

Cisco Optical Network Controller (CONC)

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Product overview

The Cisco® Optical Network Controller (CONC) provides an SDN-compliant domain controller for Cisco optical networks. Using an industry-standard OIF transport API (T-API) interface over RESTCONF, CONC gives a Hierarchical Controller (HCO) or orchestrator abstracted visibility and control for Cisco optical networks.

CONC is a hybrid optical domain controller with centralized PCE (path computation engine) and distributed APC (automatic power control). It has a Web UI with multiple applications providing full CRUD (create, read, update, and delete) services and NMS (Network Management System).

CONC design is based on microservices to enable scaling and alignment with Cisco automation products and platforms.

Supported platforms

- Cisco Site Manager 7.11.2 and 24.1.1–NCS 1010, NCS 1014

Features and benefits

CONC is built to address several challenges in network management:

- Controller, NMS, and EMS functions
- Integration into an SDN management environment including abstraction of vendor details
- Integration with Cisco automation software products like HCO, COSM, and CONP
- Support for current and future network topologies, including routed optical networking
- Centralized software control of the Cisco optical network, including movement of distributed-PCE network functions to a centralized-PCE
- Web UI with applications like inventory, topology, service manager, service assurance, etc.
- Single sign-on for seamless node (site) manager cross-launch

Cisco Optical Network Controller architecture

Cisco Optical Network Controller was designed to align with an ACTN (abstraction and control of traffic-engineered networks) standard architecture. CONC acts as a Provisioning Network Controller (PNC) in an ACTN as shown in the following figure.

Abstraction and Control of Traffic Engineered Networks (ACTN) Standard

• SBI - Southbound Interface

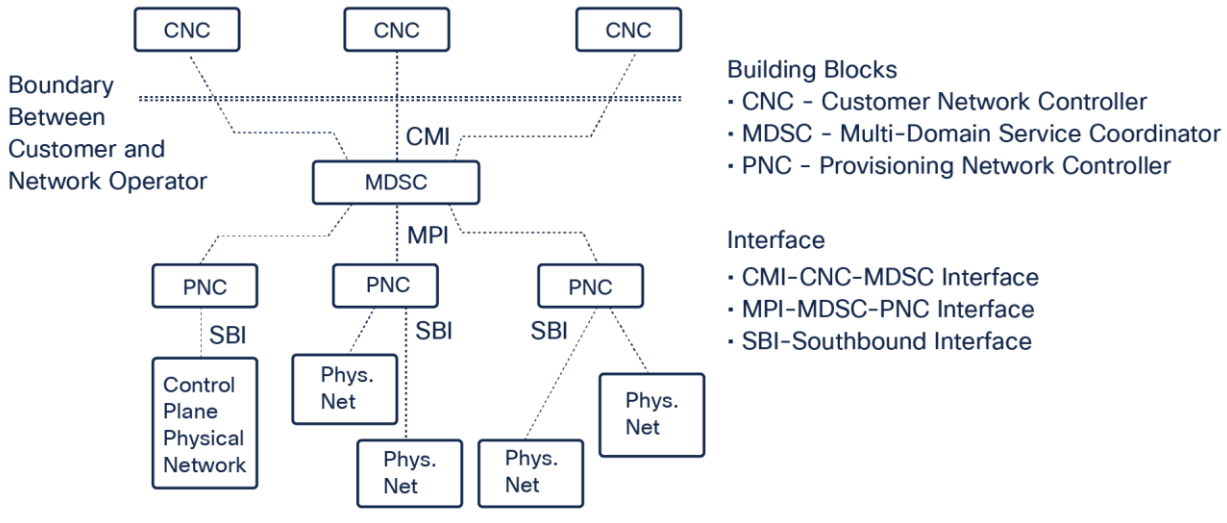


Figure 1.
ACTN standard architecture

The following figure shows the CONC architecture. The northbound interface allows CONC to interact with any OSS solution while the southbound allows the monitoring and configuring of Cisco NCS 2000 and NCS 1000 optical devices. Additionally, the Crosswork framework on which CONC exists today provides functions including user management, logging and monitoring, and the common Kafka bus as well as the underlying platform for High Availability (HA) and scale.

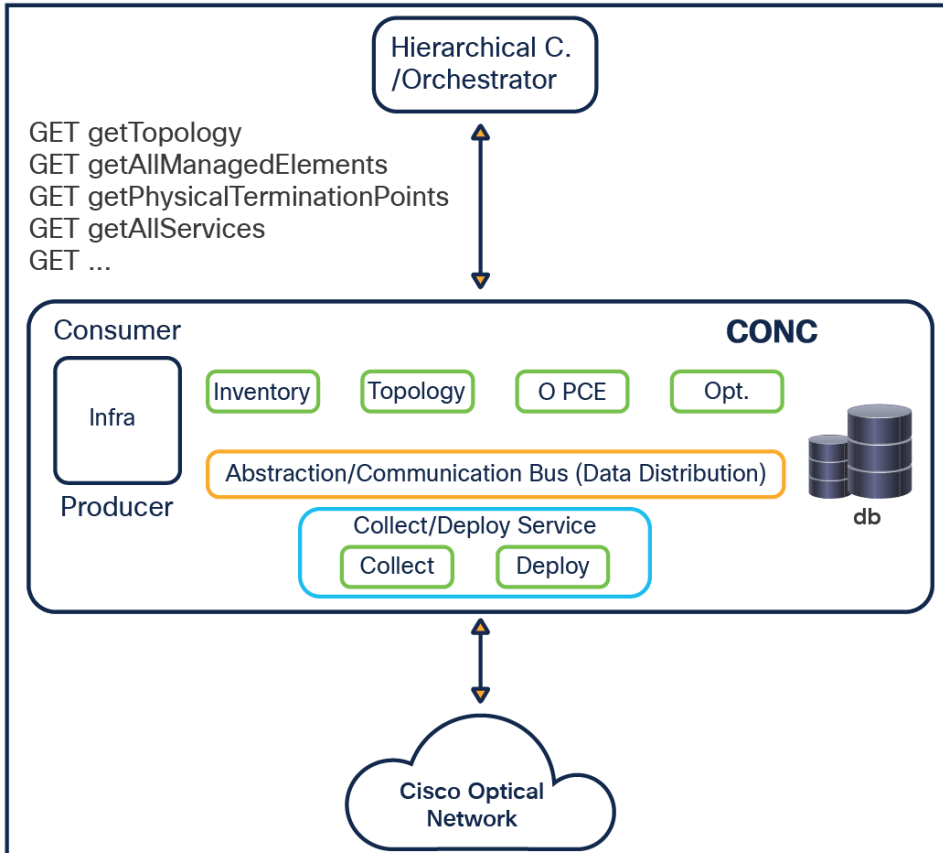


Figure 2.
Cisco Optical Network Controller high-level architecture

The functions that are created as parts of CONC include the centralized optical path computation element (O-PCE), which is the key to determining optically valid paths in a Cisco optical network. Additional CONC functions include device onboarding, topology, inventory, collector services (to gather information from the network), deployer services (to push information into the network), and capacity to add future applications.

Some architectural advantages of CONC are as follows:

- Components are designed as microservices and run as docker containers
- Being packaged as Docker images and launched in K8s pods
- Being designed to work in a distributed compute environment (future)

The next figure shows the overall architecture for Cisco’s management and automation offering. It is key to understand that CONC is built for and intended to be integrated within larger SDN OSS management frameworks.

1. In the RON use case (but also applicable outside RON), CONC is integrated with the Crosswork Hierarchical Controller (HCO). In this case, HCO is acting as the hierarchical controller providing visibility to the entire network and using the TAPI interface to manage optical devices using CONC as the optical domain controller (understanding the optical inventory and topology, provisioning optical services).
2. Cisco Optical Site Manager (COSM) interacts with CONC where COSM provides detailed node-level management for the Cisco NCS 1000 product line.

3. Given that CONC provides an industry-standard TAPI interface over RESTCONF, an HCO or orchestration system can use the topology/inventory and service-provisioning functions as well. To support third-party products, CONC has been integrated with Cisco Hierarchical Controller (now HCO, formerly Sedona NetFusion). This proves the ability for an OEM product to integrate to CONC over the TAPI interface.
4. ZTP provisioning of the optical devices can also be done by customers who prefer this option.
5. The CONP optical network planner tool can provide the necessary configuration files (NETCONF-YANG, JSON) that can be consumed by the CONC controller and or COSM. The data is then utilized to bulk configure NCS 1000 devices in the optical network according to the planning data.
6. EPNM is an optional software that can be added to provide software image management, PM history, and SNMP NBI as an intermediate step until CONC supports it.

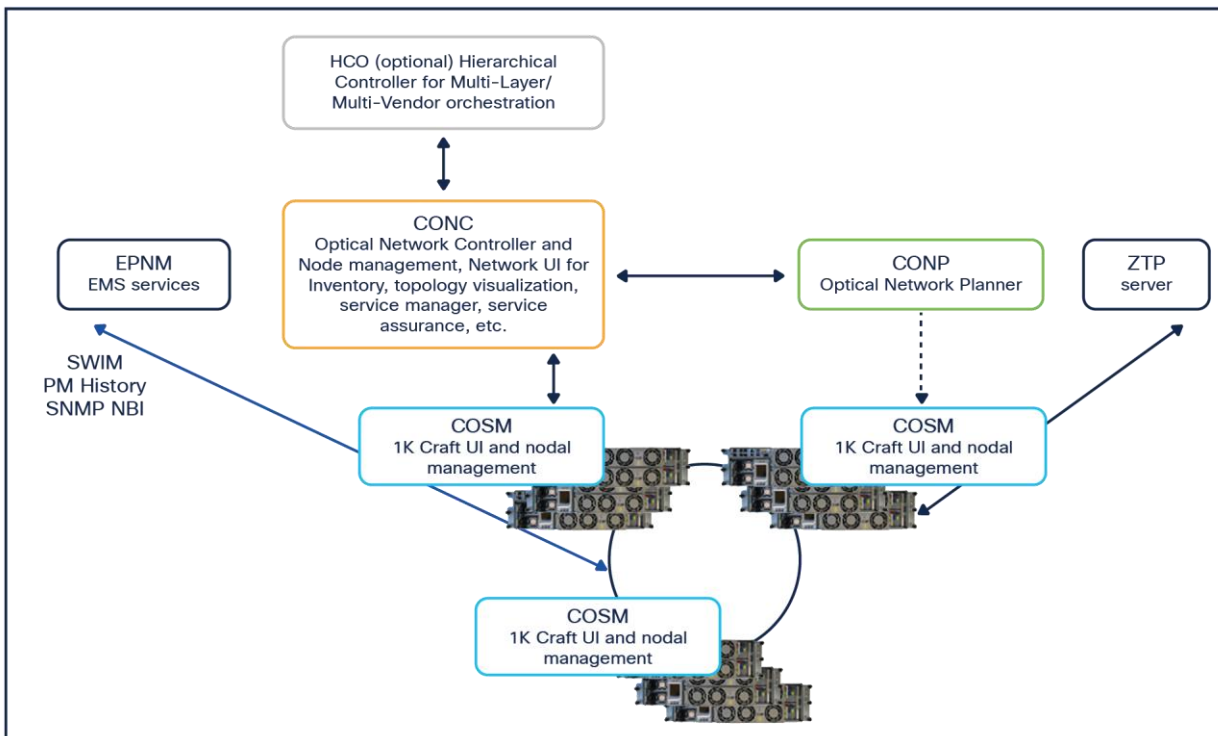


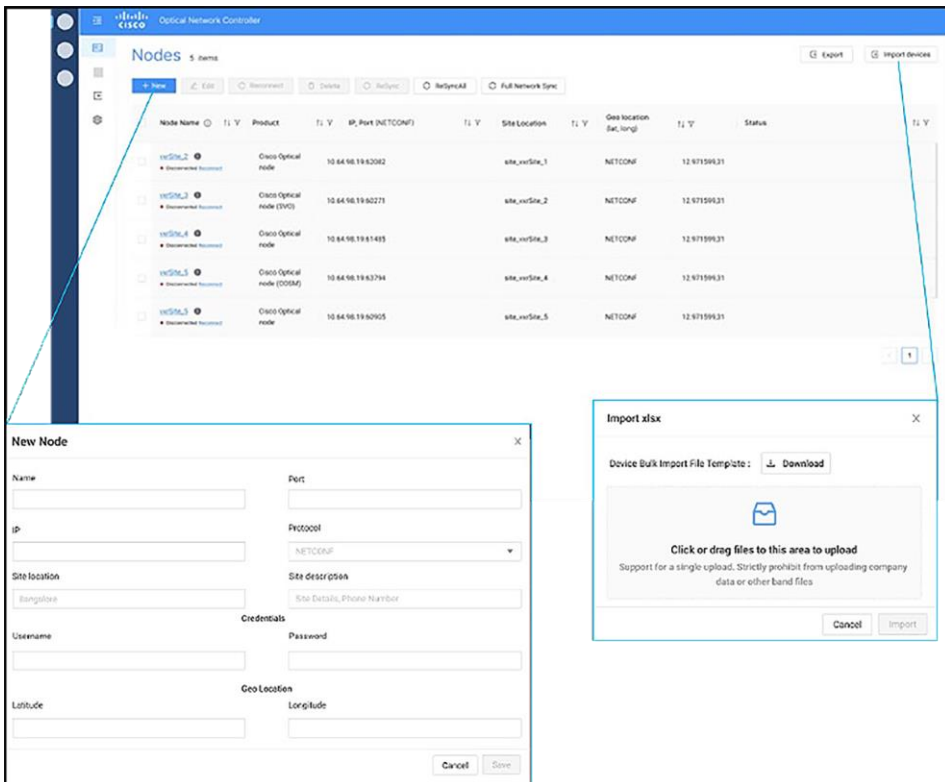
Figure 3.
Overall architecture for management and automation

CONC 3.1 applications

Nodes application

Nodes (enrollment) app provides:

- COSM enrolment for NCS 1000 sites (nodes)
- Future SVO enrolment for NCS 2000 sites (nodes)
- Add/edit lat/long values
- Resync a specific site or multiple selected sites
- Periodic network sync
- Cross-launch a specific node functional view
- Bulk enrollment–import from excel file
- Export to an Excel file



Inventory application

The Inventory application provides the following information: node name, admin state, equipment type, equipment state, actual equipment type, serial number, product ID, hardware part number, CLEI code, version ID, hardware rev, software rev, boot ROM rev, manufacturing date, manufacturing id, and site location.

This is represented in a **tree view** (hierarchical view) when browsed “manually” by the user or in **flat view** as a reply to a user search.

Search supports the two types of searches: (1) Quick search—This is a free text search (minimum 3 characters are required) or (2) a Custom search—Search will be based on the column’s names and string entered in the text box.

The user can add/remove columns and filter the data.

The user can export a tree table or a flat tabled after a search or the entire network inventory data.

The screenshot displays the Network Inventory application interface. It features a sidebar on the left with a tree view showing a hierarchy of nodes under '2 Nodes'. The main area shows a table of nodes with columns: Node Name, Admin State, Equip Type, Equip State, Actual Equip type, Serial No, Product ID, HW Part No, and CLEI Code. A search dialog box is open, showing options for 'Quick Search' and 'Custom Search'. The 'Custom Search' dialog has two input fields for 'Please select' and 'Enter search text', along with 'Clear' and 'Search' buttons. Below the search dialog, a 'Result Table' is visible, showing a flat table of items with columns: Node Name, Admin State, Equip Type, Equip State, Actual Equip Type, HW Serial No, Product ID, HW Part No, CLEI Code, and Version ID.

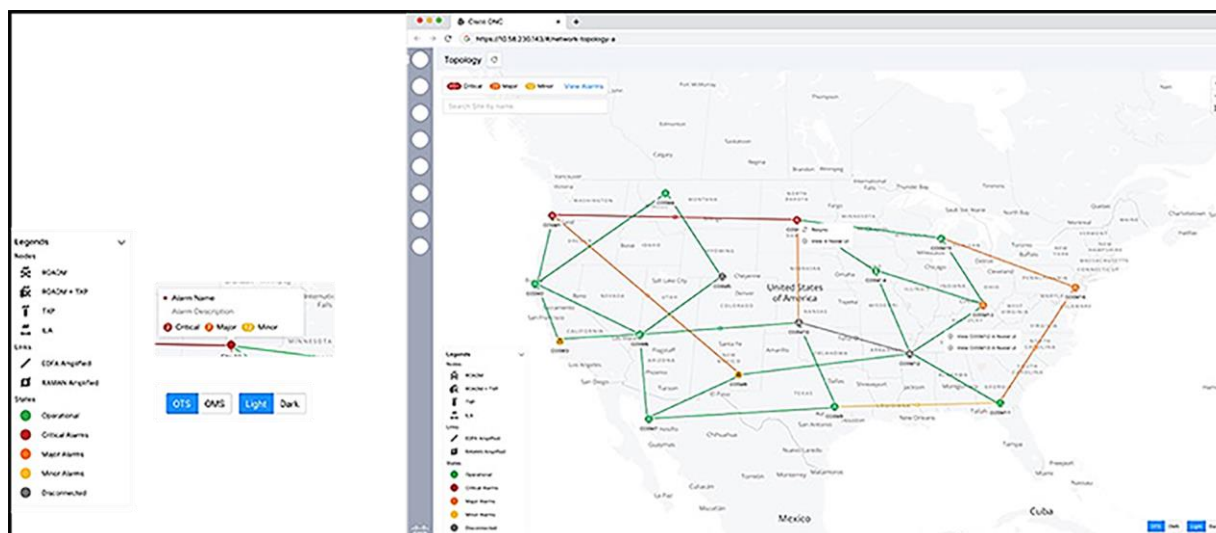
Node Name	Admin State	Equip Type	Equip State	Actual Equip type	Serial No	Product ID	HW Part No	CLEI Code
COGM 1				roadm				NCS2K-SVD-K9
Shelf 0	LOOKED	NCS1010-SA		NCS1010-SA				NCS2K-SVD-K9
Current Cards								
Slot APO	LOOKED	NCS1010-ONTLR-K9	active	NCS1010-ONTLR-K9	00CHANGE0ED			NCS2K-SVD-K9
Slot Cards								
Slot 0	LOOKED	NCS1K-OLT-R-C			CHANGE ME-			NCS2K-SVD-K9
Shelf 2	LOOKED	NCS1K-BRK-SA		NCS1K-BRK-SA				NCS2K-SVD-K9
Slot Cards								
Slot 1	LOOKED	NCS1K-BRK-B		NCS1K-BRK-B	CHANGE ME-			NCS2K-SVD-K9
Slot 2	LOOKED	NCS1K-BRK-24		NCS1K-BRK-24	CHANGE ME-			NCS2K-SVD-K9
Passive Unit 1	LOOKED	NCS1K-MD-320-C		NCS1K-MD-320-C				NCS2K-SVD-K9
Passive Unit 3								
COGM 2								

Node Name	Admin State	Equip Type	Equip State	Actual Equip Type	HW Serial No	Product ID	HW Part No	CLEI Code	Version ID
Shelf 0	Enabled	NCS-SVD-FAN	Active	SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN	Active	NCS2006	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN	Active	CA7223381C5	NCS2K-SVD-K9				
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			
Shelf 0	Enabled	NCS1010-FAN		SVD	CA7223381C5	NCS2K-SVD-K9			

Topology application

The topology application provides:

- Sites and links assembling the topology
- Expandable/collapsible legend
- Per site alarm popovers: On hovering each site, highest severity current and alarm summary
- Site search flies into the site's location
- Link info (free text user subscription)
- Cross-launch to COSM for deep-dive site info
- Resync a site with an indicator
- OTS/OMS toggle
- A light/dark mode toggle



Alarm application

The alarm application provides:

- Up to 72 weeks of current and history alarms
- Site/chassis/card/port/pluggable—fetched from COSM, stored in CONC DB + updates notified by COSM
- Service-level alarms
- List of current alarms; alarm history (selected range date/time)
- Search/filter/sort add/remove columns
- Alarm acknowledgement
- User notes
- Cross-launch relevant alarms to COSM
- Show alarm severity in the topology/show in site (COSM)
- Auto filter alarms to other apps (topology, service assurance, service manager)

- Alarms exportable to XSLX file, saved in the local user storage
- User could cross-launch each alarm to the relevant COSM view

Alarms

Alarms History

Alarm(s) acknowledged successfully.

8 Alarms

Last Updated on 10/01/2022 at 12:00:35. Refresh Export

10 Critical 03 Major 02 Minor

Annotation Change Status

Eqpt Location	Node Name	Severity	Service Affect	Alarm Type	Timestamp	Object	Description	Direction	User Notes	Acknowledge
Shelf0_Slot0	ncs2k-1	Critical	NSA	AUD-LOG-LOSS	05/31/2023, 16:23:22	DEVICE: ncs2k-1	Audit Log 100 Percent Full - Oldest records will be lost	NA		
Shelf0_Slot2	ncs2k-1	Critical	NSA	FRNGSYNC	05/31/2023, 07:34:12	CHASSIS: 1	Free Running Synchronization Mode	NA		✓
Shelf2_Slot1	ncs2k-1	Critical	NSA	IMPROPRMVL	05/31/2023, 07:34:05	MODULE: 1/1	Improper Removal	NA		
Shelf2_Slot3	ncs2k-1	Minor	SA	EQPT-MISS	05/31/2023, 06:32:46	PWR: 1/1	Replaceable Equipment/Unit is Missing	NA		
Shelf2_Slot4	ncs2k-1	Major	NSA	CARLOSS	05/31/2023, 07:34:12	PORT: 1/MS -ISC/2/1	Carrier Loss On The LAN	NA		

Alarms

Alarms History

5 Alarms

Last Updated on 10/01/2022 at 12:00:35. Refresh Export

10 Critical 03 Major 02 Minor

Select Time Period 1 month Start date End date

Location	Device Name	Severity	Service Affect	Alarm Type	Timestamp	Object	Description	Direction	User Notes	Acknowledge
Shelf1_Slot0	ncs2k-1	Critical	NSA	AUD-LOG-LOSS	05/31/2023, 16:23:22	DEVICE: ncs2k-1	Audit Log 100 Percent Full - Oldest records will be lost	NA		
Shelf2_Slot0	ncs2k-1	Critical	NSA	IMPROPRMVL	05/31/2023, 07:34:05	MODULE: 1/1	Improper Removal	NA		
Shelf2_Slot1	ncs2k-1	Major	NSA	CARLOSS	05/31/2023, 07:34:12	PORT: 1/MS -ISC/2/1	Carrier Loss On The LAN	NA		
Shelf3_Slot1	ncs2k-1	Major	SA	MFGMEM	05/31/2023, 07:34:17	FAN: 1-1	Manufacturing Data Memory (EEPROM) Failure	NA		
Shelf4_Slot1	ncs2k-1	Minor	NSA	USER-LOGOUT	05/31/2023, 07:34:37	SYSTEM:R	Logout of User	NA		

Service manager application

The service manager application provides:

- A list of discovered/provisioned services—search/sort/filter add/remove columns
- A list of circuits filtered by topology selection—link (all the circuits running through that link), site (all the circuits running through that site), multiple links/sites
- List fields are service name; source and destination endpoints; tag (customer name); type (NC/trail); profile (unprotected/etc.); rate; central-freq + BW; related services (trail over NC)
- The list is exportable to XSLX.
- Provisioning OCH-NC with OSNR sigma threshold, admin state, wavelength central-freq/blank, app. code, single/multicarrier, endpoint selection from map and inventory (plus drop-down list); PCE criteria—hop, cost, OSNR, distance/latency; path disjoint; node/link ERO/XRO, allow regen
- Discovering OCH-NC/trail
- Provisioning OCH-trail—same as OCH-NC + discovered trunk app. code and wavelength configuration
- Error messages in case of PCE failure (e.g., spectrum not available) and in case of execution (e.g., device disconnected)

- Service edit—edit service name
- Service delete

Service Manager

Service List

8 Services

Last Updated on 10/01/2022 at 12:00:35. Refresh Export

<input checked="" type="checkbox"/>	Name	Customer Name	Source	Destination	Type	Protection Profile	Frequency (GHz)	Bandwidth	Operational State	Admin State	Discovery Date
<input checked="" type="checkbox"/>	vrSite1-10-vrSite2	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	MG	PROTECTED	191.34	75 GB	UP	Enabled	06/06/2023
<input type="checkbox"/>	vrSite1-10-vrSite2	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	TRAL	UNPROTECTED	194	150 GB	DOWN	Disabled	05/06/2023
<input type="checkbox"/>	vrSite1-10-vrSite2	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	CC	RESTOR	193.25	80 GB	UP	Enabled	05/06/2023
<input type="checkbox"/>	vrSite1-10-vrSite2	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	MG	PROTECTED	195.45	85 GB	UP	Enabled	04/06/2023
<input type="checkbox"/>	vrSite1-10-1-vrSite2	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	CC	PROTECTED	192.4	150 GB	UP	Enabled	01/06/2023
<input type="checkbox"/>	NodeA-NodeD I	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	MG	PROTECTED	196.32	150 GB	UP	Enabled	02/06/2023
<input type="checkbox"/>	vrSite1-10-vrSite2	CISCO	vrSite1-device1-075-01/0/0/2	vrSite2-device2-OAS-01/0/0/2	CC	PROTECTED	194.56	75 GB	DOWN	Disabled	05/06/2023

Service Manager

Service List

OCH HG

General **Constraints** Application code Application code Summary

Optimization Goal: Number of Hops

Disjoint from Service: Choose a link from the map or from links table

Include Nodes or Links: Select a node from the map or dropdown, Select a Link from map or table (No items)

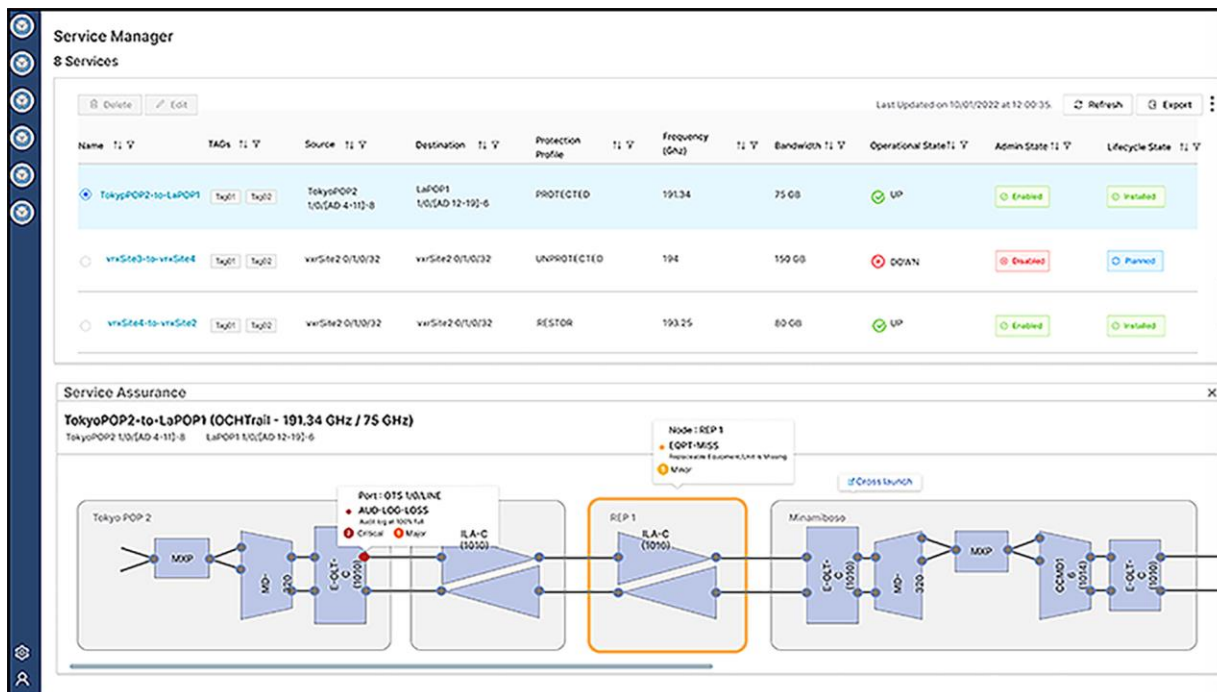
Exclude Nodes or Links: Select a node from the map or dropdown, Select a Link from map or table (OAS-10000)

Back Next

Service assurance application

The service assurance application provides:

- Service data path visualization: TXP/MXP, PSM (future), MD/BRK/CCOFS, OLT, OLA, ports, links (client DSR, trunks, OCH, OTS)
- Service name; tag (customer) name; rate; cent freq + bandwidth; opp state, admin state, components ID (COSM/SVO-chassis-slot-port)
- Alarm severity visualization plus alarm app filter
- User could cross-launch each component to the relevant COSM NFV
- Exportable to XSLX file, saved in the local user storage
- OCH-NC, OCH-trail



Audit logs application

The audit logs application provides logs related to admin, system, and microservices logs, either with text logs or Graphana.

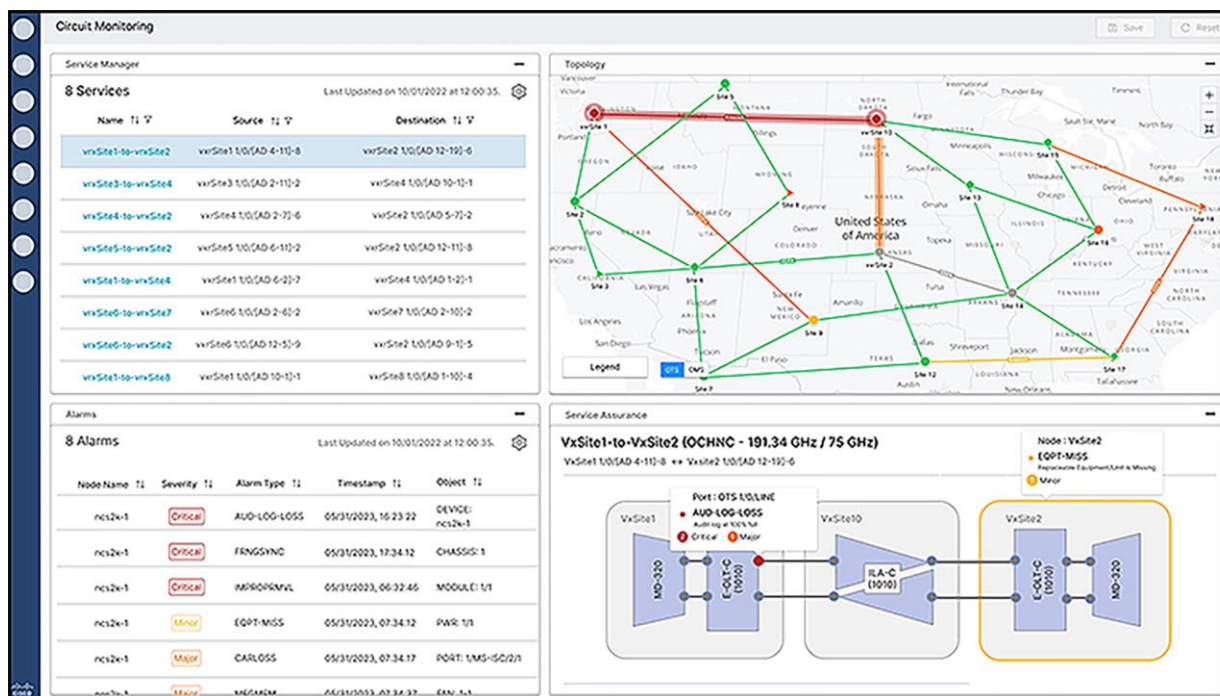
Workspace application

The workspace application provides ways to accomplish different day-to-day workflows; a workspace consists of multiple applications that interact with each other within the same view.

A few of the common workflows have been predefined (e.g., circuit provisioning, circuit monitoring, network monitoring). We are looking to add a user-defined workspace in a later release.

For a given predefined workspace, the user can resize and position different applications to be in a favorite order and save it for the next launch. Clicking on one application will result in updates on the other applications.

For example, in the following screenshot, a user clicks on service (circuit) from the service manager (top-left window). Then this circuit will be highlighted in the topology app (top-right window), will be fetched to the service assurance app (bottom-right window), and will filter the relevant alarms in the alarm app (bottom-left window).



CONC TAPI interface

CONC's NorthBound Interface (NBI) is based on the ONF-standard TAPI model and is accessible via RESTCONF. Within the TAPI model, CONC 3.1 has implemented the following:

- Service-interface-point
 - List all the interfaces available for client signal connection and possible termination point of service creation
- Topology-context
 - Include topological information of all network nodes with their owned Network-Edge-Point (NEP)
 - Include topological link that connects nodes in the network at their NEP
- Connectivity-context
 - Include connection-service (circuits) present in the network
 - Include connections that compose all connection-service
 - Allow for creation and deletion of connection-service
- Physical-context
 - Provide the inventory information off all network nodes including the hierarchical rack, shelf, slot, etc., relationship

CONC 3.1 supports two network-provisioning models through TAPI (HCO UI):

1. Provisioning wavelength service path (OCH) for router-based ZR+ optics
 - Used when CONC controls the OLS network (ROADMs, amps, DWDM filters) but DCO (digital coherent optic) is in the router
 - CONC determines if the DCO service can be carried, and then sets it up (if feasible) and returns values for to HCO
 - HCO does settings on router (through CNC IP controller)
2. Provisioning service path with NCS 2000 and NCS 1000 (or third-party DWDM system)
 - Used when values are already known for a service riding the optical network (e.g., when NCS 1004 is used or alien transceiver spec imported from CONC)
 - CONC determines if that wavelength service can be carried and then sets it up (if feasible)
 - User does settings on TXP

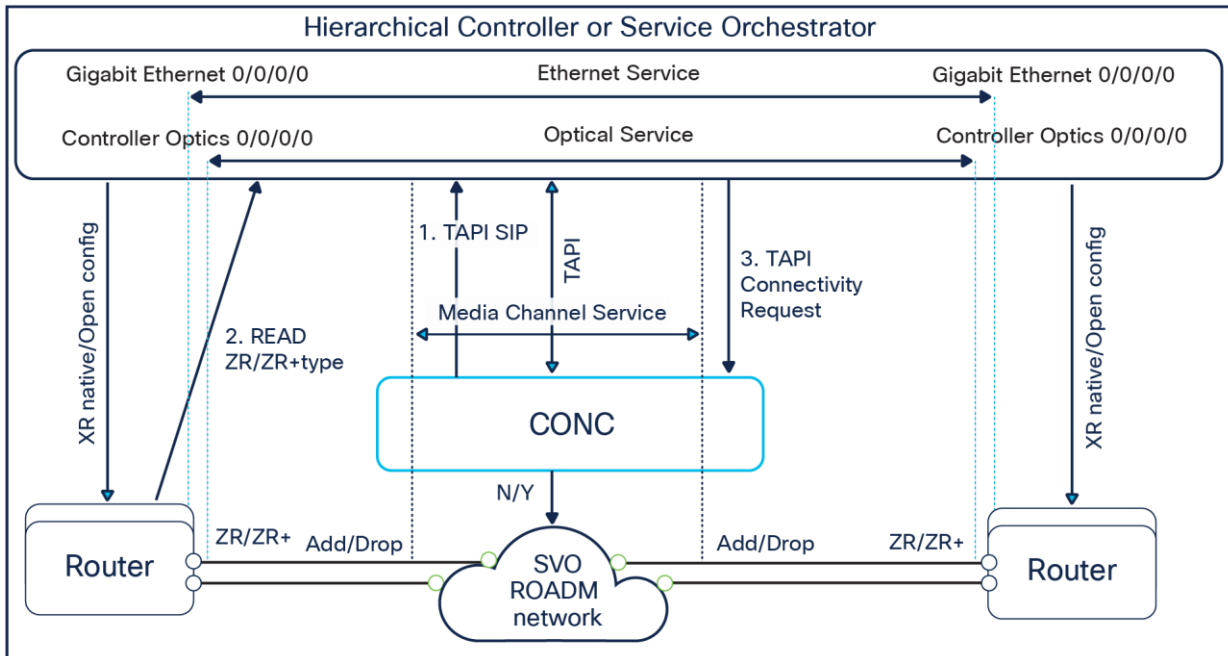


Figure 4. CONC 2.x (or later release) service provisioning with router-based ZR+ optics workflow

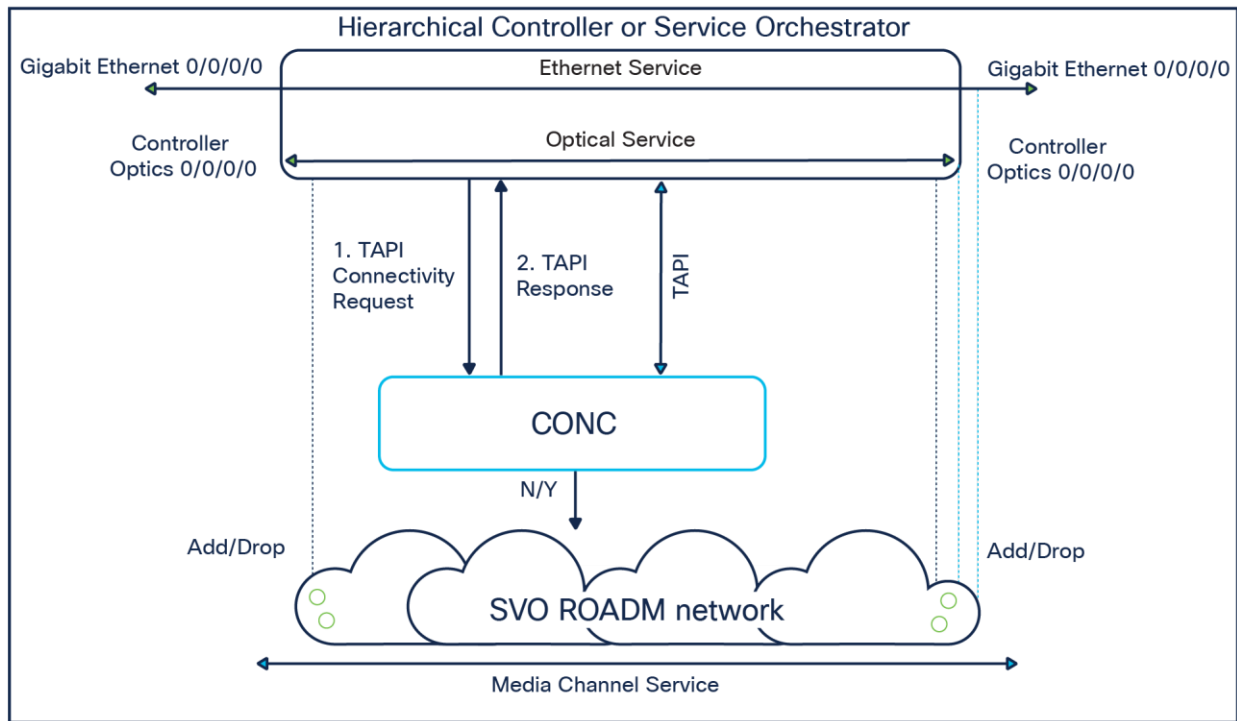


Figure 5.
CONC 2.x (or later release) service provisioning with NCS 1000 or third-party DWDM

Product specifications

CONC is deployed in VMware with the following requirements:

1. VMware data center requirements:
 - a. vSphere server and client of version 7.0
 - b. ESXi version of 6.7.0/7.0
 - c. Requires two networks for deployment:
 - i. Control plane → private network
 - ii. VM management → northbound network
 - d. Can be deployed in a different ESXi host, but it needs 10G network between them.

2. Following sizing rules apply for CONC3.1:

High availability requires three VMs: active, standby, and arbitrator

Non-high availability requires a single active VM

Table 1. CONC Sizing Rule

Deployment >	S (up to 500 NEs)			XS (up to 100 NEs)		
VM	CPU cores	RAM (GB)	SSD storage (TB)	CPU cores	RAM (GB)	SSD storage (TB)
Active	24	96	1	12	48	0.5
Standby	24	96	1	12	48	0.5
Arbitrator	24	96	1	12	48	0.5

3. PIDs for Cisco servers:

- UCSC-C220-M5SX (rack server)
- UCSB-B200-M5 (blade server)

Appendix 1: Supported equipment

NCS1010-SA

NCS1K-BRK-SA

NCS1014

NCS1010-AC-PSU

NCS1010-DC-PSU

NCS1010-FAN

NCS1K14-FAN

NCS1010-FTF

NCS1K14-BLANK

NCS1K-CNTRLR2

NCS1010-CNTRLR-K9

NCS1010-CTLR-2-K9

NCS1K14-CNTRLR-K9

NCS1K14-CCMD-16-C

NCS1K14-2.4T-L-K9

NCS1K14-2.4T-K9

NCS1K14-2.4T-X-K9

NCS1K14-2.4TXL-K9
NCS1K14-2.4TX-FB2C
NCS1K14-2.4TX-LC1C
NCS1K14-2.4TX-LC2C
NCS1K14-2.4TX-FB1C
NCS1K-ILA-2R-C
NCS1K-ILA-C
NCS1K-ILA-R-C
NCS1K-OLT-C
NCS1K-OLT-R-C
NCS1K-E-ILA-R-C
NCS1K-E-ILA-2R-C
NCS1K-E-ILA-R-C-2
NCS1K-E-OLT-C
NCS1K-E-OLT-R-C
NCS1K-BRK-8
NCS1K-BRK-24
NCS1K-MD-32E-C
NCS1K-MD-32O-C
NCS1K-MD-32E-L
NCS1K-MD-32O-L

Warranty information

Find warranty information on Cisco.com at the [Product Warranties](#) page.

Ordering information

To place an order, visit the [Cisco Ordering Home Page](#) and refer to Table 3. To download software, visit the [Cisco Software Center](#).

Table 2. Ordering information for Cisco Optical Network Controller

Part number	Description
S-OAS-CONC3.1-SW	CONC3.1 software image
CONC-RTM-ESS-SM	Essential CONC subscription for small device with support
CONC-RTM-SPC-SM	Spectrum CONC subscription for small device with support
CONC-RTM-API-SM	API CONC subscription for small device with support
CONC-RTM-ESS-LG	Essential CONC subscription for large device with support
CONC-RTM-SPC-LG	Spectrum CONC subscription for large device with support
CONC-RTM-API-LG	API CONC subscription for large device with support

- CONC licenses have two types of devices.
 - Small: 1010 (future: 1001, 2002, 1012)
 - Large: 1014 (future: 1004, 2006, 2015, 1020)
- Please refer to the diagram above describing the features/functions available per package.
 - ESS (Essential) level is mandatory and has to be ordered for all the devices managed by CONC
 - SPC (Spectrum) is optional. An SPC package requires ESS first. Thus, both ESS and SPC would be ordered for the relevant devices.
 - API is optional. An API package requires ESS first. Thus, both ESS and API would be ordered for the relevant devices.
 - The following combinations are legit: ESS, ESS+SPC, ESS+API, and A full blown of ESS+SPC+API.
- CONC licenses are subscription based, with 36- to 60-month terms, which include:
 - SW upgrades to latest current CONC release (excluding labor)
 - CONC CX support during the subscription term

Cisco services for migrating converged IP + optical solutions

Services from Cisco and our partners help you get the most value from your investments in the Cisco converged IP + optical solution, quickly and cost-effectively. We can help you design, implement, and validate your solution to speed migration and cutover. Coordinate every step through to interworking, strengthen your team, and make the most of tomorrow's opportunities. Learn more at www.cisco.com/go/spsservices.

Cisco environmental sustainability

Information about Cisco's environmental sustainability policies and initiatives for our products, solutions, operations, and extended operations or supply chain is provided in the "Environment Sustainability" section of Cisco's [Corporate Social Responsibility](#) (CSR) report.

Reference links to **information about key environmental sustainability topics** (mentioned in the "Environment Sustainability" section of the CSR report) are provided in the following table:

Sustainability topic	Reference
Information on product material content laws and regulations	Materials
Information on electronic waste laws and regulations, including products, batteries, and packaging	WEEE compliance

Cisco makes the packaging data available for informational purposes only. It may not reflect the most current legal developments, and Cisco does not represent, warrant, or guarantee that it is complete, accurate, or up to date. This information is subject to change without notice.

Cisco Capital

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For more information

For more information about the Cisco Optical Network Controller, visit www.cisco.com/go/ncs4000 or contact your local Cisco account representative.

Document history

New or revised topic	Described in	Date
CONC2.0 features	CONC datasheet	November 1, 2022
CONC PIDs	CONC datasheet	December 9, 2023
CONC3.1 applications and features	CONC datasheet	

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