



Cisco Crosswork Hierarchical Controller 6.0

Assurance and Performance Guide

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Introduction

This document is a how-to-use guide for Cisco Crosswork Hierarchical Controller assurance.

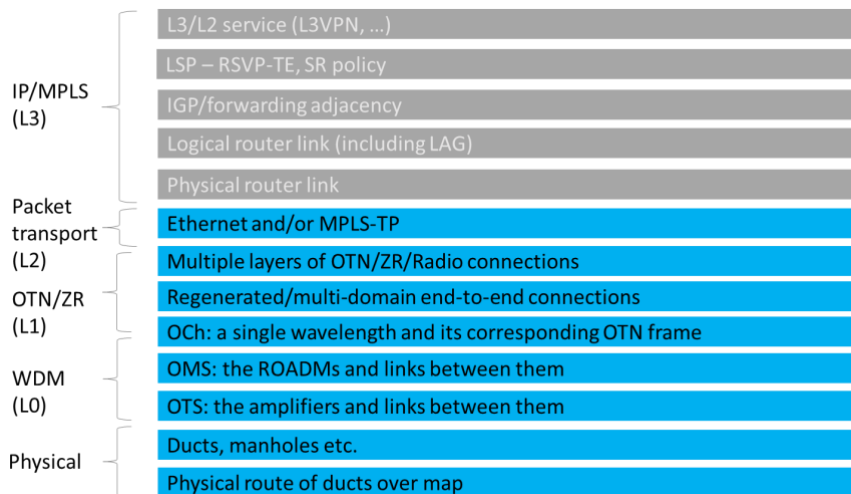
The following table lists the assurance applications. The Legend column indicates if the application falls into one of the following categories:

- **Common:** Common to all layers and multi-layer
- **IP:** Relevant to IP links and services
- **Optical:** Relevant to fibers, optical links, OTN/ETH connections

Table 1. Assurance Applications

Category	Application name	Legend	Description
Assurance	Performance	IP	Traffic utilization and OAM PM of port, links, tunnels and VPNs, group links by topology context (all LAG members, between router A to B), prediction of packet traffic utilization.
		Optical	L0-L1 performance, show correlation between photonic to L1 layer. Show power level across a span of ROADMs and Amplifiers.
	Service Assurance	Common	Visualize L1-L2-L3 service configuration and underlay paths, with UNIs performance and events history.
	Link Assurance	Optical	Visualize RON links across ZR and OLS with performance in all layers.
	Path Analysis	IP	Calculate, on demand, an IGP path between two routers, visualize path and show performance of IP links across the path.
	RCA	Common	Show which services and links in the upper layers were impacted by a lower layer link failure, especially in the case of a multi-layer where an optical link failure impacted IP links and services.

Layers



Terminology

Table 2. Terms

Term	Definition
Adapter	The software used by Crosswork Hierarchical Controller to connect to a device or to the manager, to collect information required by the network model and configure the device.
Agg link	Agg is Link Aggregation Group (LAG) where multiple ETH links are grouped to create higher bandwidth and resilient link.
BGP	Border Gateway Protocol
Circuit E-Line	An Ethernet connection between two ETH client ports on Transponder or Muxponder over OTN signal.
CNC	Crosswork Network Controller.
Device	Optical network element, router, or microwave device.
Device Manager	The application that manages the deployed adapters.
eMBB	Enhanced Mobile Broadband.
ETH link	ETH L2 link, spans from one ETH UNI port of an optical device to another, and rides on top of ODU.
ETH chain	A link whose path is a chain of Ethernet links cross-subnet-connected (found using Crosswork Hierarchical Controller cross-mapping algorithm). Eth-chain is a replacement for R_PHYSICAL link in cases where one side of the link is in devices out of the scope discovered by Crosswork Hierarchical Controller.
Fiber segment	Physical fiber line that spans from one passive fiber endpoint (manhole, splice etc.) to another and is used as a segment in a fiber link.
Fiber	Chain of fiber segments that spans from one optical device to another.
IGP	IGP is the link between two routers that carries IGP protocol messages. The link represents an IGP adjacency.
IP-MPLS	IP multi-protocol label switching.
L3-VPN link	The connection between two sites of a specific L3-VPN (can be a chain of LSP connections or IGP path).
L3 physical	L3 physical is the physical link connecting two router ports. It may ride on top of an ETH link if the IP link is carried over the optical layer.
L3-VPN	A virtual private network based on L3 routing for control and forwarding.
Logical link, IGP, LSP	Logical link connects VLANs on two IP ports.
LSP	Label Switched Path, used to carry MPLS traffic over a label-based path. LSP is the MPLS tunnel created between two routers over IGP links, with or without TE options.
NMC (OCH-NC, OTSiMC)	NMC is the link between the xPonder facing ports on two ROADMs. This link is the underlay for OCH and it is an overlay on top of OMS links. This is relevant only for disaggregation cases where the ROADM and OT box are separated.
NMS	Network Management System.
OC/OCG	SONET/SDH links that span from one optical device to another and carry SONET/SDH lower bandwidth services, the links ride on top of OCH links and terminate in TDM client ports.
OCH	OCH is a wavelength connection spanning between the client port one OT device (transponder, muxponder, regen) and another. 40 or 80 OCH links can be created on top of OMS links. The client port can be a TDM or ETH port.

Term	Definition
ODU	ODU links are sub-signals in OTU links. Each OTU links can carry multiple ODU links, and ODU links can be divided into finer granularity ODU links recursively.
OSPF	Open Shortest Path First, an Interior Gateway Protocol between routers.
OTN-Line	An OTN connection between two ODU client ports over OTN path.
OTS	OTS is the physical link connecting one line amplifier or ROADM to another. An OTS can be created over a fiber link.
OTU	OTU is the underlay link in OTN layer, used for ODU links. It can ride on top of an OCH.
Packet E-Line	A point-to-point connection between two routers or transponders/muxponders over MPLS-TP or IP-MPLS.
PCC	Path Computation Client. Delegated to controller. Router is responsible for initiating path setup and retains the control on path updates.
PCE	Path Computation Element. Controller-initiated.
Radio Media	The media layer as a carrier of radio channels.
Radio Channel	Multiple radio channels can be on top of radio media, each channel represents a different ETH link with its own rate.
RD	Route Distinguisher.
RSVP-TE	Resource Reservation Protocol to control traffic engineered paths over MPLS network.
RT	Route Target.
SCH	A super-channel is an evolution of DWDM in which multiple, coherent optical carriers are combined to create a unified channel of a higher data rate, and which is brought into service in a single operational cycle.
SDN Controller	Software that manages multiple routers or optical network elements.
SR Policy	Segment Routing Policy. A segment routing path between two nodes, with mapping to the IGP links based on SIDs list.
STS	Large and concatenated TDM circuit frame (such as STS-3c) into which ATM cells, IP packets, or Ethernet frames are placed. Rides on top of OC/OCG as optical carrier transmission rates.
uRLLC	Ultra-Reliable Low Latency Communications.
VRF	Virtual Routing Function, acts as a router in L3-VPN.
ZR Media	The media layer as a carrier of ZR channels, on top of OCH link.
ZR Channel	Multiple ZR channels can be on top of ZR media, each channel represents a different IP link with its own rate.

Performance

The Performance application provides statistical information on both packet-based traffic and optical (layer 0 and layer 1) performance:

- For layer 0 (OCH, NMC, OMS and OTS), provides Rx and Tx power data (minimum, average, and maximum).
- For layer 1 (ZR Media), provides Pre-FEC (Forwarding Error Correction), Post-FEC, Q Margin and Q Factor.
- For packet-based bandwidth traffic the application provides statistical information on packet-based bandwidth/traffic usage of ports, links and LSPs over the selected time period. The information is calculated based on collected intervals/bins (15 minutes or 1 hour) of Rx and Tx octets and displayed in tables and in graphs.

You can run a query by selecting resources and the time duration. This returns the Performance for the selected resources for a specified period and time window each day. A Performance test can be run explicitly on up to ten ports, links or LSPs by selecting the specific resources. The test can run on more ports and links by querying for ports, links or LSPs by tags or devices.

The displayed results include the resource capacity/speed and the statistical utilization info. Information on utilization is displayed for the selected resource and for the lower, upper, and adjacent resource, for example: logical ports on top of selected physical port, physical links lower to aggregation (LAG) link.

Resources can be selected explicitly by their type. After selecting the type, the user can use the model selector to select a resource (port, link or LSP). Ports, links or LSPs can also be selected by their tags, and routers (devices) can be selected using the model selector or by tag.

Utilization data is collected on IP links, for both physical and logical links. When links are selected, the user can select to view utilization for specific links/underlay (lower) links. If for example, an underlay link is selected, the application returns the utilization for both the underlay link itself and all the links above it that have utilization data.

It is also possible to view utilization data for links with devices in a single endpoint or links with devices in two endpoints. These endpoints can be defined by specific devices or by tags. For example, this allows the user to select a router and get the utilization data for all the links that end in this router or select two routers and get the utilization data for all the links between the two routers.

Using tags, means that the user can view utilization data for all links between devices with, for example, tag A, and devices with, for example, tag B.

Similarly, it is possible to select specific LSP/underlay links, as well as LSPs by devices in one or two endpoints.

The capacity appears for ports and links, and the reserved bandwidth for LSPs. For all resources, the average utilization, peak utilization, various percentiles (98, 95 and 75), and standard deviation are shown. For ports, lower and upper port capacity and average utilization also appears, and for links the lower physical links, upper aggregate link, and upper logical links names are listed (if they exist).

You can select the following types of resources:

- **Ports:** Packet Ports, Optical Port, and ZR Ports
- **Links:** IP Links, Optical Links, and ZR Links
- **LSPs:** RSVP-TE tunnels and SR Policies.

Traffic Utilization Tab

The Traffic Utilization fields that appear vary according to the type of utilization being viewed.

Note: When selecting optical (layer 0 and 1) links, the **Traffic Utilization** tab appears with the information for the related L3 physical or logical layer.

For ports:

- Device
- Port
- Capacity [Gbps]
- In Link (if this exists)
- Average [%]
- Peak [%]
- Percentile 98[%]
- Percentile 95[%]
- Percentile 75[%]
- St. Deviation
- Lower Ports (only for logical port; aggregate or physical port name)
- Lower Ports Capacity [Gbps]
- Lower Ports Average [%]
- Upper Ports (only for physical port; the logical or aggregate port name, if exists)
- Upper Ports Average (%) (only for physical port)

For Ethernet and IP Links:

- Link
- Layer
- Capacity [Gbps]
- Average [%]
- Peak [%]
- Percentile 98[%]
- Percentile 95[%]
- Percentile 75[%]
- St. Deviation
- Lower Physical Links (link name of one layer lower, if exists)
- Upper Aggregate Link (link name, if exists)
- Upper Logical Links (link name, if exists)

For LSP Tunnels and LSP Policy Links:

- Link (full LSP name including site/device)
- Reserved BW [Mbps]
- Services (Traversing Over This LSP)
- Average Rate [Mbps]
- Peak Rate [Mbps]
- Percentile 98[Mbps]
- Percentile 95[Mbps]
- Percentile 75[Mbps]
- St. Deviation

Note: The export file includes extended information. The **Average** column appears in the UI, but in the export, there are two columns: **Average IN** and **Average OUT**. The UI shows the greater value of these two values.

Performance (OAM) Tab

The following Performance fields appear for Ethernet and IP links:

- Link
- Layer
- Jitter Average (Usec)
- Maximal Round Trip Time Average (Usec)
- Minimal Round Trip Time Average (Usec)
- Delay Average (Usec)

The Performance application has the option to predict the behavior of packet traffic utilization for the next 14 days based on the historical collection of performance monitoring counters. It is possible to view a prediction of packet traffic behavior assuming that you have at least 7 days of data available to base the prediction on.

The utilization graph can be opened per selected packet port or link (Ethernet or IP), and you can view the prediction as a linear line on the graph. The prediction is based on an algorithm that creates traffic patterns based on time of day, weekdays vs. weekends, and seasonal events in the local area where the system is deployed. The graph displays the linear utilization prediction line, as well as lower and upper bounds, indicating the prediction confidence interval. The prediction takes seasonal events into account.

Optical Power Tab

The Optical Power tab appears for layer 0 links (OTS, OMS, and OCH) and includes the following fields:

- Link
- Layer
- A to Z Average Power (DBm)
- A to Z Minimum Power (DBm)
- A to Z Maximum Power (DBm)
- Z to A Average Power (DBm)
- Z to A Minimum Power (DBm)
- Z to A Maximum Power (DBm)

ZR Tab

The ZR tab appears for layer 1 links (ZR Links) and includes the following fields:

- Link
- Layer
- A to Z Pre FEC BER (Q)
- A to Z Post FEC BER (Q)
- A to Z Q Factor (DBq)
- A to Z Q Margin (DBq)

Ports Traffic Utilization and Performance

You can view performance for Ethernet and IP ports:

- Specific ports
- Ports that are tagged with specific tags and tag values
- Ports on specific devices
- Ports by L3VPN Services

To configure performance for ports:

1. In the applications bar, select **Performance**.

Performance Run Test Saved Configurations

1. Select Test Resources

☒ Ports ☐ Links ☐ LSP Links

☒ By Specific
☐ By Tag(s)
☐ By Device(s)
☐ By Device(s) Tag(s)
☐ By L3VPN Service(s)

+ Add Port

2. Define Time Frame

Select Time Span
Today

Select Daily Time Frame
Over entire day

Run

Select resources and the time settings in the form to the left and test the resources performance

2. Ensure that **Ports** is selected.
3. To check the performance for specific ports, select **By Specific**, and then click **Add Port**. In the **Advanced** tab, select from the **Packet Ports**, **Optical Ports** or **ZR Ports** tabs, or click on the **3D Explorer** tab to select a port. Click **OK**. You can add up to 10 items.

Note: For more information on 3D Explorer, see the *Cisco Crosswork Hierarchical Controller Network Visualization Guide*.

Name	Device	Type	Capacity	Description	Admin Status
279 ITEMS					
HundredGigE0/0/1/8	CR1.DAR	R_LOGICAL		to ER1.DAR:100ge-0/1/1	UP
10ge-0/1/1	CR1.CAI	R_LOGICAL		to CR1.BRI:TenGigE0/0/2/6	UP
TenGigE0/0/2/9	ER1.SYD	R_PHYSICAL	10.00 GB		UP
FourHundredGigE0/0/1/7	CR2.SYD	R_PHYSICAL	400.00 GB	L3 Physical of Cisco RON Cisco QSFP28 10...	UP
FourHundredGigE0/0/1/9	CR2.MEL	ETH	400.00 GB	Ethernet of Cisco RON Cisco QSFP28 100G ...	UP
HundredGigE0/0/1/6	ER1.BRI	R_PHYSICAL	100.00 GB	to CR1.BRI:HundredGigE0/0/3/6	UP
10ge-0/1/1	CR1.CAI	R_PHYSICAL	10.00 GB	to CR1.BRI:TenGigE0/0/2/6	UP
FourHundredGigE0/0/1/9	CR2.SYD	R_PHYSICAL	400.00 GB	L3 Physical of Cisco RON Cisco QSFP28 10...	UP
HundredGigE0/0/1/6	CR1.PER	R_PHYSICAL	100.00 GB	to CR1.ADE:HundredGigE0/0/1/8	UP
Bundle-Ether0	CR2.BRI	R_LOGICAL		to ER1.BRI:Bundle-Ether1	UP
HundredGigE0/0/1/8	CR1.DAR	R_PHYSICAL	100.00 GB	to ER1.DAR:100ge-0/1/1	UP
FourHundredGigE0/0/1/10	CR2.MEL	R_PHYSICAL	400.00 GB	L3 Physical of Cisco RON Cisco QSFPDD 40...	UP
FourHundredGigE0/0/1/7	CR2.SYD	R_LOGICAL		to CR2.MEL:FourHundredGigE0/0/1/7	UP
HundredGigE0/0/1/7	CR1.DAR	R_PHYSICAL	100.00 GB	to CR1.PER:HundredGigE0/0/1/8	UP
Bundle-Ether1	ER1.BRI	R_LOGICAL		to CR2.BRI:Bundle-Ether0	UP
HundredGigE0/0/1/13	CR1.ADE	R_PHYSICAL	100.00 GB	to CR2.ADE:HundredGigE0/0/1/6	UP
Bundle-Ether0	CR2.SYD	RAggregate			UP

Cancel OK

4. To check the performance for ports by tag, select **By Tags(s)**, click **Add Tag**, and then select the tags and click **OK**.

The screenshot shows a web interface with a sidebar on the left and a main content area. The sidebar has two sections: 'Links' and 'Ports'. Under 'Links', there is a checkbox labeled 'R_PHY'. Under 'Ports', there are two checkboxes labeled 'R_PHY' and 'All'. The main content area is titled 'Tags' and currently shows '(No items)'. At the bottom right of the interface, there are 'Cancel' and 'OK' buttons.

5. To check the performance for ports by device, select **By Device(s)**, and then click **Add Device**. In the **Advanced** tab, select from the **Router**, **Optical Node** or **Radio** tabs, or click on the **3D Explorer** tab to select a device. Click **OK**. You can add up to 10 items.

The screenshot shows the 'Advanced' tab of the interface. It contains a table with the following columns: Name, Description, Site, Vendor, and Tags. The table is currently displaying 18 items, all of which are routers. The 'ROUTER' tab is selected. At the bottom right, there are 'Cancel' and 'OK' buttons.

Name	Description	Site	Vendor	Tags
ER1.ADE		ADE	Cisco RON	
ER1.PER		PER	Huawei	
CR1.CAI		CAI	Nokia	
ER1.MEL		MEL	Cisco	
CR2.MEL		MEL	Cisco RON	
CR1.ADE		ADE	Cisco RON	
CR1.BRI		BRI	Cisco RON	
ER1.BRI		BRI	Cisco	
CR2.SYD		SYD	Cisco RON	
ER1.DAR		DAR	Juniper	
CR1.MEL		MEL	Cisco RON	
CR1.PER		PER	Cisco	
CR2.ADE		ADE	Cisco	
CR1.SYD		SYD	Cisco RON	
CR2.BRI		BRI	Cisco RON	
CR1.DAR		DAR	Cisco	
ER1.SYD		SYD	Cisco	

6. To check the performance for ports by device tag, select **By Device(s) Tags(s)**, click **Add Tag**, and then select the tags and click **OK**.
7. To check the performance for ports by L3VPN services, select **By L3VPN Services(s)**, and then click **Add L3VPN Service**. In the **Advanced** tab, select an L3VPN service, or click on the **3D Explorer** tab to select a L3VPN service. Click **OK**. You can add up to 10 items.
8. Continue to [View Utilization and Performance](#).

Links Traffic Utilization and Performance

You can view performance for:

- Specific and underlay links
- Links that are tagged with specific tags and tag values
- Links that include a device in a specific endpoint
- Links that include devices that are tagged with specific tags and tag values
- Links that include devices in two endpoints

To configure performance for links:

1. In the applications bar, select **Performance**.
2. Select **Links**.

The screenshot shows the 'Performance' configuration page. On the left, there are two sections: '1. Select Test Resources' and '2. Define Time Frame'. In the first section, 'Links' is selected under 'Select Test Resources'. Below this, 'By Specific And Underlay Link(s)' is selected. In the second section, 'Custom' is selected for 'Select Time Span', and 'Over entire day' is selected for 'Select Daily Time Frame'. There are 'From' and 'To' time input fields. At the bottom of the sidebar is a 'Run' button. The main area on the right has a search icon and the text 'Select resources and the time settings in the form to the left and test the resources performance'.

3. To check the performance for specific links, select **By Specific And Underlay Lower Link(s)**, click **Add Link**, and then select a link. In the **Advanced** tab, select from the **IP LINKS**, **OPTICAL LINKS** or **ZR LINKS** tabs, or click on the **3D Explorer** tab to select a link. Click **OK**. You can add up to 10 items.

Note: For more information on 3D Explorer, see the *Cisco Crosswork Hierarchical Controller Network Visualization Guide*.

- To check the performance by devices in an endpoint, select **By Device(s) In Some Endpoint**, and then click **Add Device**. In the **Advanced** tab, select from the **Router**, **Optical Node** or **Radio** tabs, or click on the **3D Explorer** tab to select a device. Click **OK**. You can add up to 10 items.

Advanced					
3D Explorer					
ROUTER					
OPTICAL NODE					
RADIO					
Name	Description	Site	Vendor	Tags	
18 ITEMS					
ER1.ADE		ADE	Cisco RON		
ER1.PER		PER	Huawei		
CR1.CAI		CAI	Nokia		
ER1.MEL		MEL	Cisco		
CR2.MEL		MEL	Cisco RON		
CR1.ADE		ADE	Cisco RON		
CR1.BRI		BRI	Cisco RON		
ER1.BRI		BRI	Cisco		
CR2.SYD		SYD	Cisco RON		
ER1.DAR		DAR	Juniper		
CR1.MEL		MEL	Cisco RON		
CR1.PER		PER	Cisco		
CR2.ADE		ADE	Cisco		
CR1.SYD		SYD	Cisco RON		
CR2.BRI		BRI	Cisco RON		
CR1.DAR		DAR	Cisco		
ER1.SYD		SYD	Cisco		

- To check the performance for by device tag, select **By Device(s) Tag(s) In Some Endpoint**, click **Add Tag**, and then select the tags and click **OK**.
- To check the performance for links with devices in two endpoints, select **By Device(s) In 2 Endpoints** and then select one of the following for **Endpoint 1** and **Endpoint 2**.

1. Select Test Resources

☐ Ports
☒ Links
☐ LSP Links

☐ By Specific And Underlay Link(s)
☐ By Tag(s)
☐ By Device(s) In Some Endpoint
☐ By Device(s) Tags(s) In Some Endpoint
☒ By Device(s) In 2 Endpoints

Endpoint 1
☒ Specific Device(s)
☐ Device(s) By Tag(s)

+ Add Device

Endpoint 2
☒ Specific Device(s)
☐ Device(s) By Tag(s)

+ Add Device

- **Specific Device(s)**: Click **Add Device** and then select a device In the **Advanced** tab, select from the **Router**, **Optical Node** or **Radio** tabs, or click on the **3D Explorer** tab to select a device. Click **OK**. You can add up to 10 items.
- **Device(s) By Tag(s)**: Click **Add Tag** and then select the tags and click **OK**.

8. Continue to [View Utilization and Performance](#).

LSP Links Traffic Utilization and Performance

You can view performance for:

- Specific LSP links
- LSP links that are tagged with specific tags and tag values
- LSP links that include a device in a specific endpoint
- LSP links that include devices that are tagged with specific tags and tag values
- LSP links that include devices in two endpoints

To configure performance for LSP links:

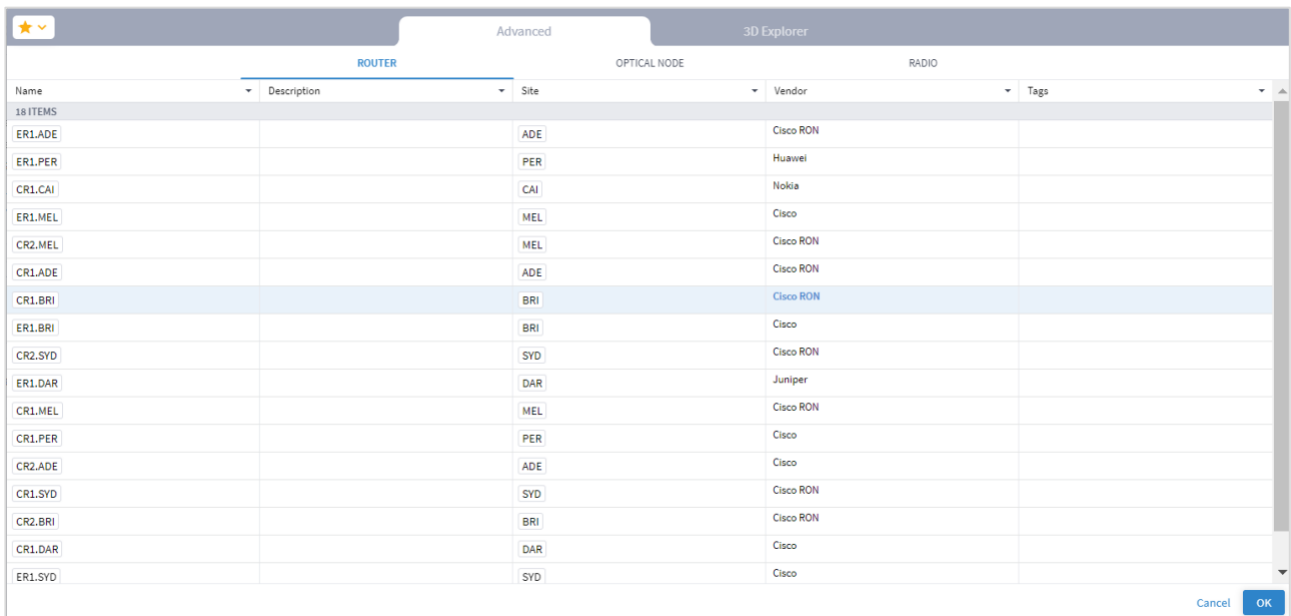
1. In the applications bar, select **Performance**.
2. Select **LSP Links**.

The screenshot shows the 'Performance' configuration window. The 'Run Test' tab is active. On the left, under '1. Select Test Resources', the 'LSP Links' radio button is selected. Below it, the 'By Specific And Related Lower Link(s)' radio button is selected. There is an 'Add Link' button. Under '2. Define Time Frame', the 'Select Time Span' dropdown is set to 'Custom', with 'From' and 'To' time pickers. The 'Select Daily Time Frame' dropdown is set to 'Over entire day'. A 'Run' button is at the bottom left. The main area on the right contains a magnifying glass icon and the text: 'Select resources and the time settings in the form to the left and test the resources performance'.

3. To check the performance for specific LSP links, select **By Specific And Related Lower Link(s)**, click **Add Link**, and then select a link. In the **Advanced** tab, select from the **LSP**, **IGP**, **IP Links**, **Optical Links** or **FIBER** tabs, or click on the **3D Explorer** tab to select a link. Click **OK**. You can add up to 10 items.

Note: For more information on 3D Explorer, see the *Cisco Crosswork Hierarchical Controller Network Visualization Guide*.

- To check the performance by devices in an endpoint, select **By Device(s) In Some Endpoint**, and then click **Add Device**. In the **Advanced** tab, select from the **ROUTER**, **OPTICAL NODE** or **RADIO** tabs, or click on the **3D Explorer** tab to select a device. Click **OK**. You can add up to 10 items.



Name	Description	Site	Vendor	Tags
ER1.ADE		ADE	Cisco RON	
ER1.PER		PER	Huawei	
CR1.CAI		CAI	Nokia	
ER1.MEL		MEL	Cisco	
CR2.MEL		MEL	Cisco RON	
CR1.ADE		ADE	Cisco RON	
CR1.BRI		BRI	Cisco RON	
ER1.BRI		BRI	Cisco	
CR2.SYD		SYD	Cisco RON	
ER1.DAR		DAR	Juniper	
CR1.MEL		MEL	Cisco RON	
CR1.PER		PER	Cisco	
CR2.ADE		ADE	Cisco	
CR1.SYD		SYD	Cisco RON	
CR2.BRI		BRI	Cisco RON	
CR1.DAR		DAR	Cisco	
ER1.SYD		SYD	Cisco	

- To check the performance for by device tag, select **By Device(s) Tag(s) In Some Endpoint**, click **Add Tag**, and then select the tags and click **OK**.
- To check the performance for links with devices in two endpoints, select **By Device(s) In 2 Endpoints**, and then select one of the following for **Endpoint 1** and **Endpoint 2**.

1. Select Test Resources

☐ Ports
☐ Links
☒ LSP Links

☐ By Specific And Related Lower Link(s)
☐ By Tag(s)
☐ By Device(s) In Some Endpoint
☐ By Device(s) Tag(s) In Some Endpoint
☒ By Device(s) In 2 Endpoints

Endpoint 1
☒ Specific Device(s)
☐ Device(s) By Tag(s)

+ Add Device

Endpoint 2
☒ Specific Device(s)
☐ Device(s) By Tag(s)

+ Add Device

- **Specific Device(s):** Click **Add Device** and then select a device In the **Advanced** tab, select from the **Router**, **Optical Node** or **Radio** tabs, or click on the **3D Explorer** tab to select a device. Click **OK**. You can add up to 10 items.
- **Device(s) By Tag(s):** Click **Add Tag** and then select the tags and click **OK**.

8. Continue to [View Utilization and Performance](#).

View Traffic Utilization and Performance

After specifying the ports, links or LSP links, you must configure the time frame and window. You can then view the results in table and graph form.

To view performance:

1. In the **Select time** area, specify the period to report on:
 - **Select Time Span:** Select the required period, either **Today**, **Past 24 hours**, **Past 7 days**, **Past 14 days**, **Past 30 days**, **Past 60 days**, or **Custom**. If you select **Custom**, then click **From** and **To** and select a date and specify a time.

2. Define Time Frame

Select Time Span
Custom

From

To

Select Daily Time Frame
Over entire day

- In the **Select Daily Time Frame** area either select **Over entire day** or **Specific time span per day**. If you select **Specific time span per day**, then click **From** and **Until** to specify a time.

2. Define Time Frame

Select Time Span
Past 14 days

Select Daily Time Frame
Specific time span per day

From

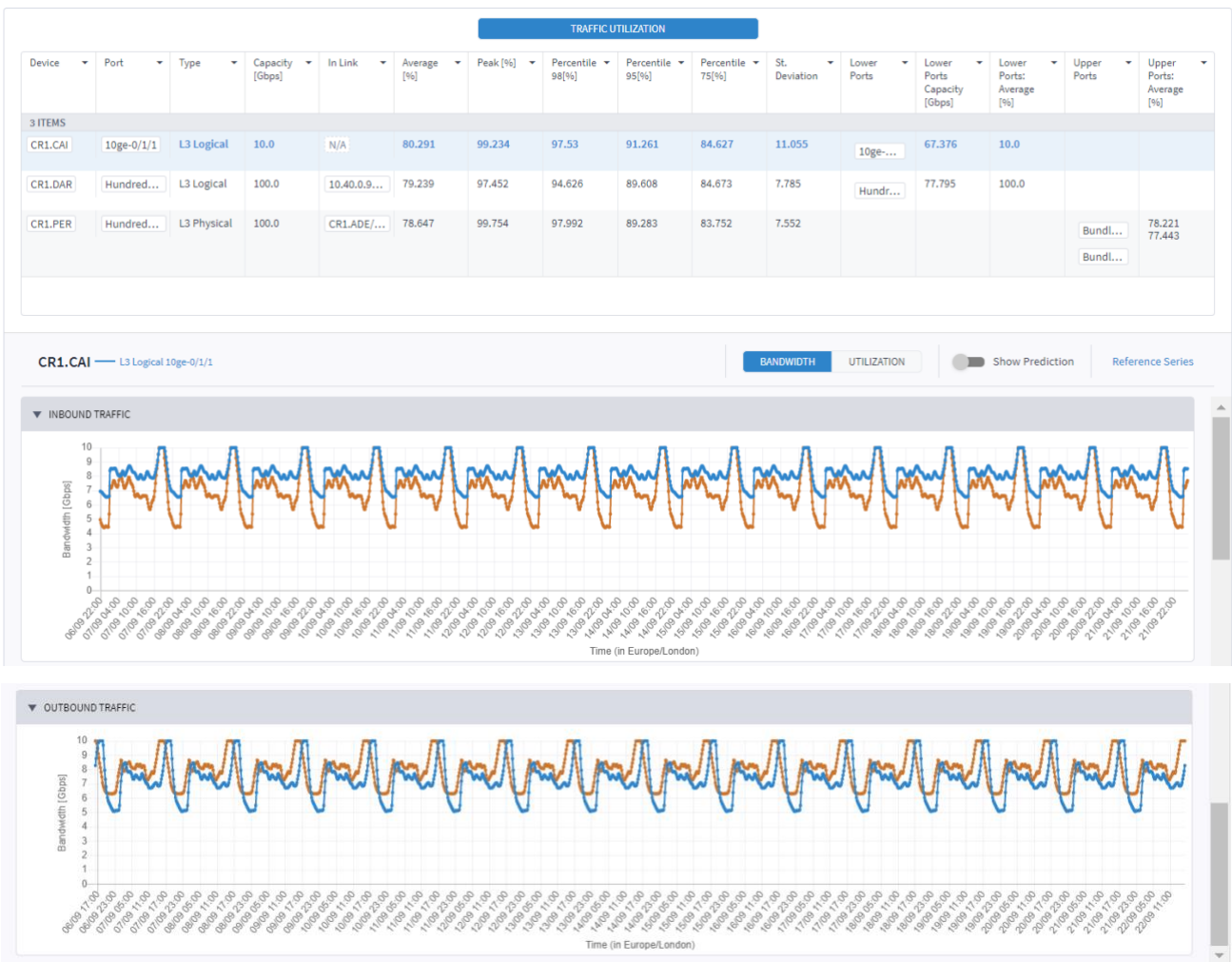
To

2. Click **Run**. If there are no relevant results, a **Utilization information is not available for the selected resources** message appears.

Note: When selecting optical (layer 0 and 1) links, the **Traffic Utilization** tab appears with the information for the related L3 physical, logical, or aggregate layers.

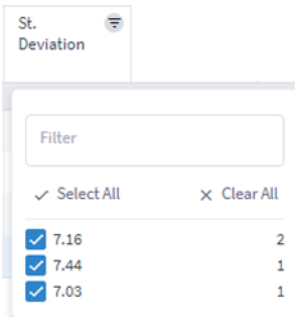
TRAFFIC UTILIZATION															
Device	Port	Type	Capacity [Gbps]	In Link	Average [%]	Peak [%]	Percentile 98[%]	Percentile 95[%]	Percentile 75[%]	St. Deviation	Lower Ports	Lower Ports Capacity [Gbps]	Lower Ports: Average [%]	Upper Ports	Upper Ports: Average [%]
3 ITEMS															
CR1.CAI	10ge-0/1/1	L3 Logical	10.0	N/A	80.291	99.234	97.53	91.261	84.627	11.055	10ge-...	67.376	10.0		
CR1.DAR	Hundred...	L3 Logical	100.0	10.40.0.9...	79.239	97.452	94.626	89.608	84.673	7.785	Hundr...	77.795	100.0		
CR1.PER	Hundred...	L3 Physical	100.0	CR1.ADE/...	78.647	99.754	97.992	89.283	83.752	7.552				Bundl...	78.221 77.443

3. Select an item to see more details on the **INBOUND TRAFFIC** and **OUTBOUND TRAFFIC**.

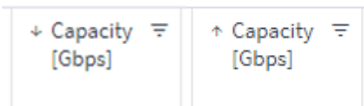


4. To filter the table, click  and select the required options:

- In numerical fields, the filter is numerical, and you can specify expressions including =, >, <, >=, <=, !=.
- In textual fields, the filter is character-based (regular expression).



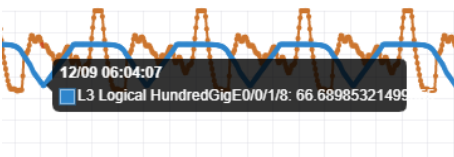
- To sort the table, click on a column heading.



- In the **TRAFFIC UTILIZATION** tab, to change the y-axis scaling, click **BANDWIDTH** or **UTILIZATION**.
- To view the prediction, select **Show Prediction**.



- Hover over a data point on the graph to see the date, time, element name and utilization value.

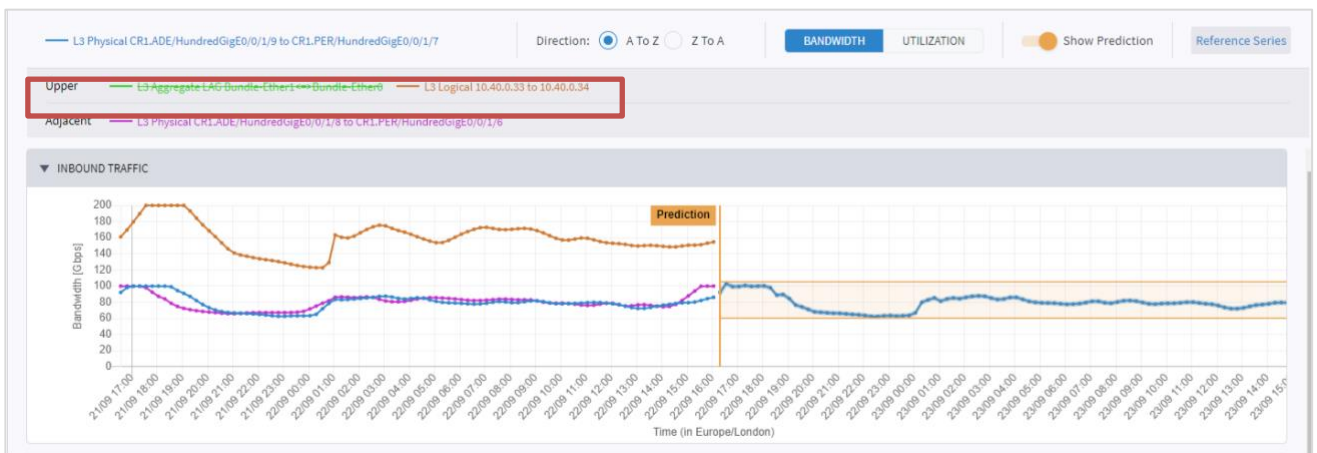


- To change the date range of the graph and zoom in or out, click on a graph and then using the mouse wheel, scroll up (to zoom in) or scroll down (to zoom out).
- If you select to view the data over more than one day, for a specific time of day, for example, for the past 7 days between 13:00 and 15:00, the utilization graph appears with the values for the selected time window.

11. To view the reference series toggle, select **Reference Series**.



12. To remove a reference series, click on the series description.

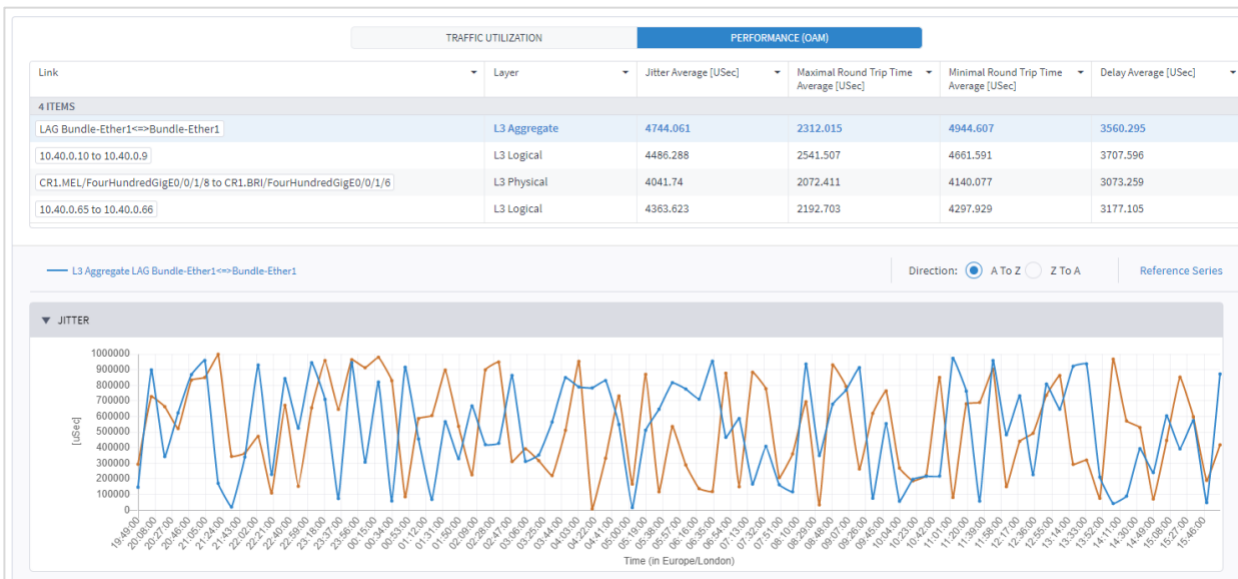


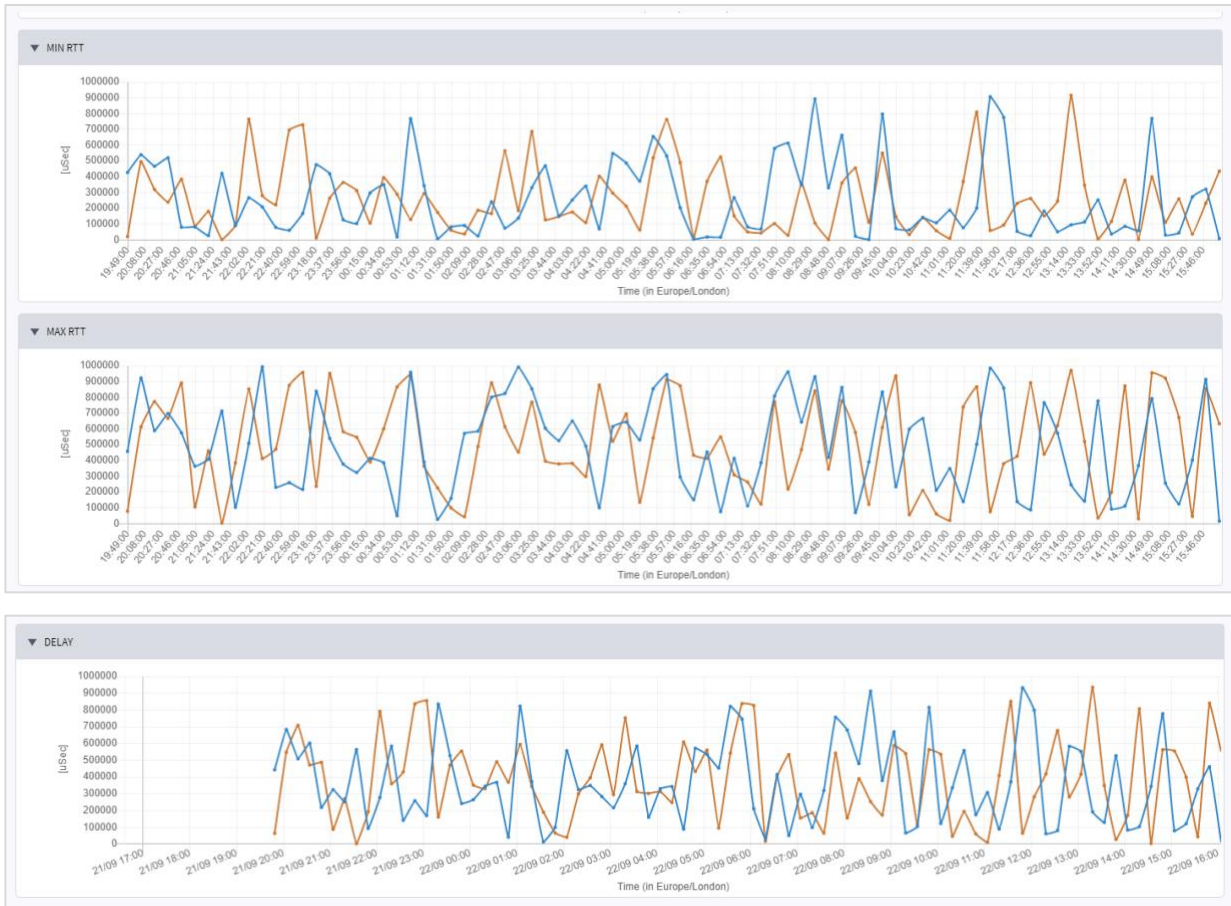
13. To change the direction, select **A to Z** or **Z to A**.

14. To view the OAM data (if relevant), click the **PERFORMANCE (OAM)** tab.

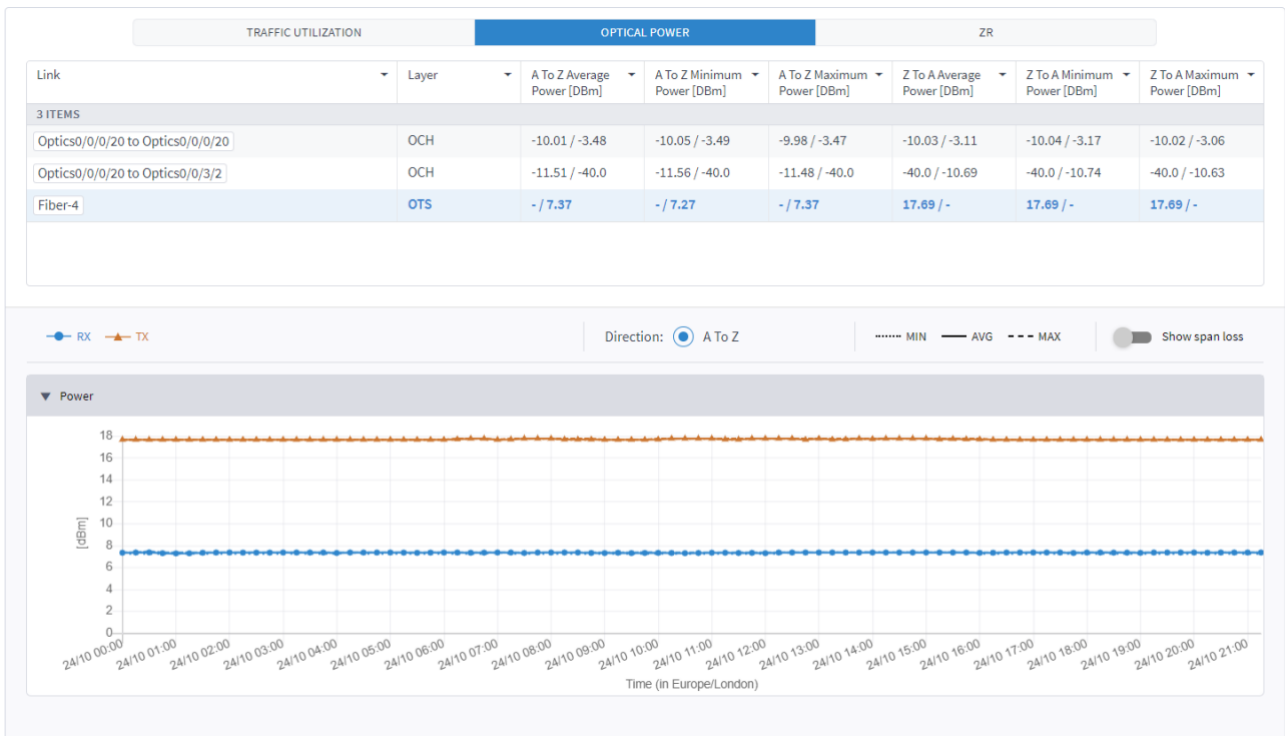
TRAFFIC UTILIZATION		PERFORMANCE (OAM)			
Link	Layer	Jitter Average [Usec]	Maximal Round Trip Time Average [Usec]	Minimal Round Trip Time Average [Usec]	Delay Average [Usec]
18 ITEMS					
CR1.MEL/FourHundredGigE0/0/1/7 to CR2.MEL/FourHundredGigE0/0/1/6	L3 Physical	4773.845	2353.843	4569.303	3429.28
CR1.ADE/HundredGigE0/0/1/9 to CR1.PER/HundredGigE0/0/1/7	L3 Physical	4446.235	1999.178	4213.782	3035.84
CR2.ADE/HundredGigE0/0/1/8 to CR2.MEL/HundredGigE0/0/2/6	L3 Physical	3931.215	2046.172	4396.224	2946.475
CR1.ADE/HundredGigE0/0/1/10 to CR1.DAR/HundredGigE0/0/1/6	L3 Physical	4704.44	2431.859	4536.792	3469.373
CR1.MEL/FourHundredGigE0/0/1/8 to CR1.BRI/FourHundredGigE0/0/1/6	L3 Physical	4190.033	2179.715	4229.106	3124.64
CR2.SVD/FourHundredGigE0/0/1/8 to CR2.BRI/FourHundredGigE0/0/1/6	L3 Physical	4917.803	2217.877	4233.33	3208.933
CR2.MEL/FourHundredGigE0/0/1/7 to CR2.SVD/FourHundredGigE0/0/1/7	L3 Physical	4301.153	2328.121	4313.07	3308.909
CR1.SVD/FourHundredGigE0/0/1/7 to CR2.SVD/FourHundredGigE0/0/1/6	L3 Physical	4698.631	1972.953	4042.561	3002.009
CR1.SVD/FourHundredGigE0/0/1/8 to CR1.BRI/FourHundredGigE0/0/1/7	L3 Physical	4047.538	2384.987	4653.397	3365.912
CR1.ADE/HundredGigE0/0/1/6 to CR1.MEL/HundredGigE0/0/2/6	L3 Physical	4501.58	2108.263	4724.52	3458.121
CR1.ADE/HundredGigE0/0/1/12 to CR1.SVD/HundredGigE0/0/2/7	L3 Physical	3957.105	2089.483	4408.032	3179.302
CR2.ADE/HundredGigE0/0/1/9 to CR2.MEL/HundredGigE0/0/2/7	L3 Physical	4805.431	1916.372	4248.098	3239.325
CR1.MEL/FourHundredGigE0/0/1/6 to CR1.SVD/FourHundredGigE0/0/1/6	L3 Physical	4145.374	2100.352	4748.385	3381.403
CR1.ADE/HundredGigE0/0/1/8 to CR1.PER/HundredGigE0/0/1/6	L3 Physical	3977.8	2027.184	4354.035	3223.713
CR1.DAR/HundredGigE0/0/1/7 to CR1.PER/HundredGigE0/0/1/8	L3 Physical	4373.257	2355.717	4737.333	3571.675
CR1.ADE/HundredGigE0/0/1/7 to CR1.MEL/HundredGigE0/0/2/7	L3 Physical	4547.57	1964.507	4217.899	3290.365
CR1.BRI/TenGigE0/0/2/6 to CR1.CAI/10ge-0/1/1	L3 Physical	4645.89	2047.15	4627.032	3192.799
CR1.ADE/HundredGigE0/0/1/11 to CR1.SVD/HundredGigE0/0/2/6	L3 Physical	4174.743	1972.574	4477.83	3384.236

15. Select an item to see more details on **JITTER**, **MIN RTT**, **MAX RTT**, **DELAY**, and **OUTBOUND TRAFFIC**.





16. To view the optical data (if relevant), click the **OPTICAL POWER** tab. Select an item to see **Power** details.



17. To view the ZR media data (if relevant), click the **ZR** tab. Select an item to see **FEC BER** and **Q** details.




Export Test Results

The tabular test results can be exported into a zip file with CSV files for offline analysis.

The export file includes extended information. The **Average** column appears in the UI, but in the export, there are two columns: **Average IN** and **Average OUT**. The UI shows the greater value of these two values.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	Execution	Value																	
2	Time	14:55:44	10-05-2020	UTC															
3																			
4	Device	Port	Capacity [C	In Link	Average IN	Peak IN [%	Percentile	Percentile	Percentile	St. Deviatric	Average OI	Peak OUT	Percentile	Percentile	Percentile	St. Deviatric	Lower Port	Lower Port	Low
5	ER1.SQY	L3 Physical	10	L3 Physical	80.68	100	100	100	100	5.28	85.63	100	100	100	93.81	6.82	-	-	-
6	ER1.SQY	L3 Physical	10	L3 Physical	82.84	100	100	100	100	4.73	76.43	100	100	100	100	6.44	-	-	-
7	ER1.SQY	L3 Physical	10	-	71.69	100	100	100	100	6.09	74.38	100	100	100	100	6.54	-	-	-
8	ER1.SQY	L3 Logical	10	-	71.69	100	100	100	100	6.09	74.38	100	100	100	100	6.54	L3 Physical	10	

To export the test results:

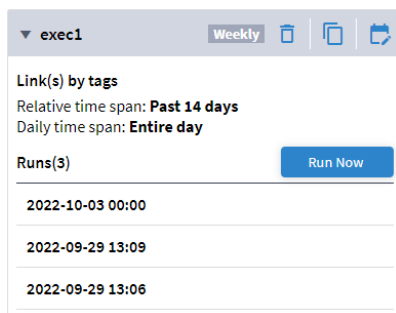
1. In the applications bar, select **Performance**.
2. Run the required test.
3. Click . The file is downloaded automatically.

Manage Configurations

You can save the test configuration and either run the test when required or use it as a basis for a new test. You can also configure a test to run periodically.

To view a saved test result:

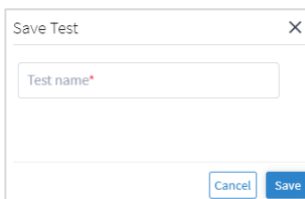
1. In the applications bar, select **Performance**.
2. Expand the required test.



3. Select a run to view the results or click **Run Now** to execute the test.

To save a test configuration:

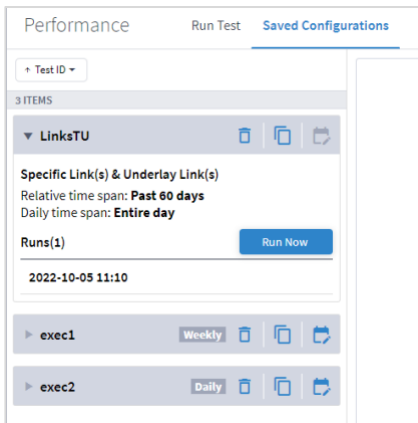
1. In the applications bar, select **Performance**.
2. Run the required test.
3. Click **Save**.




4. Enter a test name.
5. Click **Save**. The configuration is now available to run on the **Saved Configurations** tab.


To run a saved test configuration:

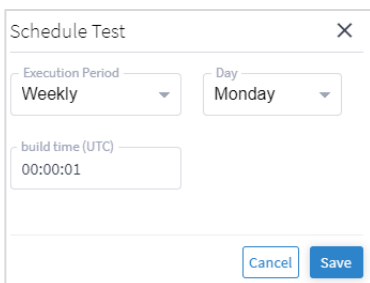
1. In the applications bar, select **Performance**.
2. Select the **Saved Configurations** tab.



3. To run a test, expand the required test.
4. Click **Run Now** or if you want to edit the test, click , modify the test as required, and then click **Run**.


To set a test to run periodically:

1. In the applications bar, select **Performance**.
2. Select the **Saved Configurations** tab.
3. For the required test, click .



4. Select whether to execute the test **Weekly** (and on which day), or **Daily**.
5. Specify the **build time (UTC)**.
6. Click **Save**.

To delete a test:

1. In the applications bar, select **Performance**.
2. Select the **Saved Configurations** tab.
3. Click . The test is deleted (there is no confirmation).

Other Ways to See Performance Data

- In Explorer, for a physical or logical port of a router, the **Utilization Over 24h** graph also appears in the Info window (if the port was utilized over latest 24 hours). For links and LSP links no data is presented in the Explorer window.

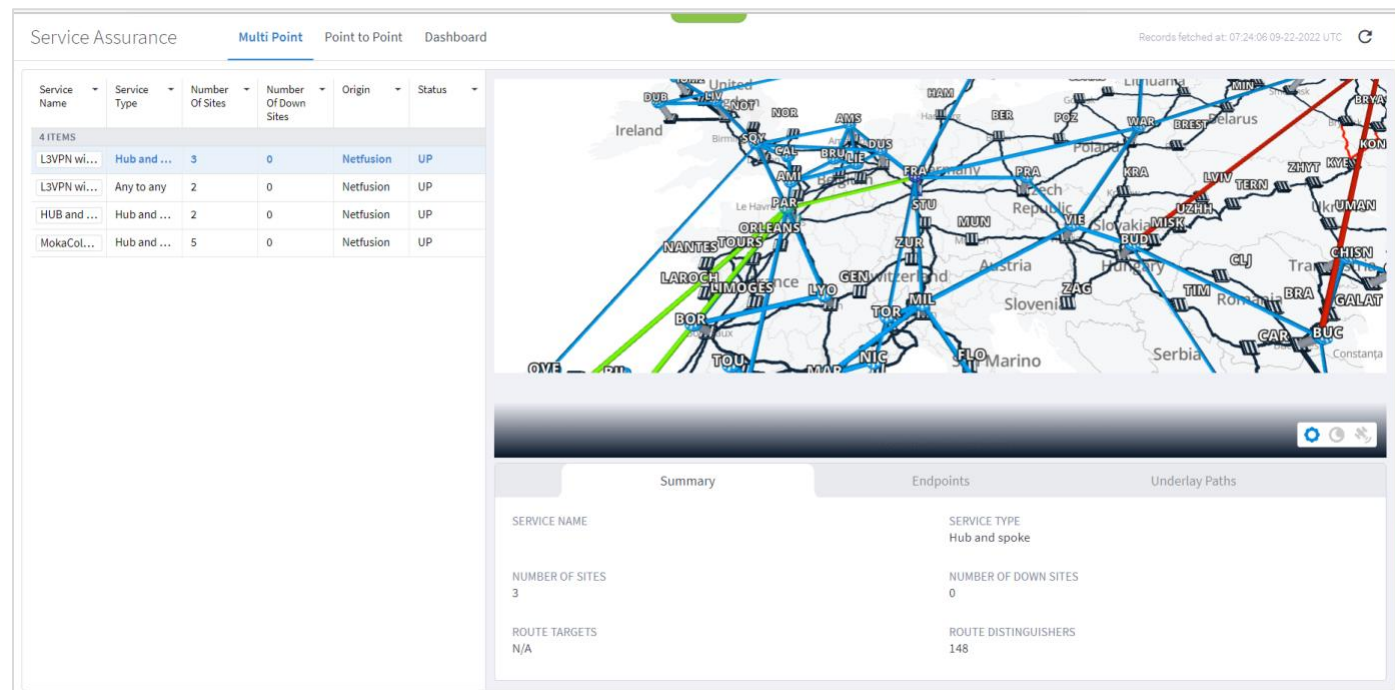


- In the Service Assurance application, for point to point services. See [View the Point to Point Services](#).
- In the Path Analysis application, for a path. See [Analysis a Path](#).

Service Assurance

The Service Assurance application enables you to visualize the L1-L2-L3 service configuration and underlay paths, with UNIs performance and service-related events history.

For more information on services and service provision, see the *Cisco Crosswork Hierarchical Controller Service Provisioning User Guide*.



For more information on the 3D Explorer application, see the *Cisco Crosswork Hierarchical Controller Network Visualization Guide*.

View the Multi Point Services

Crosswork Hierarchical Controller discovers L3-VPN sites (endpoints), VRFs and underlay paths as LSPs across multiple domains (autonomous systems) and vendors and maps it to the optical network. Discovered VPNs are displayed in the Service Assurance application with their Route Distinguishers (RDs), Route Targets (RTs), type (hub & spoke or any to any/full mesh), sites, underlay LSPs and IGP path visualized on the map. The RD is used to keep all prefixes in the BGP table unique, and the RT is used to transfer routes between VRFs/VPNs.

You can view a list of these Multi Point services and view their endpoints and underlay paths. The Multi Point services can be of type:

- **Any to any:** A full mesh non-hierarchical service where any site can communicate with any site.
- **Hub and spoke:** A hierarchical service where hub sites can communicate with all other sites and spoke sites can only communicate with hub sites.

To view the Multi Point Services:

1. In the applications bar, select **Service Assurance**.
2. Select the **Multi Point** tab. The table on the left lists the multi point services and includes information on:
 - **Service Name:** The name of the service as defined in the Services Manager.
 - **Service Type:** The service type, **Any to any** or **Hub and spoke**.

- **Number of Sites:** The number of sites in the service.
 - **Number of Down Sites:** The number of sites in the service that are **DOWN**.
 - **Origin:** The origin of the service, either **Netfusion** (created by Crosswork Hierarchical Controller) or **Network**.
 - **Status:** The service status, either **UP** or **DOWN**.
3. Select the required service. The Explorer map shows all sites and the underlay paths for the selected service.

Service Assurance Multi Point Point to Point Dashboard Records fetched at: 07:24:06 09-22-2022 UTC

Service Name	Service Type	Nur Of Site	Nur Of Dow Site	Orig	Stat
4 ITEMS					
L3VPN with RSVP underlay	Hub and spoke	3	0	Ne...	UP
L3VPN with Segment Routing underlay	Any to any	2	0	Ne...	UP
HUB and Spoke L3VPN with SRTE underlay	Hub and spoke	2	0	Ne...	UP
MokaCola L3VPN with RSVP underlay	Hub and spoke	5	0	Ne...	UP

Summary			Endpoints		Underlay Paths			
Device Name	Port Name	Operati State	Admin State	VRF Name	VRF Description	VLAN ID	IP Address	Tags
2 ITEMS								
ZR_ER2.SQY	L3_VPN port at ZR...	UP	UP		L3 VPN port at serv...	1400	20.20...	
ZR_ER2.LIS	L3_VPN port at ZR...	UP	UP		L3 VPN port at serv...	1300	20.20...	

4. The **Summary** tab includes the following details:
- **Service Name:** The service name.
 - **Service Type:** The service type, **Any to any** or **Hub and spoke**.
 - **Number of Sites:** The number of sites in the service.
 - **Number of Down Sites:** The number of sites in the service that are DOWN.
 - **Route Targets:** The number of route targets.
 - **Route Distinguishers:** The number of route distinguishers.

Summary	Endpoints	Underlay Paths
SERVICE NAME	SERVICE TYPE	
	Hub and spoke	
NUMBER OF SITES	NUMBER OF DOWN SITES	
3	0	
ROUTE TARGETS	ROUTE DISTINGUISHERS	
N/A	148	

5. A list of the **Endpoints** appears below the map with the following details:
- **Device Name:** The device name.
 - **Port Name:** The interface port name.
 - **Operational State:** The operational status of the port (**UP** or **DOWN**).

- **Admin State:** The admin status of the port (**UP** or **DOWN**).
- **VRF Name:** The Virtual Routing and Forwarding (VRF) name.
- **VRF Description:** The VRF description.
- **VLAN ID:** The endpoint VLAN ID.
- **IP Address:** The endpoint IP address.
- **Role:** The role of the endpoint, **SPOKE** or **HUB**.
- **Tags:** The endpoint tags.

Summary				Endpoints		Underlay Paths				
Device Name	Port Name	Operational State	Admin State	VRF Name	VRF Description	VLAN ID	IP Address	Role	Tags	
3 ITEMS										
CR1.LIS	L3_VPN port at CR1.LIS, s...	UP	UP		L3 VPN port at service L3VPN with RSVP underlay	1901	10.1.12...	SPOKE		
CR1.PAR	L3_VPN port at CR1.PAR, s...	UP	UP		L3 VPN port at service L3VPN with RSVP underlay	1900	10.1.10...	HUB		
CR1.FRA	L3_VPN port at CR1.FRA, s...	UP	UP		L3 VPN port at service L3VPN with RSVP underlay	1902	10.1.14...	SPOKE		

6. The **Underlay Paths** tab includes the following details:

- **RT:** The route target number.
- **LSP Name:** The LSP name (if RSVP-TE or LDP).
- **Path Type:** The type of the underlay path, SR Policies or RSVP-TE Tunnels.
- **Source (Export):** The source site name (geo site:device:port:vlan).
- **Destination (Import):** The destination site name (geo site:device:port:vlan).
- **Underlay Hops:** The number of hops in the underlay path.
- **Link Layer:** The link layer.
- **Tags:** The underlay tags.

Summary				Endpoints		Underlay Paths			
RT	LSP Name	Path Type	Source (Export)	Destination (Import)	Underlay Hops	Link Layer	Oper Statu	Tags	
2 ITEMS									
N/A	SR_P_600	SR_POLICY	SPB CR1.SPB L3_VPN port at CR1.SPB, ser...	DUB CR1.DUB L3_VPN port at CR1.DUB, se...	11	L3 VPN	N_A	Tag All	
N/A	SR_P_600_reverse	SR_POLICY	DUB CR1.DUB L3_VPN port at CR1.DUB, se...	SPB CR1.SPB L3_VPN port at CR1.SPB, ser...	11	L3 VPN	N_A	Tag All	

Note: Underlay paths are not discovered or calculated for sites located in different domains (inter-AS option C).

7. Select a path in the table to display it in the map.

View the Point to Point Services

You can view point to point services of type:

- **Circuit E-Line:** An Ethernet connection between two ETH client ports on Transponder or Muxponder over OTN signal.
- **Packet E-Line:** A point-to-point connection between two routers or transponders/muxponders over MPLS-TP or IP-MPLS.

To view the point to point services:

1. In the applications bar, select **Service Assurance**.
2. Select the **Point to Point** tab. The table on the left lists the multi point services and includes information on:
 - **Service Name:** The name of the service as defined in the Services Manager.
 - **Service Type:** The service type, **Packet e-line** or **Circuit e-line**.
 - **Number of Down Sites:** The number of sites in the service that are DOWN.
 - **Origin:** The origin of the service.
 - **Status:** The service status, either **UP** or **DOWN**.
3. Select the required service. The Explorer map shows the selected service.

The screenshot displays the 'Service Assurance' dashboard with the 'Point to Point' tab selected. The top navigation bar includes 'Multi Point', 'Point to Point', and 'Dashboard'. The main content area is divided into three sections:

- Service List (Left):** A table with columns: Service Name, Service Type, Num of Down Site, Orig, and Stat. It lists 6 items, all with a status of 'UP'.
- Explorer Map (Right):** A map of Europe showing network paths and service areas.
- Service Details (Bottom):** A detailed view of a selected service, showing a table with columns: Device Name, Port Name, Operational State, Admin State, VLAN ID, BW Eir, BW Cir, and Tags. It lists 2 items, both with a status of 'UP'.

4. The **Summary** tab includes the following details:
 - **Service Name:** The service name.
 - **Service Type:** The service type, **Packet e-line** or **Circuit e-line**.
 - **Status:** The service status, either **UP** or **DOWN**.
 - **Origin:** The origin of the service.
 - **Creation Date:** The date the service was created.
 - **Optimization Goal:** The optimization goal as defined in the service.
 - **Include Link:** The IP or optical links that were included in the service intent.
 - **Exclude Link:** The IP or optical links that were excluded in the service intent.
 - **Disjoint Service Name:** The disjoint service name. This means that the new Packet E-Line or Circuit E-Line must not traverse this exclusionary path (this would be equivalent to adding all the links that constitute the disjoint path to the exclude items from path list).

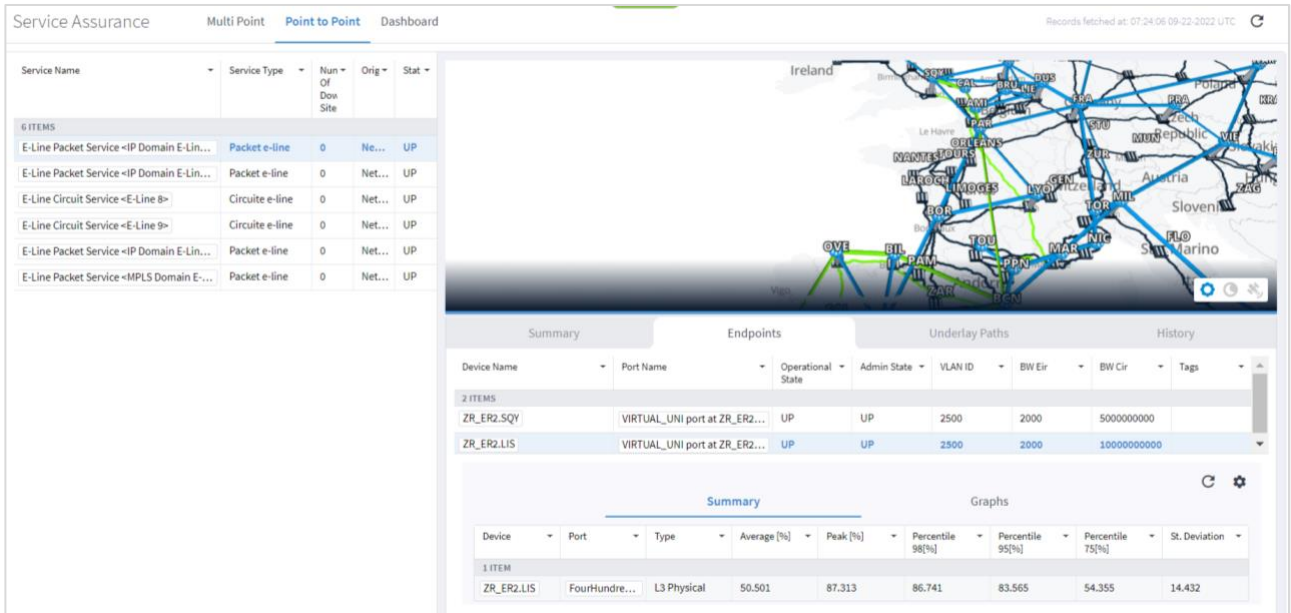
Summary	Endpoints	Underlay Paths	History
SERVICE NAME E-Line Packet Service <IP Domain E-Line 1>		SERVICE TYPE Packet e-line	
STATUS UP		ORIGIN Netfusion	
CREATION DATE 2022-08-25 15:56:01		OPTIMIZATION GOAL NUMBER_OF_HOPS	
INCLUDE LINK N/A		EXCLUDE LINK N/A	
DISJOINT SERVICE NAME N/A			

5. In the **Endpoint** tab, a list of the **Endpoints** appears below the map with the following details:

- **Device Name:** The device name.
- **Port Name:** The interface port name.
- **Operational State:** The operational status of the port (**UP** or **DOWN**).
- **Admin State:** The admin status of the port (**UP** or **DOWN**). If **DOWN**, this element constitutes a root cause failure in and of itself (and not simply an affected element).
- **VLAN ID:** The endpoint VLAN ID.
- **BW Eir:** The bandwidth Excess Information Rate (EIR).
- **BW Cir:** The bandwidth Committed Information Rate (CIR).
- **Tags:** The endpoint tags.

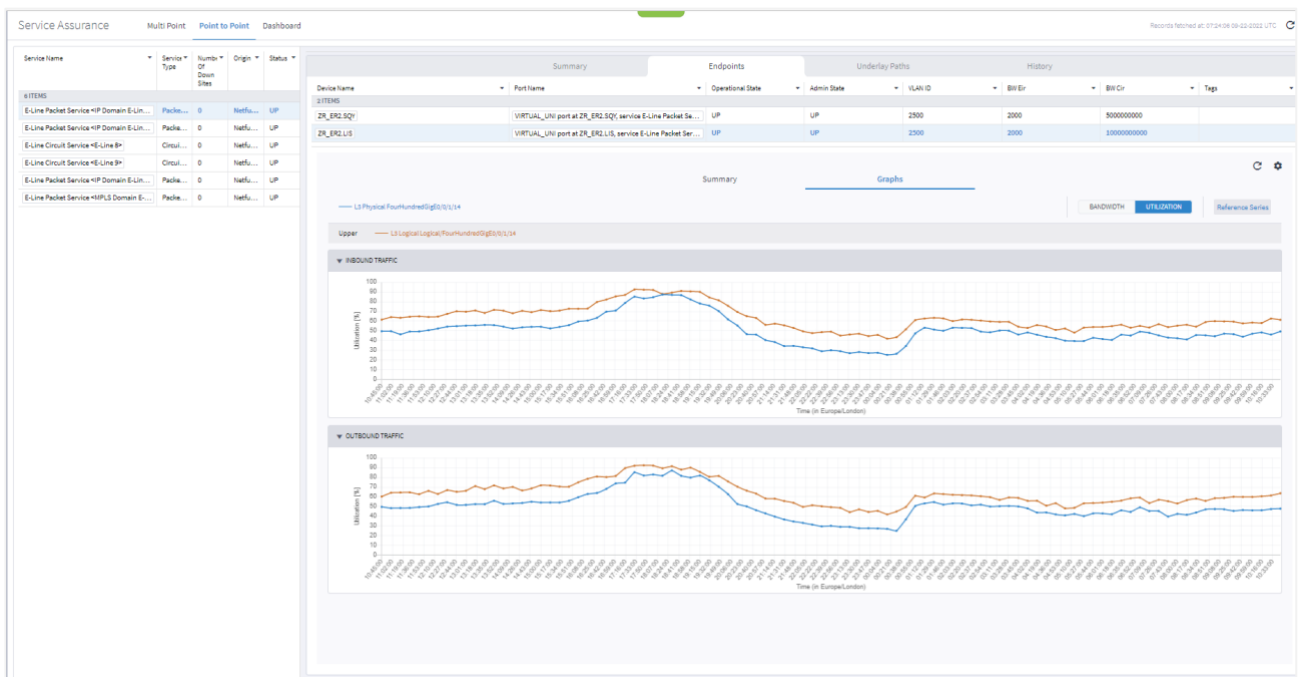
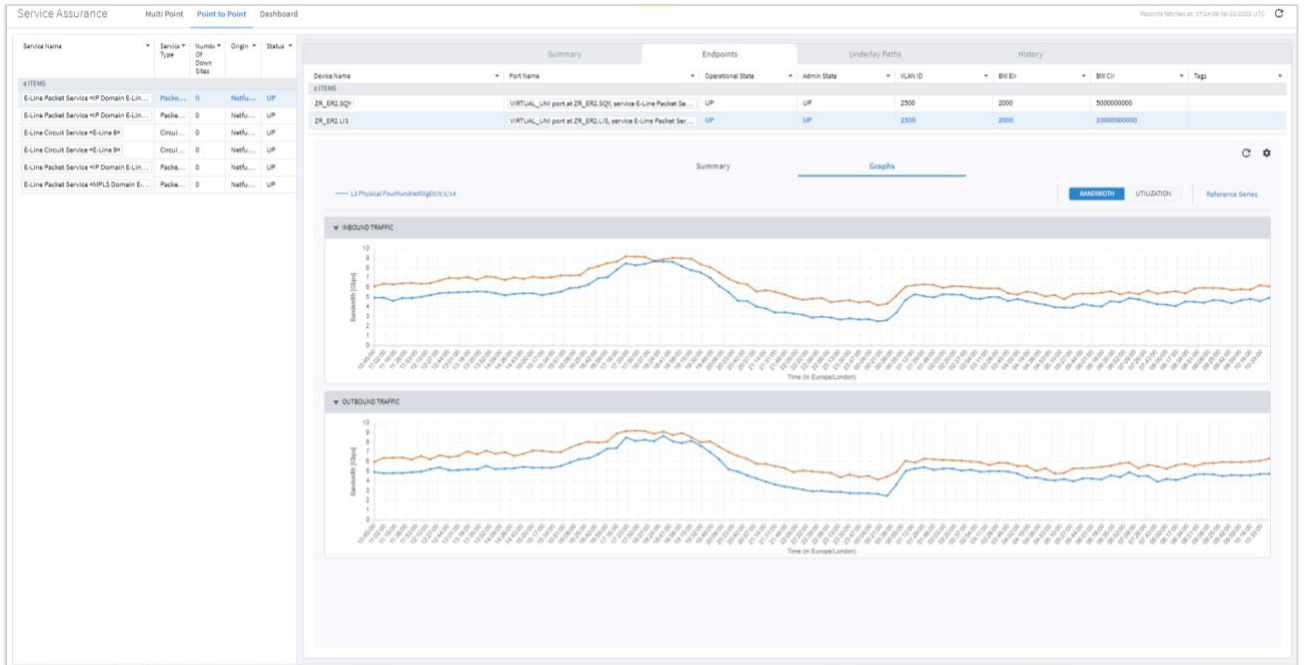
6. Select the required endpoint. The performance information appears for the selected service map with the following details:

- **Device Name:** The device name.
- **Port:** The port name.
- **Type:** The port name.
- **Average [%]**
- **Peak [%]**
- **Percentile [98%]**
- **Percentile [95%]**
- **Percentile [75%]**
- **St Deviation**



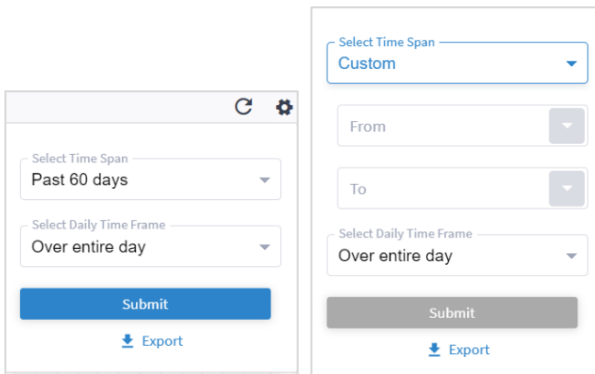
Summary		Endpoints		Underlay Paths			History	
Device Name	Port Name	Operational State	Admin State	VLAN ID	BW Eir	BW Cir	Tags	
2 ITEMS								
ZR_ER2.SQY	VIRTUAL_UNI port at ZR_ER2...	UP	UP	2500	2000	5000000000		
ZR_ER2.LIS	VIRTUAL_UNI port at ZR_ER2...	UP	UP	2500	2000	10000000000		
Summary				Graphs				
Device	Port	Type	Average [%]	Peak [%]	Percentile 98[%]	Percentile 95[%]	Percentile 75[%]	St. Deviation
1 ITEM								
ZR_ER2.LIS	FourHundre...	L3 Physical	50.501	87.313	86.741	83.565	54.355	14.432

To view graphs of the performance, click the **Graphs** tab in the lower pane. For additional information on performance, see [Performance](#).

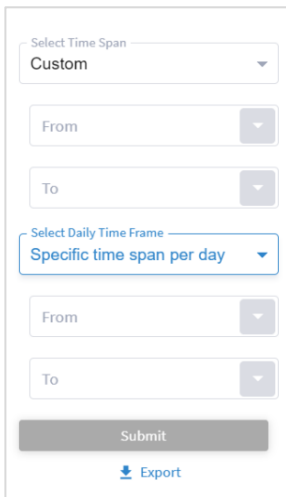


7. Click  and specify the period to report on:

- **Select Time Span:** Select the required period, either **Today**, **Past 24 hours**, **Past 7 days**, **Past 14 days**, **Past 30 days**, **Past 60 days**, or **Custom**. If you select **Custom**, then click **From** and **To** and select a date and specify a time.



- In the **Select Daily Time Frame** area either select **Over entire day** or **Specific time span per day**. If you select **Specific time span per day**, then click **From** and **Until** to specify a time.



8. Click **Export** to download the performance statistics.

9. The **Underlay Paths** tab includes the following details:

- **Link Name:** The link name.
- **Source (Export):** The source site name (geo site:device:port:vlan).
- **Destination (Import):** The destination site name (geo site:device:port:vlan).
- **Link Layer:** The link layer. For Circuit e-line: **ODU**. For Packet e-line: **MPLS TP**, **SR Policy**, or **LSP**.
- **Oper Status:** The operational status.
- **Role:** Either the **main** path or the **protection** path.
- **Tags:** The underlay tags.

Summary		Endpoints		Underlay Paths		History	
Link Name	Source (Export)	Destination (Import)	Link Layer	Oper Status	Role	Tags	
2 ITEMS							
SR_P_100_reverse	ZR_ER2.SQY-100.0.0.157 (router-id) loopb...	ZR_ER2.LIS-100.0.0.134 (router-id) loopb...	SR Policy	Up	main	Tag All	
SR_P_100	ZR_ER2.LIS-100.0.0.134 (router-id) loopb...	ZR_ER2.SQY-100.0.0.157 (router-id) loopb...	SR Policy	Up	main	Tag All	

10. The **History** tab shows all changes in configuration or in operational status of the service and its underlay path links or tunnels and includes the following details:

- **Time:** The time of the event.
- **Object Name:** The object name.
- **Object Type:** The object type, port, service, or link.
- **Action Type:** The action type, **UPDATE**, **INSERT** or **DELETE**.
- **Changed Attributes:** The attributes changed.

Summary		Endpoints		Underlay Paths		History	
Time	Object Name	Object Type	Action Type	Changed Attributes			
10 ITEMS							
Aug 25 2022 16:02:47 UTC	E-Line Packet Service <IP Domain...	Service	UPDATE	tags: {} → {"Tag": ["All"]}	View all changes (1)		
Aug 25 2022 16:02:47 UTC	SR_P_100_reverse	Link	UPDATE	tags: {} → {"Tag": ["All"]}	View all changes (1)		
Aug 25 2022 16:02:47 UTC	SR_P_100	Link	UPDATE	tags: {} → {"Tag": ["All"]}	View all changes (1)		
Aug 25 2022 16:00:31 UTC	VIRTUAL_UNI port at ZR_ER2.LIS, ...	Port	UPDATE	tags: {} → {"Tag": ["All"]}	View all changes (1)		

View the Dashboard

In the Dashboard you can see how many services were discovered and how many services are operationally down.

To view the Dashboard:

1. In the applications bar, select **Service Assurance**.
2. Select the **Dashboard** tab.

Service Assurance

Multi Point

Point to Point

Dashboard

Records fetched at: 07:24:06 09-22-2022 UTC

Discovered Services

29

Operationally Down Services

0

View the Services using SHQL

If you have access to SHQL, you can execute a query to view a list of the various services (by type).

To view the services using SHQL:

1. In the applications bar, select **SHQL Query**.
2. Enter **service | add_counters()** and click **RUN**. This shows you the total number of configured services.

SHQL

Saved Queries

service | add_counters()

RESULTS (29)

ShqlCounters (1) OTN Line Service (1) E-Line Service (6) L3 VPN Service (4) Tunnel Service (18)

Attribute Name	Attribute Value	Counter
1 ITEM		
total		29

3. Click the required service tab to view a list of the services, for example, OTN Line Services, E-Line Services, L3 VPN Services, or Tunnel Services (RSVP Tunnel and SR Policy).

SHQL

Saved Queries

service | add_counters()

RESULTS (29)

ShqlCounters (1) **OTN Line Service (1)** E-Line Service (6) L3 VPN Service (4) Tunnel Service (18)

Guid	Type	AdminStatus	ContainedPor	CustomerDet	CustomerName	DeploymentS	Desc	Name	OperStatus	Provider	ServiceIntent	ServiceIntentI	Tags	Extra
1 ITEM														
SV/OTNLine1	OTN_LINE	UP	[{"guid": "PO...	Shipbuildin...	Shipbuildin...	DEPLOYME...	OTN Line Se...	OTN Line Se...	UP	TOPOGEN_...	SI/OTNLine1	INTENT_FU...	[{"Tag": "All"}]	[{"linkGuid": "...

SHQL

Saved Queries

service | add_counters()

RESULTS (29)

ShqlCounters (1) OTN Line Service (1) **E-Line Service (6)** L3 VPN Service (4) Tunnel Service (18)

Guid	Type	AdminStatus	ContainedPor	CustomerDet	CustomerName	DeploymentS	Desc	Name	OperStatus	Provider	ServiceIntent	ServiceIntentI	Tags	Extra
6 ITEMS														
SV/IPDomai...	E_LINE	UP	[{"guid": "PO...	Automobile...	Automotive...	DEPLOYME...	E-Line Pack...	E-Line Pack...	UP	TOPOGEN_...	SI/IPDomai...	INTENT_FU...	[{"Tag": "All"}]	[{"linkGuid": "...
SV/IPDomai...	E_LINE	UP	[{"guid": "PO...	Tractor Indu...	General Tra...	DEPLOYME...	E-Line Pack...	E-Line Pack...	UP	TOPOGEN_...	SI/IPDomai...	INTENT_FU...	[{"Tag": "All"}]	[{"linkGuid": "...
SV/E-Line8	E_LINE	UP	[{"guid": "PO...	Corduba Ca...	Corduba Ca...	DEPLOYME...	E-Line Circu...	E-Line Circu...	UP	TOPOGEN_...	SI/E-Line8	INTENT_FU...	[{"Tag": "All"}]	[{"linkGuid": "...
SV/E-Line9	E_LINE	UP	[{"guid": "PO...	Spacecrafts...	Spacecrafts...	DEPLOYME...	E-Line Circu...	E-Line Circu...	UP	TOPOGEN_...	SI/E-Line9	INTENT_FU...	[{"Tag": "All"}]	[{"linkGuid": "...
SV/IPDomai...	E_LINE	UP	[{"guid": "PO...	J.W. Heritag...	J.W. Heritag...	DEPLOYME...	E-Line Pack...	E-Line Pack...	UP	TOPOGEN_...	SI/IPDomai...	INTENT_FU...	[{"Tag": "All"}]	[{"linkGuid": "...
SV/MPLSDo...	E_LINE	UP	[{"guid": "PO...	Italy-Swede...	Italy-Swede...	DEPLOYME...	E-Line Pack...	E-Line Pack...	UP	TOPOGEN_...	SI/MPLSDo...	UNKNOWN	[{"Tag": "All"}]	[{"linkGuid": "...

SHQL

Saved Queries

service | add_counters()

RUN

RESULTS (29)

ShqlCounters (1) OTN Line Service (1) E-Line Service (6) L3 VPN Service (4) Tunnel Service (18)

Guid	Type	AdminStat	Contained	CustomerI	CustomerI	Deployme	Desc	Name	OperStatu	Provider	ServiceInt	ServiceInt	Tags	Extra	AnyToAnyt	SpokeRou	VpnTopole
4 ITEMS																	
SV/L3VP...	L3_VPN	UP	{{'guid': '...	Test L3 V...	Test	DEPLOY...	L3 VPN s...	L3VPN wi...	UP	TOPOGE...	SI/L3VPN...	INTENT_...	{'Tag': ['A...	{'linkGui...			HUB_AN...
SV/L3VP...	L3_VPN	UP	{{'guid': '...	Test L3 V...	Test	DEPLOY...	L3 VPN s...	L3VPN wi...	UP	TOPOGE...	SI/L3VPN...	INTENT_...	{'Tag': ['A...	{'linkGui...			ANY_TO...
SV/HUB...	L3_VPN	UP	{{'guid': '...	Agile Dev...	ADT.Ltd	DEPLOY...	L3 VPN s...	HUB and ...	UP	TOPOGE...	SI/HUB...	INTENT_...	{'Tag': ['A...	{'linkGui...	66002	66002	HUB_AN...
SV/Moka...	L3_VPN	UP	{{'guid': '...	Moka Col...	Moka Cola	DEPLOY...	L3 VPN s...	MokaCol...	UP	TOPOGE...	SI/Moka...	INTENT_...	{'Tag': ['A...	{'linkGui...	273	273	HUB_AN...

SHQL

Saved Queries

service | add_counters()

RUN

RESULTS (29)

ShqlCounters (1) OTN Line Service (1) E-Line Service (6) L3 VPN Service (4) Tunnel Service (18)

Guid	Type	AdminStatus	CustomerDetails	CustomerName	DeploymentStat	Desc	Name	OperStatus	Provider	ServiceIntent	ServiceIntentRel	Extra
18 ITEMS												
SV/lsp/igp/d16...	TUNNEL	UP	Cisco (Sedona)	SedonaSys	DEPLOYMENT...	RSVP Tunnel <...	RSVP Tunnel <...	UP	TOPOGEN_RS...	SI/RSVP2Rama...	INTENT_FULLY...	{'tunnelGuid': '...
SV/lsp/igp/c8e...	TUNNEL	UP	Automobile In...	Automotive Ltd.	DEPLOYMENT...	RSVP Tunnel <...	RSVP Tunnel <...	UP	TOPOGEN_RS...	SI/RSVP1Bella...	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Botas de traba...	Botas de trabajo	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_500_f...	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Putilivsky Zav...	Putilivsky Zavod	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_600_f...	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Automobile In...	Automotive Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_100	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Automobile In...	Automotive Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_100_f...	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Fashion Indust...	Fashion Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_400	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Military Indust...	Military & Wea...	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_300_f...	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Fashion Indust...	Fashion Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_400_f...	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Automobile In...	Automotive Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_101	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Aerospace Ind...	Aerospace Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_201	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Military Indust...	Military & Wea...	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_300	INTENT_FULLY...	{'tunnelGuid': '...
SV/sr_policy/i...	TUNNEL	UP	Aerospace Ind...	Aerospace Ltd.	DEPLOYMENT...	SR Policy Tunn...	SR Policy Tunn...	UP	TOPOGEN_SR...	SI/SR_P_201_f...	INTENT_FULLY...	{'tunnelGuid': '...

View the Services in Services Manager

Services Manager is an application that manages provisioning, modification, and deletion of services of all types. If you have access to Services Manager, you can view a list of the tunnels, point to point services, and multi point services.

Services Manager provides information on configuration of the services. It can help you view the status of user operations and to track mismatches between desired and actual configuration.

To view the services in Services Manager:

1. In the applications bar, select **Services Manager**.
2. Select the required tab.

Services Manager

Tunnels Point to Point Multi Point

Operations Settings

Create New Tunnel

Tunnel Name	Type	Configuration State	Creation Date	BW Reservation [Mbps]	Control Method	Last 24h Operations	Last Operation
18 ITEMS							
SR Policy Tunnel <SR_P_400>	Segment Routing Policy	INSTALLED		5000	PCE	0	
SR Policy Tunnel <SR_P_300>	Segment Routing Policy	INSTALLED		10000	PCE	0	
SR Policy Tunnel <SR_P_101_reverse>	Segment Routing Policy	INSTALLED		1000	PCE	0	
SR Policy Tunnel <SR_P_600_reverse>	Segment Routing Policy	INSTALLED		3000	PCE	0	
SR Policy Tunnel <SR_P_600>	Segment Routing Policy	INSTALLED		3000	PCE	0	
SR Policy Tunnel <SR_P_500>	Segment Routing Policy	INSTALLED		3000	PCE	0	

SR Policy Tunnel <SR_P_400>

Summary Endpoints Underlay Path Operations Events Actions

GUID	Site	Role	Port	Device	Operational State	Admin State
2 ITEMS						
PO/igp/isis/default-domain/ZR...	MAD	Source	ZR_ER2.MAD-100.0.0.127 (route...	ZR_ER2.MAD	Up	N A
PO/igp/isis/default-domain/ZR...	SQY	Destination	ZR_ER2.SQY-100.0.0.157 (route...	ZR_ER2.SQY	Up	N A

Services Manager

Tunnels Point to Point Multi Point

Operations Settings

Create New P2P

Name	P2P Type	Configuration State	Creation Date	Endpoint A	Endpoint B	Speed	Operational State	Last 24h Operations	Last Operation
7 ITEMS									
E-Line Packet Service <MPLS Doma...	Packet E-Line	INSTALLED		CR1.MIL - HundredGigE0/0/2...	CR1.STO - HundredGigE0/0/...	10000 Mbps	Up	0	
E-Line Packet Service <IP Domain E...	Packet E-Line	INSTALLED		CR2.PRA - HundredGigE0/0/...	CR2.HEL - GigabitEthernet0/...	3000 Mbps...	Up	0	
E-Line Packet Service <IP Domain E...	Packet E-Line	INSTALLED		CR2.BEL - HundredGigE0/0/...	CR2.COR - HundredGigE0/0/...	100000 Mbps	Up	0	
E-Line Packet Service <IP Domain E...	Packet E-Line	INSTALLED		ZR_ER2.LIS - FourHundredG...	ZR_ER2.SQY - FourHundred...	10000 Mbp...	Up	0	
OTN Line Service <OTN Line 1>	OTN Line	INSTALLED		OTN1VAL01 - 1-1-2	OTN1ROM01 - 1-1-2	ODU2	Up	0	
E-Line Circuit Service <E-Line 9>	Circuit E-Line	INSTALLED		OTN1MAN01 - 1-1-2	OTN2WAR01 - OPT-1-1-2	Eth 40G	Up	0	
E-Line Circuit Service <E-Line 8>	Circuit E-Line	INSTALLED		OTN1COR01 - 1-1-2	OTN1MIL01 - 1-1-2	Eth 40G	Up	0	

Services Manager

Tunnels Point to Point Multi Point

Operations Settings

Create L3 VPN

Name	Type	Configuration State	Creation Date	No. Of Sites	Customer Name	Last 24h Operations	Last Operation
4 ITEMS							
MokaCola L3VPN with RSVP underlay	L3 VPN	INSTALLED		5	Moka Cola	0	
HUB and Spoke L3VPN with SRTE und...	L3 VPN	INSTALLED		2	ADT.Ltd	0	
L3VPN with Segment Routing underlay	L3 VPN	INSTALLED		2	Test	0	
L3VPN with RSVP underlay	L3 VPN	INSTALLED		3	Test	0	

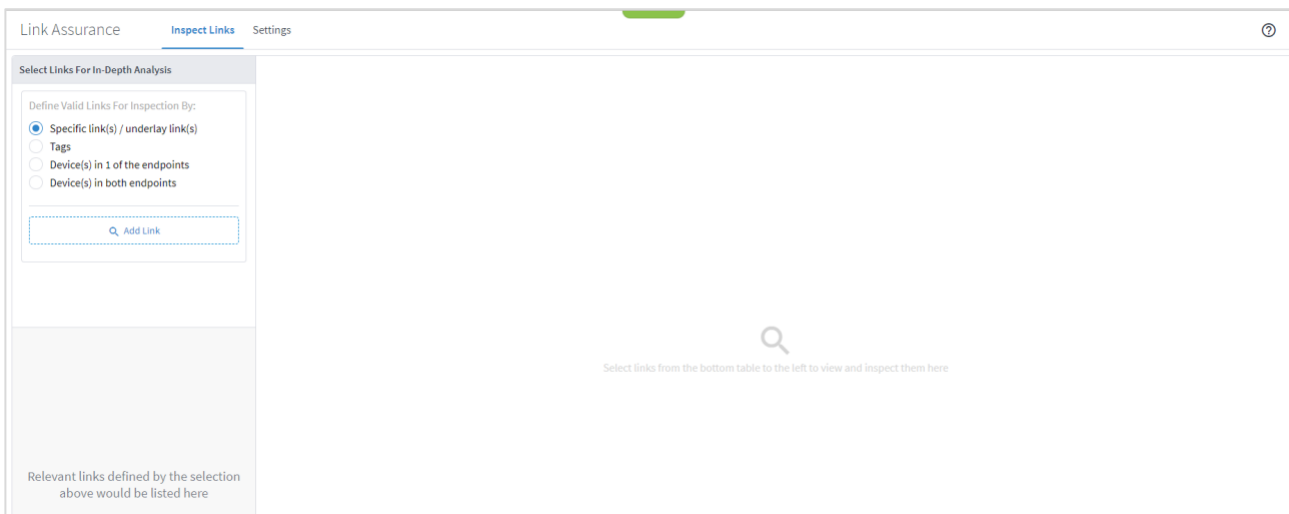
Link Assurance

The Link Assurance application allows you to visualize any IP or Ethernet links across ZR and OLS with performance in all layers, that is, RON links. This all-in-one app is used for analysis of router-to-router or OT-to-OT link across ZR/+ pluggables and optical line systems and enables you to view aggregated link status as propagated from all layers, and drill down to performance and events history per link.

Inspect Links

To inspect links:

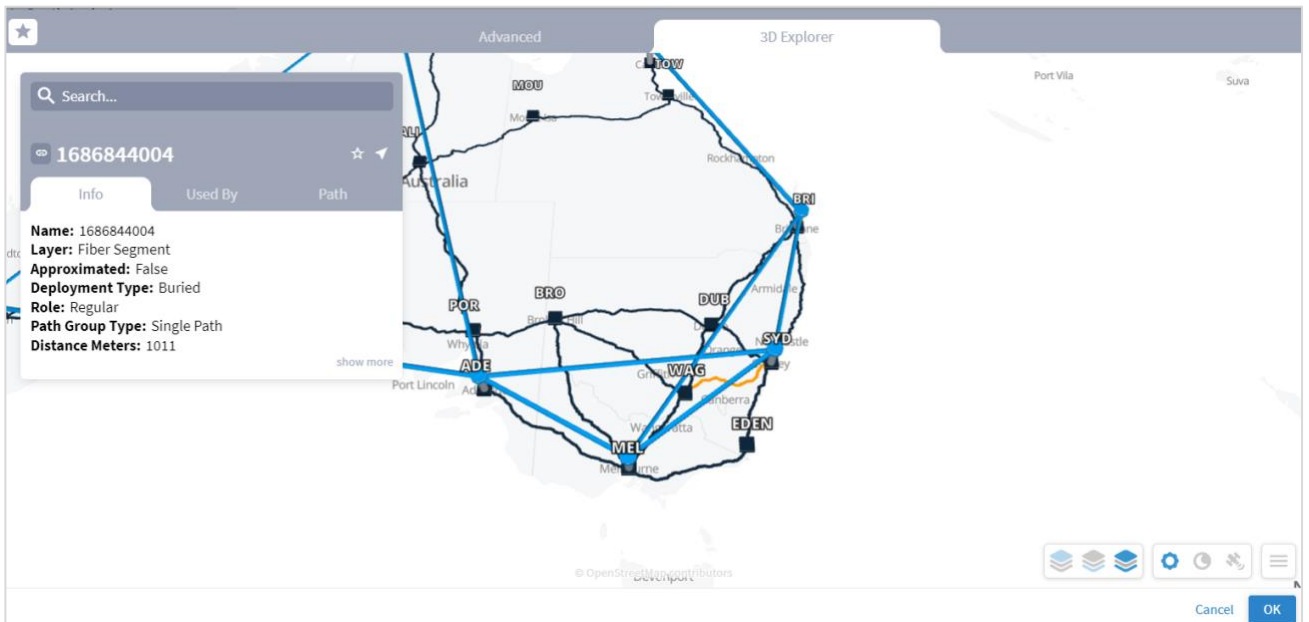
1. In the applications bar, select **Link Assurance**.



2. To inspect links for specific links/underlay links, select **Specific link(s) / underlay link(s)**, click **Add Link**. In the **Advanced** tab, select a link in the **LINKS** tab, or click on the **3D Explorer** tab to select a link (optical links are in black). Click **OK**. You can add up to 10 items.

Note: For more information on 3D Explorer, see the *Cisco Crosswork Hierarchical Controller Network Visualization Guide*.

Advanced 3D Explorer							
LINKS							
Name	Layer	Device A	Port A	Device B	Port B	Operational Status	Role
43485 ITEMS							
ILA-SD1EVO01-SD1LIS01-0...	OTS	ILA-SD1EVO01-SD1LIS01-0	1-1-3-8_5	SD1LIS01	1-2-3-8_5	UP	REGULAR
2141748004	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
5512734037	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
2047682057	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
7321748029	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
675963032	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
1010617026	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
2277890071	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
5765253008	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
1160392045	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
7005042027	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
4627150058	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
5927468010	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
6848239012	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
6018374011	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
3387558003	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR
4013129079	FIBER_SEGMENT	N/A	N/A	N/A	N/A	UP	REGULAR



Link Assurance **Inspect Links** Settings

Select Links For In-Depth Analysis

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

Add Link

Name Type Status

3 ITEMS

SD1BRI02/1-2-1_2 to SD1CA...	NMC	UP
SD1BRI02/1-2-1 to SD1CAI0...	OCH	UP
SD1BRO02/1-2-1-8_5 to SD...	OMS	UP

3. To inspect links by tag, select **Tags**, click **Add Tag**, and then select the tags and click **OK**.

★ Tags

▼ Links

☐ R_PHY

▼ Ports

☐ R_PHY ☐ All

(No items)

Cancel OK

- To inspect links by endpoint, select **Device(s) in 1 of the endpoints**, and then click **Add Endpoint**. In the **Advanced** tab, select a device in the **DEVICES** tabs, or click on the **3D Explorer** tab to select a device. Click **OK**. You can add up to 10 items.

Advanced

3D Explorer

DEVICES

Name	Type	Description	Site
1300 ITEMS			
ILA-SD2MAL01-SD2THE02-3	ONE	ONE by Coriant at ILA-SD2MAL01-SD2THE02-3	ILA-SD2MAL01-SD2THE02-3
ILA-SD1BARI02-SD2PATRA01-4	ONE	ILA 7100 ONE by Coriant at ILA-SD1BARI02-SD2PATRA01-4	ILA-SD1BARI02-SD2PATRA01-4
ILA-SD2HEL02-SD2OULU01-4	ONE	ONE by Coriant at ILA-SD2HEL02-SD2OULU01-4	ILA-SD2HEL02-SD2OULU01-4
ILA-SD1LMS01-SD2HERKL01-7	ONE	6500 7-Slot Optical Shelf Assembly ILA ONE by Ciena MCP at ILA-S...	ILA-SD1LMS01-SD2HERKL01-7
ILA-SD1MAR01-SD1MIL01-4	ONE	ONE by Ciena MCP at ILA-SD1MAR01-SD1MIL01-4	ILA-SD1MAR01-SD1MIL01-4
ILA-SD2GTBR1-SD2UPP01-1	ONE	ONE by Coriant at ILA-SD2GTBR1-SD2UPP01-1	ILA-SD2GTBR1-SD2UPP01-1
SD1FLO01	ONE	6500 32-Slot Packet-Optical Shelf Assembly Hybrid ONE by Ciena ...	FLO
ILA-SD2KRA01-SD2LVIV01-1	ONE	ONE by Coriant at ILA-SD2KRA01-SD2LVIV01-1	ILA-SD2KRA01-SD2LVIV01-1
ILA-CI_ONC_SD1COR01-CI_ONC_SD1LIS01-0	ONE	ONE by Cisco ONC at ILA-CI_ONC_SD1COR01-CI_ONC_SD1LIS01-0	ILA-CI_ONC_SD1COR01-CI_ONC_SD1LIS01-0
ILA-SD2DIL01-SD2LAM01-0	ONE	ONE by Coriant at ILA-SD2DIL01-SD2LAM01-0	ILA-SD2DIL01-SD2LAM01-0
ILA-SD2LAR02-SD2THE01-0	ONE	ONE by Coriant at ILA-SD2LAR02-SD2THE01-0	ILA-SD2LAR02-SD2THE01-0
ILA-CI_ONC_SD1BIL01-CI_ONC_SD1PAR01-4	ONE	ONE by Cisco ONC at ILA-CI_ONC_SD1BIL01-CI_ONC_SD1PAR01-4	ILA-CI_ONC_SD1BIL01-CI_ONC_SD1PAR01-4
RD_PAR01_ODR	RADIO_DEVICE	FiberAir IP-10G Radio by Ceragon at PAR	PAR
ILA-SD2KONO01-SD2KYE01-2	ONE	ONE by Coriant at ILA-SD2KONO01-SD2KYE01-2	ILA-SD2KONO01-SD2KYE01-2
ILA-SD2ODES01-SD2UMAN01-1	ONE	ONE by Coriant at ILA-SD2ODES01-SD2UMAN01-1	ILA-SD2ODES01-SD2UMAN01-1
ILA-SD1LMS01-SD2HERKL01-9	ONE	6500 7-Slot Optical Shelf Assembly ILA ONE by Ciena MCP at ILA-S...	ILA-SD1LMS01-SD2HERKL01-9
ZR_CR2.FRA	ROUTER		FRA

Cancel

OK

- To check the performance for links with devices in two endpoints, select **Device(s) in both endpoints** and then click **Add First Endpoint** and select a device. Repeat for the second endpoint.

Select Links For In-Depth Analysis

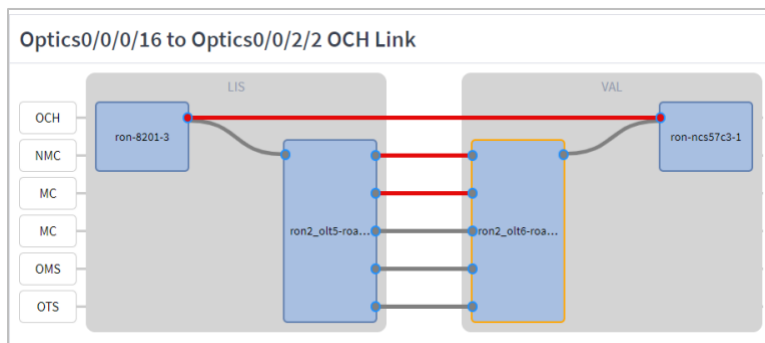
Define Valid Links For Inspection By:

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

- Continue to [View Links and Performance](#).

View Links and Performance

After specifying the links, you can select one of the links in the list of the left and view the hierarchy of the link layers on the right.

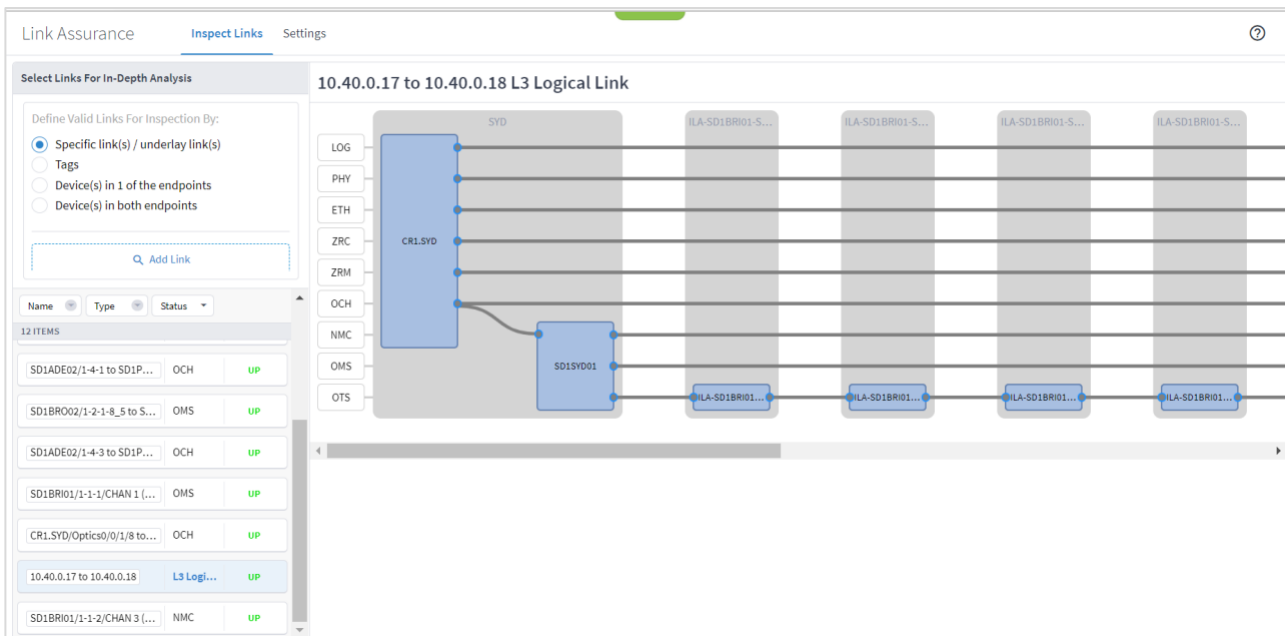


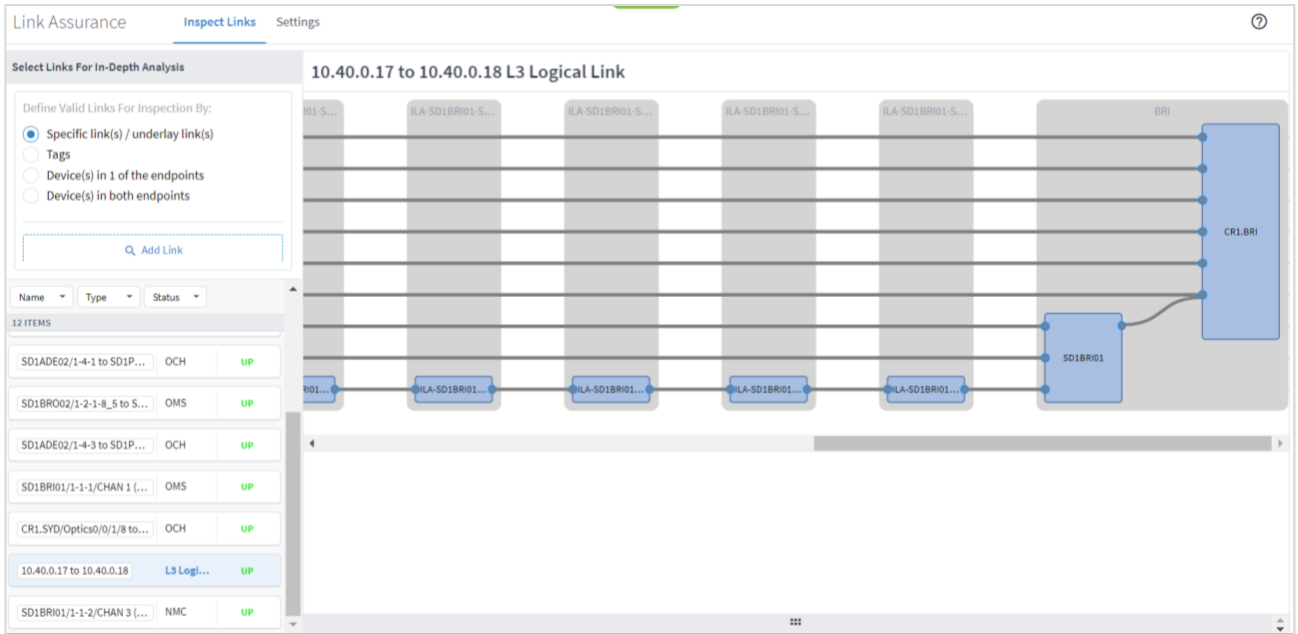
Legend:

- **Blue Filled Rectangle:** Node or router
- **Lines:** Links
- **Circles:** Ports
- **Grey fill:** Up
- **Red fill:** Down
- **Blue Frame:** Not selected
- **Orange Frame:** Selected

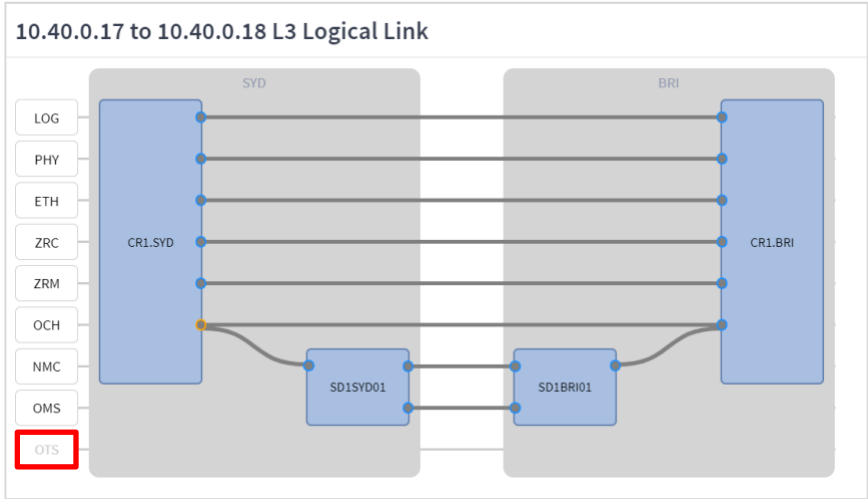
To view links:

1. Select one of the link layers. You can scroll left and right to see the full path.



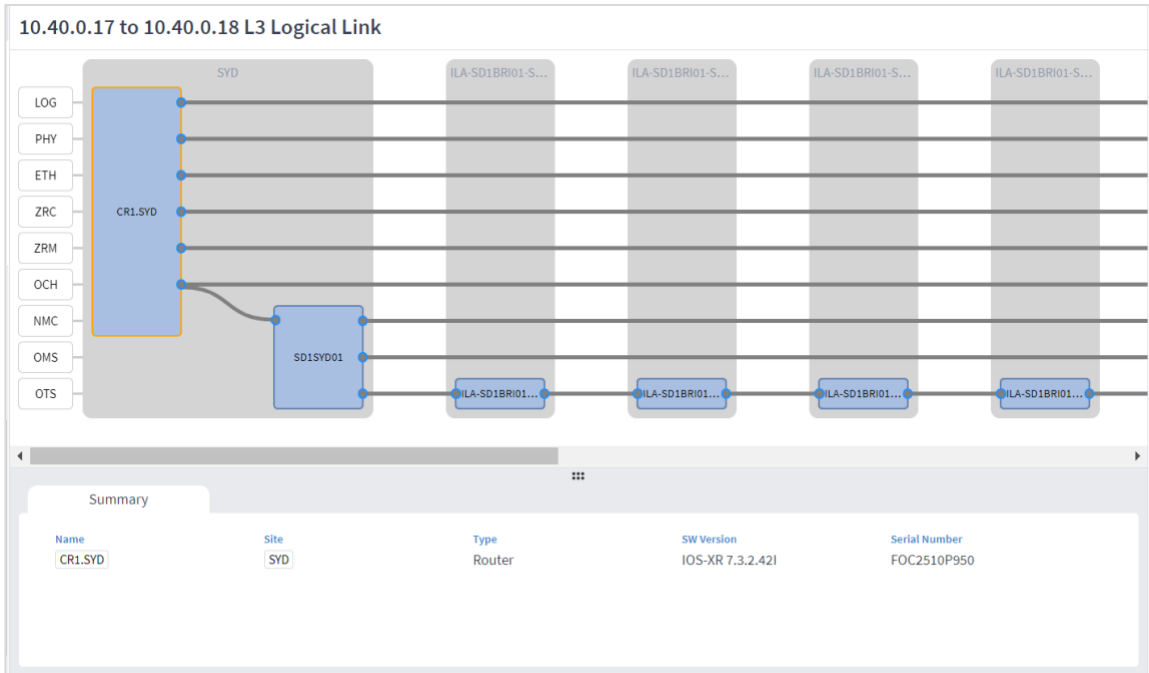


2. Click on a layer name to exclude the layer from the view. For example, click on **OTS**.



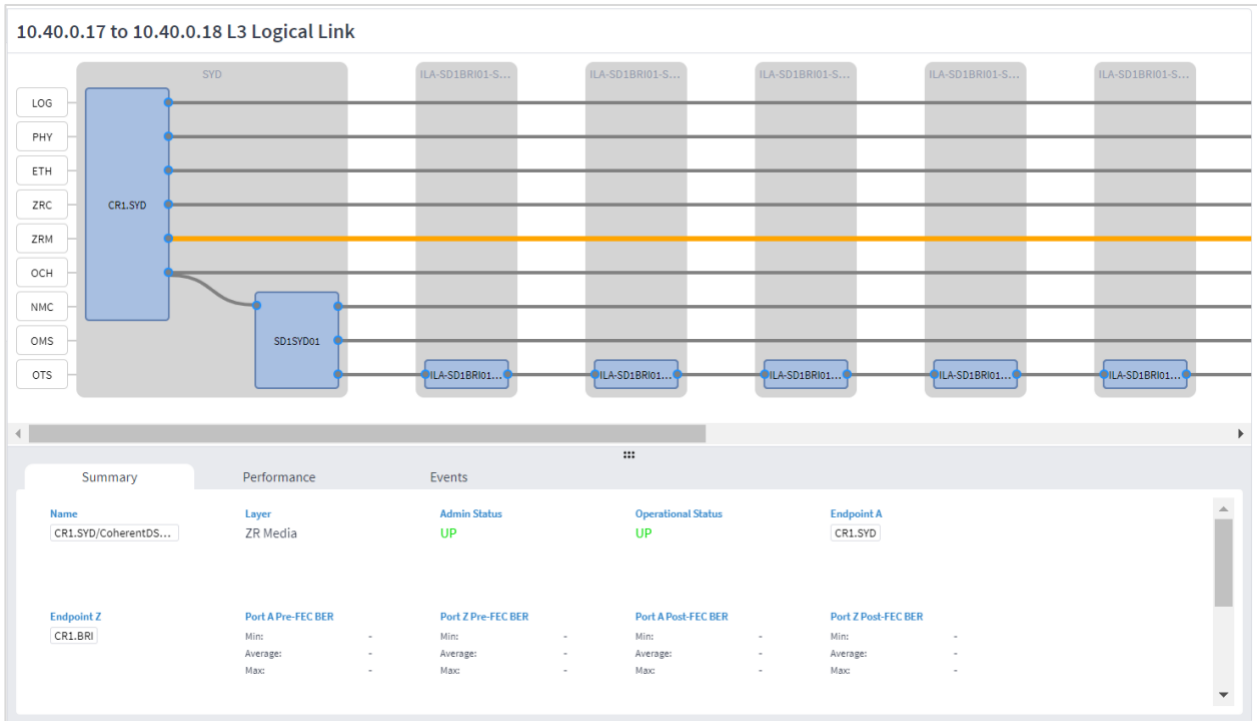
3. Click the blue square representing a router or optical node to view the details for the router or optical node. The router or optical node is framed in orange. The **Summary** tab includes the following details:

- **Name:** The name of the router or optical mode.
- **Site:** The site name.
- **Type:** Router or Optical Node.
- **SW Version:** The software version on the router.
- **Serial Number:** The router or optical node serial number.



4. Click the line representing the link to view the link details. The selected link is orange. The **Summary** tab includes the following details:

- **Name:** The name of the link.
- **Layer:** The layer type: **L3 Logical**, **L3 Physical**, **Ethernet**, **ZR Channel**, **ZR Media**, **OCH**, **NMC**, **OMS** or **OTS**.
- **Admin Status:** The admin status: **UP** or **DOWN**.
- **Operational Status:** The operational status: **UP** or **DOWN**.
- **Endpoint A:** The starting endpoint.
- **Endpoint Z:** The terminating endpoint.
- For Ethernet links, the rate for **Port A Rate [Gbps]** and **Port Z Rate [Gbps]**.
- For ZRM links, the min, average and max values for **Port A Pre-FEC BER**, **Port Z Pre-FEC BER**, **Port A Pre-FEC BER** and **Port Z Pre-FEC BER**.
- For OCH, NMC, OMS, and OTS links, the min, average and max values for **Port A Tx Power [dbm]**, **Port Z Tx Power [dbm]**, **Port A Rx Power [dbm]** and **Port Z Rx Power [dbm]**.



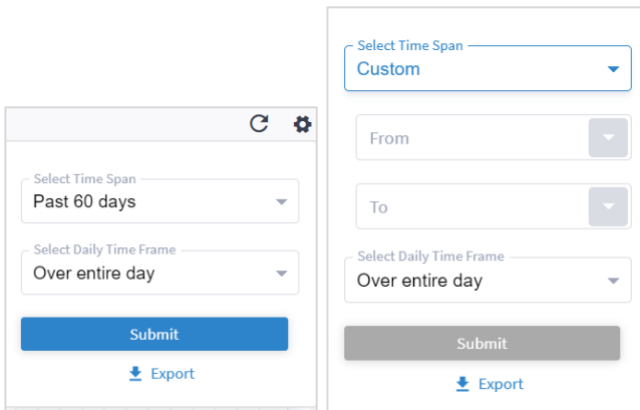
- For Ethernet and IP links or ports the **Performance** tab includes **INBOUND TRAFFIC** and **OUTBOUND TRAFFIC** graphs for **BANDWIDTH** and **UTILIZATION**.

For additional information on performance, see [Performance](#).



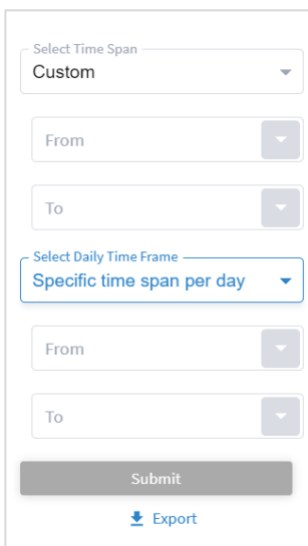
6. Click  and specify the period to report on:

- **Select Time Span:** Select the required period, either **Today**, **Past 24 hours**, **Past 7 days**, **Past 14 days**, **Past 30 days**, **Past 60 days**, or **Custom**. If you select **Custom**, then click **From** and **To** and select a date and specify a time.



The image shows two side-by-side screenshots of a configuration interface. The left screenshot shows the 'Select Time Span' dropdown set to 'Past 60 days' and the 'Select Daily Time Frame' dropdown set to 'Over entire day'. Below these are 'Submit' and 'Export' buttons. The right screenshot shows the 'Select Time Span' dropdown set to 'Custom', with 'From' and 'To' date pickers below it. The 'Select Daily Time Frame' dropdown is also set to 'Over entire day'. Below these are 'Submit' and 'Export' buttons.

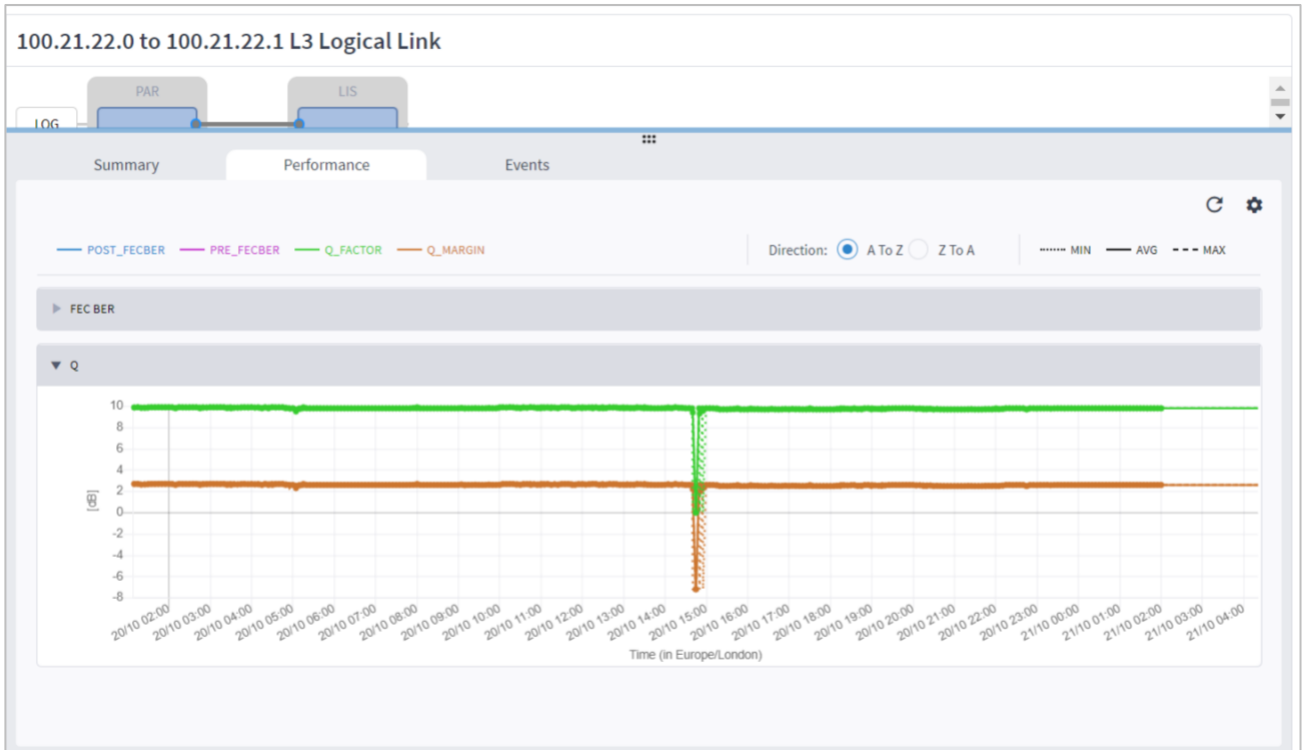
- In the **Select Daily Time Frame** area either select **Over entire day** or **Specific time span per day**. If you select **Specific time span per day**, then click **From** and **Until** to specify a time.



The image shows a single screenshot of the 'Select Daily Time Frame' configuration panel. The 'Select Daily Time Frame' dropdown is set to 'Specific time span per day'. Below it are 'From' and 'To' date pickers. At the bottom are 'Submit' and 'Export' buttons.

7. Click **Export** to download the performance statistics.

8. For layer 1 (ZR Media), the **Performance** tab includes **Post_FECBER**, **Pre_FECBER**, **Q_Factor** and **Q_Margin**.
For additional information on performance, see [Performance](#).



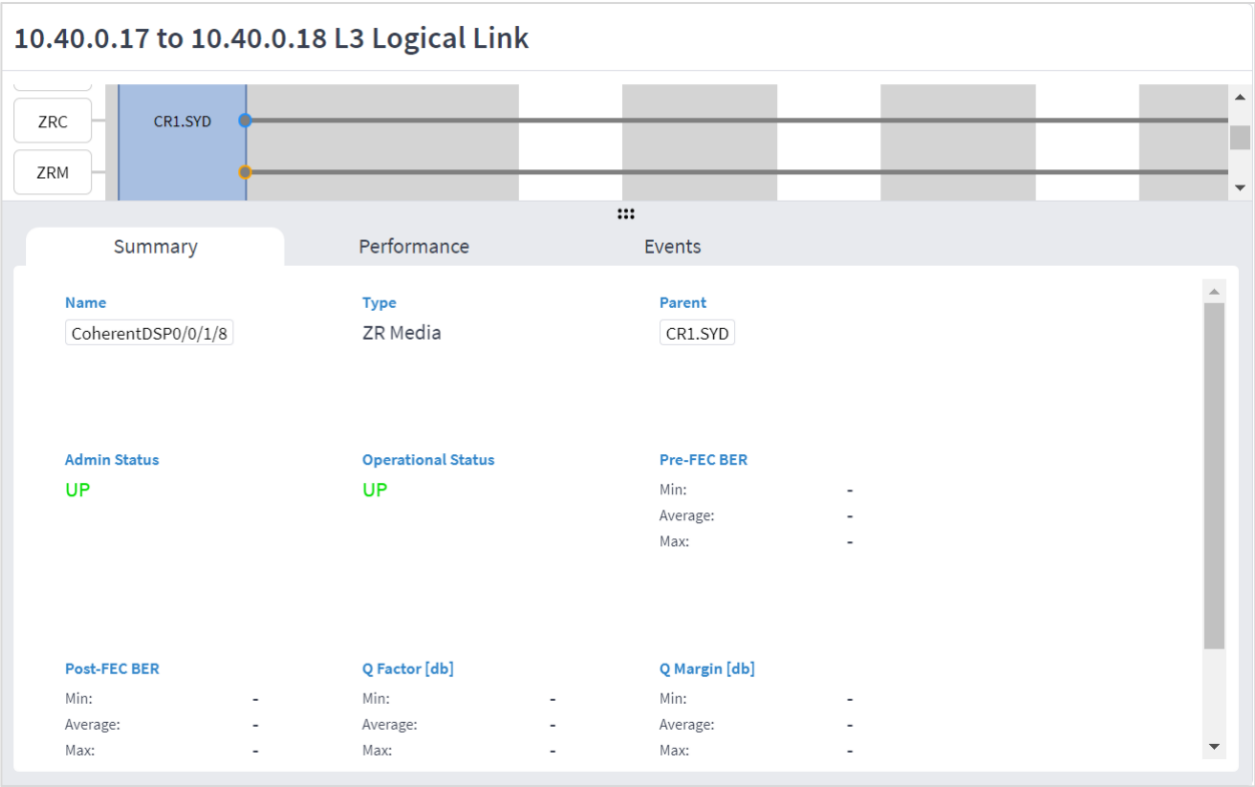
9. For layer 0 (OCH, NMC, OMS and OTS), the **Performance** tab includes Rx and Tx power data.

For additional information on performance, see [Performance](#).

10. The **Events** tab includes a list of the operational status changes.

Summary		Performance		Events		...	
Events were fetched from 08/07/2022 19:48:30 UTC to now							
Time				Operational Status Change			
NO ITEMS							
(No items)							

11. Click the port to view the related summary, performance, and events.



Configure Link Assurance

- The **Days Back** setting applies to the statistics data for the **Summary** and **Performance** tabs. Use this configuration to apply the **Days Back** to **Performance** tabs of all ports and links that can be selected, without having to repeat the settings for every port/link.

Link Assurance Inspect Links Settings

GENERAL SETTINGS

Days Back*
1

Path Analysis

This application analyses the potential IGP paths between two endpoints. Each path is analyzed and broken down into links, and the cost of each path is calculated. The path-selection decision is based on the minimum cost, where the cost is the total of the IGP metric values for the links in the path. All paths with a similar cost are returned.

Dynamic paths such as LDP and SR-ISIS, over IGP links, are supported (where no path preferences are provided).

Path Analysis Terminology

Table 3. Path Analysis Terms

Term	Definition
Cost	The accumulated IGP metric for the path, that is, sum of the IGP metrics of the various links in the path.
Hops	The number of links in the path.
IGP Metric	The hop IGP metric.
Latency	The total latency of the links in the path.
TE Metric	The hop TE tunnel metric.

Analysis a Path

To analysis a path, select two endpoints. Endpoints can be a router or UNI port connected to a VPN service. The application returns all the alternate paths with the same minimum cost, where cost is defined as the aggregation of the IGP Metrics for the links in the path. Related performance data can be viewed for the logical IP links in the path.

To analysis a path:

1. In the applications bar, select **Path Analysis**.

The screenshot shows the 'Path Analysis' application window. On the left, there is a 'Find Path' sidebar with a 'SELECT ENDPOINTS' section. It contains two input fields: 'Endpoint A *' and 'Endpoint B *', each with a search icon to its right. Below these fields is a 'Find Path' button. The main area of the application is a large, light blue rectangle. In the center of this area is a stylized icon of two connected nodes (a 'U' shape) and the text 'Select Endpoints and find all optimized paths between them'.

2. Click  to add a router as endpoint A.

Specific Items

Routers

UNI Ports

Name	Type	Description	Site
93 ITEMS MATCHING FILTERS			
cr1.abi	ROUTER		abi
cr1.abq	ROUTER		abq

There is 1 item pending selection

cr1.syr02 X

Cancel

Select

3. (Optional) Select the **UNI Ports** tab.

Specific Items

Routers

UNI Ports

Name	Type	Capacity	Description	Device	Admin Status
558 ITEMS					
TenGigE0/0/0/1	R_PHYSICAL	10000000000		cr1.chi	UP
TenGigE0/0/0/7	R_PHYSICAL	10000000000		cr1.knx	UP
10ge-0/1/3	R_PHYSICAL	10000000000		cr1.okc	UP
TenGigE0/0/0/3	R_PHYSICAL	10000000000		cr1.che	UP
TenGigE0/0/0/9	R_PHYSICAL	10000000000		cr1.ric	UP
10ge-0/1/3	R_PHYSICAL	10000000000		cr1.hst	UP
TenGigE0/0/0/4	R_PHYSICAL	10000000000		cr1.che	UP
TenGigE0/0/0/8	R_PHYSICAL	10000000000		cr1.chi	UP
TenGigE0/0/0/3	R_PHYSICAL	10000000000		cr1.boi	UP
TenGigE0/0/0/5	R_PHYSICAL	10000000000		cr1.spf	UP
TenGigE0/0/0/2	R_PHYSICAL	10000000000		cr1.fre	UP
GigabitEthernet1/1/2	R_PHYSICAL	10000000000		cr1.pdx	UP
TenGigE0/0/0/1	R_PHYSICAL	10000000000		cr1.roa	UP
TenGigE0/0/0/5	R_PHYSICAL	10000000000		cr1.nth	UP
TenGigE0/0/0/1	R_PHYSICAL	10000000000		cr1.bos	UP
TenGigE0/0/0/5	R_PHYSICAL	10000000000		cr1.sea	UP

No items selected yet

Cancel

Select

- Select an endpoint and click **OK**.
- Repeat to select endpoint B. A list of the paths with the same cost appears.

Path Analysis

< Back

ENDPOINTS

CR1.OVE — CR1.VIE

0 RSVP TE Tunnels were found between the endpoints
0 SR Policies were found between the endpoints

Path	Latency (MS)	Cost	Hops
1	10.92	89442	6
2	10.92	89442	7

Path 1

Path Summary

Number Of Hops: 6, Latency: 10.92 ms, Distance: 2228.80 Km, IGP Domains: 1, Admin Cost: 89442

#	Link	Router A	Router B	IGP Metric	TE Metric	Operational Status
1	10.40.1.218 to 10.40.1.217	CR1.OVE	CR2.MAD	40442	40442	UP
2	10.40.1.214 to 10.40.1.213	CR2.MAD	CR1.MAD	10000	10000	UP
3	10.40.1.230 to 10.40.1.229	CR1.MAD	CR2.BCN	10000	10000	UP
4	10.40.1.226 to 10.40.1.225	CR2.BCN	CR1.BCN	10000	10000	UP
5	10.40.2.69 to 10.40.2.70	CR1.BCN	CR1.MIL	10000	10000	UP
6	10.40.1.178 to 10.40.1.177	CR1.MIL	CR1.VIE	9000	9000	UP

- Click on a path to see the number of hops, latency, distance, number of IGP domains and admin cost for the path. The table details each of the links with their endpoint routers, IGP metric and TE metric.
- Click on a link in the path to see the related performance information. The information appears in the **Summary** tab in the lower pane.

Path Analysis

< Back

ENDPOINTS

CR2.AMS — CR2.BUC

0 RSVP TE Tunnels were found between the endpoints
0 SR Policies were found between the endpoints

Path	Latency (MS)	Cost	Hops
1	23.42	160612	11

Path 1

Path Summary

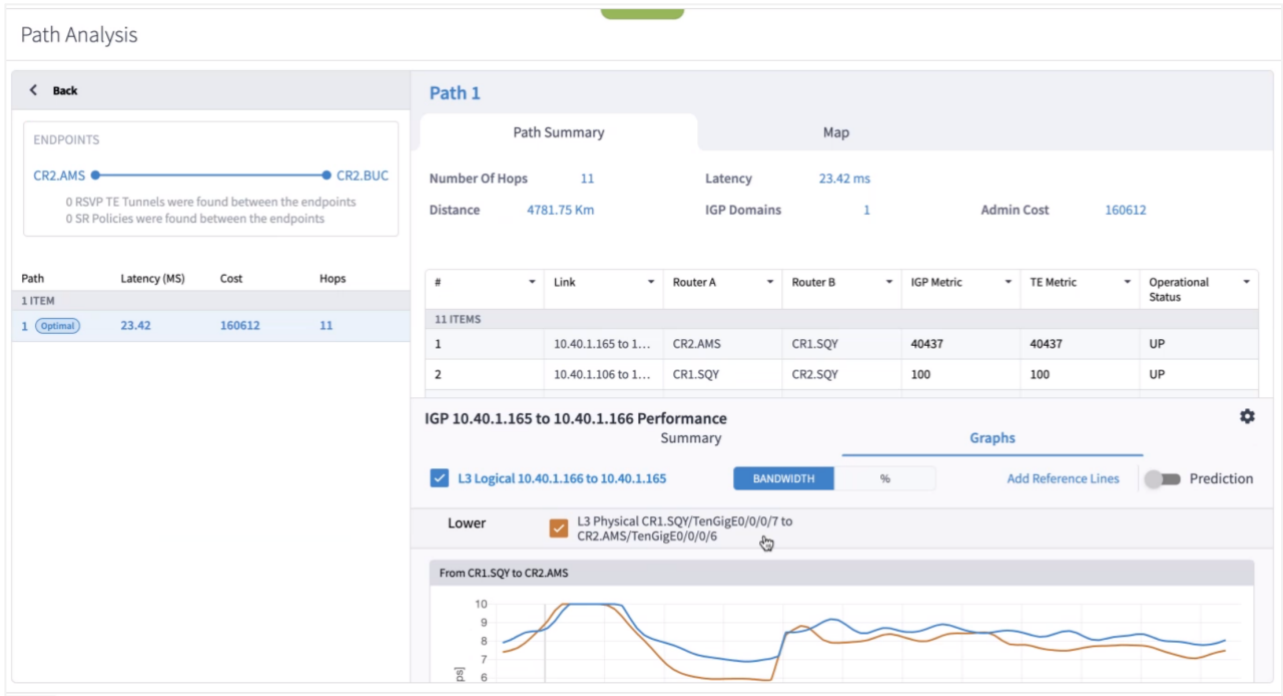
Number Of Hops: 11, Latency: 23.42 ms, Distance: 4781.75 Km, IGP Domains: 1, Admin Cost: 160612

#	Link	Router A	Router B	IGP Metric	TE Metric	Operational Status
5	10.40.1.134 to 1...	CR2.BKL	CR1.PAR	40411	40411	UP
6	10.40.1.145 to 1...	CR1.PAR	CR2.FRA	10000	10000	UP
7	10.40.1.186 to 1...	CR2.FRA	CR1.WAR	10000	10000	UP
8	10.40.1.214 to 1...	CR1.WAR	CR1.SMOL	5000	5000	UP

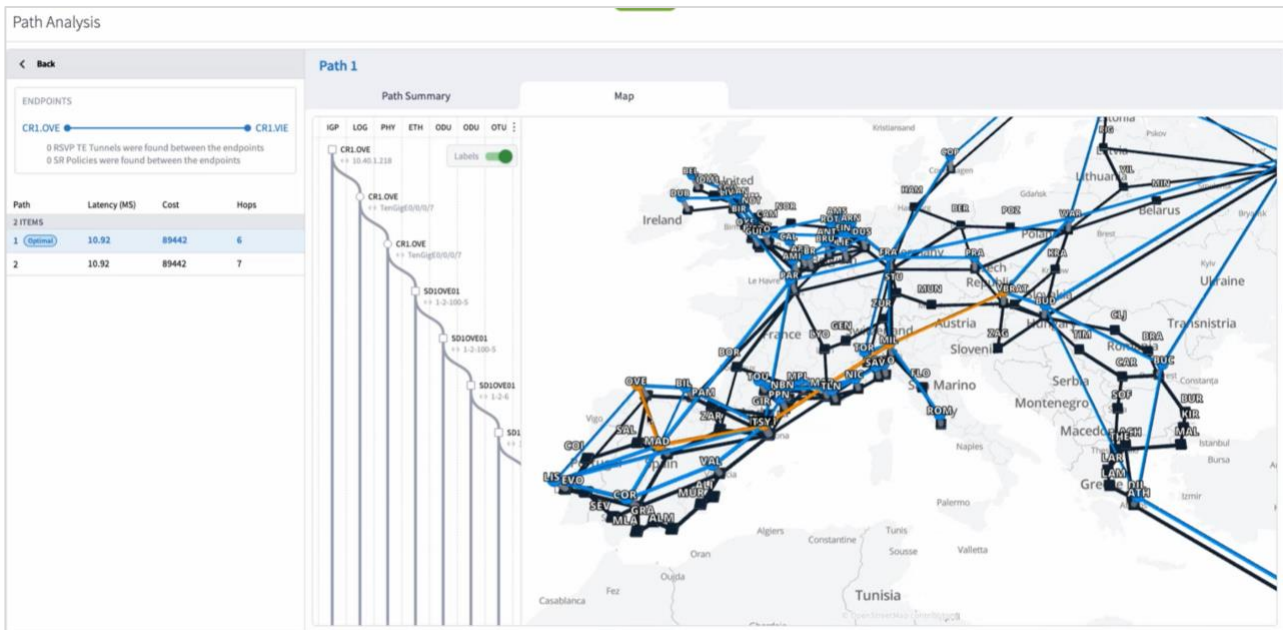
IGP 10.40.1.165 to 10.40.1.166 Performance Summary

Link	Average [%]	Peak [%]	Percentile 98[%]	Percentile 95[%]	Percentile 75[%]	St. Deviation
L3 Logical 10.40....	86.756	99.359	98.167	96.254	89.261	6.182

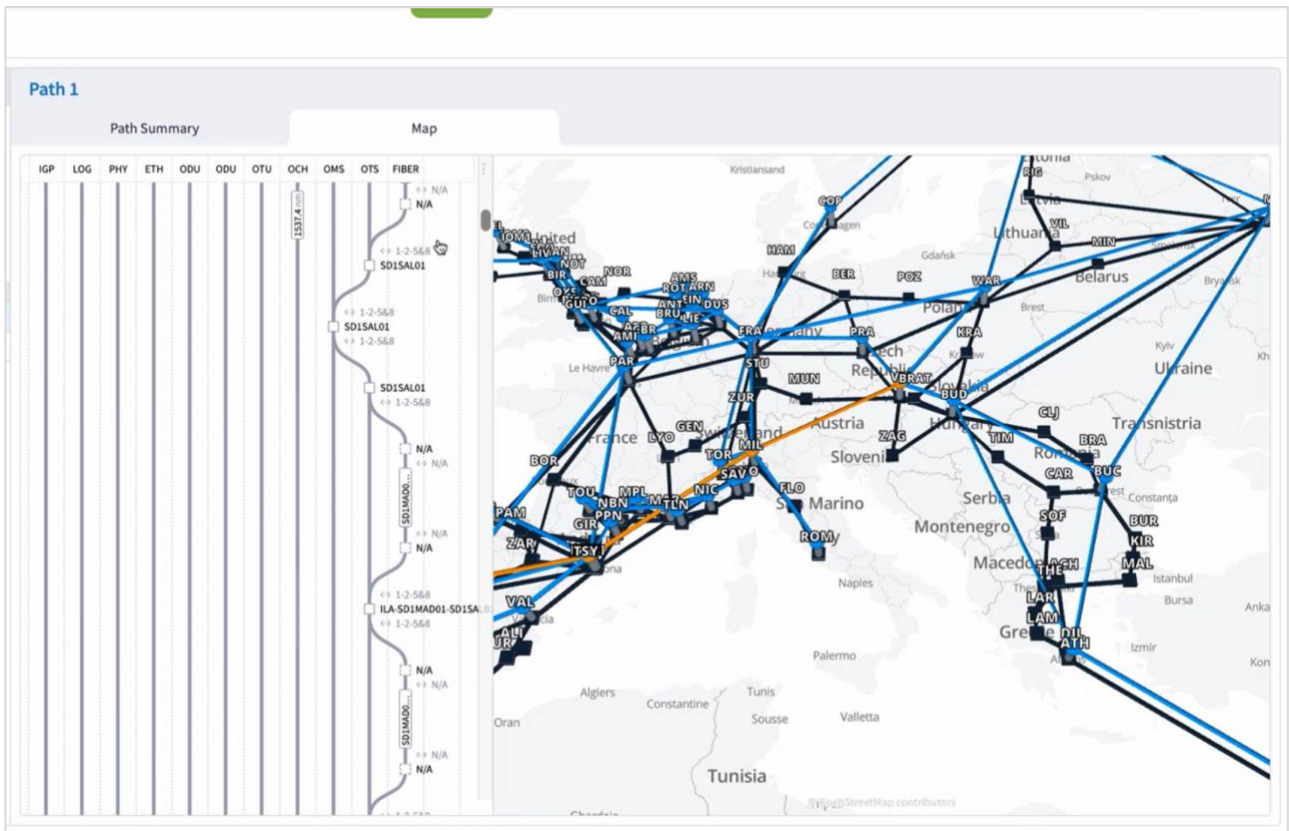
8. To view graphs of the performance, click the **Graphs** tab in the lower pane. For additional information on performance, see [Performance](#).



9. Click the **Map** tab to view the path in the 3D Explorer map.



10. You can expand and scroll in the Metro view to see more of the path details.



11. You can also filter the path as required.



Root Cause Analysis

The Root Cause Analysis application finds the failed lower layer links that are the root cause of a link or a service failure. To establish root cause failures, Crosswork Hierarchical Controller considers both the operational status (up/down) of the links and the admin status (up/down) of the router ports.

When the operational status of a link is down, this is considered a failure. Crosswork Hierarchical Controller then checks all the lower layer links that have failed, until the element at the lowest level is identified. This is the root cause element. All elements above this root cause element are considered affected elements. A link with operational status down but with no links above it is still considered as a root cause.

If an element has an admin status of down, it is classified as a root cause element (and not as an affected element).

View Root Causes

You can view a list of the root causes and can view the:

- Root cause resource type: L3 Logical, OCH, OTS, LSP, or OMS.
- Root cause tags
- Number of affected links
- Affected capacity (Gbps)
- Time
- A list of the link layers and elements affected

You can also hover over the affected element to view the element in the map (and then view the element in Explorer) or click on the element name to drilldown directly to the element in Explorer.

Table 4. Elements

Links	Description
LSP	The MPLS tunnel created between two routers over IGP links, with or without TE options.
IGP	The link between two routers that carries IGP protocol messages. The link represents an IGP adjacency.
L3 Logical (R_LOGICAL)	A link that connects VLANs on two IP ports.
L3 Physical (R_PHYSICAL)	The physical link connecting two router ports. It may ride on top of an ETH link if the IP link is carried over the optical layer.
Ethernet (ETH)	An ETH L2 link, spans from one ETH UNI port of an optical device to another, and rides on top of ODU.
ODU	ODU links are sub signals in OTU links. Each OTU link can carry multiple ODU links, and ODU links can be divided into finer granularity ODU links recursively.
OTU	The underlay link in the OTN layer, used for ODU links. It can ride on top of an OCH.
OCH	A wavelength connection spanning the client port of one OEO device (transponder, muxponder, regen) and another. 40 or 80 OCH links can be created on top of OMS links. The client port can be TDM or ETH port.
OMS	The link connecting one ROADM to another. One OMS can be created over a chain of OTS links.
OTS	The physical link connecting between one line amplifier or ROADM and another. One OTS can be created over a fiber link.

For more information on Explorer and the various links, see the *Cisco Crosswork Hierarchical Controller Network Visualization Guide*.

To view root cause failures:

- In the applications bar, select **RCA**. A list of the root causes appears with the following information:
 - Root Cause Resource Name:** The root cause link name. In this example, the OTS link.
 - Root Cause Resource Type:** The root cause link type.
 - Root Cause Tags:** The root cause tags.
 - Affected Links:** The total number of elements affected by this root cause.
 - Affected Capacity (Gbps):** The total bandwidth lost in Gbps (the total of all links).

Root Cause Analysis Records fetched at: 15:48:55 09-21-2022 UTC

Filter By Impacted

Root Cause Resource Name	Root Cause Resource Type	Root Cause Tags	Affected Links	Affected Capacity (Gbps)	Time
9 OUT OF 40 ITEMS MATCHING FILTERS					
10.40.2.202 to 10.40.2.201	L3 Logical	Tag All	66	193.0	
SD2BUC01/OCH-1-1-20 to SD2MOS01/OCH-1-1-15	OCH	Tag All	4	10.0	
SD2BUD01/OCH-1-1-36 to SD2MOS01/OCH-1-1-18	OCH	Tag All	4	10.0	
SD2KHAR01/OCH-1-1-9 to SD2KURSK01/OCH-1-1-12	OCH	Tag All	4	10.0	
ILA-SD2KHAR01-SD2KURSK01-1/OTS-1-1-3 to ILA-SD2KHAR01-SD2KURSK01-2/OTS-1-1-2	OTS	Tag All	2	0.0	
10.40.3.238 to 10.40.3.237	L3 Logical	Tag All	1	0.0	
ILA-SD2KONO01-SD2ORYOL01-1/OTS-1-1-3 to ILA-SD2KONO01-SD2ORYOL01-2/OTS-1-1-2	OTS	Tag All	1	0.0	
ILA-SD2BRYA01-SD2KONO01-1/OTS-1-1-3 to ILA-SD2BRYA01-SD2KONO01-2/OTS-1-1-2	OTS	Tag All	2	0.0	
10.40.2.225 to 10.40.2.226	L3 Logical	Tag All	50	147.0	

- Select the required root cause. Detailed information for the root cause appears.

Root Cause Analysis Records fetched at: 15:48:55 09-21-2022 UTC

Filter By Impacted


Root Cause Resource Name	Root Cause Resource Type	Root Cause Tags	Affected Links	Affected Capacity (Gbps)	Time
9 OUT OF 40 ITEMS MATCHING FILTERS					
10.40.2.202 to 10.40.2.201	L3 Logical	Tag All	66	193.0	
SD2BUC01/OCH-1-1-20 to SD2MOS01/OCH-1-1-15	OCH	Tag All	4	10.0	
SD2BUD01/OCH-1-1-36 to SD2MOS01/OCH-1-1-18	OCH	Tag All	4	10.0	
SD2KHAR01/OCH-1-1-9 to SD2KURSK01/OCH-1-1-12	OCH	Tag All	4	10.0	
ILA-SD2KHAR01-SD2KURSK01-1/OTS-1-1-3 to ILA-SD2KHAR01-SD2KURSK01-2/OTS-1-1-2	OTS	Tag All	2	0.0	
10.40.3.238 to 10.40.3.237	L3 Logical	Tag All	1	0.0	

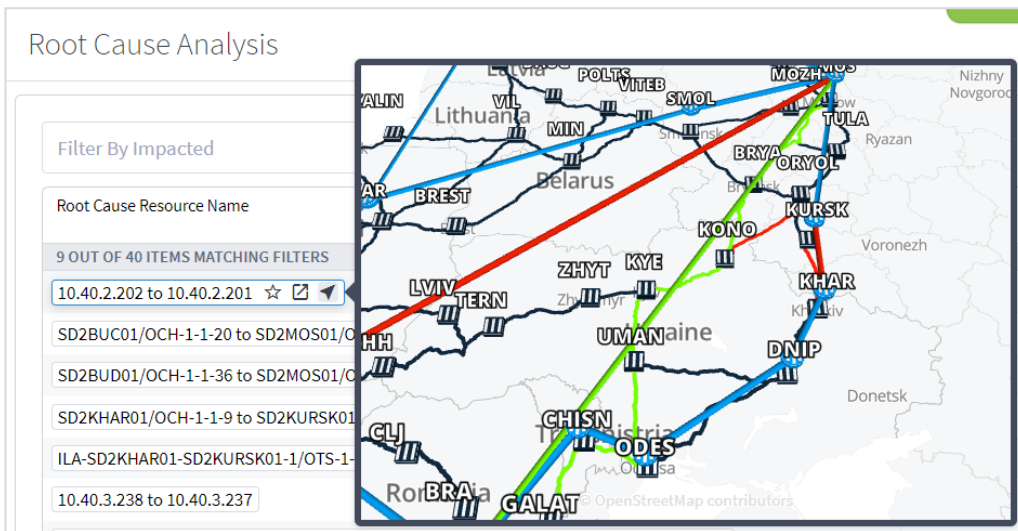
⋮


Affected Links

Root Cause: **SD2KHAR01/OCH-1-1-9 to SD2KURSK01/OCH-1-1-12**

Link Name	Link Description	Link Type	Link Tags	Link Speed (Gbps)	Impact Type
4 ITEMS					
SD2KHAR01/ETH-1-1-8 to SD2KURSK01/ETH-1-1-11		Ethernet	Tag All	10.0	Link down
SD2KHAR01/ODU-1-1-8 to SD2KURSK01/ODU-1-1-...		ODU	Tag All	0.0	Link down
SD2KHAR01/ODU-1-1-9 to SD2KURSK01/ODU-1-1-...		ODU	Tag All	0.0	Link down
SD2KHAR01/OTU-1-1-9 to SD2KURSK01/OTU-1-1-...		OTU	Tag All	0.0	Link down

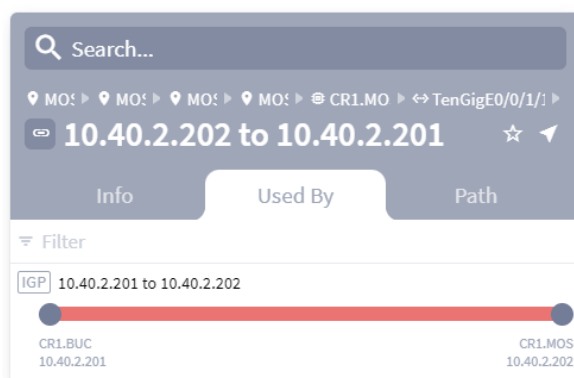
3. Hover over the root cause resource name and click  to view the root cause in the map.



4. Click  **Open in Explorer** to open the root cause in Explorer.



5. You can navigate up and down the link layers by clicking on the **Used By** tab.
6. In the **Used By** tab, click on the link name.



- _____

🔍 Search...

📍 BUC ▶ 📍 BUC ▶ 📍 BUC ▶ 📍 BUC ▶ 🔒 CR1.BUC ▶ ↔ 10.40.2.201 ▶

📄 10.40.2.201 to 10.40.2.202
☆ ↗

Info
Used By
Path

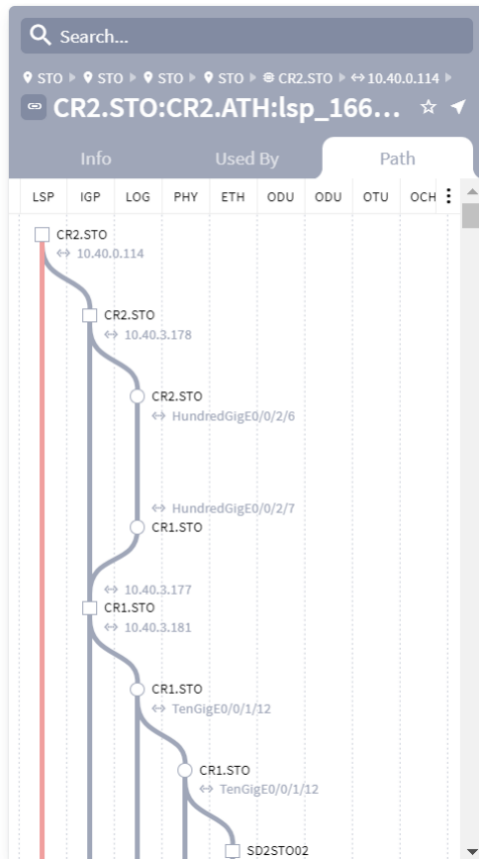
☰ Filter

[LSP]	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <div style="background-color: #e91e63; height: 20px; width: 100%;"></div> <div style="display: flex; justify-content: space-between; padding: 5px;"> <div> CR2.STO 10.40.0.114 </div> <div> CR2.ATH 10.40.0.73 </div> </div> </div> </div>	▶
[LSP]	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <div style="background-color: #e91e63; height: 20px; width: 100%;"></div> <div style="display: flex; justify-content: space-between; padding: 5px;"> <div> CR1.BUC 10.40.0.71 </div> <div> CR1.STO 10.40.0.54 </div> </div> </div> </div>	▶
[LSP]	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <div style="background-color: #e91e63; height: 20px; width: 100%;"></div> <div style="display: flex; justify-content: space-between; padding: 5px;"> <div> CR1.BUC 10.40.0.71 </div> <div> CR2.COP 10.40.0.52 </div> </div> </div> </div>	▶
[LSP]	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <div style="background-color: #e91e63; height: 20px; width: 100%;"></div> <div style="display: flex; justify-content: space-between; padding: 5px;"> <div> ER1.ATH 10.41.1.85 </div> <div> ER1.BEL 10.41.0.45 </div> </div> </div> </div>	▶
[LSP]	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <div style="background-color: #e91e63; height: 20px; width: 100%;"></div> <div style="display: flex; justify-content: space-between; padding: 5px;"> <div> CR2.ATH 10.40.0.73 </div> <div> CR2.HEL 10.40.0.47 </div> </div> </div> </div>	▶
[LSP]	<div style="display: flex; align-items: center;"> <div style="flex: 1;"> <div style="background-color: #e91e63; height: 20px; width: 100%;"></div> <div style="display: flex; justify-content: space-between; padding: 5px;"> <div> CR1.HEL 10.40.0.115 </div> <div> CR2.BUC 10.40.0.72 </div> </div> </div> </div>	▶

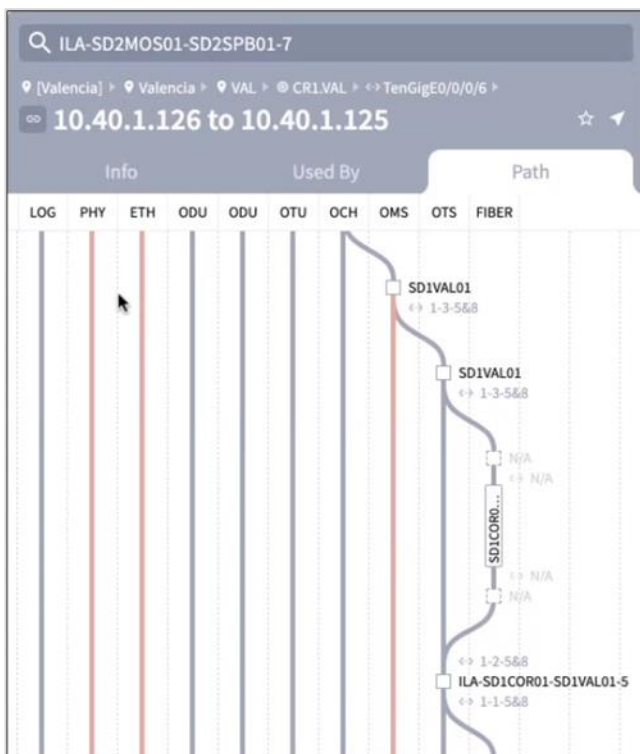
- Continue until you get to the uppermost layer. The Explorer map is updated as you navigate.



9. Select the **Path** tab to view the layers.



10. In this example, there are two root cause failures. The **Ethernet** root cause failure affects the **PHY** layer above it, but the **OMS** root cause failure does not affect any of the links above it and so there are 0 affected elements.



11. In this example, the root cause failure affects two links, the MC and OMS links.

Root Cause Analysis Records fetched at: 15:48:55 09-21-2022 UTC

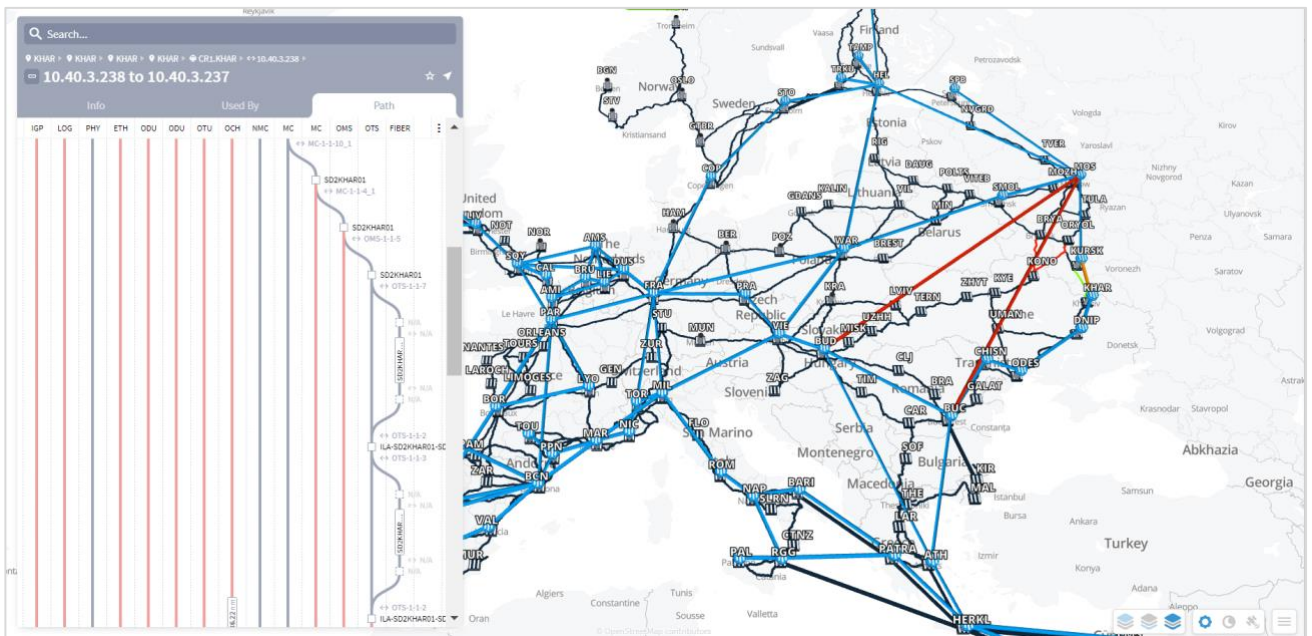
Filter By Impacted

Root Cause Resource Name	Root Cause Resource Type	Root Cause Tags	Affected Links	Affected Capacity (Gbps)	Time
9 OUT OF 40 ITEMS MATCHING FILTERS					
10.40.2.202 to 10.40.3.201	L3 Logical	Tag All	66	193.0	
SD2BUC01/0CH-1-1-20 to SD2MOS01/0CH-1-1-15	OCH	Tag All	4	10.0	
SD2BUD01/0CH-1-1-36 to SD2MOS01/0CH-1-1-18	OCH	Tag All	4	10.0	
SD2KHAR01/0CH-1-1-9 to SD2KURSK01/0CH-1-1-12	OCH	Tag All	4	10.0	
ILA-SD2KHAR01-SD2KURSK01-1/OTS-1-1-3 to ILA-SD2KHAR01-SD2KURSK01-2/OTS-1-1-2	OTS	Tag All	2	0.0	
10.40.3.238 to 10.40.3.237	L3 Logical	Tag All	1	0.0	

Affected Links

Root Cause: ILA-SD2KHAR01-SD2KURSK01-1/OTS-1-1-3 to ILA-SD2KHAR01-SD2KURSK01-2/OTS-1-1-2

Link Name	Link Description	Link Type	Link Tags	Link Speed (Gbps)	Impact Type
2 ITEMS					
SD2KHAR01/MC-1-1-4_1 to SD2KURSK01/MC-1-1-2_1	MC line SD2KHAR01/MC-1-1-4_1 to SD2KURSK01/MC-1-1-2_1	MC	Tag All	0.0	Link down
SD2KHAR01/OMS-1-1-5 to SD2KURSK01/OMS-1-1-3		OMS	Tag All	0.0	Link down



12. In this example, there is an **Admin Status: Down**. This means that this element constitutes a root cause failure in and of itself (and not simply an affected element).

Search: ILA-SD2MOS01-SD2SPB01-7

[Cordoba] > Cordoba > COR > CR1.COR >

TenGigE0/0/0/7

Info

GUID: PO/r_physical/640eb904b3651f8e/ad2095e495c...

Name: TenGigE0/0/0/7

Type: Router Physical Port

ETH Port Type: ETH 10G

Physical Address: aa:bb:cc:dd:ee:ff

Speed BPS: 10.0 Gbps

Provider: Topogen

Description: to CR1.VAL:TenGigE0/0/0/6

Relative Direction: None

Admin Status: Down

Operational Status: Up


Device: CR1.COR

show less

Download the Root Causes

You can download a comma separated file with the root cause information.

To download root causes:

1. In the applications bar, select **RCA**.
2. Click . A **root_cause_analysis_<date>.csv** file is downloaded.
3. Open the downloaded file to view a list of the root causes appears with the following information:
 - **Root Cause:** The root cause link name. In this example, the OTS link.
 - **Root Cause Type:** The root cause link type.
 - **Affected Link:** The link affected by this root cause.
 - **Affected Type:** The type of the link affected by this root cause.
 - **Capacity [Gbps]:** The bandwidth lost in Gb for the affected link.

Execution Parameter	Value			
Time Machine	14/05/2020 00:21			
Root Cause	Root Cause Type	Affected Link	Affected Type	Capacity [Gbps]
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.SQY:CR1.FRA:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.MAN:CR1.ROM:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.ROM:CR1.BEL:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.SQY:CR2.COR:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	10.40.0.26 to 10.40.0.25	IGP	0
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.BKL:CR2.SQY:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.LIV:CR2.FRA:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.OVE:CR2.SQY:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	SD1BKL01/1-10-1 to SD1SQY01/1-6-1	OTU	0
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.PAR:CR2.SQY:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.MIL:CR1.SQY:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.DUB:CR2.VIE:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.ROM:CR1.LIV:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.BKL/TenGigE0/0/0/6 to CR2.SQY/TenGigE0/0/0/6	R_PHYSICAL	10
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.LIS:CR1.MAN:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.MIL:CR2.DUB:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.DUB:CR1.BEL:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.BEL:CR2.BIL:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	SD1BKL01/1-4-1 to SD1CAM01/1-9-1	OTU	0
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.DUB:CR1.BKL:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.MAN:CR1.FRA:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.LIV:CR1.BKL:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.BEL:CR1.OVE:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.VIE:CR2.MAN:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.VIE:CR1.DUB:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	SD1BKL01/1-10-100-2 to SD1DUS01/1-4-100-2	ETH	10
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.DUB:CR2.FRA:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR2.BKL:CR1.MIL:lsp_0	LSP	0.01
SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8	OTS	CR1.BEL:CR1.SQY:lsp_0	LSP	0.01

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