is turned on.
- Login URL:** `https://172.29.11.75:30603/crosswork/sso/idp/profile/SAML2/Redirect/SSO`
- Entity ID:** `https://172.29.11.75/idp`
- Base URL:** `https://172.29.11.83:8443` with a "Use Current" button.
- Signing Certificate:** A large text area containing a long alphanumeric string representing the certificate.
- Groups Attribute Name:** `authenticationMethod`

At the bottom right of the configuration area, there are three buttons: "Reload" (white), "Save" (blue), and "Use Current" (white).

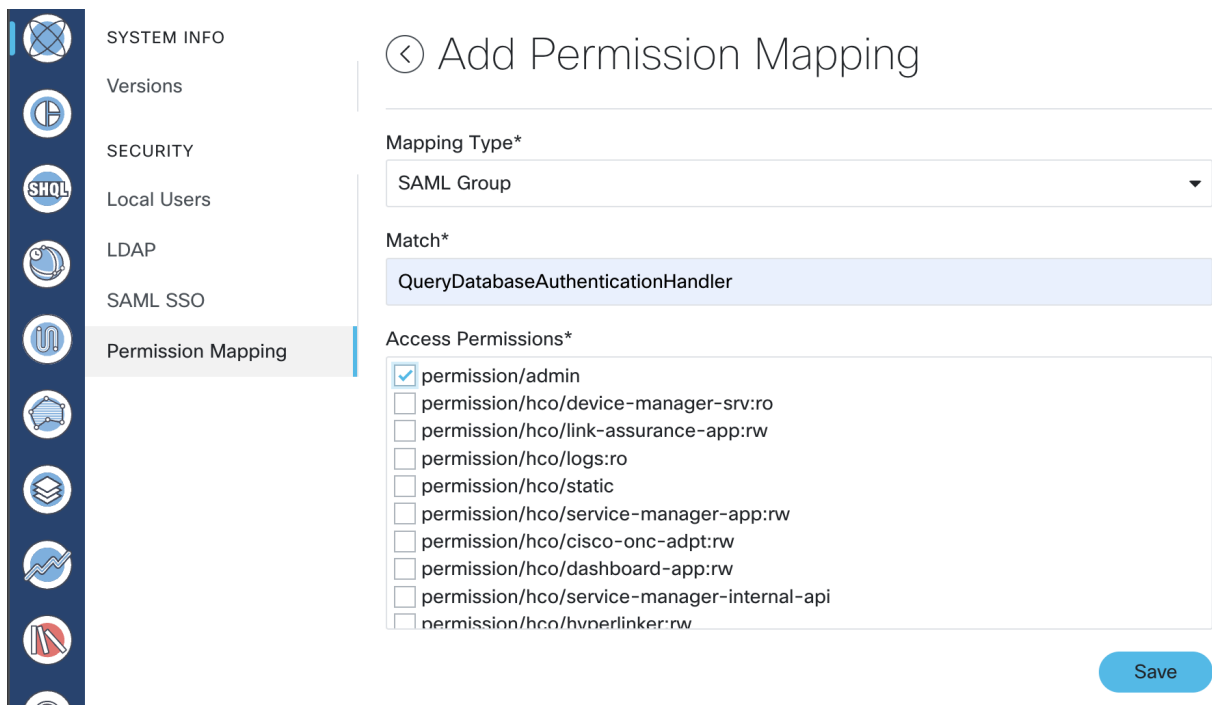
- Click **Settings > Security > Permission Mapping**.

Figure 18: Crosswork Hierarchical Controller permission-mapping sample



- c. Add a **Match** condition for **SAML Group of QueryDatabaseAuthenticationHandler** with a permission of `permission/admin`.

Figure 19: Crosswork Hierarchical Controller permission-mapping sample



Step 2 Copy the SAML metadata from Crosswork Hierarchical Controller to a file.

The metadata is at `https://<HCO_IP_address>:<port>/sso/metadata`. This file is a sample.

```
<EntityDescriptor entityID="https://172.29.11.83:8443" xmlns="urn:oasis:names:tc:SAML:2.0:metadata"
xmlns:assertion="urn:oasis:names:tc:SAML:2.0:assertion" xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
```

```
<SPSSODescriptor AuthnRequestsSigned="false" WantAssertionsSigned="false"
protocolSupportEnumeration="urn:oasis:names:tc:SAML:2.0:protocol">
```

```

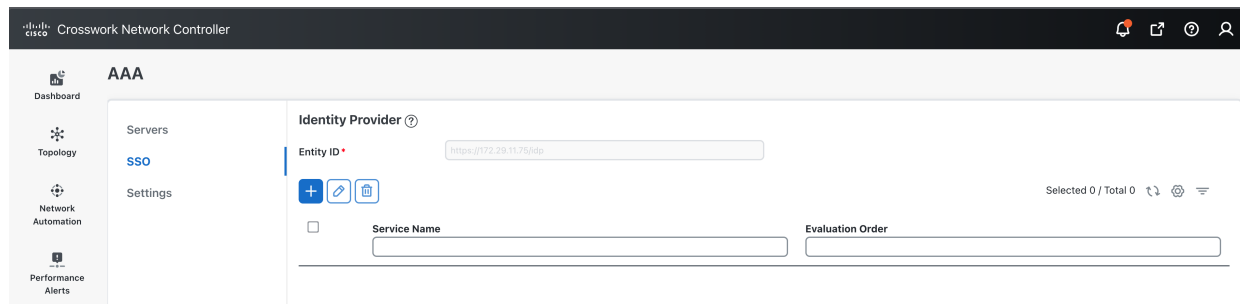
<NameIDFormat>urn:oasis:names:tc:SAML:1.1:nameid-format:emailAddress</NameIDFormat>
<SingleLogoutService Binding="urn:oasis:names:tc:SAML:2.0:bindings:HTTP-Redirect"
Location="https://172.29.11.83:8443/sso/logout">
</SingleLogoutService>
<AssertionConsumerService index="0" Binding="urn:oasis:names:tc:SAML:2.0:bindings:HTTP-POST"
Location="https://172.29.11.83:8443/sso/acs">
</AssertionConsumerService>
</SPSSODescriptor>
</EntityDescriptor>

```

Step 3 Configure Crosswork Network Controller.

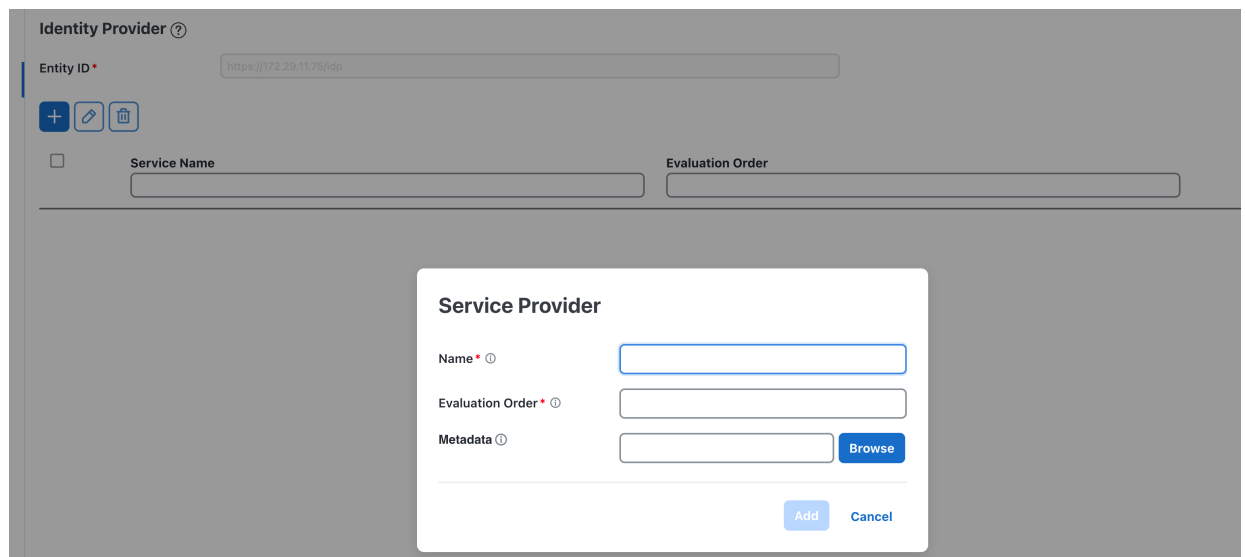
- Log in to Crosswork Network Controller and click **Administration > AAA > SSO**.

Figure 20: Crosswork Network Controller AAA



- Click **+** and enter the required information:
 - Enter a name.
 - Enter a unique evaluation order number.
 - Upload the metadata file of HCO in XML format.

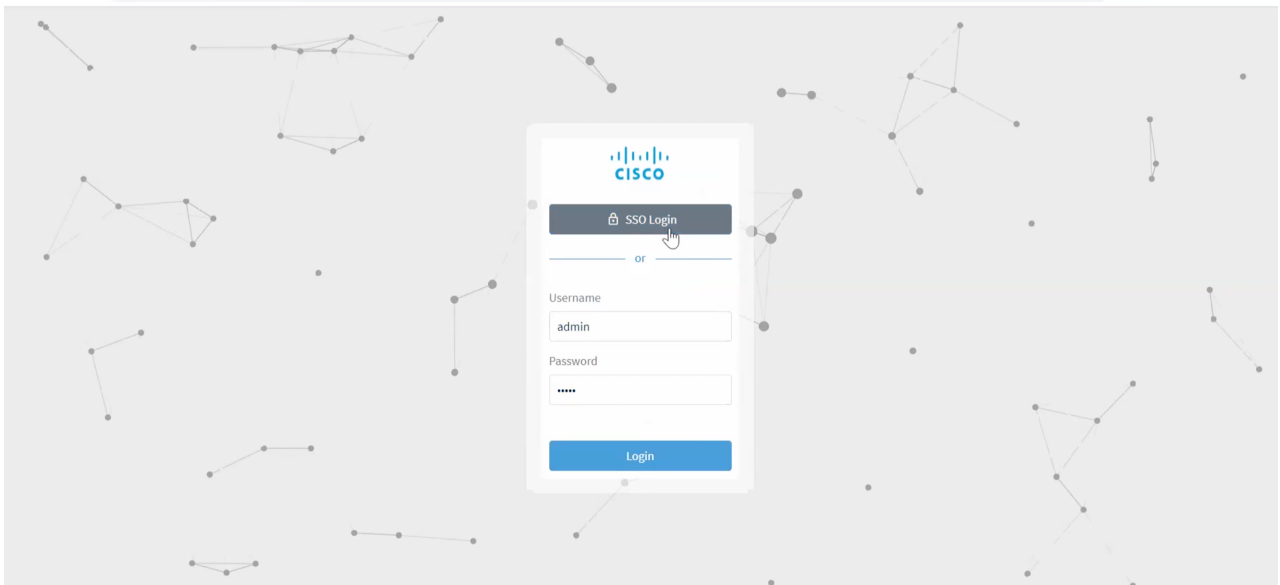
Figure 21: Crosswork Network Controller-add new service provider



- Click **Save**.

Step 4 Log in to Crosswork Network Controller.

Figure 22: Crosswork Network Controller AAA



Troubleshooting Cisco Crosswork Hierarchical Controller SSO

- Use the **sedo logs security audit** in the Crosswork Hierarchical Controller to get the logs.
- Ensure that the time between Cisco Crosswork Hierarchical Controller and Cisco Crosswork Network Controller is synchronized
- If there is an error related to `QueryDatabaseAuthenticationHandler`, add the SAML group mapping in Crosswork Hierarchical Controller configuration and map to group Admin.

Crosswork Hierarchical Controller enables SSO for authorized users.

Cross-launch from Crosswork Hierarchical Controller

SSO is supported across Crosswork Hierarchical Controller 8.0, Crosswork Network Controller 6.0, Cisco Optical Network Controller, and Cisco Optical Site Manager.

Procedure

- Step 1** Cross launch from the IGP link source or destination router in Crosswork Hierarchical Controller to Crosswork Network Controller.
- Click **Links > IGP**.
 - Hover over the source device or the destination device. Click the ellipsis and then click **IGP device at Crosswork Network Controller**.

Figure 23: Network inventory

Network Inventory

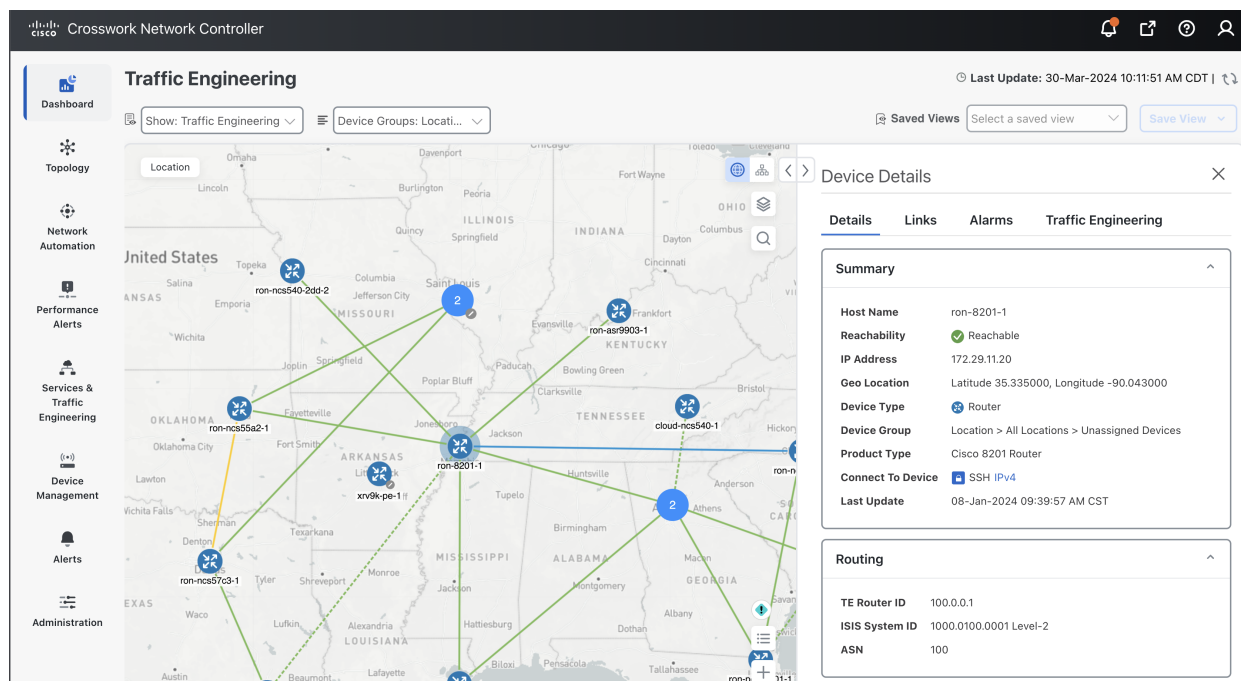
Filter inventory by: Regions/Sites/Devices

Devices	Sites	Links	Connections	Services	Power Supplies					
FIBER	OTS	OMS	ZR MEDIA	ZR CHANNEL	L3 PHYSICAL	L3 AGGREGATE				
22 ITEMS										
ron-8201-1	100.1.1.14	to ron-asr9903-1	100.1.1.15	100.1.1.20/31	ron-8201-1					
ron-8201-1	100.1.1.20	to ron-ncs55a2-1	100.1.1.21	100.1.4.1/31	ron-ncs540-1					
ron-ncs540-1	100.1.4.1	to ron-poc-8201-1	100.1.4.0	100.1.2.2/31	ron-8201-2					
ron-8201-2	100.1.2.2	to ron-8201-4	100.1.2.3	67.67.67.0/31	ron-8201-1					
ron-8201-1	67.67.67.0	to ron-ncs5504-1	67.67.67.1	139.1.1.2/30	ron-ncs57b1-1					
ron-ncs57b1-1	139.1.1.2	to ron-ncs57c3-1	139.1.1.1	100.1.1.16/31	ron-8201-1					
ron-8201-1	100.1.1.16	to ron-ncs540-1	100.1.1.17							

More Information:
[IGP device at CNC](#)

This operation displays router traffic engineering information in Crosswork Network Controller.

Figure 24: Traffic engineering



Step 2 Cross launch from Crosswork Hierarchical Controller SR Policy to Crosswork Network Controller.

- Click **Connections** > **SR Policy**.
- Hover over a policy, and click the ellipsis to open cross launch.

Figure 25: Network inventory

Network Inventory

Filter inventory by: Regions/Sites/Devices

Devices Sites Links **Connections** Services Cards Ports Transceivers Power Supplies Fans Shelves

NMC OCH ETHERNET **SR POLICY** MC

Apply Inventory Filter On Connections [Export Table](#)

Name	Source Device	Destination Device	Operation State	Protecter	IGP Hops Count	Tags	Color	Preference
100.0.0.20 to 100.0.0.3, color 1000	ron-ncs57b1-1	ron-8201-32FH-3	UP	SINGLE...	3		1000	200
100.0.0.50 to 100.0.0.52, color 101		-1	UP	SINGLE...	3		101	100
100.0.0.50 to 100.0.0.52, color 1000		-1	UP	SINGLE...	3		1000	200
100.0.0.50 to 100.0.0.52, color 705		-1	UP	SINGLE...	3		705	200
100.0.0.50 to 100.0.0.52, color 103		-1	UP	SINGLE...	3		103	200
100.0.0.50 to 100.0.0.27, color 705		3-1	UP	SINGLE...	3		705	200
100.0.0.52, color 10000		-1	UP	SINGLE...	3		10000	200
100.0.0.50 to 100.0.0.52, color 102		-1	UP	SINGLE...	3		102	100
100.0.1.1 to 100.0.1.3, color 9010		b1-1	UP	SINGLE...	1		9010	100
100.0.1.1 to 100.0.0.27, color 9009		3-1	UP	SINGLE...	3		9009	100
100.0.0.52 to 100.0.1.3, color 1000		b1-1	UP	SINGLE...	3		1000	100
100.0.0.52 to 100.0.0.27, color 5227		3-1	UP	SINGLE...	3		5227	100
100.0.0.52 to 100.0.0.50, color 4000	ron-ncs540-1	cloud-ncs540-1	UP	SINGLE...	3		4000	200

This operation displays detailed policy information in Crosswork Network Controller.

Figure 26: Traffic engineering

Crosswork Network Controller

Traffic Engineering

Location: Show: Participating Only IGP Path

Show Groups Auto-Focus

SR Policy Details

Current History

Headend **A** cloud-ncs540-1 | Source IP: 100.0.0.50
TE RID: 100.0.0.50
PCC IP: 100.0.0.50

Endpoint **Z** ron-ncs540-1 | Dest IP: 100.0.0.52
TE RID: 100.0.0.52

Color: 10000

Summary

- Admin State: Up
- Oper State: Up
- Binding SID: 24010
- Policy Type: Regular
- Profile ID: -
- Description: -
- Traffic Rate: 0 Mbps
- Unused: True

Candidate Path

Path Name	Preference	Path Type	State
<input checked="" type="checkbox"/> cf_g_srte_c_10000_ep_100...	200	Unknown	Up

Step 3 Cross launch from Crosswork Hierarchical Controller optical node to Cisco Optical Site Manager.

- Click **Devices** > **ONS**.
- Hover over a device, click the ellipsis, and then click **Optical Node at COSM**.

Figure 27: Network inventory

Network Inventory

Filter inventory by: Regions/Sites/Devices

More Information:

[Optical Node at COSM](#)

Name	IP	Vendor	Model	Site	Reachability
OLT1-roadm				VAL	REACHABLE
OLT5_R_C				LIS	REACHABLE
OLT6-roadm				VAL	REACHABLE
ILA2				Geneva	REACHABLE
OLT2_OLT3				BAR	REACHABLE
ILA1	172.27.227.101	Cisco	ola	MAL	REACHABLE
ron-poc-ols-1-roadm	172.29.111.73	Cisco	roadm	COR	REACHABLE
				FRA	REACHABLE

Step 4 Cross launch from Crosswork Hierarchical Controller optical port to Cisco Optical Site Manager.

- Click **Ports > OTS**.
- Hover over a port, click the ellipsis, and then click **Optical Port at COSM**.

Figure 28: Network inventory

Network Inventory

Filter inventory by: Regions/Sites/Devices

More Information:

[Port at Component View \(COSM\)](#)

Name	Device Vendor	Spans	Site	Operations Status	Admin Status	Supported Links
1t6/1/0/LINE	Cisco		Geneva	UP	UP	▶ 1 Link
ron_ncs1010_01	Cisco		VAL	UP	UP	▶ 1 Link
ron_ncs1010_olt	Cisco		MAL	UP	UP	▶ 1 Link
ron_ncs1010_ila	Cisco		COR	UP	UP	▶ 1 Link
ron_ncs1010_olt	Cisco		LIS	UP	UP	▶ 1 Link
ron_ncs1010_ila	Cisco		COR	UP	UP	▶ 1 Link
ron_ncs1010_ila2-r-c/1/0...	Cisco	Port: 1/0/LINE-2, Physical ...	BAR	UP	UP	▶ 1 Link
ron_ncs1010_olt2/8/0/LINE	Cisco	Port: 8/0/LINE, Physical D...	MAL	UP	UP	▶ 1 Link

Step 5 Cross launch from Crosswork Hierarchical Controller Link Assurance node to Cisco Optical Site Manager or SVO.

- Click **Link Assurance > Inspect links**.
- Hover over a node, click the ellipsis, and then click **Optical Node at COSM**.

Figure 29: Link assurance

Name	IP	Vendor	Model	Site	Reachability
OLA1	172.27.227.101	Cisco	ola	COR	REACHABLE
ron-poc-ols-1-roadm	172.29.11.73	Cisco	roadm	FRA	REACHABLE
OLT1-roadm				VAL	REACHABLE
OLT5_R_C				LIS	REACHABLE
OLT6-roadm				VAL	REACHABLE
ILA2				Geneva	REACHABLE
OLT2_OLT3				BAR	REACHABLE
				MAL	REACHABLE

This operation displays the node functional view in Cisco Optical Site Manager for NCS 1000 series devices or in SVO for NCS 2000 series devices.

Rack	UID	Device Name	Severity	Service Affe...	Condition	Timestamp
1/1	1	ron-poc-ols-1	Warning	NSA	SSM-ST3	08/12/2001, 05:11:32
1/1	1	ron-poc-ols-1	Warning	NSA	FRNGSYNC	08/12/2001, 05:11:37
1/1	1	ron-poc-ols-1	Minor	NSA	EQPT-MISS	08/12/2001, 05:12:04

Step 6 Cross launch from Crosswork Hierarchical Controller Link Assurance port to Cisco Optical Site Manager.

- a. Click **Link Assurance > Inspect links**.
- b. Hover over a port, click the ellipsis, and click **Optical Port at COSM**.

Figure 30: Link assurance

The screenshot displays the NSO Link Assurance interface. The main view shows a network diagram titled "45.54.23.0 to 45.54.23.1 L3 Logical Link". The diagram illustrates a network topology with three main sections: VAL, BAR, and Geneva. In the VAL section, there is a device labeled "ron-9201-32F...". In the BAR section, there is a device labeled "ILAZ". In the Geneva section, there is a device labeled "ron-ncs57b1-1". The diagram shows connections between these devices, including a central OLT5_R_C-ro... device and an OLT6-roadm device. A summary table below the diagram shows the link details:

Name	Type	Status
10.28.29.20 to 10.28.29.21	L3 Logi...	UP
100.28.30.23 to 100.28.3...	L3 Logi...	UP
2.2.2.1 to 2.2.2.0	L3 Logi...	UP
45.54.23.0 to 45.54.23.1	L3 Logi...	UP
123.200.200.4 to 123.200...	L3 Logi...	UP
123.200.200.6 to 123.200...	L3 Logi...	UP

The interface also includes a "Define Valid Links For Inspection By:" section with options for "Specific link(s) / underlay link(s)", "Tags", "Device(s) in 1 of the endpoints", and "Device(s) in both endpoints". A "Links LinkType is 'RON with Optical'" filter is applied. A "More Information:" pop-up window is visible, showing a link to "Port at Component View (COSM)".

Provision an ML service using NSO Routed Optical Networking CFP

Follow these steps to provision the Routed Optical Networking ML service using the NSO Web UI.

Procedure

Step 1

To add a new device, perform these steps:

- a. In the Device manager, click the + to add a new device. Specify a name for the new device and click **Confirm**.

The screenshot shows the Cisco Device Manager interface with a table of devices. An 'Add device' dialog box is open, allowing the user to enter the name of a new device. The name 'ron-poc-8202-1' is entered in the 'name' field. The dialog has 'cancel' and 'confirm' buttons.

name	address	port	type	services	ping	connect	check-sync	sync-from	sync-to	compare-config	alarm
cloud-ncs540-1	172.29.11.120		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3	0	ping	connect	check-sync	sync-from	sync-to	compare-config	con
onc-cw-100	172.29.11.100	30666	onf-tapi-nc-1.0:onf-tapi-nc-1.0	3	ping	connect	check-sync	sync-from	sync-to	compare-config	co
onc-poc-62	172.29.11.62	30666	onf-tapi-nc-1.0:onf-tapi-nc-1.0	3	ping	connect	check-sync	sync-from	sync-to	compare-config	co
onc-softest-72	172.29.11.72	30666	onf-tapi-nc-1.0:onf-tapi-nc-1.0	0	ping	connect	check-sync	sync-from	sync-to	compare-config	co
ron-8201-1	172.29.11.20		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3	3	ping	connect	check-sync	sync-from	sync-to	compare-config	▲
ron-8201-2	172.29.11.21		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3	2	ping	connect	check-sync	sync-from	sync-to	compare-config	▲
ron-8201-3	172.29.11.22		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3		ping	connect	check-sync	sync-from	sync-to	compare-config	▲
ron-8201-4	172.29.11.23		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3		ping	connect	check-sync	sync-from	sync-to	compare-config	▲
ron-asr9903-1	172.29.11.27		cisco-iosxr-cl-7.33...cisco-iosxr-cl-7.33		ping	connect	check-sync	sync-from	sync-to	compare-config	co
ron-ncs540-1	172.29.11.25		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3		ping	connect	check-sync	sync-from	sync-to	compare-config	co
ron-ncs57b1-1	172.29.11.26		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3		ping	connect	check-sync	sync-from	sync-to	compare-config	co
ron-poc-57b1-1	172.29.11.30		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3		ping	connect	check-sync	sync-from	sync-to	compare-config	co
ron-poc-8201-1	172.29.11.28		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3	1	ping	connect	check-sync	sync-from	sync-to	compare-config	▲
ron-poc-8201-2	172.29.11.29		cisco-iosxr-nc-7.3:cisco-iosxr-nc-7.3	1	ping	connect	check-sync	sync-from	sync-to	compare-config	▲
xrv9k-pe-1	172.29.11.24		cisco-iosxr-cl-7.33...cisco-iosxr-cl-7.33		ping	connect	check-sync	sync-from	sync-to	compare-config	co

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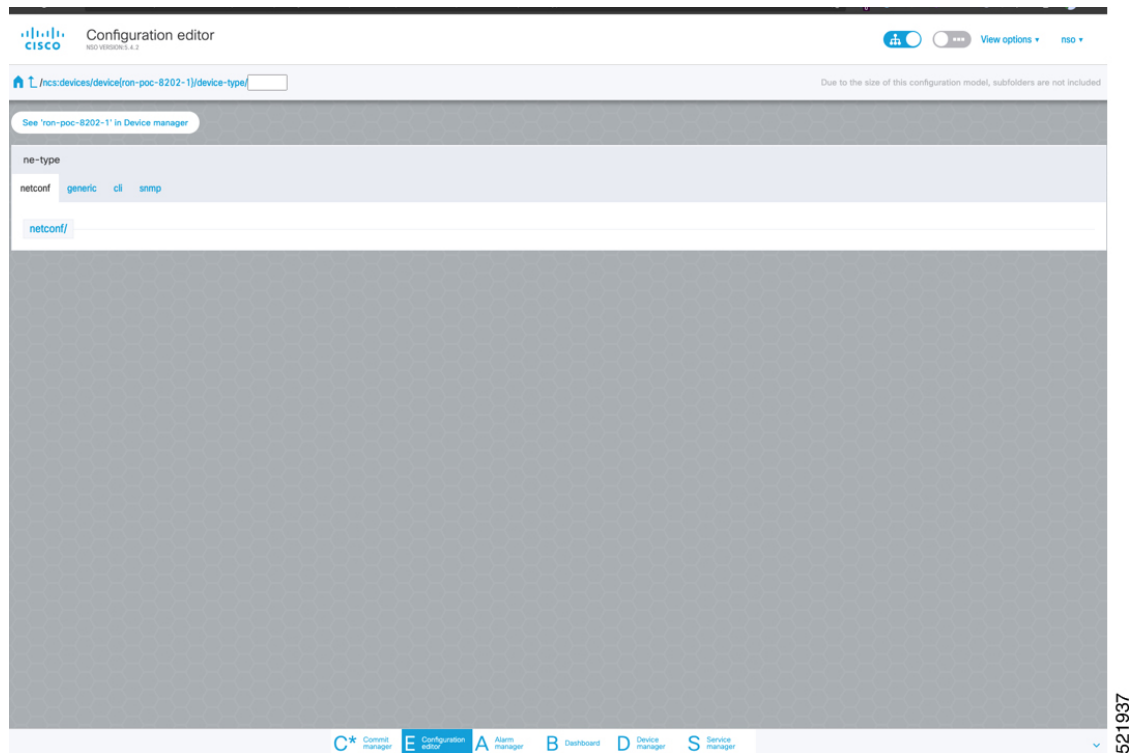
- b. After creating the new device, click its name. Then, enter both required and optional parameters. In this screen, you must provide the authgroup and the IP address of the device.

The screenshot shows the Cisco Configuration Editor interface for the device 'ron-poc-8202-1'. The interface displays various configuration fields and options:

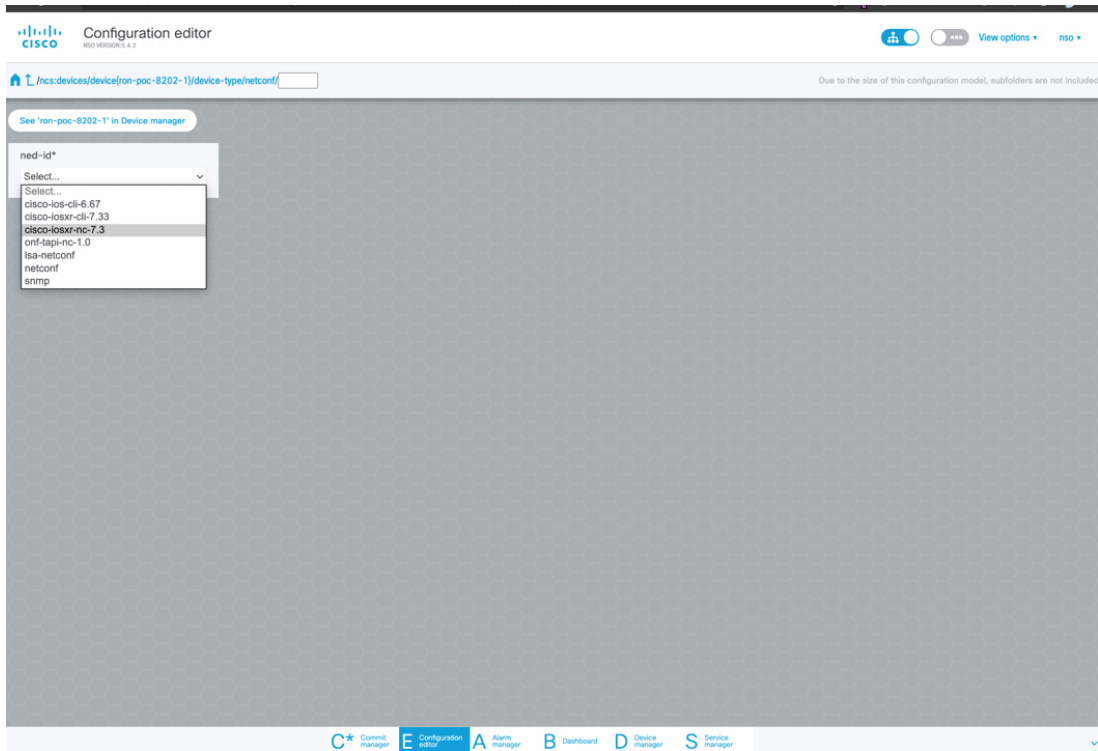
- name:** ron-poc-8202-1
- authgroup:** routers
- read-timeout:** Valid range: 1 .. 4294967
- out-of-sync-commit-behaviour:** reject
- local-user:** [empty field]
- device-profile:** [empty field]
- write-timeout:** Valid range: 1 .. 4294967
- snmp-notification-address:** [empty field]
- description:** Cisco 8202 router in PoC lab
- connect-timeout:** Valid range: 1 .. 4294967
- trace:** pretty - Pretty-printed data
- trace-output:**
 - file
 - external
- address-choice:**
 - device:**
 - address:** 172.29.11.31
 - port:** Valid range: 0 .. 65535
 - remote-node:** [empty field]

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- c. Scroll down in the device configuration screen. Click 'device-type' to open the device type selection screen. The supported device type for Routed Optical Networking ML FP is IOS-XR CLI NED.

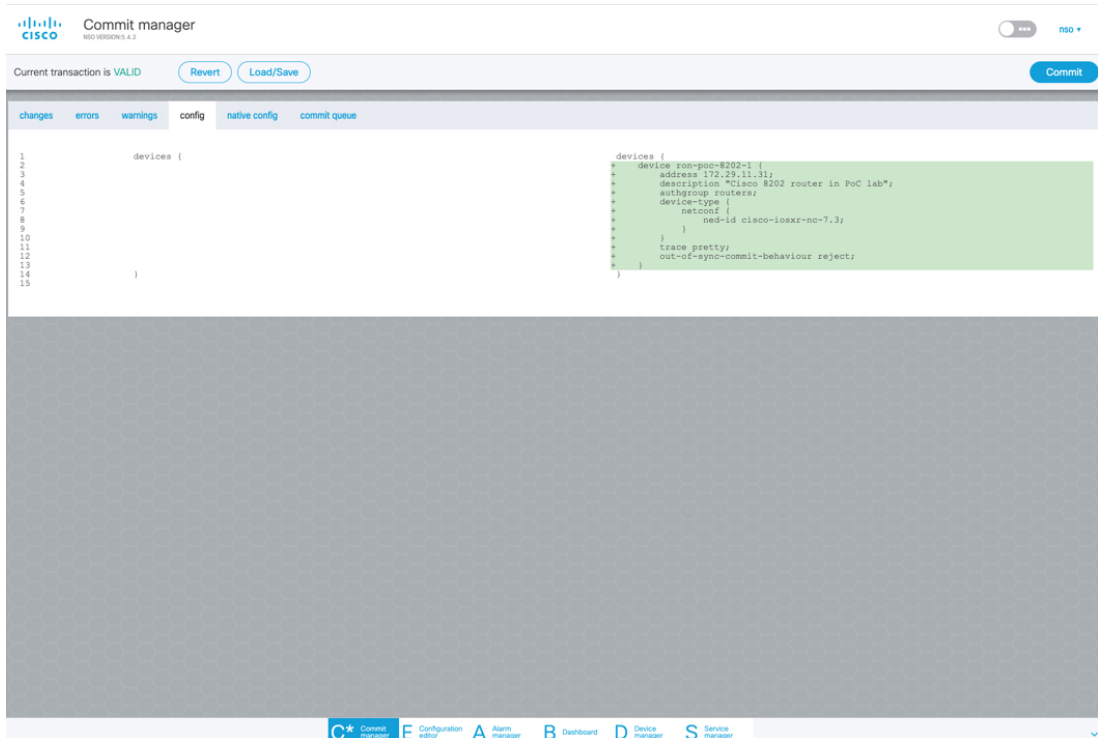


- d. Click NETCONF to select the appropriate NED. The Routed Optical Networking ML FP requires the use of the **cisco-iosxr-nc-7.3** NED.



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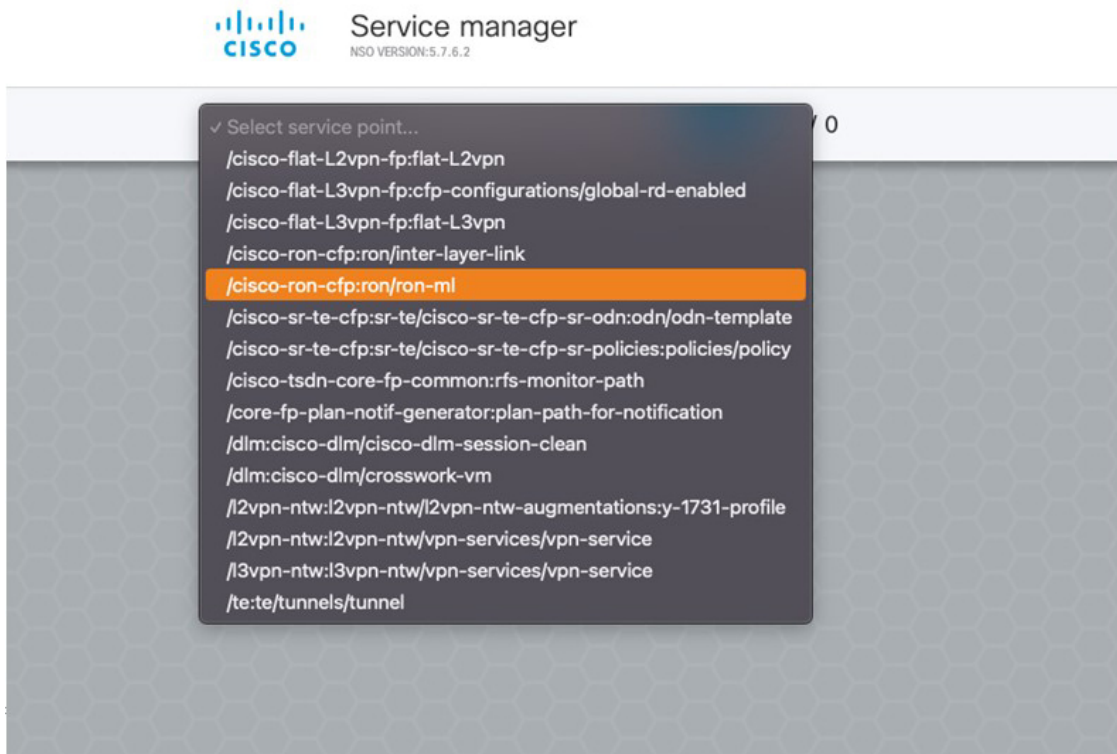
- e. Click the Commit manager to view the NSO CLI configuration being applied. Click **Commit** to save the device configuration to NSO.



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Note

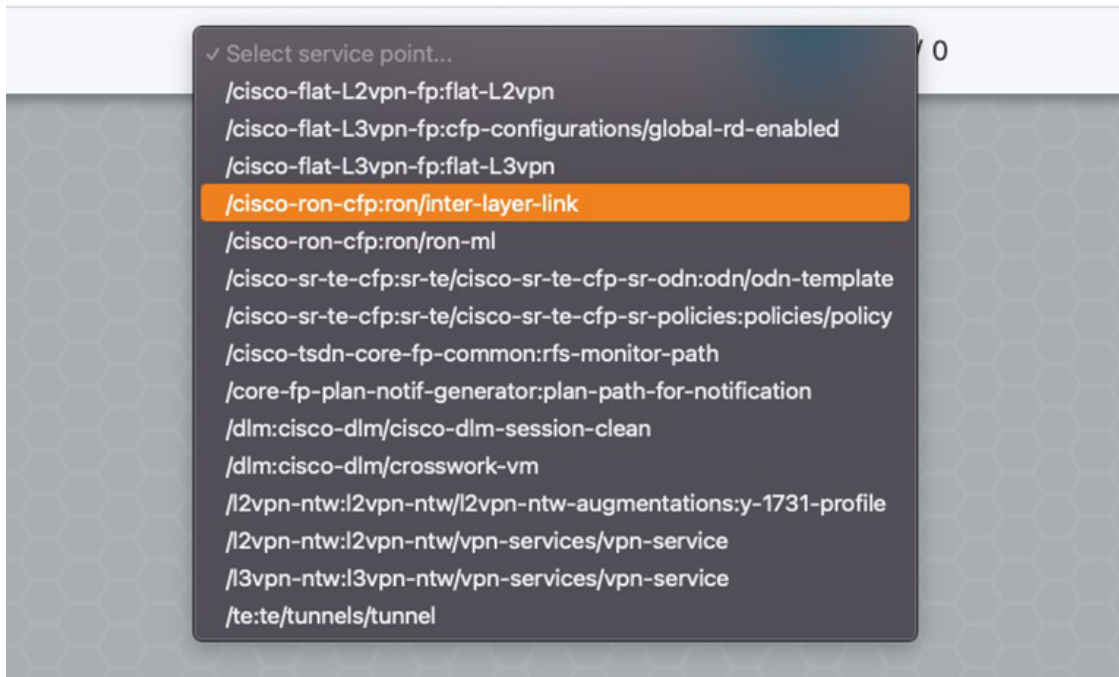
Next we add the multilayer end-to-end service to configure and provision both the optical line system and routers. We recommend you to click **check-sync** in the Device manager to ensure that the device configuration is properly in sync with NSO before provisioning. Initial provisioning fails if the device is out of sync.



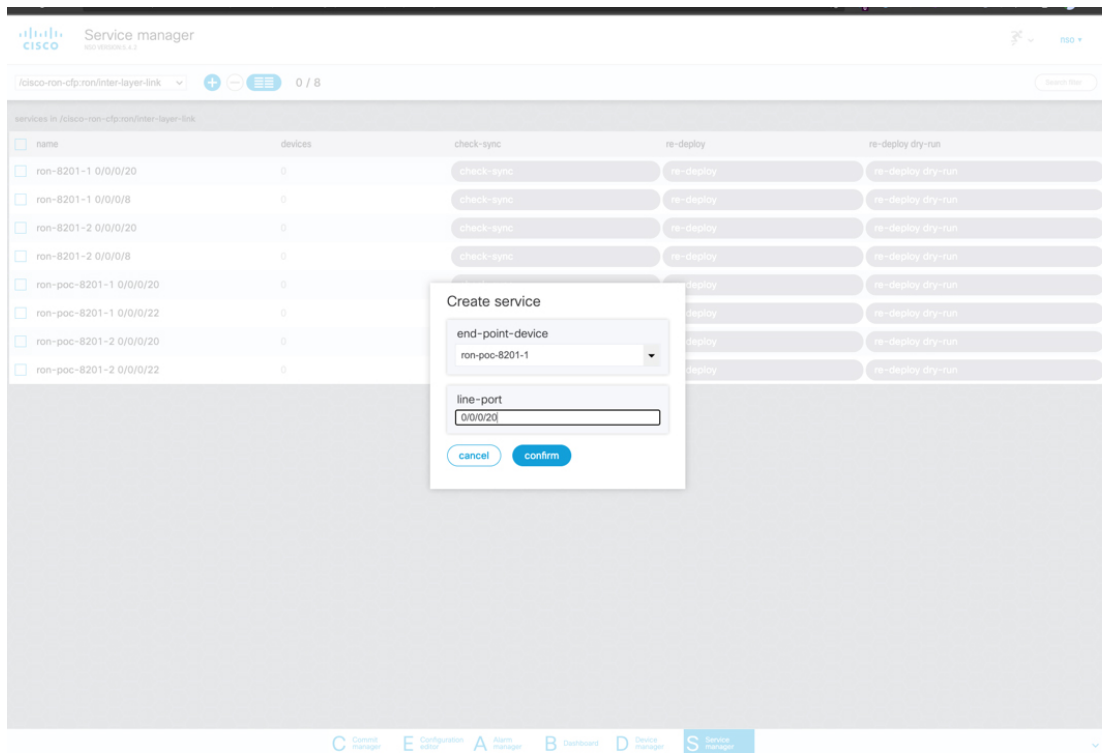
Step 2

To configure the interlayer link service in NSO, perform these steps:

- In the Service manager, select the inter-layer-link service point from the drop-down list.


Service manager
 NSO VERSION: 5.7.6.2


- b. Specify the end-point-device and the line port. These are required values. The endpoint device is the 8201 router. Specify the router optics port that is connected to the optical line system add-drop port in the line port field. Click **Confirm**.



- c. In the Configuration editor, edit the inter-layer-link service by clicking the newly created draft service to complete the information required. In this example, we add the site name, optical add-drop network element, and the optical add-drop port. The optical controller field specifies which Optical Network Controller instance is used for provisioning. This parameter is optional if a global instance is defined. A global Cisco Optical Network Controller instance can be set in NSO and will be used if the field is not populated. The add-drop port uses the inventory ID of the physical port on the NCS1K-MD-64-C multiplexer for frequency XXXX.YY. The add-drop reference includes both RX and TX directions. In addition to specifying the network-element and add-drop in R/S/I/P form, a TAPI SIP can also be used to identify the add-drop port.

The screenshot shows the Cisco Configuration Editor interface for configuring an inter-layer-link service. The breadcrumb path is `/cisco-ron-cfp:ron/inter-layer-link(ron-poc-8201-1 0/0/0/20)`. The configuration tree on the left includes:

- `end-point-device` (ron-poc-8201-1)
- `line-port` (0/0/0/20)
- `site` (Los Angeles)
- `ols-domain/`
- `optical-controller` (onc-poc-62)
- `optical-service-interface`
 - `add-drop` (sip)
 - `network-element*` (ron-poc-ols-1)
 - `optical-add-drop*` (1/2007/1/25,26)

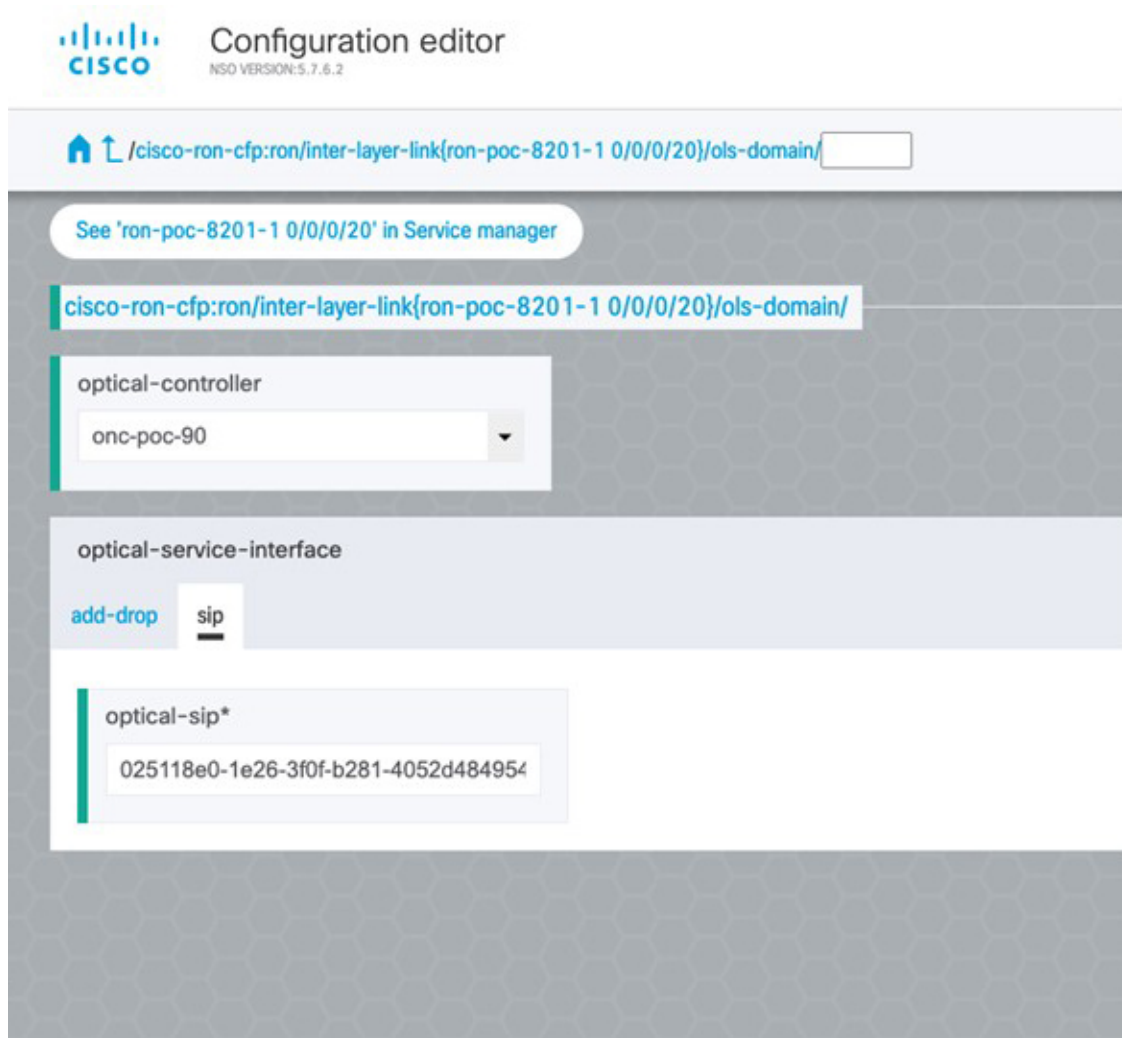
The bottom navigation bar shows tabs for `C* Current manager`, `E Configuration editor` (active), `A Alarm manager`, `B Dashboard`, `D Device manager`, and `S Service manager`. A vertical label `521922` is visible on the right side of the interface.

These elements are the only required elements in the inter-layer-link service type.

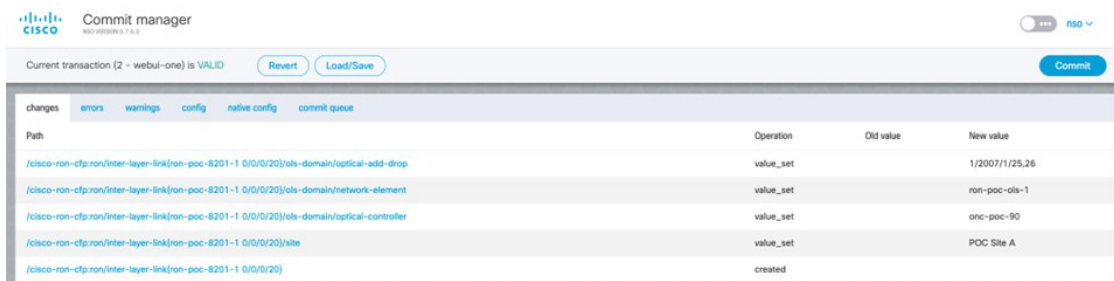
- d. Perform Ols-domain optical-service-interface configuration.
 - Optical-controller specifies the Cisco Optical Network Controller instance managing the OLS.
 - Network-element specifies the optical element name as shown in TAPI topology.
 - Optical-add-drop specifies the port to be used on the optical network element.

The screenshot shows the Cisco NSO Configuration editor interface. At the top left is the Cisco logo and the text "Configuration editor" with "NSO VERSION: 5.7.6.2" below it. The breadcrumb path is "/cisco-ron-cfp:ron/inter-layer-link{ron-poc-8201-1 0/0/0/20}/ols-domain/". A notification bubble says "See 'ron-poc-8201-1 0/0/0/20' in Service manager". The current configuration path is "cisco-ron-cfp:ron/inter-layer-link{ron-poc-8201-1 0/0/0/20}/ols-domain/". Under the "optical-controller" section, a dropdown menu is set to "onc-poc-90". The "optical-service-interface" section has two tabs: "add-drop" (selected) and "sip". Under "add-drop", there are two fields: "network-element*" with the value "ron-poc-ols-1" and "optical-add-drop*" with the value "1/2007/1/25,26".

- The optical-service-interface can also be added as a TAPI SIP UUID.



- e. Click the config tab in the Commit manager to see the NSO CLI configuration that will be committed to NSO.



- f. Click **Commit** in the upper right corner to commit the service. An end-to-end service requires two inter-layer-links, one for each router connected to its optical line system add-drop port.

Create service

name

mode

bandwidth

[cancel](#) [confirm](#)

- b. In the Configuration editor, click the newly created service name for editing the additional parameters that are required for the service. In this example, set the circuit-id name in the global parameters. The frequency is set by the optical

controller based on the specified optical add-drop port. The dac-rate is set to the default value.

The screenshot shows the Cisco Configuration Editor interface for a circuit named 'poc_circuit_195200'. The configuration fields are as follows:

Field	Value
name	poc_circuit_195200
circuit-id	This is a demo circuit
dac-rate	
mode*	transponder
grid-type	(100mhz-grid)
clear-rollback	
bandwidth*	400
frequency	

Below the configuration fields, there are three sections:

- end-point**: This list is empty. Add list item → +
- ols-domain**: Contains one item: service-state (UNLOCKED).
- custom-template**: This list is empty. Add list item → +

The bottom navigation bar includes: Control manager, Configuration editor (selected), Alarm manager, Dashboard, Device manager, and Service manager.

Note

- User configuration global options are frequency and dac-rate.
 - Dac-rate controls the TX shaping parameters: 1x1.25 = enabled, 1x1 = disabled. If you leave this field blank, the system uses the default setting of enabled.
 - Modulation of 16 QAM is available for 2x100G muxponder mode.
- c. After the ols-domain is added, you must add end-points to the circuit. Two end-points are always required. The end-points are the routers with ZR/ZR+ optics.

Configuration editor
v1.0 (v1.0.0.1)

See 'poc_circuit_195200' in Service manager

name poc_circuit_195200	circuit-id This is a demo circuit	dac-rate
mode* transponder	grid-type (100mhz-grid)	clear-rollback
bandwidth* 400	frequency	

end-point
This list is empty Add list item +

ols-domain/

service-state
(UNLOCKED)

custom-template
This list is empty Add list item +

521927

- d. Add the end-point-device to the service. Click **Confirm**.

Configuration editor
v1.0 (v1.0.0.1)

See 'poc_circuit_195200' in Service manager

name poc_circuit_195200	circuit-id This is a demo circuit	dac-rate
mode* transponder	grid-type (100mhz-grid)	clear-rollback
bandwidth* 400	frequency	

end-point
This list is empty Add list item +

ols-domain/

service-state
(UNLOCKED)

custom-template
This list is empty Add list item +

Add new list item

end-point-device
ron-poc-8201-1

cancel confirm

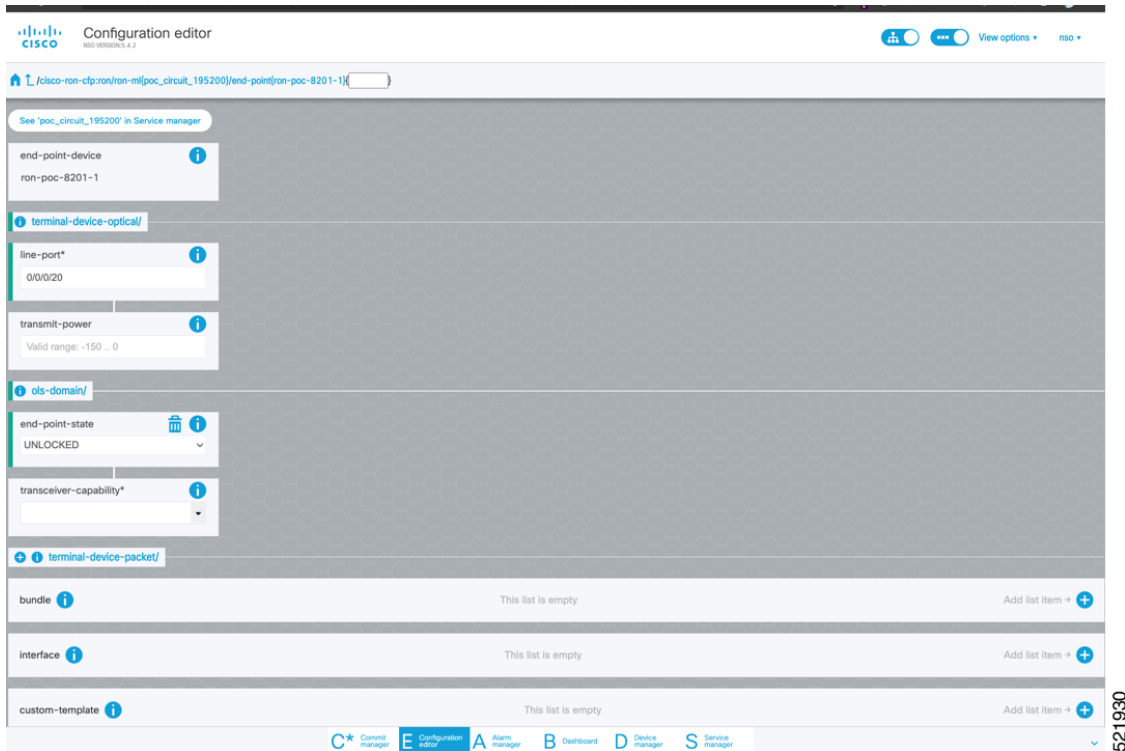
521928

After the end-point is created, click the end-point to edit the end-point parameters. The line port is a required parameter and refers to the optics port on the router. In this example, the line port for the end-point matches the value specified in the inter-layer-link service.

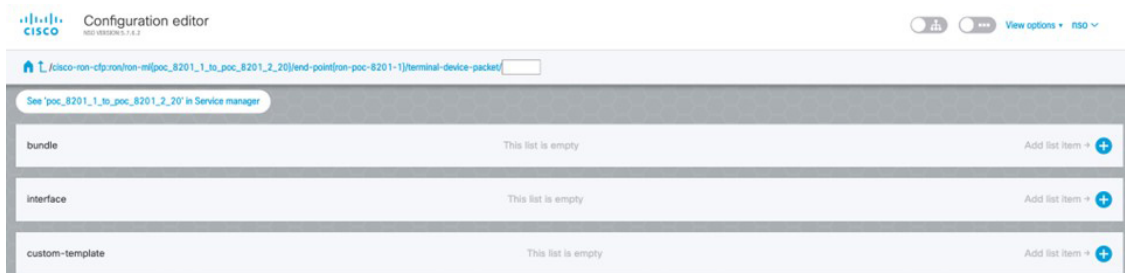
The screenshot shows a modal dialog titled "Add new list item". Inside the dialog, there is a text input field with the value "end-point-device". Below this field is a dropdown menu with the selected value "ron-poc-8201-2". At the bottom of the dialog are two buttons: "cancel" and "confirm". To the right of the dialog, a portion of a table is visible, showing a list of "end-point" items. The items are "end-point-device", "ron-poc-8201-1", and "ron-poc-8201-2". The "ron-poc-8201-2" item is highlighted.

The transmit-power is an optional parameter for end-to-end provisioning. If you omit this parameter, the Cisco Optical Network Controller provides the transmit power. Transmit power sets the transmit power, the value is calculated as 100 times the value in 0.1 dBm increments. For example, a value of -100 equals -10 dBm. If you do not specify a value, the system uses a default of -10 dBm for QDD-400G-ZR-S or QDD-400G-ZRP-S, and 0 dBm for DP04QSDD-HE0 (Bright ZR+). The transceiver-capability field specifies the optic type and is only required if no packet layer configuration is being performed. In this example, you are performing packet layer provisioning so specifying the transceiver capability is not required.

Add the line port of 0/0/0/20 to the Routed Optical Networking ML service.



- e. Click endpoint to return to the top-level endpoint configuration, click **terminal-device-packet** to configure Ethernet/IP parameters



Note

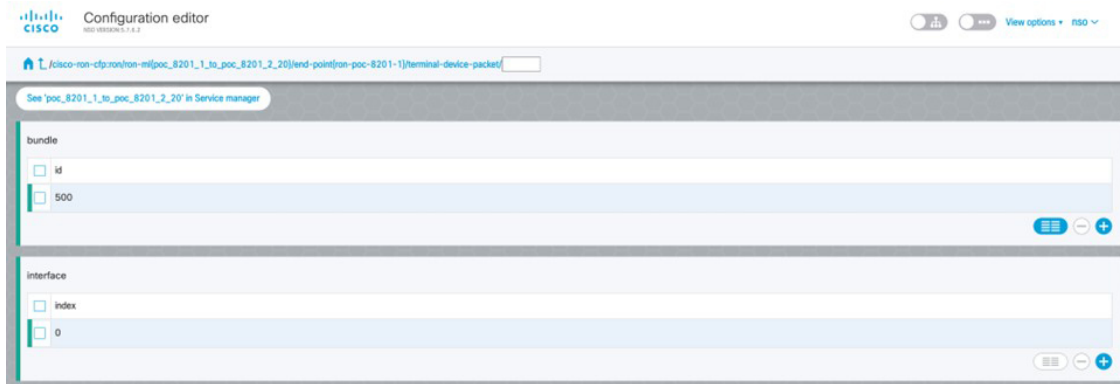
- Ethernet and IP configuration is optional.
- Bundle configuration adds an interface to an existing bundle or creates a new bundle and adds the newly created IP interface to it.

Interface configuration is used for configuring IP address parameters on newly created Ethernet interfaces.

In this example, we add a new Bundle and assign an IP address to the Bundle.

- f. Click the plus sign next to the bundle to create a bundle with the identifier 500. This action creates a bundle interface, Bundle-Ether 500, on the endpoint router.

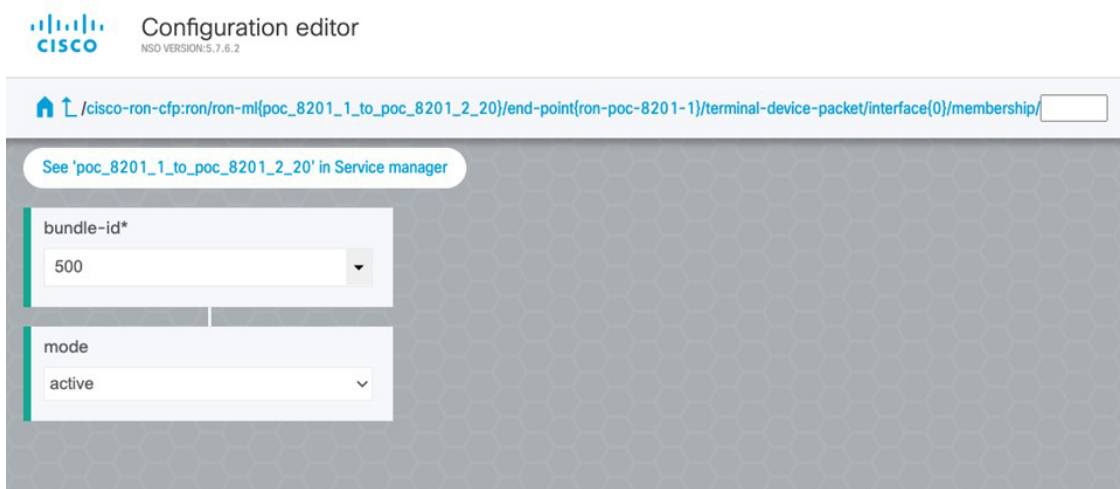
The interface index for a bundle use case is always 0. In a non-bundle configuration in muxponder mode, the index can be 0 to 3, representing the number of interfaces created as part of the muxponder configuration.



- g. Click the bundle number and *ip-address* to configure an IP address on the bundle.



- h. Return to the top-level endpoint configuration. Select index 0 that you created previously, and click **membership** to add the interface to the bundle.



Note

- Bundle-id selects the previously created bundle.

- Mode sets the bundle LAG signaling mode. Active=LACP, passive=LACP listener only, on=No active signaling, inherit=Inherit signaling from Bundle interface configuration. Default is active.

- Return to the top level of the service configuration. Then configure the second endpoint in the same manner.

Configuration editor (NSO VERSION 21.3.2)

See 'poc_8201_1_to_poc_8201_2_20' in Service manager

name: poc_8201_1_to_poc_8201_2_20

circuit-id: poc_circuit

dac-rate: []

mode*: transponder

grid-type: (100mhz-grid)

clear-rollback: []

bandwidth*: 400

frequency: 1952000

end-point

- end-point-device
- ron-poc-8201-1
- ron-poc-8201-2

ols-domain/ srlg/

- Click **SRLG** to perform SRLG configuration

Configuration editor (NSO VERSION 21.3.2)

See 'poc_8201_1_to_poc_8201_2_20' in Service manager

group: []

value-list

id	value
<input checked="" type="checkbox"/> 10	1000
<input type="checkbox"/> 20	2000

name-list: This list is empty. Add list item +

Note

- Configuration options are to specify a preconfigured group, a list of numeric SRLG values, or a list of SRLG names associated with preconfigured name:value pairs.
- Each type can be populated in the same configuration.
- In this example we specify a list of explicit numeric values. An index is used along with the numeric value.

Step 4

In the Commit manager, click the config tab. The NSO CLI configuration for the end-to-end service is displayed. If the ols-domain component is not specified in the global configuration, no optical line system provisioning is performed, only router provisioning. You can preview and then commit the configuration.

The screenshot shows the Cisco NSO Commit Manager interface. At the top, it says "Commit manager" and "NSO VERSION 5.7.2". Below that, it indicates "Current transaction is VALID" and provides buttons for "Revert", "Load/Save", and "Commit". The main area is divided into tabs: "changes", "errors", "warnings", "config", "native config", and "commit queue". The "config" tab is active, showing a configuration tree on the left and a code editor on the right. The code editor displays the configuration for a service named "ron", including a "poc_circuit" service and two "end-point" services. The code is as follows:

```

1  ron {
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37

```

The code in the editor is:

```

ron {
  ron-ml poc_circuit 195200 {
    mode transponder;
    bandwidth 400;
    circuit-id "This is a demo circuit";
    ols-domain {
    }
  }
  end-point ron-poc-8201-1 {
    terminal-device-optical {
      line-port 0/0/0/20;
    }
  }
  ols-domain {
    end-point-state UNLOCKED;
  }
  terminal-device-packet {
    interface 0 {
      ip-address {
        v4 51.63.12.1/30;
      }
    }
  }
  end-point ron-poc-8201-2 {
    terminal-device-optical {
      line-port 0/0/0/20;
    }
  }
  terminal-device-packet {
    interface 0 {
      ip-address {
        v4 51.63.12.2/30;
      }
    }
  }
}

```

At the bottom of the interface, there is a navigation bar with icons for "Commit manager", "Configuration editor", "Alarm manager", "Dashboard", "Device manager", and "Service manager".

521934

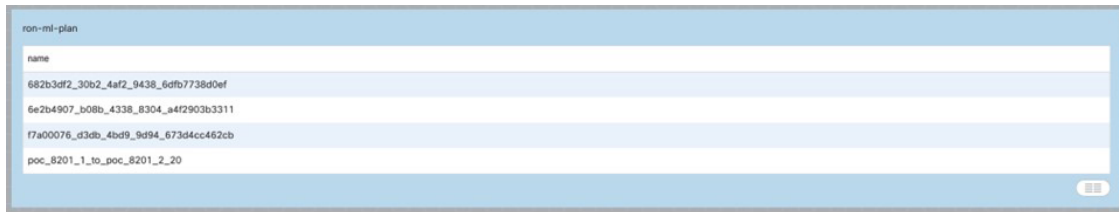
Step 5 Verify status in NSO UI.

You can verify the status by inspecting the plan associated with the service. You can find the plan under the main ron-ml configuration which you can access by clicking the top portion of the service configuration. An example is highlighted in this image.

The screenshot shows the Cisco NSO Configuration editor interface. At the top, it says "Configuration editor" and "NSO VERSION 5.7.2". Below that, there is a breadcrumb navigation path: "/cisco-ron-cfp:ron/ron-ml(poc_8201_1_to_poc_8201_2_20)". A notification bubble says "See 'poc_8201_1_to_poc_8201_2_20' in Service manager". The main area is a configuration table with the following data:

name poc_8201_1_to_poc_8201_2_20	bandwidth* 400	frequency 1952000
plan-location /cisco-ron-cfp:ron/cisco-ron-cfp:ron-ml-plan[cisco-ron-cfp:name='poc_8201_1_to_poc_8201_2_20']	circuit-id poc_circuit	dac-rate
mode* transponder	grid-type (100mhz-grid)	clear-rollback

- Inspect the plan by clicking on the newly created service



If all steps are green and complete, the service has been properly deployed to the network

```

RP/0/RP0/CPU0:ron-poc-8201-1#show configuration commit changes last 1
Mon Oct 17 09:51:11.625 PDT
Building configuration...
!! IOS XR Configuration 7.7.1
srlg
 interface Bundle-Ether500
  10 value 1000
  20 value 2000
  !
!
 interface Bundle-Ether500
  ipv4 address 102.20.20.20 255.255.255.254
  !
!
 controller Optics0/0/0/20
  description poc_circuit
  transmit-power -100
  fec OFEC
  dwdm-carrier 100MHz-grid frequency 1952000
  DAC-Rate 1x1.25
  !
!
 interface FourHundredGigE0/0/0/20
  bundle id 500 mode active
  !
!
End

```

```

RP/0/RP0/CPU0:ron-poc-8201-1#show controllers optics 0/0/0/20
Mon Oct 17 09:57:25.475 PDT

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Green

FEC State: FEC ENABLED

Optics Status

  Optics Type: QSFPDD 400G ZRP
  DWDIM carrier Info: C BAND, MSA ITU Channel=19, Frequency=195.20THz,
  Wavelength=1535.822nm

Alarm Status:
-----
Detected Alarms: None

```

b. Inspect router configuration.

The **show configuration commit changes last 1** command shows the CLI config applied to the device during the NSO provisioning.

The **show optics controller 0/0/0/20** command verifies the operational status.

```

RP/0/RP0/CPU0:ron-poc-8201-1#show configuration commit changes last 1
Mon Oct 17 09:51:11.625 PDT
Building configuration...
!! IOS XR Configuration 7.7.1
srlg
 interface Bundle-Ether500
  10 value 1000
  20 value 2000
  !
!
 interface Bundle-Ether500
  ipv4 address 102.20.20.20 255.255.255.254
  !
!
 controller Optics0/0/0/20
  description poc_circuit
  transmit-power -100
  fec OFEC
  dwdm-carrier 100MHz-grid frequency 1952000
  DAC-Rate 1x1.25
  !
!
 interface FourHundredGigE0/0/0/20
  bundle id 500 mode active
  !
!
End

```

```

RP/0/RP0/CPU0:ron-poc-8201-1#show controllers optics 0/0/0/20
Mon Oct 17 09:57:25.475 PDT

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Green

FEC State: FEC ENABLED

Optics Status

  Optics Type: QSFPDD 400G ZRP
  DWDIM carrier Info: C BAND, MSA ITU Channel=19, Frequency=195.20THz,
  Wavelength=1535.822nm

Alarm Status:
-----
Detected Alarms: None

```

Provision a Routed Optical Networking ML service using Crosswork Hierarchical Controller

Follow these steps to provision Routed Optical Networking ML service using Crosswork Hierarchical Controller.

Procedure

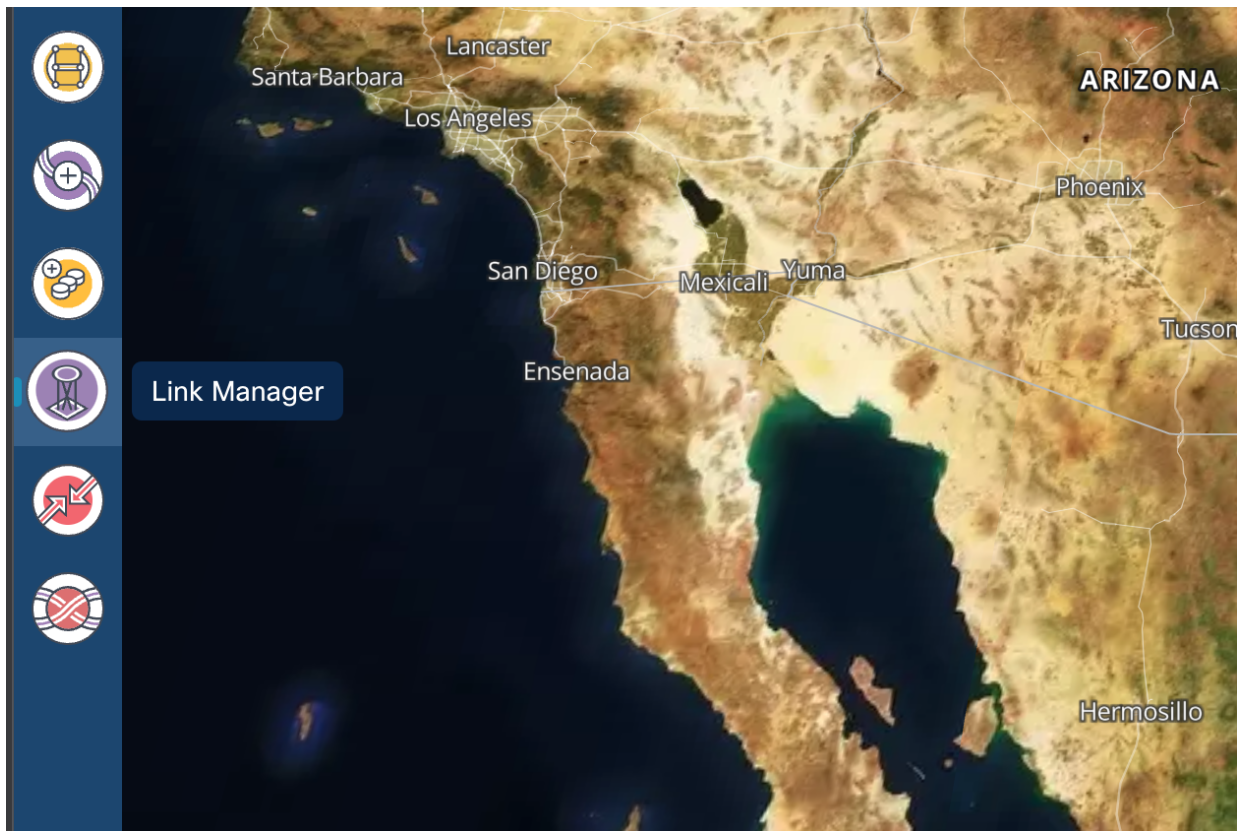
Step 1

If you are performing both router and optical line system provisioning, you must create NMC Cross Links between router optics port and optical line system add-drop port.

Crosswork Hierarchical Controller 8.0 in Routed Optical Networking 3.0 also supports “router only” provisioning. This type of provisioning applies optical parameters to the router optics port and IP layer parameters, but does not provision the optical line system.

- a. Select **Link Manager** application.

Figure 31: Crosswork Hierarchical Controller



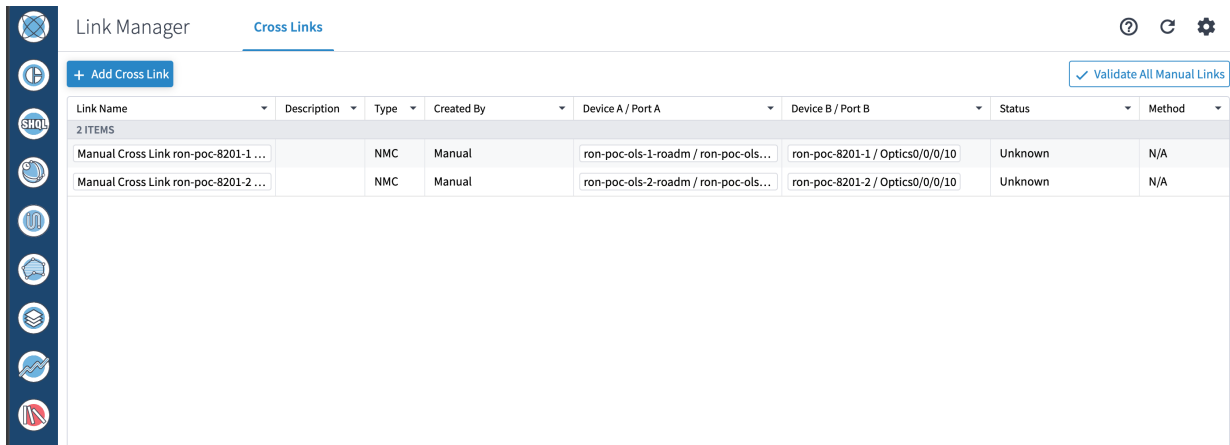
The initial view displays a list of cross links.

 A screenshot of the Link Manager application showing a table of cross links. The table has columns for Link Name, Description, Type, Created By, Device A / Port A, Device B / Port B, Status, and Method. There are two rows of data, both representing manual cross links.

Link Name	Description	Type	Created By	Device A / Port A	Device B / Port B	Status	Method
Manual Cross Link ron-poc-8201-1 / Optics0/0/0/10 to ron...		NMC	Manual	ron-poc-els-1-roadm / ron-poc-els-1/1/CHAN 46 (192.725)	ron-poc-8201-1 / Optics0/0/0/10	Unknown	N/A
Manual Cross Link ron-poc-8201-2 / Optics0/0/0/10 to ron...		NMC	Manual	ron-poc-els-2-roadm / ron-poc-els-2/1/CHAN 46 (192.725)	ron-poc-8201-2 / Optics0/0/0/10	Unknown	N/A

b. Click **Add Cross Link**.

Figure 32: View with list of cross links

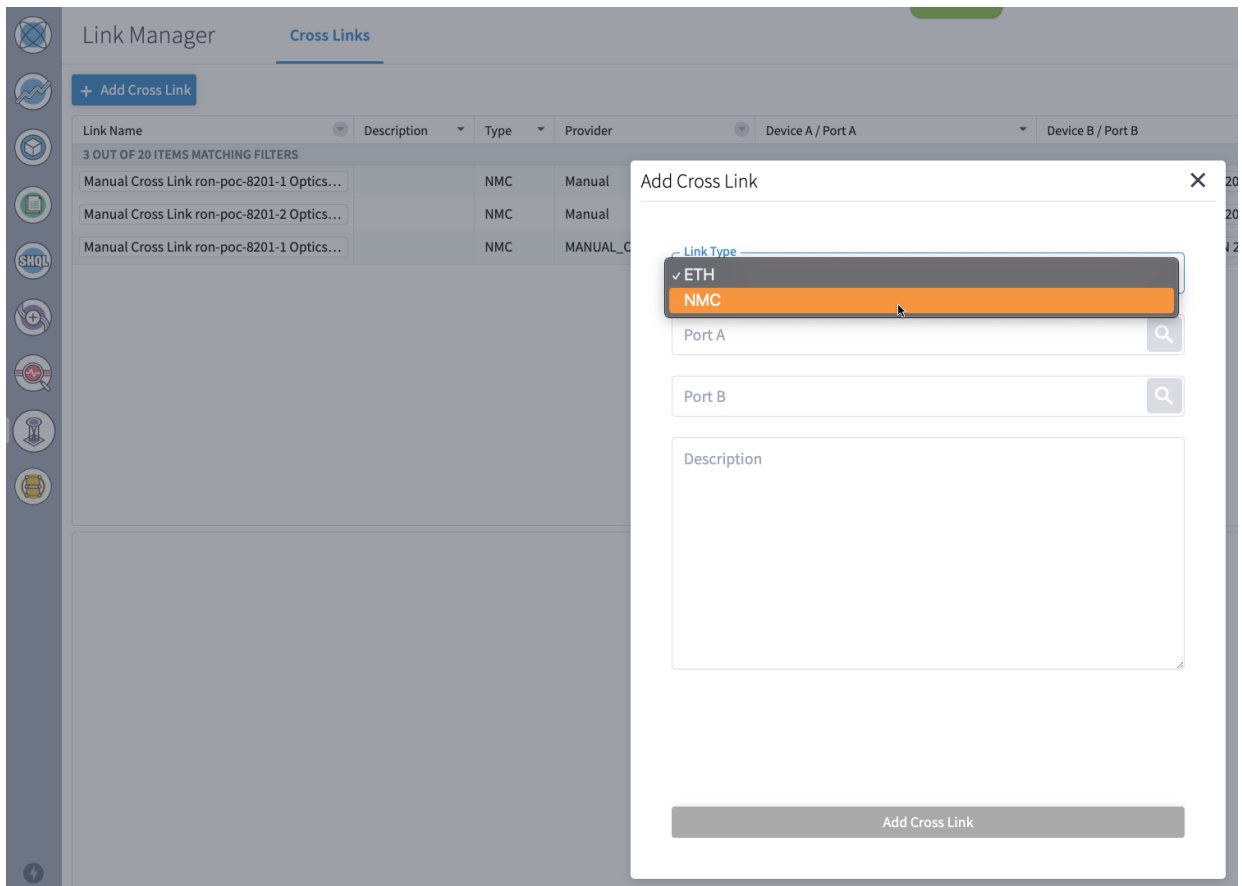


The screenshot shows the Link Manager interface with the 'Cross Links' tab selected. A table displays two items:

Link Name	Description	Type	Created By	Device A / Port A	Device B / Port B	Status	Method
Manual Cross Link ron-poc-8201-1 ...		NMC	Manual	ron-poc-ols-1-roadm / ron-poc-ols...	ron-poc-8201-1 / Optics0/0/0/10	Unknown	N/A
Manual Cross Link ron-poc-8201-2 ...		NMC	Manual	ron-poc-ols-2-roadm / ron-poc-ols...	ron-poc-8201-2 / Optics0/0/0/10	Unknown	N/A

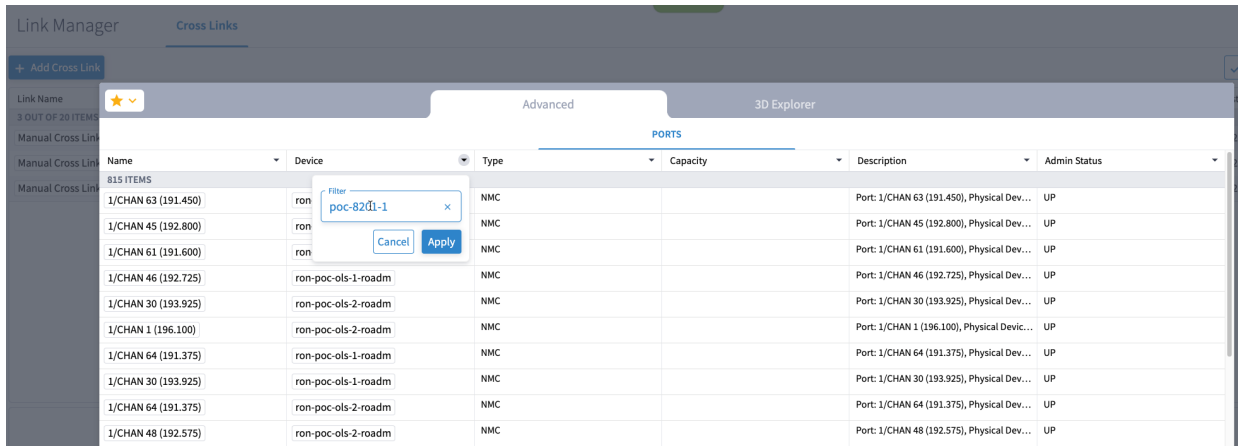
c. Select the NMC cross-link type. Cross Link Manager supports ETH and NMC cross links.

Figure 33: Add cross links screen



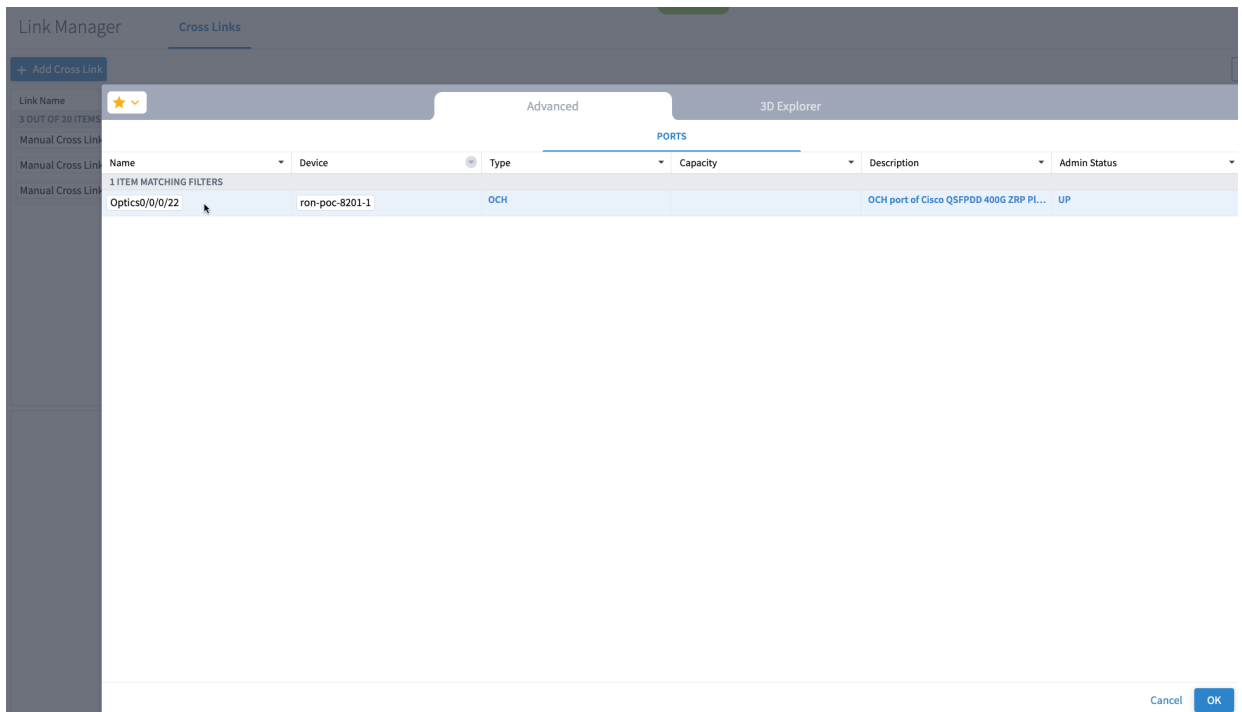
The screenshot shows the 'Add Cross Link' dialog box in the Link Manager application. The 'Link Type' dropdown menu is open, showing 'ETH' and 'NMC' options. The 'NMC' option is selected and highlighted in orange. Below the dropdown, there are input fields for 'Port A', 'Port B', and 'Description'. An 'Add Cross Link' button is visible at the bottom of the dialog.

d. You can select either the router DCO port or the optical add-drop port first using the Link Manager application. In this example, port filtering is performed by the router device used for the NMC cross-link.



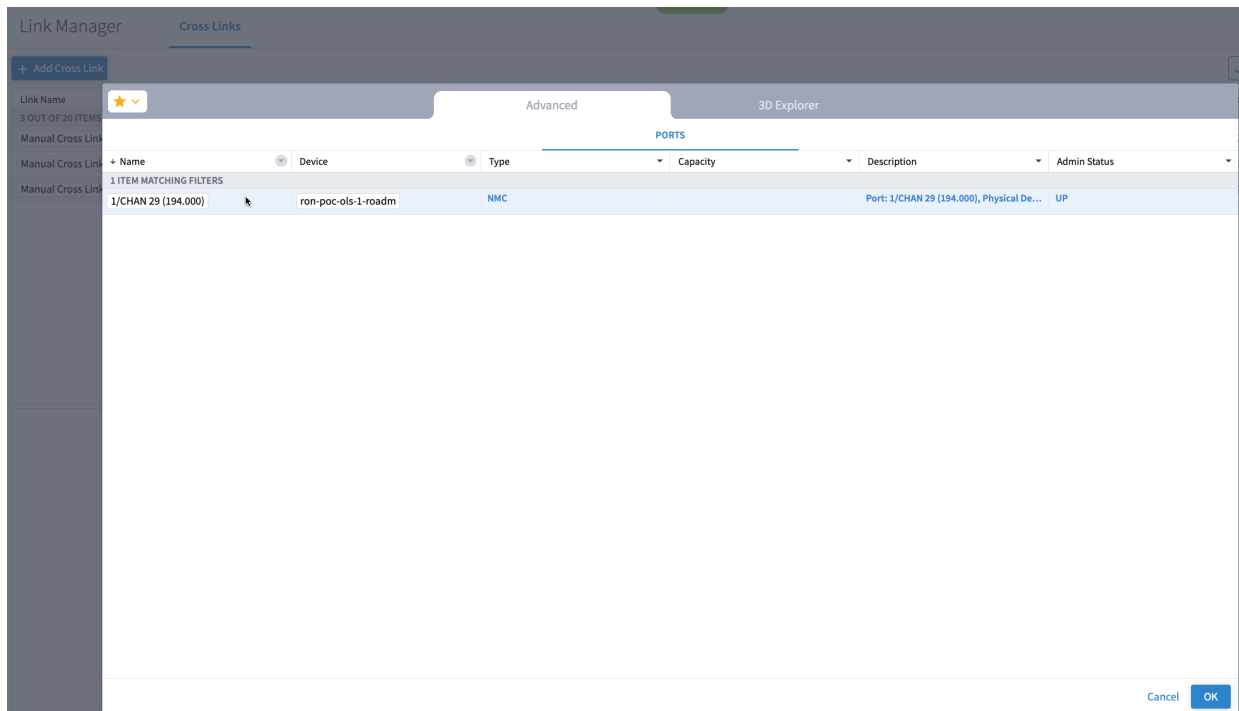
Name	Device	Type	Capacity	Description	Admin Status
815 ITEMS					
1/CHAN 63 (191.450)	ron	NMC		Port: 1/CHAN 63 (191.450), Physical Dev...	UP
1/CHAN 45 (192.800)	ron	NMC		Port: 1/CHAN 45 (192.800), Physical Dev...	UP
1/CHAN 61 (191.600)	ron	NMC		Port: 1/CHAN 61 (191.600), Physical Dev...	UP
1/CHAN 46 (192.725)	ron-poc-ols-1-roadm	NMC		Port: 1/CHAN 46 (192.725), Physical Dev...	UP
1/CHAN 30 (193.925)	ron-poc-ols-2-roadm	NMC		Port: 1/CHAN 30 (193.925), Physical Dev...	UP
1/CHAN 1 (196.100)	ron-poc-ols-2-roadm	NMC		Port: 1/CHAN 1 (196.100), Physical Devic...	UP
1/CHAN 64 (191.375)	ron-poc-ols-1-roadm	NMC		Port: 1/CHAN 64 (191.375), Physical Dev...	UP
1/CHAN 30 (193.925)	ron-poc-ols-1-roadm	NMC		Port: 1/CHAN 30 (193.925), Physical Dev...	UP
1/CHAN 64 (191.375)	ron-poc-ols-2-roadm	NMC		Port: 1/CHAN 64 (191.375), Physical Dev...	UP
1/CHAN 48 (192.575)	ron-poc-ols-2-roadm	NMC		Port: 1/CHAN 48 (192.575), Physical Dev...	UP

- e. The filtered list shows that the router, *ron-poc-8201-1*, has a single ZR+ optics port. Select this port and click OK.

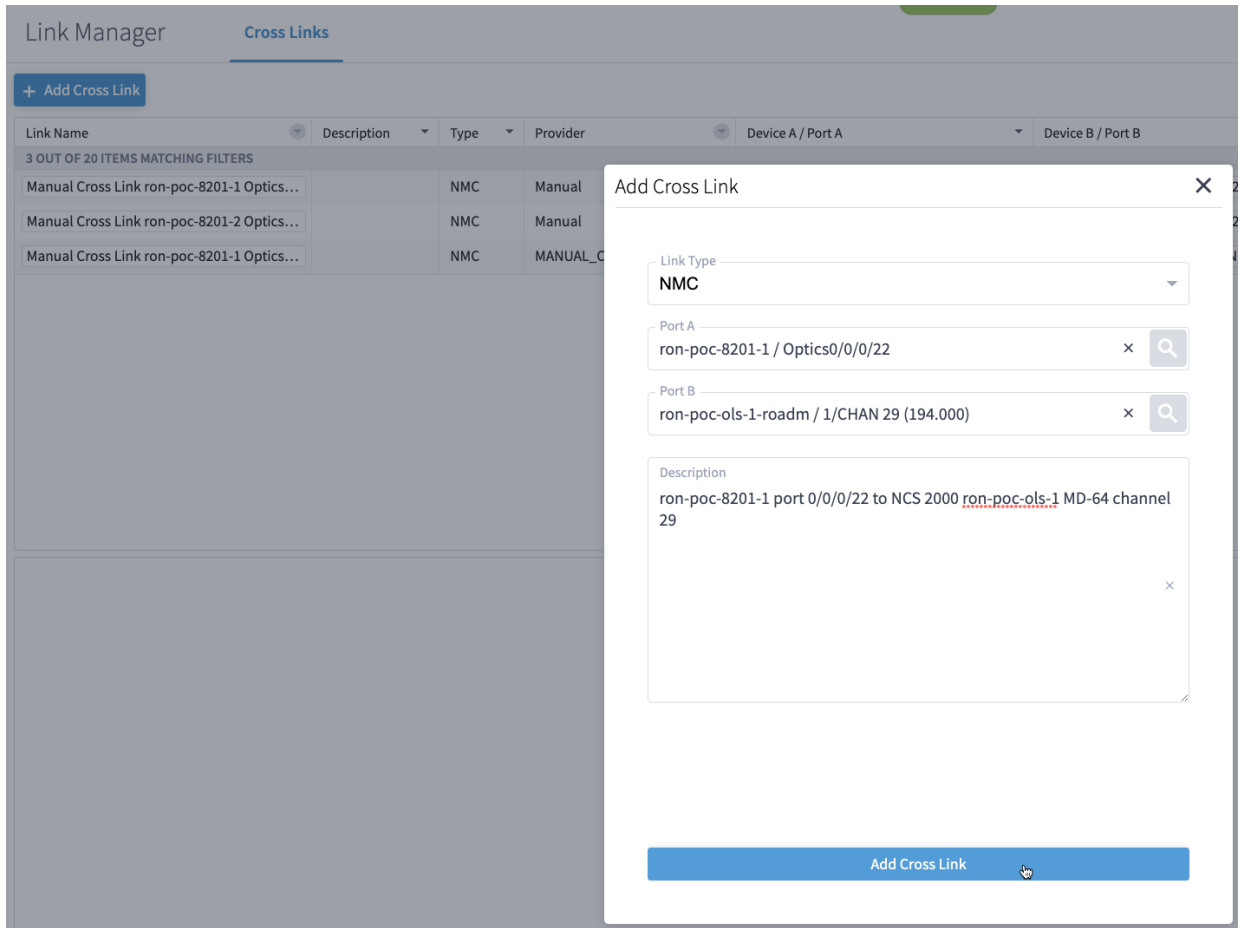


Name	Device	Type	Capacity	Description	Admin Status
1 ITEM MATCHING FILTERS					
Optics0/0/0/22	ron-poc-8201-1	OCH		OCH port of Cisco QSPDD 400G ZRP PL...	UP

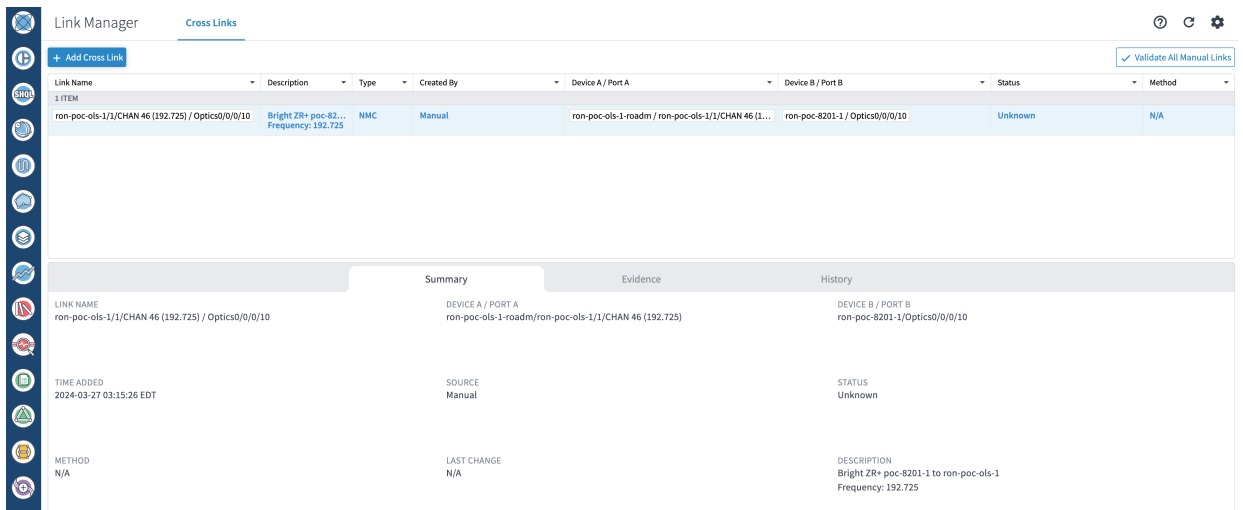
- f. Select the second port, which is the optical add-drop port. To filter for the add-drop port, set the device to *ron-poc-ols-1* and the name to *194.000*.



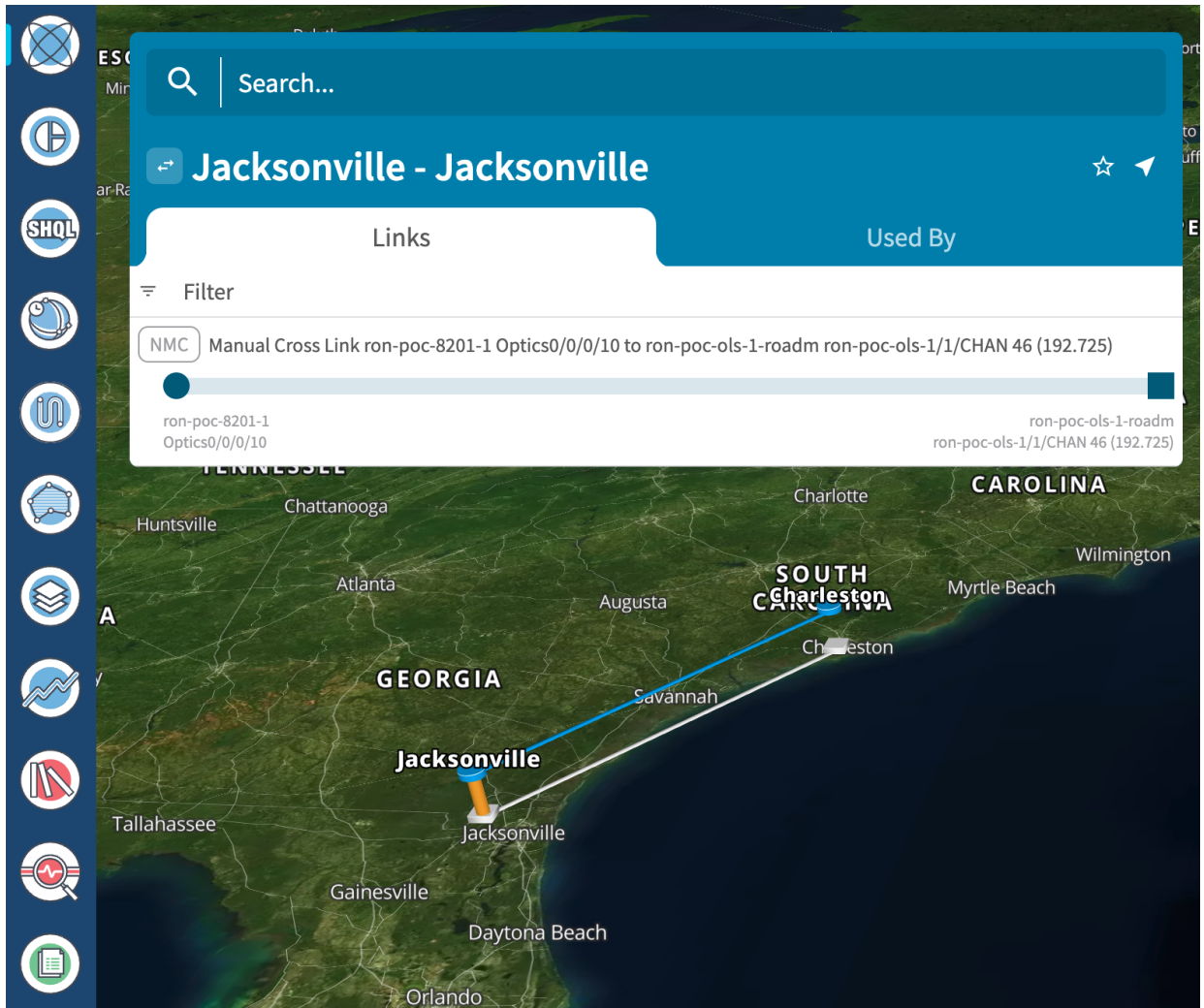
- g. Select the two ports, Ethernet and OCH, in your NMC cross-link. Click **Add Cross Link**.
(Optional) Add a description.



h. Click the added cross-link to see its attributes.



i. To view the added cross-link in the explorer app, click the link.



j. Create the second NMC cross-link using the same process as in the previous steps.

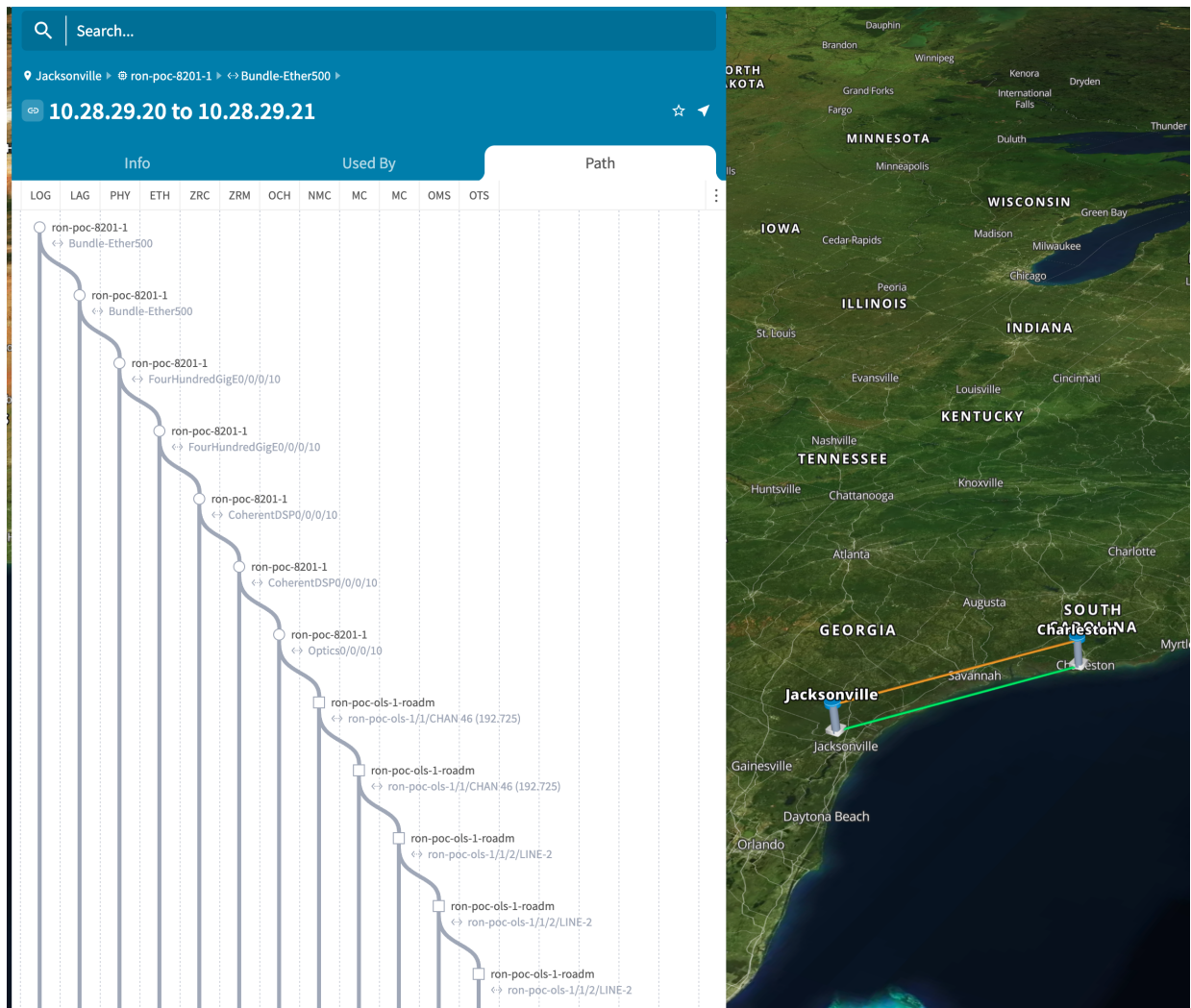
Link Manager Cross Links Validate All Manual

+ Add Cross Link

Link Name	Description	Type	Provider	Device A / Port A	Device B / Port B	Status	Method	Last Change
2 OUT OF 21 ITEMS MATCHING FILTERS								
Manual Cross Link ron-poc-8201-1 Optics0/0...	ron-poc-8201-1 ...	NMC	Manual	ron-poc-8201-1 / Optics0/0/0/22	ron-poc-ols-1-roadm / 1/CHAN 29 (194.000)	Unknown	N/A	2023-04-24 10:23:34 EDT
Manual Cross Link ron-poc-57b1-1 Optics0/0...	NCS-57B1 0/0/0/...	NMC	Manual	ron-poc-57b1-1 / Optics0/0/0/24	ron-poc-ols-2-roadm / 1/CHAN 29 (194.000)	Unknown	N/A	2023-04-24 10:29:55 EDT

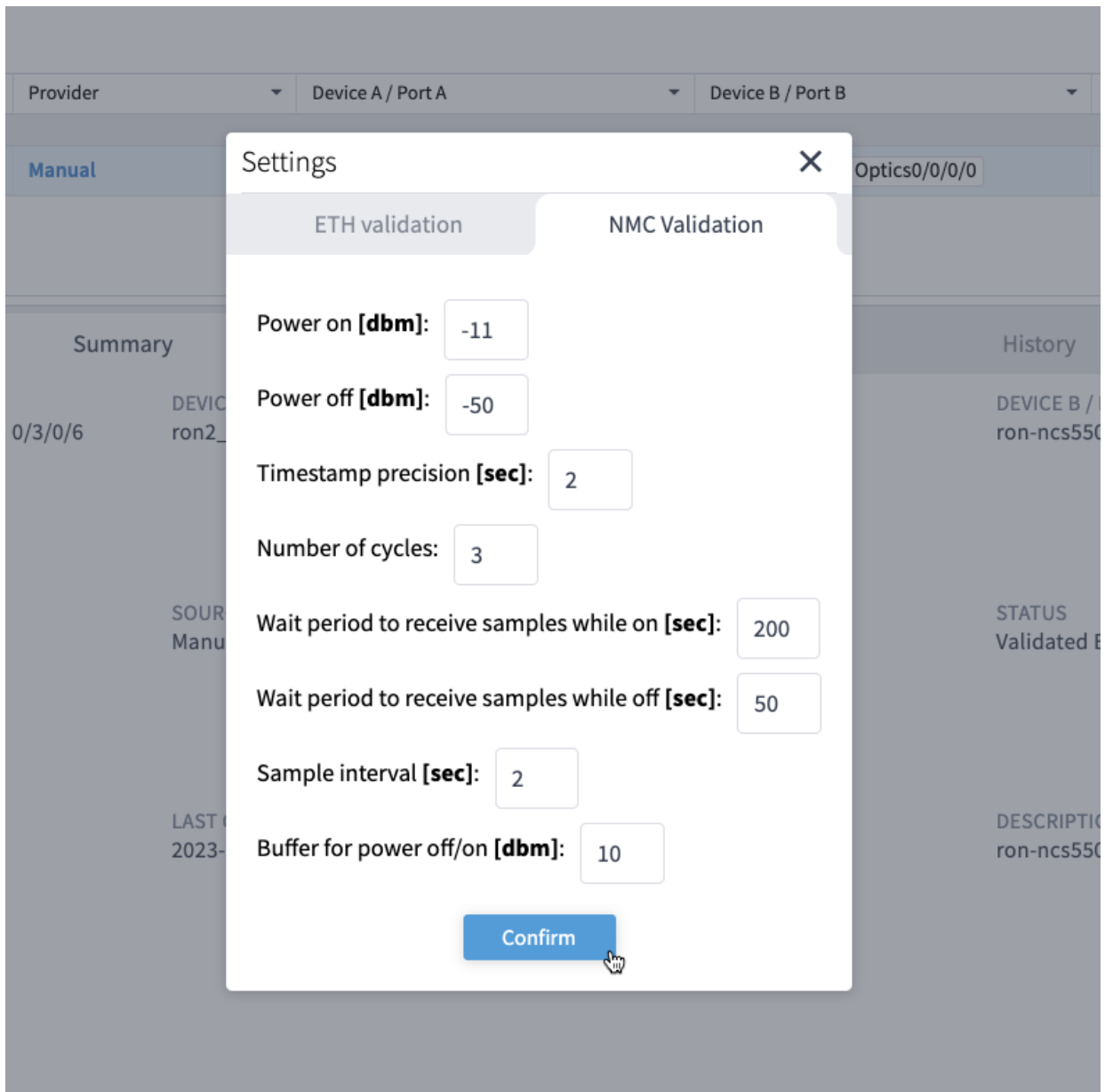
Summary		Evidence	History
LINK NAME	Manual Cross Link ron-poc-57b1-1 Optics0/0/0/24 to ron-poc-ols-2-roadm 1/CHAN 29 (194.000)	DEVICE A / PORT A	ron-poc-57b1-1/Optics0/0/0/24
		DEVICE B / PORT B	ron-poc-ols-2-roadm/1/CHAN 29 (194.000)
TIME ADDED	N/A	SOURCE	Manual
		STATUS	Unknown
METHOD	N/A	LAST CHANGE	N/A
		DESCRIPTION	NCS-57B1 0/0/0/24 to NCS 2000 MD-64 channel 29

k. View the end-to-end network with both cross-links in the Explorer app.



Step 2 (Optional) Cross-link connectivity verification

- Cross-link connectivity verification is supported on all router platforms and on NCS 1010 with MD-32 and BRK-24 modules.
 - Connectivity verification uses NSO CLI NED to modify router port state and transmit power, and is service-affecting.
 - When validation starts, Crosswork Hierarchical Controller continuously checks the RX power on the optical add-drop port while performing connectivity verification in the background.
- a. Configure NMC validation settings to control validation. Set the **Wait period to receive samples while on** to 180 seconds. Set the **Wait period to receive samples while off** to 50 seconds.



- b. Select a link and click **Validate Link**. Alternatively, you can click **Validate All Manual Links** to perform connectivity verification for all the links.

The screenshot shows the Link Manager interface with the 'Cross Links' tab selected. A table lists a cross link with the following details:

Link Name	Description	Type	Provider	Device A / Port A	Device B / Port B	Status	Method	Last Change
Manual Cross Link ron-ncs5504-1 Optic...	ron-ncs5504-1 / Optics0/0/0/0	NMC	Manual	ron2_olt2-roadm / 0/3/0/6	ron-ncs5504-1 / Optics0/0/0/0	Validated By Shut No Shut	Shut no shut	2023-03-30 04:39:03 EDT

Below the table, the 'Evidence' tab is active, showing a summary of the link's configuration and status. The status is 'Validated By Shut No Shut'. A 'Validate Link' button is visible at the bottom left, and a 'Delete Link' button is at the bottom right.

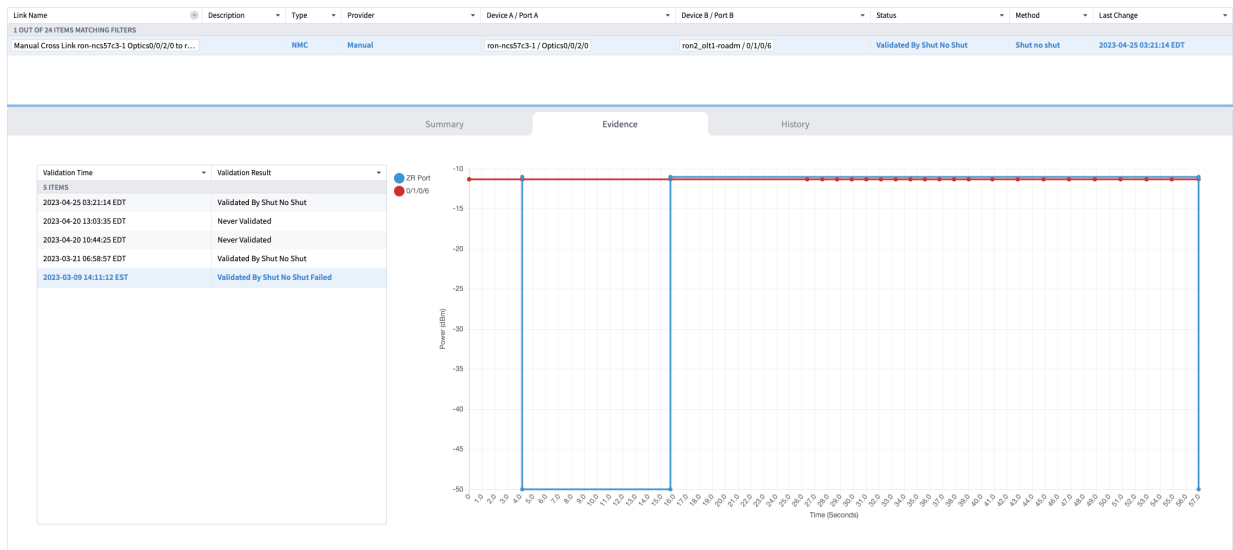
- c. After validation completes, inspect the evidence of successful or unsuccessful verification. This image shows a successful verification. The status changes from **Unknown** to **Validated By Shut No Shut**. It typically takes 60 to 80 seconds for the ZR or ZR+ interface to start transmitting after the no shut command is issued.

The screenshot shows the Link Manager interface with the 'Cross Links' tab selected. The table below shows a failed verification:

Validation Time	Validation Result
2023-03-30 04:39:03 EDT	Validated By Shut No Shut
2023-03-21 03:25:50 EDT	Validated By Shut No Shut
2023-03-09 14:08:00 EST	Validated By Shut No Shut Failed

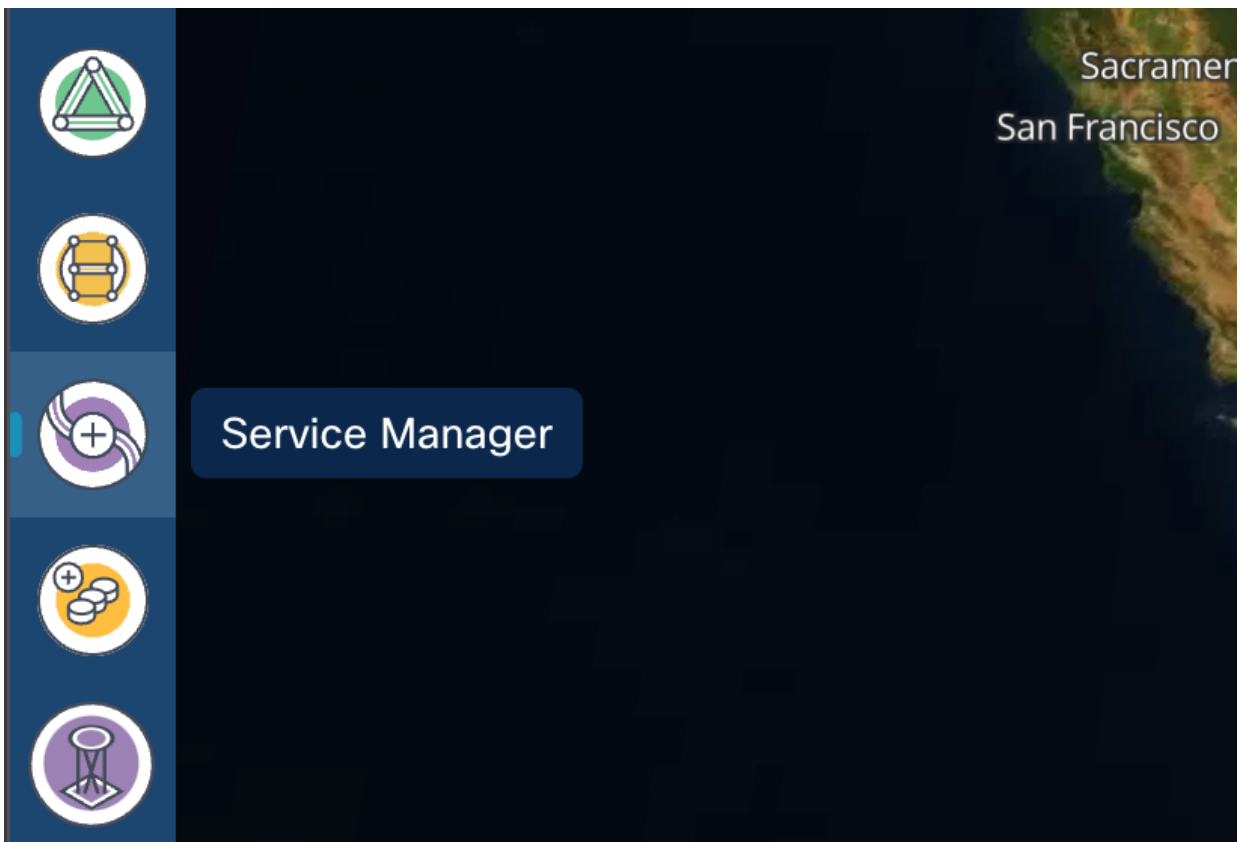
The 'Evidence' tab is active, showing a graph of Power (dBm) vs Time (Seconds). The graph shows a sharp drop in power from approximately -10 dBm to -50 dBm at the start of the test, followed by a period of stability at -50 dBm. A legend indicates that the blue line represents the ZR Port and the red line represents 0/3/0/6. The power levels remain constant at -50 dBm throughout the duration shown, indicating a failed verification.

This image shows a failed verification. There is no change in the optical device port power levels after the **no shut** operation.

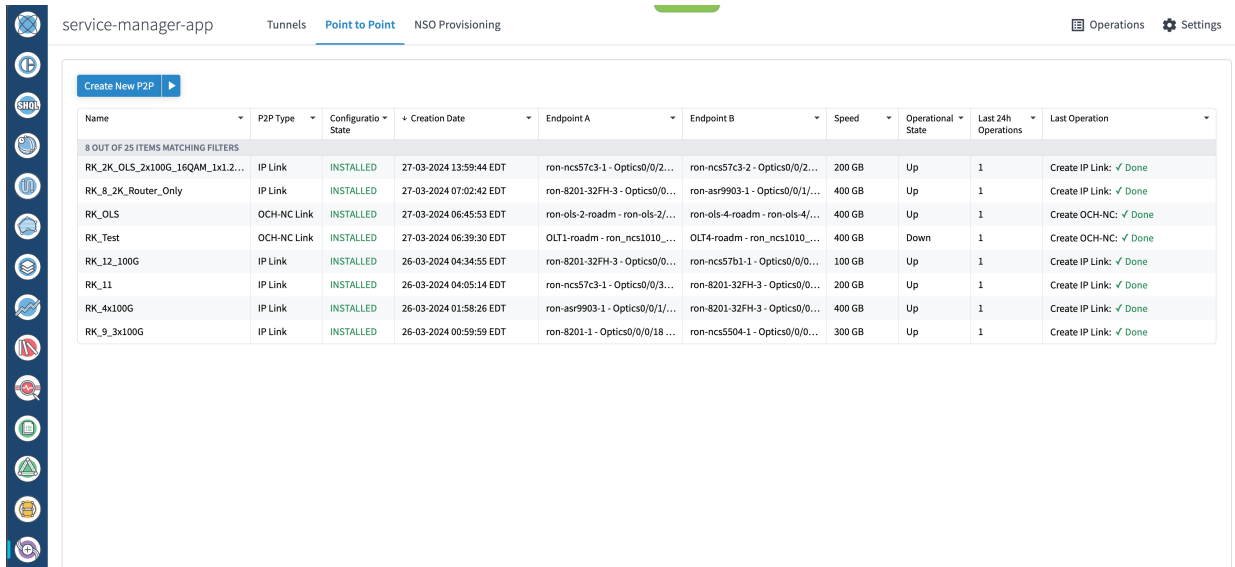


Step 3 Provision the Routed Optical Networking IP link using these steps:

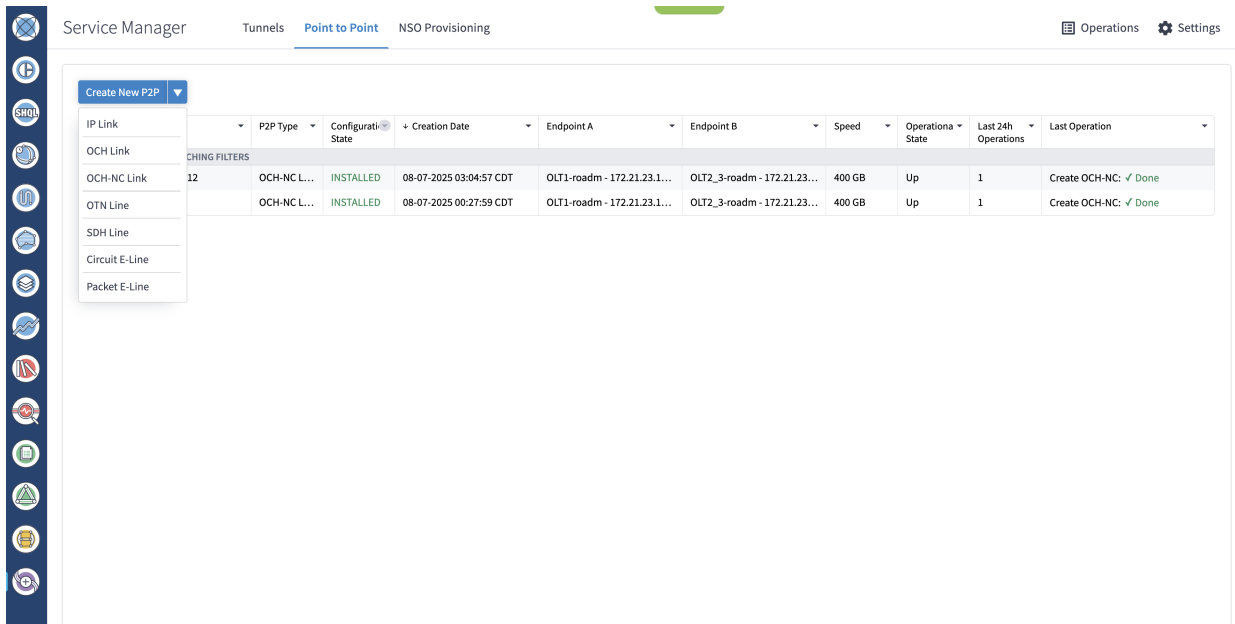
- a. In the applications bar in the Crosswork Hierarchical Controller, click the **Services Manager** icon.



The Service Manager application shows you a list of services.



- b. Select the **Point to Point** tab and click **IP Link** from the **Create New P2P** drop-down list to create end-to-end service between router DCO ports.



The **IP Link Creation** wizard appears.

- c. Enter the Cisco Crosswork Hierarchical Controller service name, description of the router optical controller, and the Link Rate Mode in the **General** tab.
 - Here, we are creating a 1x400G link. In 2x100G, 3x100G, and 4x100G modes, you can choose to create separate IP links or create a Bundle with each channel link added as a member.

Services Manager Tunnels **Point to Point** IP Services

Create New P2P ▶

Name	P2P Type	Configuration State	Creation Date	Endpoint A	Endpoint B
0 OUT OF 2 ITEMS MATCHING FILTERS					

IP Link Creation

1
2
3
4

GENERAL
ENDPOINTS
ADVANCED
SUMMARY

Name*
ron-poc-8201-1_ron-poc-57b1-1_1940000

Description
ron-poc-8201-1 0/0/0/20 to ron-poc-57b1-1 over NCS2K

Link Rate Mode*
400G - 1x400G

Router Configuration Only

× Cancel
< Back
Next >

Alternatively

- To create a 200G 16-QAM link, select the 200G–2x100G link rate mode.

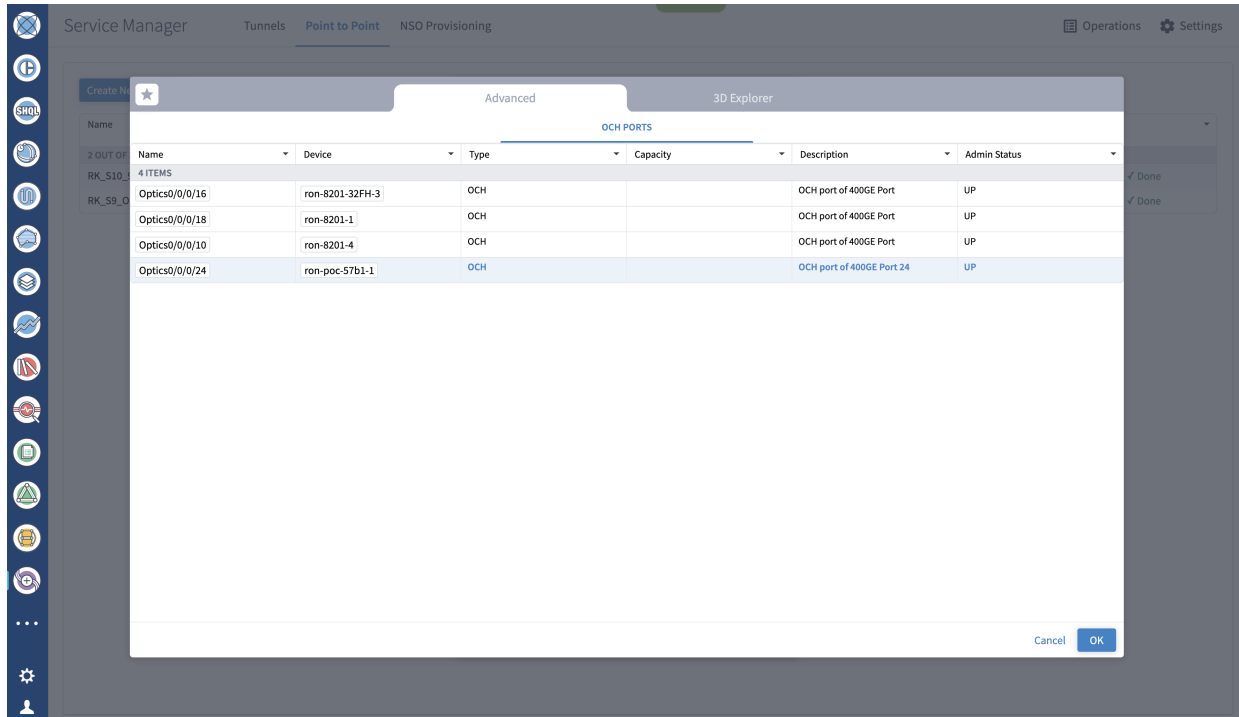
200G 16-QAM allows the use of 200G signals on 50Ghz optical line systems. The default value for 200G is QPSK at 60.1Ghz.

Alternatively

- To create a Bundle interface, Select a bundle option from the link rate mode drop down list.
You can create a 400G bundle interface (400G Member). You can also create a 300G bundle (3x100G Members) or a 200G bundle (2x100G Members).

(Optional) Check the **Router Configuration Only** check box to configure only the router optical controller and IP information and not the optical line system. This configuration is used when the OCHNC is created outside Cisco Crosswork Hierarchical Controller.

- d. Select the two router ports in the service. This is done by selecting the site and port. The transmit power for each endpoint is an optional parameter. The default transmit power is used if no value is provided.



- e. Click the magnifying glass icon to select the first router port.

The router interface selection displays interfaces on the router that satisfy these criteria:

- is a ZR or ZR+ interface,
- has no existing optics configuration, and
- has a proper NMC cross-connect configured.

This page lists all the available ZR and ZR+ ports currently unused on all the devices. Select the *ron-poc-8201-1 Optics0/0/0/22* port.

★		Advanced		3D Explorer	
OCH PORTS					
Name	Device	Type	Capacity	Description	Admin Status
17 ITEMS					
Optics0/0/0/24	ron-poc-57b1-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/24	ron-ncs57b1-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/14	ron-8201-32FH-3	OCH		OCH port of Cisco QDD 400G BRT ZRP Plug...	UP
Optics0/0/0/16	ron-8201-32FH-3	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/0	ron-ncs540-2dd-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/18	ron-8201-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/8	ron-8201-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	DOWN
Optics0/0/0/20	ron-8201-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/22	ron-8201-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/1/4	ron-asr9903-1	OCH		OCH port of 400G ZRP-S QSFPDD Module	UP
Optics0/0/1/8	ron-asr9903-1	OCH		OCH port of 400G ZR-S QSFPDD Module	UP
Optics0/0/0/10	ron-8201-2	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/20	ron-8201-2	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/0/22	ron-poc-8201-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plu...	UP
Optics0/0/0/20	ron-8201-4	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP
Optics0/0/3/0	ron-ncs57c3-1	OCH		OCH port of Cisco QDD 400G BRT ZRP Plug...	UP
Optics0/0/2/2	ron-ncs57c3-1	OCH		OCH port of Cisco QSFPDD 400G ZRP Plug...	UP

- f. Similar to the previous step, choose *ron-poc-57b1-1 Optics 0/0/0/24* as the second router port.
- g. (Optional) Set the transmit power in dBm on each port. If OLS provisioning is being performed, the OLS controller returns the optical power. If the OLS controller does not return the optical power or **router only** provisioning is being used, the router default power is used.
- h. (Optional) Enter the IP address information for interfaces. If IP addresses are not entered, ZR and ZR+ router optical configuration happens; however, IP addresses are not configured.
- i. Click **Next** to move to **Advanced** configuration.

- j. (Optional) Set the frequency. If optical provisioning is being performed, the OLS controller can return the frequency to be used, and it may be omitted. If **router only** provisioning is being performed, the frequency must be specified.
- k. (Optional) Set the DAC rate. A DAC rate setting can be used to enable OpenZR+ compatibility mode, disabling TX shaping and enhanced modem mode.

- l.** (Optional) Set links or nodes to include or exclude in the optical path. This setting is not available in **router only** provisioning.
- m.** (Optional) To add the new link or set of links to an existing Bundle LAG interface configured on the routers, choose the bundle from the **Add to existing LAG** drop-down.

- n. (Optional) If you are configuring a 200G 16-QAM link, set the DAC rate to 1 x 1.25.
200G link rate mode enables the **Modulation** selection drop-down. Modulation selection is not available in any other mode. Select the 16 QAM (30GHz) modulation.

- o. Click **Next** to review the final configuration. Verify the router endpoint and optical line system parameters. Click **Finish** to start provisioning, or click **Save** to save for later provisioning.

IP Link Creation

1
GENERAL

2
ENDPOINTS

3
ADVANCED

4
SUMMARY

Name: ron-poc-8201-1_ron-poc-57b1-1_1940000
Description: ron-poc-8201-1 0/0/0/20 to ron-poc-57b1-1 over NCS2K

▼ **Endpoint A**
Port: ron-poc-8201-1 - Optics0/0/0/22
Transmit Power: -10.0 dBm

▼ **Endpoint B**
Port: ron-poc-57b1-1 - Optics0/0/0/24
Transmit Power: -10.0 dBm

Link Rate Mode: 400G - 1x400G
Frequency: 194.0 THz
DAC rate: -
Modulation: -

Path Criteria: Latency
Optical Excluded List: -
Included List: -
Disjoint From Links: -

✕ Cancel

< Back> FinishSave

This image shows a sample summary for a 200G 16-QAM link.

- p. Go to Services Manager to view provisioning progress.

Click the **Operations > Logs** tab to view the provisioning API calls used and responses. The logs show API calls and responses for both optical line system provisioning through Cisco Optical Network Controller and router provisioning through Crosswork Network Controller.

Services Manager Tunnels **Point to Point** IP Services Operations Settings

Create New P2P ▶

Name	P2P Type	Configuration State	Creation Date	Endpoint A	Endpoint B	Speed	Operational State	Last 24h Operations	Last Operation
1 OUT OF 3 ITEMS MATCHING FILTERS									
ron-poc-8201-1_ron-poc-57b1-1_1940000	IP Link	IN PROGRESS	24-04-2023 14:44:21 UTC	ron-poc-57b1-1 - Optics0/0/0/2...	ron-poc-8201-1 - Optics0/0/0/2...	400 GB		1	Create IP Link: Discovery

ron-poc-8201-1_ron-poc-57b1-1_1940000

Summary Endpoints Underlay Path **Operations** Events Actions

Action	Lifecycle State	Creation Date	Last Update
1 ITEM			
Create IP Link	Discovery	24-04-2023 14:44:20 UTC	24-04-2023 14:44:27 UTC

SUMMARY LOGS ERRORS

Normal Flow

- Adapter #1: onc-poc-90 ✓
 - create service
 - create service response

If the provisioning is successful, the **Configuration State** field changes to INSTALLED state and the **Operational State** field changes to UP state.

Services Manager Tunnels **Point to Point** IP Services Operations Settings

Create New P2P ▶

Name	P2P Type	Configuration State	Creation Date	Endpoint A	Endpoint B	Speed	Operational State	Last 24h Operations	Last Operation
1 OUT OF 3 ITEMS MATCHING FILTERS									
ron-poc-8201-1_ron-poc-57b1-1_1940000	IP Link	INSTALLED	24-04-2023 14:44:21 UTC	ron-poc-57b1-1 - Optics0/0/0/2...	ron-poc-8201-1 - Optics0/0/0/2...	400 GB	Up	1	Create IP Link: Done

ron-poc-8201-1_ron-poc-57b1-1_1940000

Summary Endpoints Underlay Path Operations Events Actions

GUID: SI/7d4cd30b6c6d4eb7ad44a41269d2d45b
Name: ron-poc-8201-1_ron-poc-57b1-1_1940000
Creation Time: 24-04-2023 14:44:21 UTC
Last Changed: 24-04-2023 14:44:21 UTC
Template Name: default-template

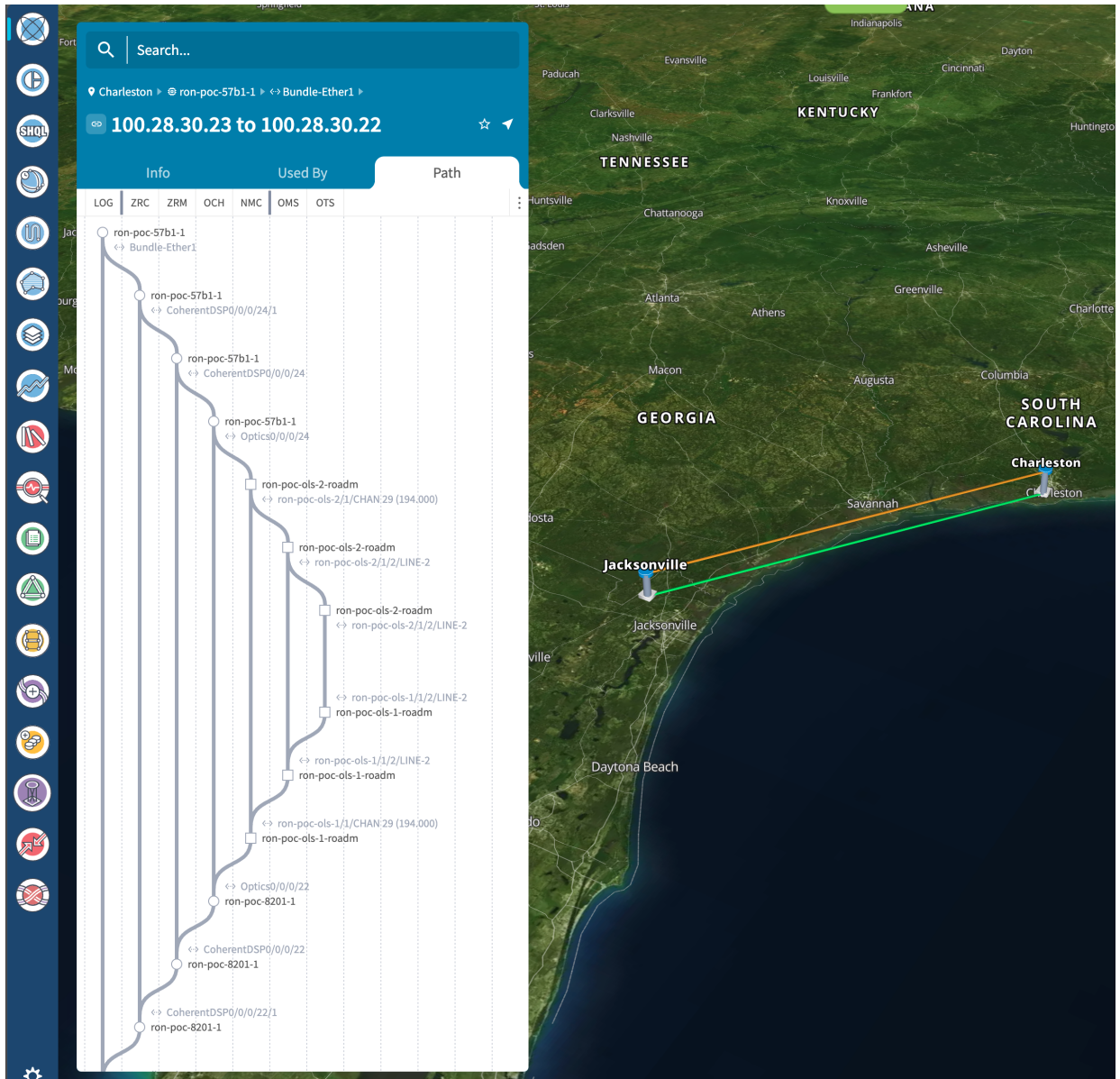
Service Links:

- 100.28.30.23 to 100.28.30.22

IP Address Assignment Policy: User Allocated
Is Bundle? No
Channel Config: 1 X 400G
Path Criteria: Latency

The **Summary** tab displays the new service link.

- q. Verify the end-to-end link across both IP and optical layers in the Explorer view.



Step 4 Use the Link Assurance application to verify the end-to-end path and view relevant PM data. Select a link or port to see data on the ZRM, OCH, and OTS layers.

The screenshot displays the Link Assurance interface for monitoring a logical link between Charleston and Jacksonville. The link is identified as "100.28.30.23 to 100.28.30.22 L3 Logical Link". The diagram shows two routers, ron-poc-5761-1 and ron-poc-8201-1, connected via an optical network controller (OTN) consisting of ron-poc-ols-2 and ron-poc-ols-1. The interface includes a sidebar with navigation icons, a main panel with a diagram of the link, and a table of performance metrics.

Define Valid Links For Inspection By:

- Specific link(s) / underlay link(s)
- Tags
- Device(s) in 1 of the endpoints
- Device(s) in both endpoints

Summary

Name	Layer	Admin Status	Operational Status	Endpoint A
Fiber-1	OTS	UP	UP	ron-poc-ols-1-roadm

Performance

Endpoint Z	Port A Tx Power [dbm]	Port Z Tx Power [dbm]	Port A Rx Power [dbm]	Port Z Rx Power [dbm]
ron-poc-ols-2-roadm	Min: -0.50 Average: -0.50 Max: -0.40	Min: 2.60 Average: 2.60 Max: 2.60	Min: -4.00 Average: -4.00 Max: -4.00	Min: -7.30 Average: -7.30 Max: -7.20

Operate phase

To monitor ZR or ZR+ optics, use EPNM and Crosswork Health Insights.

1. Use either CLI commands or EPNM to monitor router ZR or ZR+ optics for proper operation. See [Monitor ZR or ZR+ optics using EPNM, on page 74](#).
2. (Optional) Setup router ZR or ZR+ optics data collection in Crosswork Health Insights. See [Monitor ZR or ZR+ optics performance Using KPIs, on page 84](#).

To monitor NCS 1010, use Cisco Optical Network Controller and Cisco Optical Site Manager.

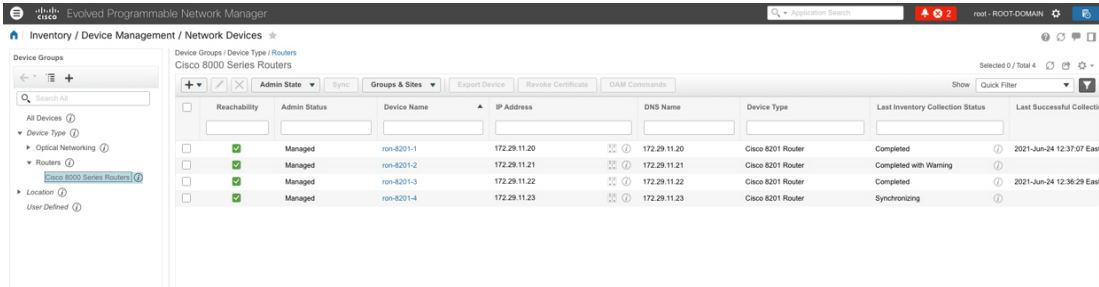
- [Monitoring using Cisco Optical Network Controller](#)
- [Network and Circuit Monitoring using Workspaces in Cisco Optical Network Controller](#)
- [Monitoring Alarms in Cisco Optical Network Controller](#)
- [Fault Monitoring using Cisco Optical Site Manager](#)

Monitor ZR or ZR+ optics using EPNM

Follow these steps to add the 8201 router to EPNM for monitoring the PM parameters on the ZR or ZR+ optics.

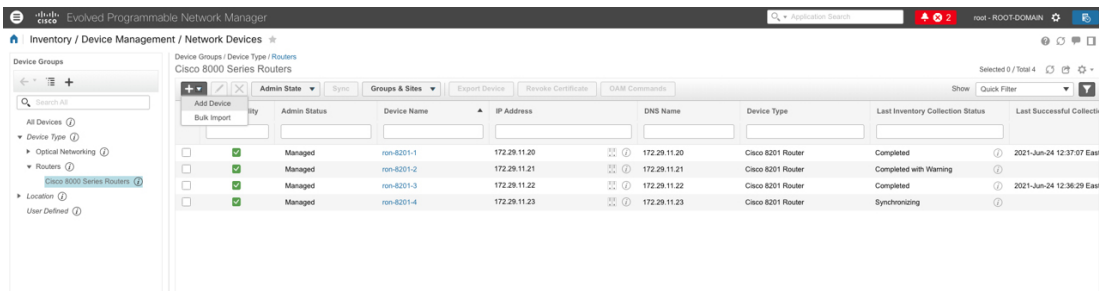
Procedure

Step 1 Choose **Inventory > Device Management > Network Devices** to add a new device to EPNM. Click **Routers** or a subgroup if it is already defined in the left panel.



521942

Step 2 Click the **+** icon above the Network Devices table, then choose **Add Device**.



521943

Step 3 Configure the General, SNMP, and SSH parameters as shown in the figures. Then click **Verify Credentials** to confirm that Cisco EPN Manager can reach the device. Click **Add** to add the device to EPNM.

Add Device



- * General ✔
- * SNMP
(Optional if TL1 is configured)
- Telnet/SSH
- HTTP/HTTPS
- TL1
- Civic Location

*** General Parameters**

IP Address

DNS Name

License Level ?

Device Role ?

Add to Group ?

Credential Profile ?

521945

Add Device



- * General ✔
- * SNMP
(Optional if TL1 is configured)
- Telnet/SSH ✔
- HTTP/HTTPS
- TL1
- Civic Location

Telnet/SSH Parameters

Protocol

* Port

* Timeout (secs)

Username

Password

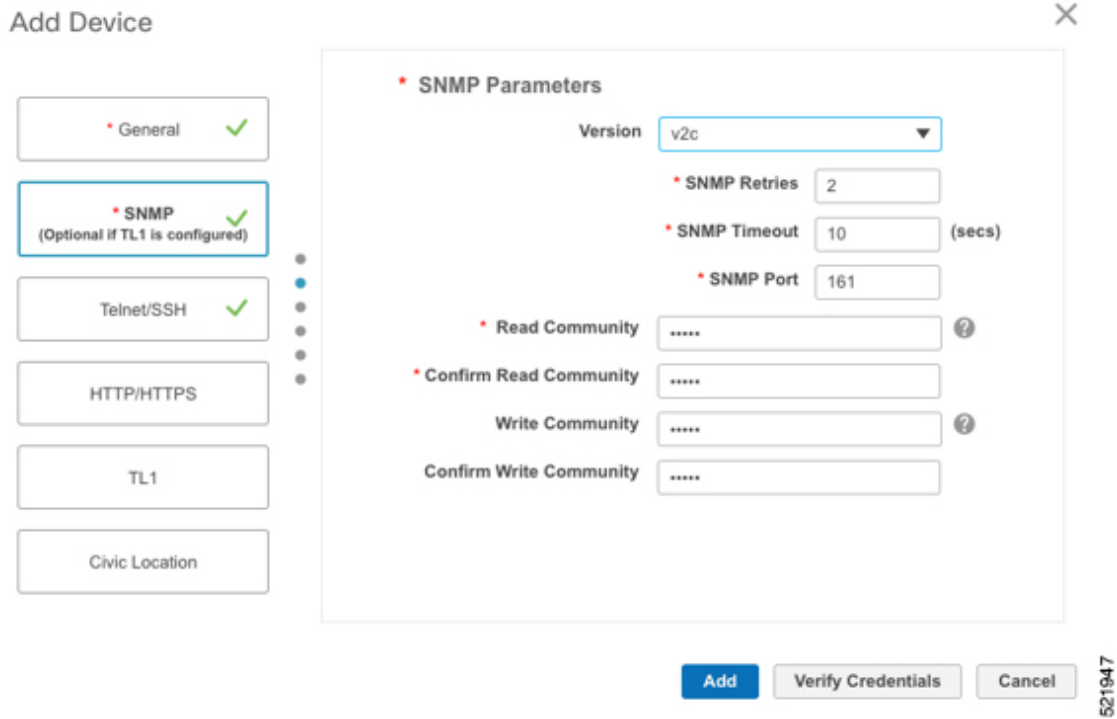
Confirm Password

Enable Password ?

Confirm Enable Password

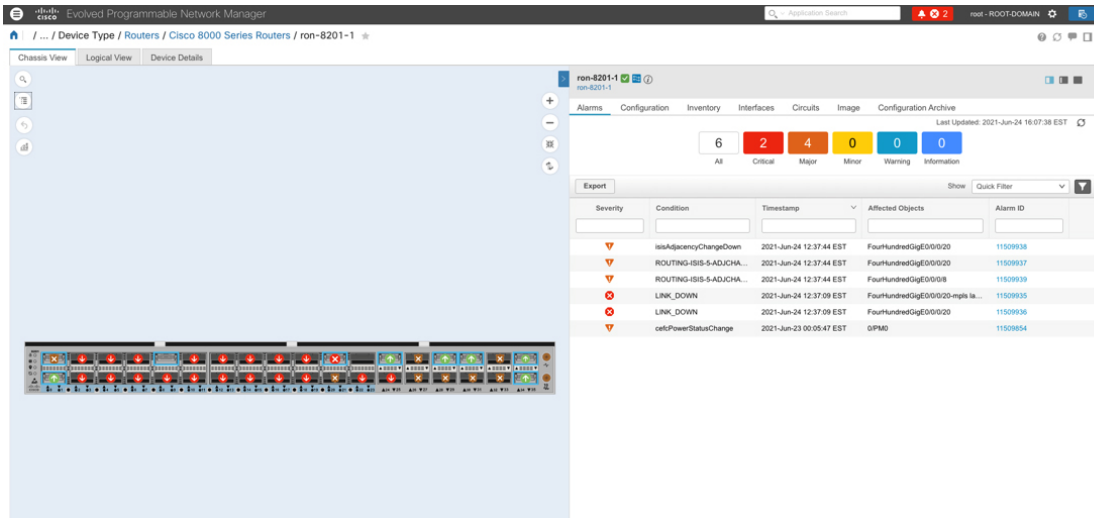
* Note: Not providing Telnet/SSH credentials may result in partial collection of inventory data.

521946



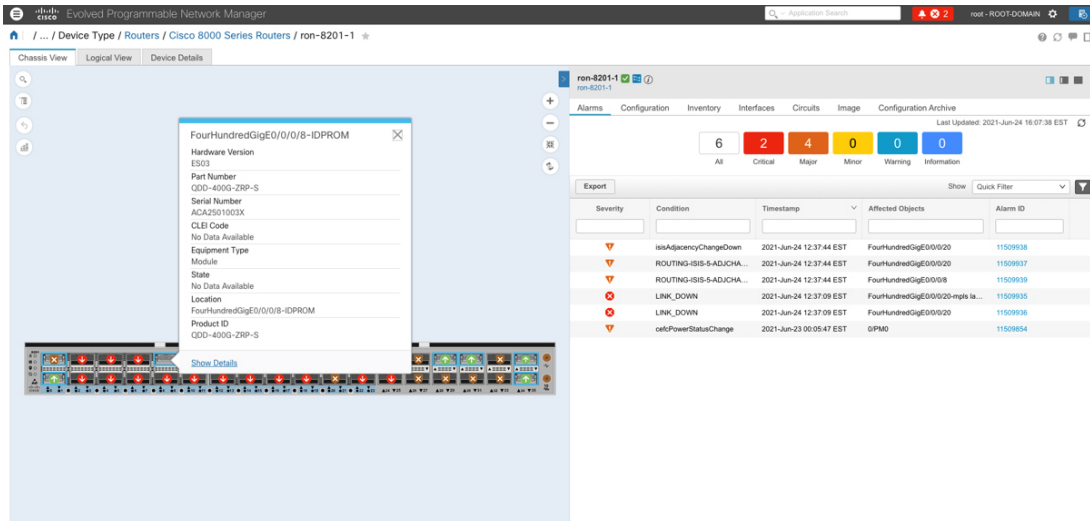
521947

Step 4 Click the device name link in the Network Devices table to open the chassis view. This figure shows the chassis view of the 8201 router.



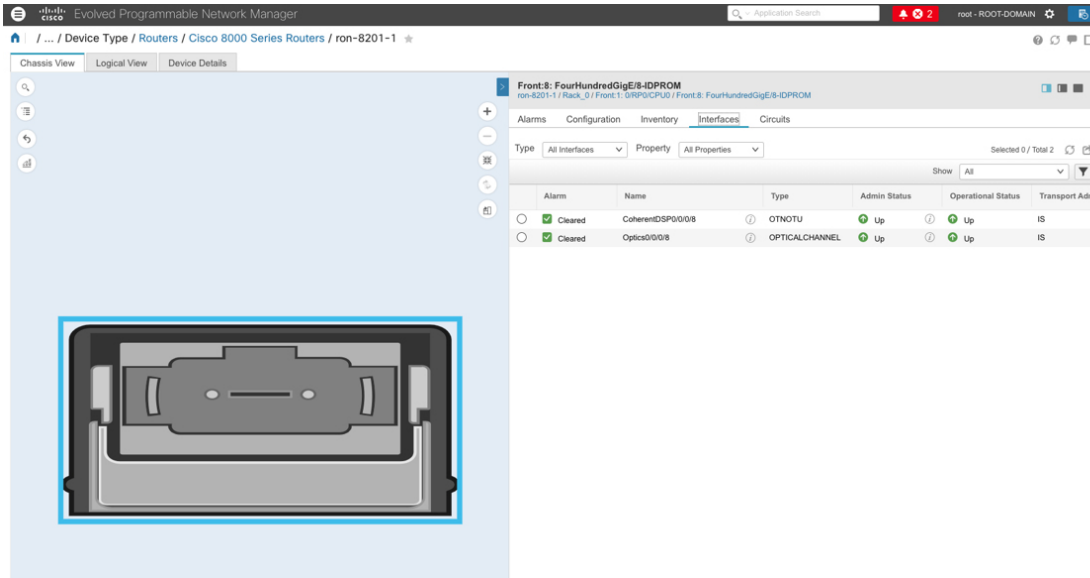
521948

Step 5 Click the QSFP-DD ZR+ port to view details about that port.



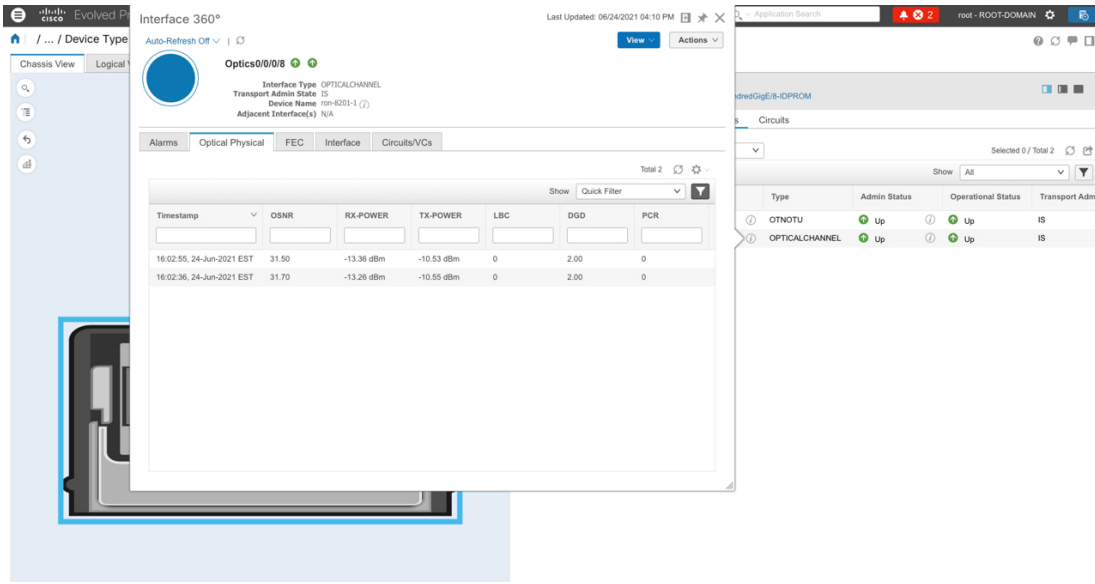
521949

Here, you can view the port, the specific optical channel, and the CoherentDSP entities.



521950

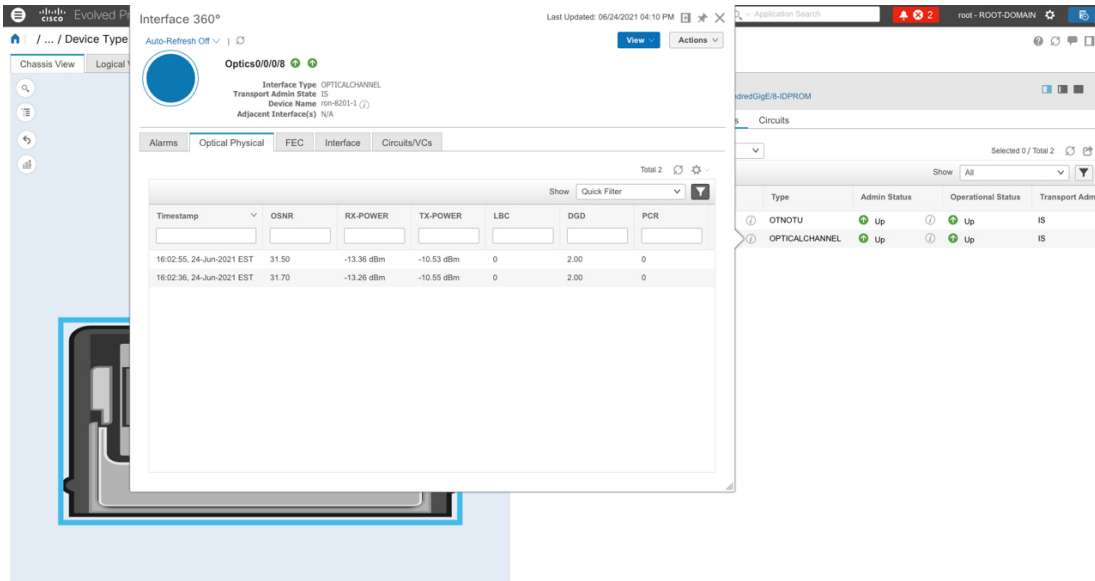
Step 6 Click the additional information icon for the optical channel. Then select the **Optical Physical** measurement tab to display relevant optical PM values such as **RX/TX signal power** and **OSNR** values.



521951

Step 7

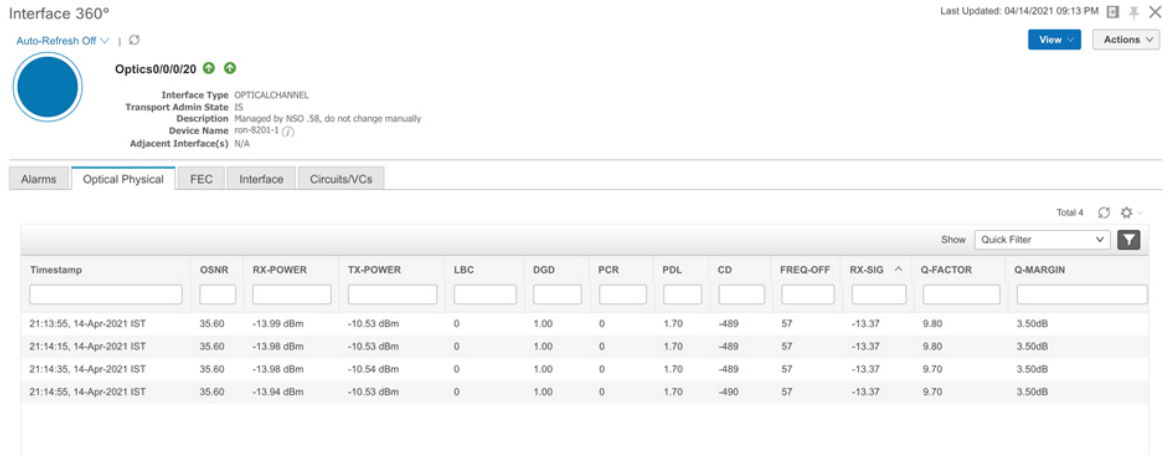
Click the additional information icon for the coherent DSP. Then select the **FEC** measurement tab to display relevant coherent DSP FEC statistics such as **PreFEC Bit Error Rate**, **Bit Error Rate Count (BIEC)**, and **Uncorrected Words (UCW)**. The UCW value must remain 0.



521951

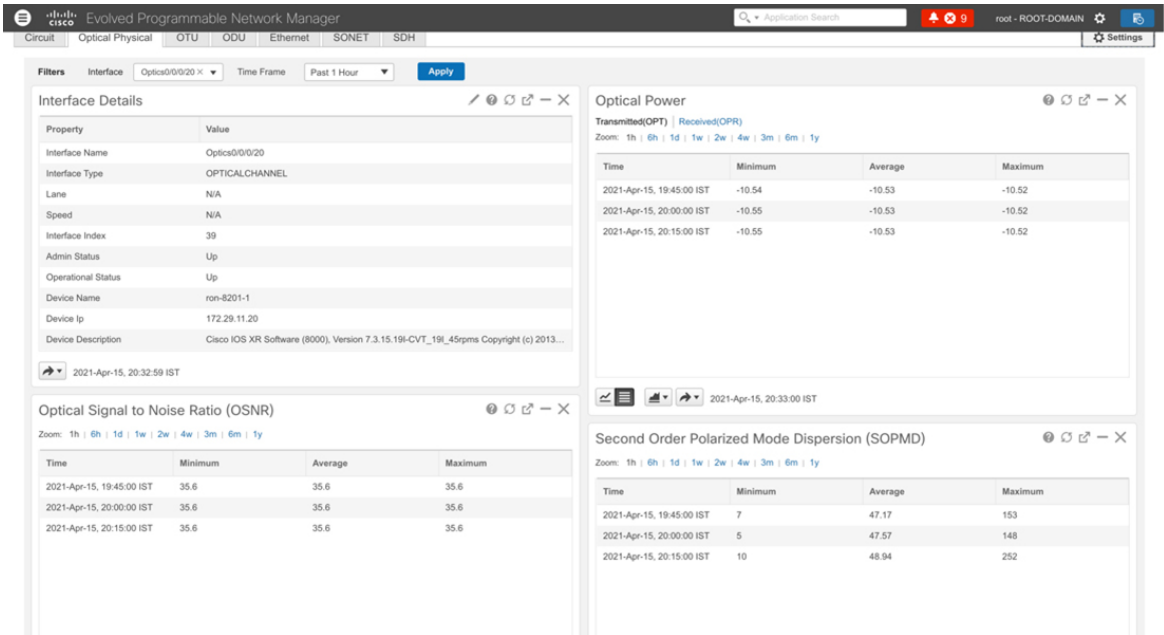
These figures display EPNM monitoring data relevant to ZR or ZR+ optics, including current and historical performance.

Figure 34: Optical physical parameters



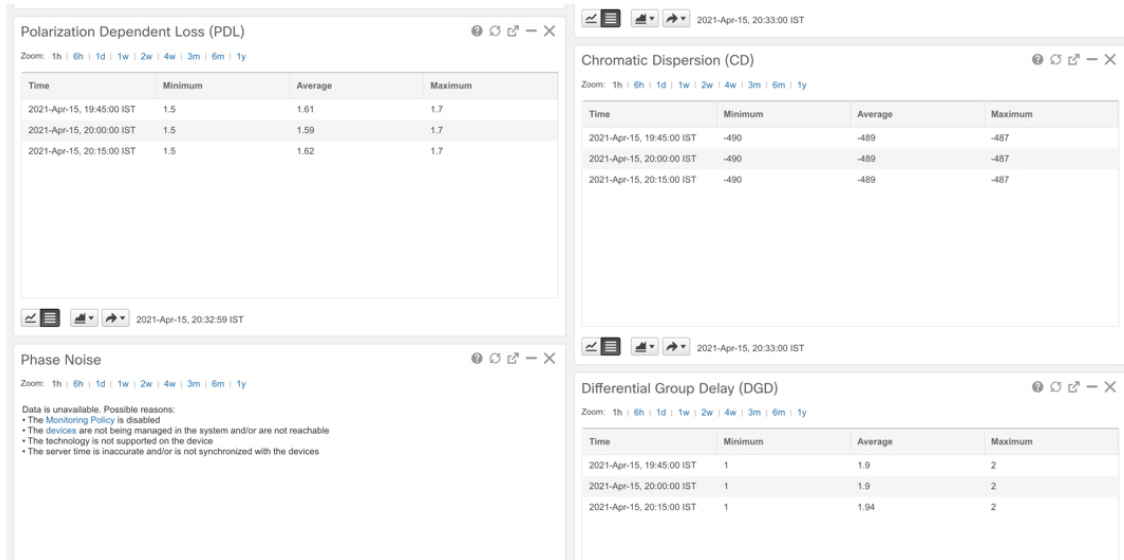
521883

Figure 35: Historical optical physical parameters



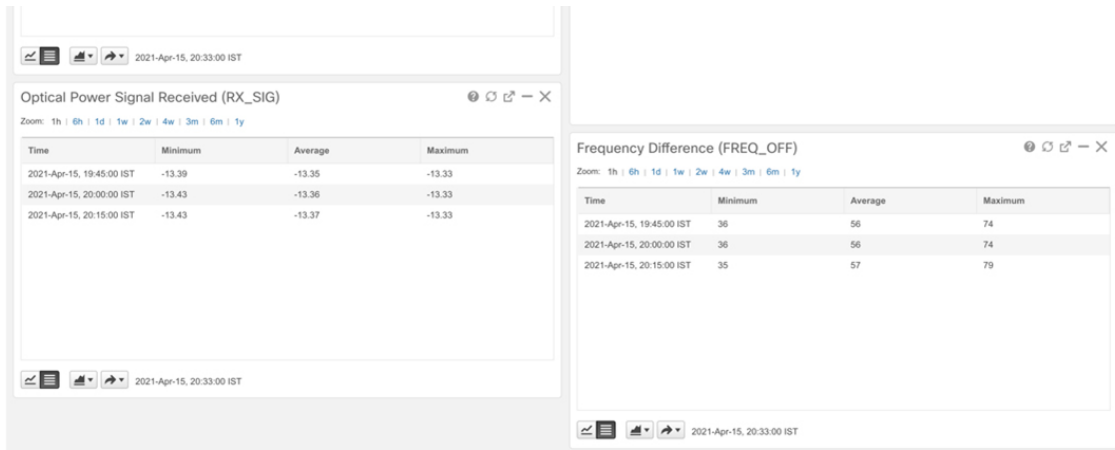
521884

Figure 36: Historical optical physical parameters



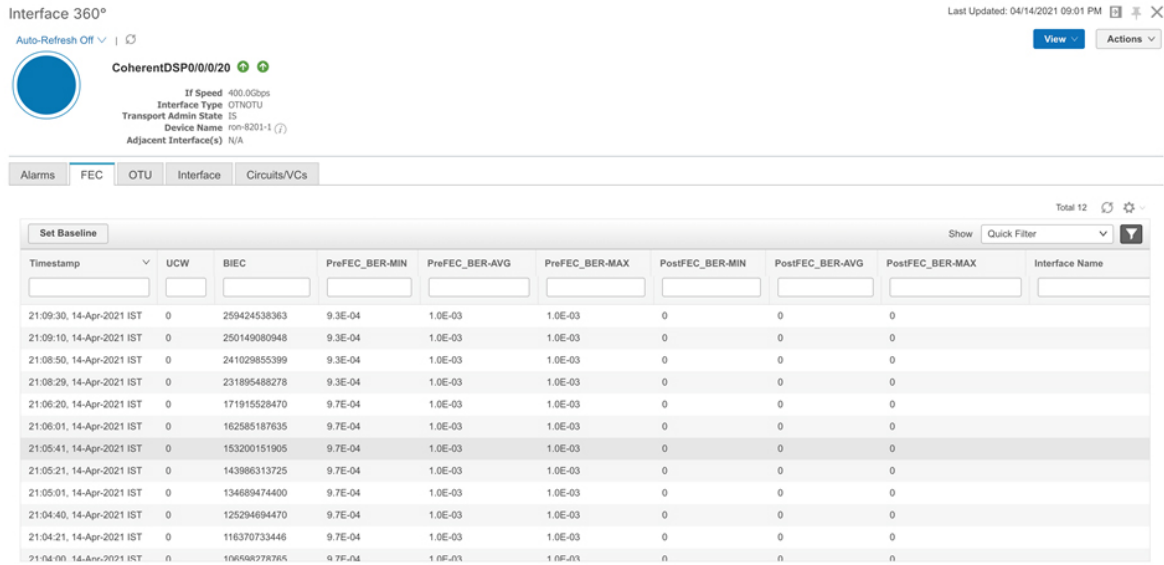
521885

Figure 37: Historical optical physical parameters



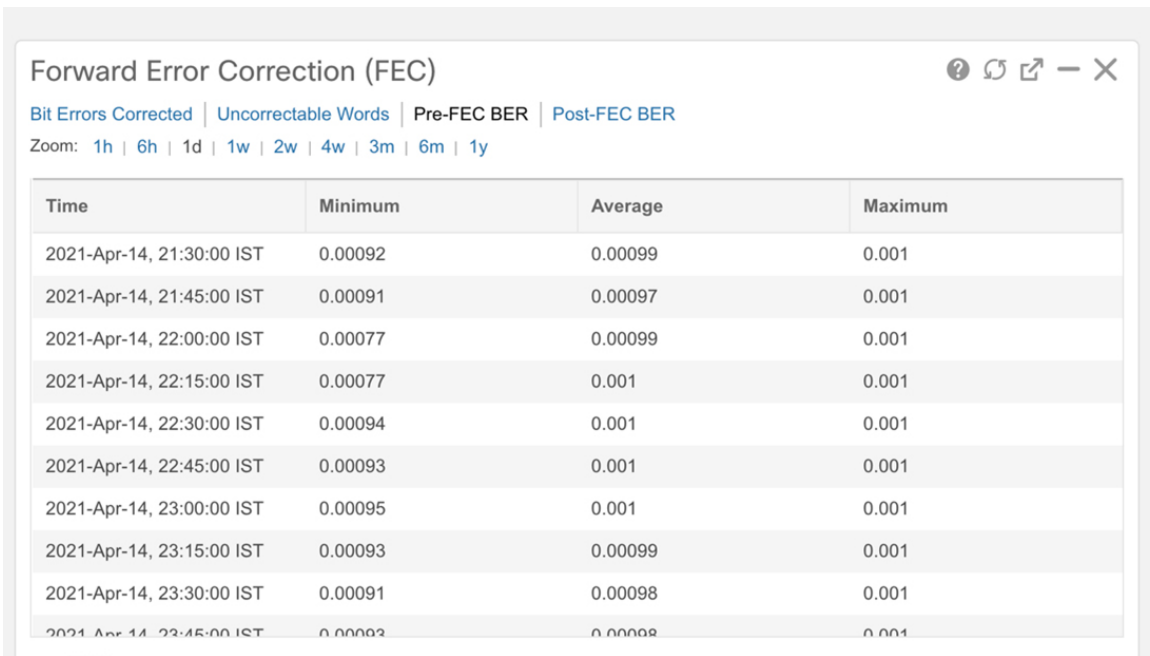
521888

Figure 38: FEC parameters



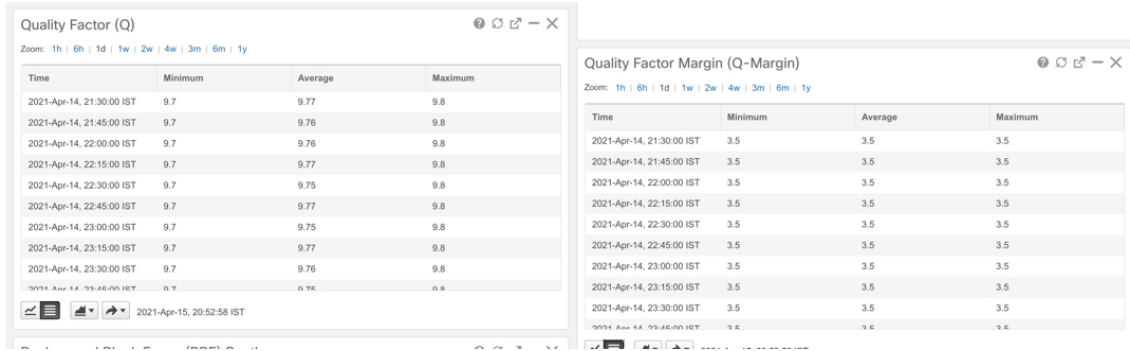
521881

Figure 39: Historical FEC parameters



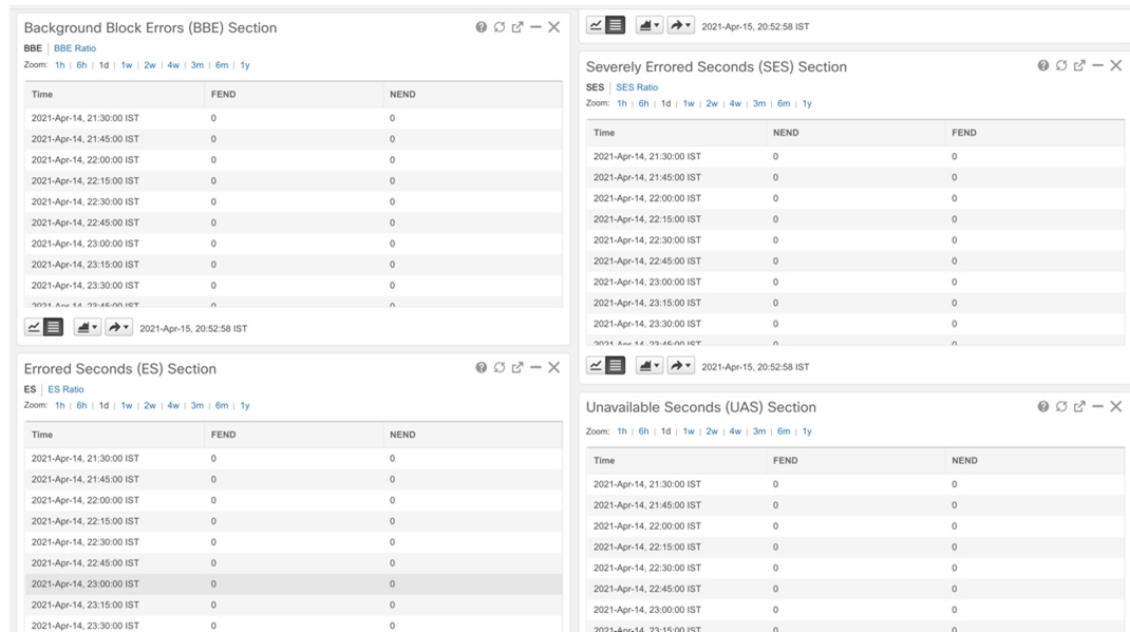
521889

Figure 40: Historical FEC parameters



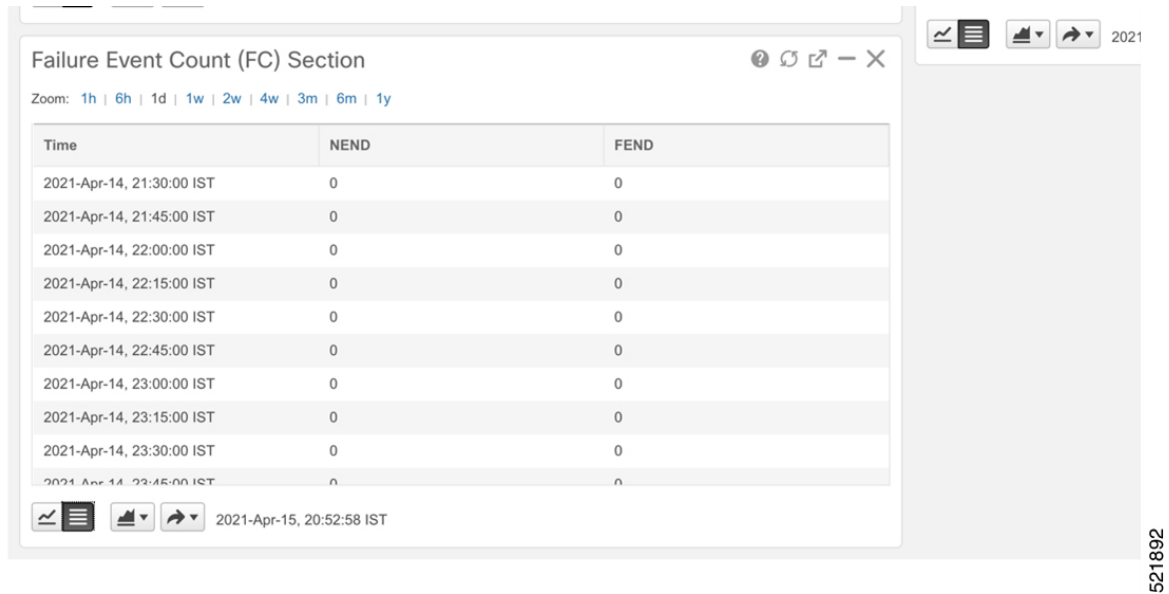
521890

Figure 41: Historical OTN parameters



521891

Figure 42: Historical OTN parameters



Monitor ZR or ZR+ optics performance Using KPIs

The purpose of the task is to enable KPI monitoring for ZR or ZR+ optics to track device health using Health Insights.

Use the KPIs supplied by Cisco to monitor specific network optics. Configure and enable KPI profiles on devices to start health monitoring.



Note Decide which KPIs supplied by Cisco to use for each device based on its function and the performance characteristics you want to monitor. Review the KPIs supplied by Cisco documented in [List of Health Insights KPIs](#). The image shows the available default L1 optics KPIs.

Key Performance Indicators (KPIs) configuration page showing available default L1 optics KPIs.

KPI Name	Category	Description	Linked Playbook
<input type="checkbox"/> Layer 1 optical alarms	Layer1-Optics	Monitors per-port optical alarms	
<input type="checkbox"/> Layer 1 optical errors	Layer1-Optics	Monitors per-port Layer 1 errors; generates ale...	
<input type="checkbox"/> Layer 1 optical FEC errors	Layer1-Optics	Monitors per-port optical FEC errors; generate...	
<input type="checkbox"/> Layer 1 optical power	Layer1-Optics	Monitors per-port optical power; generates ale...	
<input type="checkbox"/> Layer 1 optical temperature	Layer1-Optics	Monitors per-port optical temperature; generat...	
<input type="checkbox"/> Layer 1 optical voltage	Layer1-Optics	Monitors per-port optical voltage; generates al...	

521913

Procedure

Step 1 Group the relevant KPIs to create a KPI Profile focused on optics.

A KPI profile can have many different KPIs assigned. In this procedure, add only specific optics KPIs to the **optics_profile** KPI profile.

Performance Alerts / KPI Profiles / Create Profile

Create New Profile

Profile Name * Description

External Destination Details

Server Type Name

Add KPIs to Profile

All KPIs Recommended KPIs

	Category	KPI	Summary
	optics		
<input type="checkbox"/>	Layer1-Optics	Layer 1 optical alarms	Monitors per-port optical alarms
<input type="checkbox"/>	Layer1-Optics	Layer 1 optical errors	Monitors per-port Layer 1 errors; generates alert when error rates exceeds the configured threshold
<input type="checkbox"/>	Layer1-Optics	Layer 1 optical FEC errors	Monitors per-port optical FEC errors; generates an alert when FEC errors exceeds the configured th...
<input checked="" type="checkbox"/>	Layer1-Optics	Layer 1 optical power	Monitors per-port optical power; generates alert when power levels exceeds the configured threshold
<input checked="" type="checkbox"/>	Layer1-Optics	Layer 1 optical temperature	Monitors per-port optical temperature; generates alert when temperature exceeds the configured th...
<input checked="" type="checkbox"/>	Layer1-Optics	Layer 1 optical voltage	Monitors per-port optical voltage; generates alert when voltages exceeds the configured threshold

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See [Create a New KPI Profile](#).

Step 2

Enable the appropriate KPI Profile on target devices you want to monitor.

- From the main menu, choose **Performance Alerts > Enable/Disable KPI Profiles**.
- Check the checkboxes for all nodes where you want to apply the profile.
- Choose the KPI profile and click **Enable KPI Profiles**.

You can select multiple nodes. The image shows the KPI profile being applied to a single node.

Performance Alerts / Enable/Disable KPI Profiles

Select By Device Device Tags

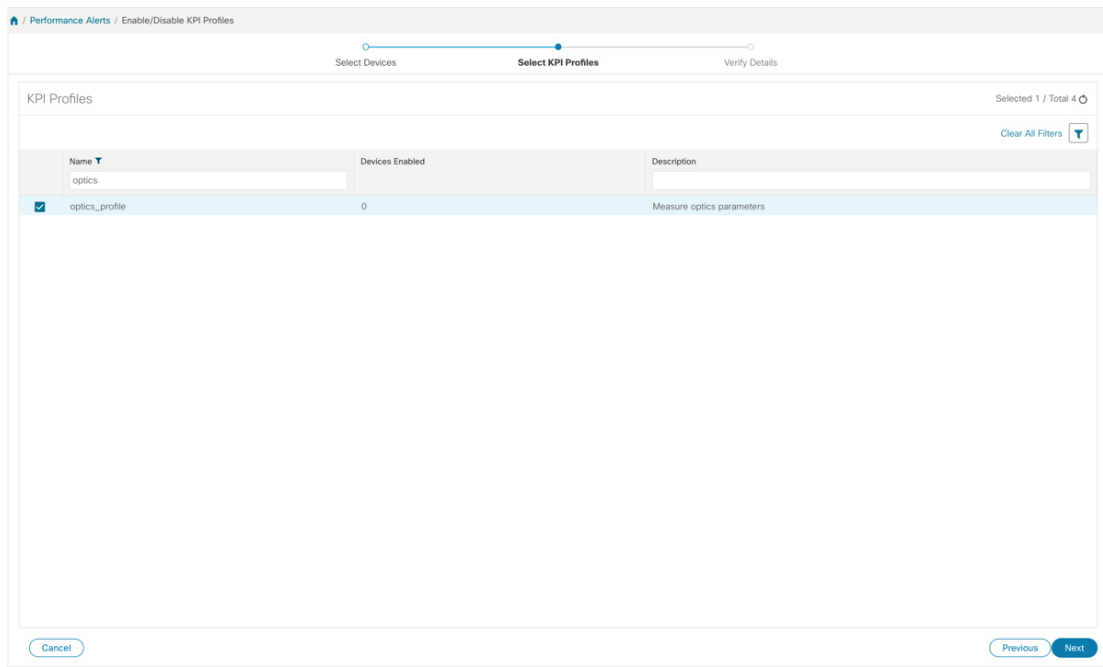
Devices Selected 1 / Total 13

Reachability	Name	Device Type	Operational State	Enabled Profiles
<input checked="" type="checkbox"/> ✔ Reachable	ron-8201-1	ROUTER	✔ OK	3

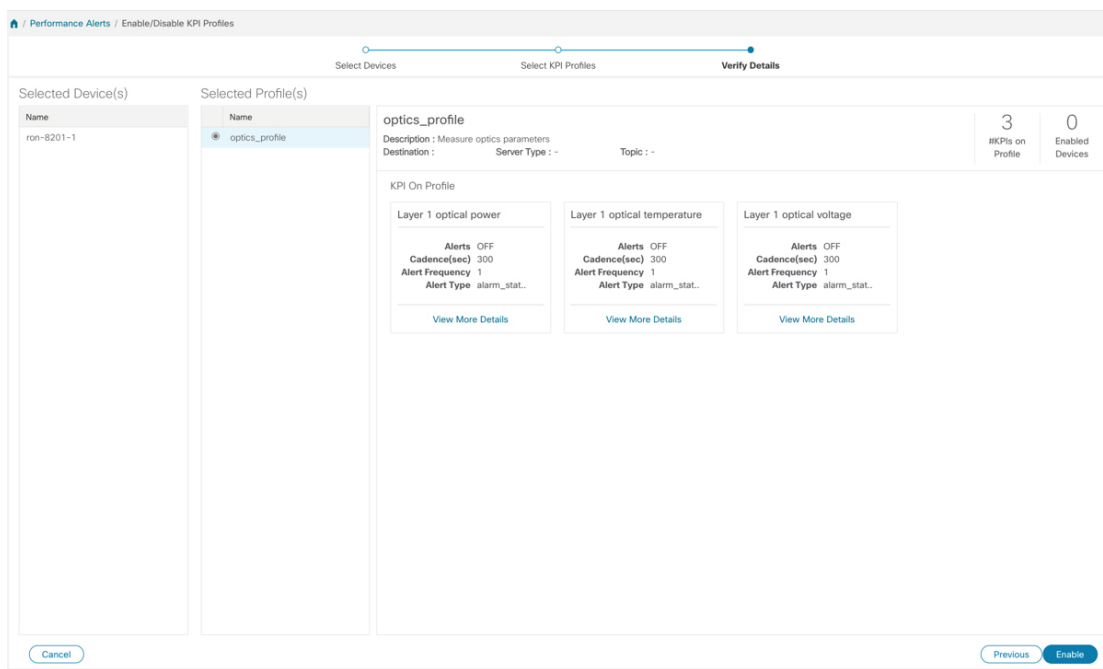
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Step 3

Select the optics_profile KPI profile and click **Next** to finalize enabling the KPI for the selected devices.



Step 4 Apply the configuration and click **Enable** to start streaming telemetry sensor data for optics KPIs. See [Enable KPI Profiles on Devices](#).



Step 5 View alerts from network devices as the system begins monitoring.

See [View Alerts for Network Devices](#)

This image shows the RX and TX power of the QDD-400G-ZR-S transceiver.



Devices begin streaming telemetry data for selected optics KPIs, and alerts become available in Health Insights.

Optimization phase

The optimization phase consists of these activities:

1. Return to planning stage.
2. Continue to add or change circuits on the network to match packet demands.