



Cisco Crosswork Hierarchical Controller 7.1

NBI and SHQL Reference Guide

August 2023

Introducing Crosswork Hierarchical Controller APIs

Cisco Crosswork Hierarchical Controller offers an extensive set of APIs as a northbound interface to service orchestrators, OSSs, and Inventory systems. These APIs are essential tools to automate operational workflows, planning scenarios, and administrative tasks. These APIs can be used to retrieve information, provision services and resources, build the network and register for notifications.

Crosswork Hierarchical Controller makes use of multiple technologies for these APIs:

- RESTCONF – based on YANG models defined for NETCONF
- REST with JSON in body
- REST with SHQL in body

API Architecture and Technologies

RESTCONF/YANG Protocol Introduction

The RESTCONF protocol is an HTTP-based protocol that provides a programmatic interface for accessing data defined in YANG 1.0 [RFC 6020] or YANG 1.1 [RFC 7950] using the data store concepts defined in the Network Configuration Protocol (NETCONF) [RFC 6241] and further extended in NMDA [RFC 8342].

The main reasons for selecting RESTCONF include:

- The capability of mapping HTTP CRUD operations to provide a model-driven API.
- The ability to use a ubiquitous REST architecture used by many Web applications.
- The ability to use and mix various standard data models defined in the YANG modeling language produced by multiple SDOs. This potentially allows an implementor a choice of SDN architectures, namely IETF ACTN, ONF TAPI, and MEF TAPI.

Crosswork Hierarchical Controller's RESTCONF implementation consists of the following resources:

- **+restconf}/data (Data API):** Create/Retrieve/Update/Delete (CRUD) based API for the entire configuration data tree defined in the YANG data models.
- **+restconf}/operations (Operations API):** RPC-based API entry to trigger RPC defined in YANG.
- **+restconf}/data/ietf-restconf-monitoring:restconf-state/streams (Notifications API):** RESTCONF API to discover possible Notification streams as defined in RESTCONF protocol. See [Device Management](#) for more information.
- **+restconf}/yang-library-version:** This mandatory leaf identifies the revision date of the "ietf-yang-library" YANG module that is implemented by this server.

As per RFC 8040, the RESTCONF implementation supports JSON encoding for YANG data [RFC 7951]. The server accepts "application/yang-data+json".

Query Filtering

According to the RESTCONF specification, each operation allows zero or more query parameters to be present in the request URI. Specifically, query operations' parameters are described in [Section 4.8 of \[RFC 8040\]](#). The following table describes the supported query parameters.

Table 1. Supported Query Parameters

Name	Methods	Description
content	GET	Select config and/or non-config data resources
depth	GET	Request limited subtree depth in the reply content
fields	GET	Request a subset of the target resource content

Transport Security

Data Integrity

Crosswork Hierarchical Controller serves all NBI-accessed data over TLS [RFC 5246] – a transport-layer providing data integrity and confidentiality. Any client accessing Crosswork Hierarchical Controller **MUST** support TLS 1.2 and above.

Server Authentication

Crosswork Hierarchical Controller NBI presents an X.509v3 certificate upon establishing a TLS connection with a client.

A client **MUST** support certificate validation as per RESTCONF [RFC 8040 Section 2]. The RESTCONF client **MUST** either (1) use X.509 certificate path validation [RFC5280] to verify the integrity of the RESTCONF server's TLS certificate or (2) match the server's TLS certificate with a certificate obtained by a trusted mechanism (e.g., a pinned certificate). If the X.509 certificate path validation fails and the presented X.509 certificate does not match a certificate obtained by a trusted mechanism, the connection **MUST** be terminated, as described in Section 7.2.1 of [RFC5246].

NOTE: For the purpose of testing, a client may disable certificate validation to check interface functionality.

Client Authentication

Crosswork Hierarchical Controller client authentication is based on HTTP Basic Authentication [RFC 7617]. A client must present a username and password over the established TLS connection. More specifically, a client must use an Authorization header using a Basic authentication scheme. For further information, see the HTTP Authentication Scheme Registry [RFC 7235].

API Endpoints

Crosswork Hierarchical Controller supports APIs for receiving notifications, information, and provisioning services.

- **Device manager:** Various APIs that allow you to manage adapters, devices and credentials
- **Get inventory:** Get optical devices and routers, their cards, ports, and their attributes.
- **Get performance counters:** Get L2 performance (throughput) counters per specific port or link.
- **Cross links:** Various APIs to administer cross links.
- **Shared risk:** Various APIs that allow you to administer shared risk policies and rules.
- **Generic queries:** Use SHQL commands to query any data from the Crosswork Hierarchical Controller model.

Object IDs

Any reference to specific objects in the APIs uses object IDs. IDs can be used for a network, site, node, TP (termination point), LSP, service, link, network access, or VLAN.

The implementation by Crosswork Hierarchical Controller for these IDs is the GUID. The GUID is a unique identifier of any object in the model and it can be retrieved as the object ID using the relevant GET API. Once retrieved, it can be used as the object reference further on.

Device Management

Crosswork Hierarchical Controller provides APIs to administer device management.

You can access the Device Manager API using Swagger:

- <https://<host>/api/v2/apps/device-manager-srv/rest/doc>

The APIs include:

- Get all adapters
- Get adapter configuration schema
- Get adapter device schema
- Get all devices
- Add device to Crosswork Hierarchical Controller
- Assign device to adapter
- Update device's adapter configuration
- Unassign device from adapter
- Update device name
- Assign device to Site
- Get device status
- Get a device
- Remove device from Crosswork Hierarchical Controller
- Get credentials keys' names and types
- Add new credentials
- Update credentials
- Delete credentials
- Get the parameters schema for the specified credentials type

Get Adapters

Use this API to get the list of all the adapters. The **guid** in the response is the **adapterGuid** used in several of the other device manager methods.

Request Method

GET

Request URL

<https://example-host/api/v2/apps/device-manager-srv/rest/adapter>

Request Parameters

None

Response Example

```
[
  {
    "guid": "cisco_ios_xr",
    "enabled": true,
    "config": {
      "polling": 300,
      "concurrency": 1,
      "ssh_config": {
        "enabled": false,
        "connect_timeout": 10,
        "command_timeout": 10
      },
      "file_bringing": {
        "enabled": false,
        "location": "",
        "file_type": "XX"
      },
      "collection_parameters": {
        "enable_igp_isis": true,
        "enable_stats": true,
        "enable_vrf": true,
        "enable_lldp": true,
        "enable_mpls": true,
        "enable_snmp": true,
        "igp_isis_priority": 1,
        "igp_seed_routers": true
      }
    }
  },
  {
    "guid": "juniper_os_1",
    "enabled": true,
    "config": {
      "polling": 300,
      "concurrency": 1,
      "ssh_config": {
        "enabled": false,
```

```

        "connect_timeout": 10,
        "command_timeout": 10
    },
    "file_bringing": {
        "enabled": false,
        "location": "",
        "file_type": "XX"
    },
    "collection_parameters": {
        "enable_igp_isis": true,
        "enable_igp_ospf": true,
        "enable_stats": true,
        "enable_vrf": true,
        "enable_lldp": true,
        "enable_mpls": true,
        "enable_snmp": true,
        "igp_isis_priority": 1,
        "igp_seed_routers": true
    }
}
]

```

Get Adapter Configuration Schema

Use this API to retrieve the adapter's configuration schema.

Request Method

GET

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/adapter/{adapterGuid}/adapter-schema`

Request Parameters

Parameter Name	Data Type	Description
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Response Example

```

{
  "$schema": "http://json-schema.org/draft-04/schema#",
  "type": "object",
  "properties": {
    "polling": {

```

```
"type": "integer",
"minimum": 0,
"default": 300,
"title": "Polling Cycle [sec]",
"description": "Poll every X seconds"
},
"concurrency": {
  "type": "integer",
  "default": 1,
  "title": "Number of concurrent routers collected"
},
"ssh_config": {
  "type": "object",
  "title": "SSH Configuration Parameters",
  "properties": {
    "enabled": {
      "type": "boolean",
      "default": false,
      "title": "Enable Tunnel"
    },
    "host": {
      "type": "string",
      "title": "Tunnel Host"
    },
    "port": {
      "type": "integer",
      "title": "Tunnel Port"
    },
    "tunnel_credentials_key": {
      "type": "string",
      "title": "Tunnel Credentials Key",
      "credentials-types": [
        "SSH_USER_PASSWORD"
      ]
    },
    "connect_timeout": {
      "type": "integer",
      "default": 10,
      "title": "Router Connect timeout"
    },
    "command_timeout": {
      "type": "integer",
```

```

        "default": 10,
        "title": "Router Command timeout"
    }
},
"additionalProperties": false
},
"file_bringer": {
    "type": "object",
    "title": "File Bringer Parameters",
    "properties": {
        "enabled": {
            "type": "boolean",
            "default": false,
            "title": "Enable File Bringer"
        },
        "location": {
            "type": "string",
            "title": "File Server Location",
            "description": "\"[sftp|file]://<server>:<port>/<absolute path>\"",
            "default": ""
        },
        "file_type": {
            "title": "File Type",
            "enum": [
                "XX",
                "XX"
            ],
            "default": "XX"
        },
        "authentication": {
            "type": "string",
            "credentials-types": [
                "SFTP"
            ]
        }
    },
    "additionalProperties": false
},
"collection_parameters": {
    "type": "object",
    "title": "Collection Parameters",
    "properties": {

```



```
"enable_igp_isis": {
  "type": "boolean",
  "default": false,
  "title": "Enable IGP IS-IS Collection"
},
"enable_stats": {
  "type": "boolean",
  "default": false,
  "title": "Enable Stats Collection"
},
"enable_vrf": {
  "type": "boolean",
  "default": false,
  "title": "Enable VRF Collection"
},
"enable_lldp": {
  "type": "boolean",
  "default": false,
  "title": "Enable LLDP Collection"
},
"enable_mpls": {
  "type": "boolean",
  "default": false,
  "title": "Enable MPLS Tunnels Collection"
},
"enable_snmp": {
  "type": "boolean",
  "default": false,
  "title": "Enable SNMP Collection"
},
"igp_isis_priority": {
  "type": "integer",
  "default": 1,
  "title": "IGP IS-IS Priority"
},
"igp_seed_routers": {
  "type": "boolean",
  "default": true,
  "title": "Collect only IGP IS-IS seed routers"
}
},
"additionalProperties": false
```

```

    }
  },
  "additionalProperties": false,
  "required": [
    "polling"
  ]
}

```

Get Adapter Device Schema

Use this API to retrieve the device configuration schema of a specific adapter.

Request Method

GET

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/adapter/{adpaterGuid}/device-schema`

Request Parameters

Parameter Name	Data Type	Description
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Response Example

```

{
  "type": "object",
  "properties": {
    "host": {
      "type": "string"
    },
    "port": {
      "type": "integer",
      "default": 22
    },
    "direct_connect": {
      "type": "boolean",
      "default": false,
      "title": "Direct Connect (avoid tunnel if configured)"
    },
    "authentication": {
      "type": "string",
      "credentials-types": [
        "SSH_USER_PASSWORD"
      ]
    }
  }
}

```

```

    },
    "enabled": {
      "type": "boolean",
      "default": false
    }
  },
  "additionalProperties": false,
  "required": [
    "enabled",
    "host",
    "port"
  ]
}

```

Get All Devices

Use this API to get all devices for a specific adapter. The **device_manager_guid** returned in the response is used as the **deviceGuid** in the relevant device manager APIs.

Request Method

GET

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/device?adapter={adpaterGuid}`

Request Parameters

Parameter Name	Data Type	Description
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Response Example

```

[
  {
    "device_manager_guid": "0a9af2d2-324a-45dd-895e-9e6edb2f9d39",
    "inventory_type": "ROUTER",
    "device_model_guid": "IN/cisco_ios_xr/ROUTER-xrv-p1",
    "name": "cisco_1",
    "adapters": {
      "cisco_ios_xr": {
        "adapter_guid": "cisco_ios_xr",
        "config": {
          "port": 22,
          "direct_connect": true,
          "enabled": true,
          "host": "10.1.0.58",

```

```
        "authentication": "Cisco"
      },
      "enabled": false
    }
  },
  "identifiers": {
    "host_name": "10.1.0.58",
    "tid": null,
    "serial": null,
    "loopback_mac": null,
    "loopback_ip": null,
    "extra": {}
  },
  "site": null,
  "pending_delete": false,
  "enabled": false
},
{
  "device_manager_guid": "9988749383",
  "inventory_type": "ROUTER",
  "device_model_guid": "IN/cisco_ios_xr/ROUTER-xrv-p2",
  "name": "cisco_2",
  "adapters": {
    "cisco_ios_xr": {
      "adapter_guid": "cisco_ios_xr",
      "config": {
        "port": 22,
        "direct_connect": true,
        "enabled": true,
        "host": "10.1.0.71",
        "authentication": "Cisco"
      },
      "enabled": false
    }
  },
  "identifiers": {
    "host_name": "10.1.0.71",
    "tid": null,
    "serial": null,
    "loopback_mac": null,
    "loopback_ip": null,
    "extra": {}
  }
}
```

```
    },
    "site": null,
    "pending_delete": false,
    "enabled": false
  }
]
```

Add Device to Crosswork Hierarchical Controller

Use this API to add a device to Crosswork Hierarchical Controller.

Request Method

POST

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/device`

Request Parameters

None

Request Body

Parameter Name	Data Type	Description
description	string	The device name.
site	string	The site or specify null for no site.

Request Body Example

```
{
  "name": "router-a",
  "site": null
}
```

Response Example

```
{
  "device_manager_guid": "a2087abe-5753-4387-b372-f8cfb571bb1e"
}
```

Assign Device to Adapter

Use this API to assign a device to an adapter.

Request Method

POST

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}/adapters/{adapterGuid}`

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Request Body

Parameter Name	Data Type	Description
description	string	<p>The adapter's device parameters. The schema can be retrieved with the Get Adapter Device Schema API.</p> <p>Ensure that you add the parameters that are marked as required. In this schema example:</p> <pre> "required": ["enabled", "host", "port"] </pre>

Request Body Example

```

{
  "host": "1.1.1.1",
  "port": 22,
  "enabled": false
}

```

Response Example

201 Successful

Update Device Adapter Configuration

Use this API to update the device adapter configuration.

Request Method

PUT

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}/adapters/{adapterGuid}`

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Request Body

Parameter Name	Data Type	Description
description	string	<p>The adapter's device parameters. The schema can be retrieved with the Get Adapter Device Schema API.</p> <p>Ensure that you add the parameters that are marked as required. In this schema example:</p> <pre> "required": ["enabled", "host", "port"] </pre>

Request Body Example

```

{
  "host": "1.1.1.1",
  "port": 22,
  "enabled": true
}

```

Response Example

200 Successful

Unassign Device from Adapter

Use this API to unassign a device from an adapter. The device is not deleted from the network.

Request Method

DELETE

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}/adapters/{adapterGuid}`

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Response Example

200 Successful

Update Device Name

Use this API to update the device name.

Request Method

PUT

Request URL

```
https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}/name/{name}
```

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.
adapterGuid	string	The adapter guid. Use the guid returned by the Get Adapters method.

Response Example

```
200 Successful
```

Assign Device to Site

Use this API to assign a device to site.

Request Method

```
PUT
```

Request URL

```
https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}/site
```

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.

Request Body

Parameter Name	Data Type	Description
guid	string	The site GUID.

Request Body Example

```
{  
  "guid": "ST/e7df76d7a9cb"  
}
```

Response Example

```
200 Successful operation.
```

Get Device Status

Use this API to get device status.

Request Method

```
GET
```

Request URL

https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}/status

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.

Response Example

```
{
  "adapte-name": {
    "last-successfull-discovery": "2020-05-04T17:50:15.530Z"
  }
}
```

Get a Device

Use this API to get a device.

Request Method

GET

Request URL

https://example-host/api/v2/apps/device-manager-srv/rest/ device/{deviceGuid}

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.

Response Example

```
{
  "device_manager_guid": "83ce57e9-a82b-488a-994b-f8c4191f0158",
  "inventory_type": null,
  "device_model_guid": null,
  "name": "router-a",
  "adapters": {
    "cisco_ios_xr": {
      "adapter_guid": "cisco_ios_xr",
      "config": {
        "host": "1.1.1.2",
        "port": 22,
        "enabled": false
      },
      "enabled": false
    }
  }
},
```

```

"identifiers": {
  "host_name": null,
  "tid": null,
  "serial": null,
  "loopback_mac": null,
  "loopback_ip": null,
  "extra": {}
},
"site": null,
"pending_delete": false,
"enabled": false
}

```

Remove Device from Crosswork Hierarchical Controller

Use this API to remove the device from Crosswork Hierarchical Controller.

Request Method

DELETE

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/device/{deviceGuid}?force=true`

Request Parameters

Parameter Name	Data Type	Description
deviceGuid	string	The device guid. Use the device_manager_guid returned by the Get All Devices method.
force	string	Whether to remove the device from the system even if it is assigned to an adapter.

Response Example

200 OK!

Get Credentials

Use this API to get all configured credentials keys' names and types.

Request Method

GET

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/credentials?type={type}`

Request Parameters

Parameter Name	Data Type	Description
type	array[string]	SSH_USER_PASSWORD, SSH_PUBLIC_KEY, HTTP, SNMP_COMMUNITY, SFTP

Response Example

```
[
  {
    "name": "A",
    "type": "SSH_USER_PASSWORD"
  },
  {
    "name": "Cisco",
    "type": "SSH_USER_PASSWORD"
  },
  {
    "name": "junos",
    "type": "SSH_USER_PASSWORD"
  }
]
```

Add New Credentials

Use this API to add new credentials.

Request Method

POST

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/credentials/{name}`

Request Parameters

Parameter Name	Data Type	Description
name	string	The credential name.

Request Body

Parameter Name	Data Type	Description
type	array[string]	SSH_USER_PASSWORD, SSH_PUBLIC_KEY, HTTP, SNMP_COMMUNITY, SFTP
config	description	The credentials parameters structure as described by the Get Credentials API.

Request Body Example

```
{
  "type": "SSH_USER_PASSWORD",
  "config": {}
}
```

Response Example

201 Successful Operation

Update Credentials

Use this API to update credentials.

Request Method

PUT

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/credentials/{name}`

Request Parameters

Parameter Name	Data Type	Description
name	string	The credential name.

Request Body

Parameter Name	Data Type	Description
type	array[string]	SSH_USER_PASSWORD, SSH_PUBLIC_KEY, HTTP, SNMP_COMMUNITY, SFTP
config	description	The credentials parameters structure as described by the Get Credentials API.

Request Body Example

```
{
  "type": "SSH_USER_PASSWORD",
  "config": {}
}
```

Response Example

200 Successful Operation

Delete Credentials

Use this API to delete credentials.

Request Method

DELETE

Request URL

`https://example-host/api/v2/apps/device-manager-srv/rest/credentials/{name}`

Request Parameters

Parameter Name	Data Type	Description
name	string	The credential name.

Response Example

200 Successful

Get the Parameters Schema for the Specified Credentials Type

Use this API to get the parameters schema for the specified credentials type.

Request Method

GET

Request URL

https://example-host/api/v2/apps/device-manager-srv/rest/XXX

Request Parameters

Parameter Name	Data Type	Description
type	array[string]	SSH_USER_PASSWORD, SSH_PUBLIC_KEY, HTTP, SNMP_COMMUNITY, SFTP

Response Example

```
{
  "type": "object",
  "properties": {
    "username": {
      "title": "Username",
      "type": "string"
    },
    "password": {
      "title": "Password",
      "type": "string",
      "encrypted": true
    }
  },
  "required": [
    "username",
    "password"
  ]
}
```

Physical Inventory

The physical inventory API provides information on devices attributes, slots, cards, and ports.

This API supports optical devices only.

Get Physical Inventory

The API accepts two queries:

- Device ID - get full list of devices or specific device by its ID.
- Full - get detailed device inventory or only its ID (full=true/false).

Request Method

GET

Request URL

```
/api/v2/apps/network-inventory-app/rest/devices/
```

Request Header

```
Accept: application/yang-data+json
```

```
Content-Type: application/yang-data+json
```

Response Example

```
{
  "id": "XX-01011",
  "type": "ONE",
  "desc": "XX-01011",
  "vendor_model": "ciena_6500",
  "tid": "TID111",
  "serial_number": "[Shelf-1 [1-XX,2-XX]]",
  "SHELF": [
    {
      "id": "1",
      "type": "SHELF",
      "desc": "6500 14-Slot Converged Optical Shelf Assembly, OCP",
      "vendor_model": "ciena_6500",
      "tid": "XX-01011",
      "aid": "SHELF-1",
      "clei": "WWW",
      "serial_number": "SSS",
      "FAN": [
        {
          "id": "FAN-1-1",
          "type": "FAN",
          "desc": "XX-01011/MNG-EQPT/FAN-1-1 (FAN), ctype=\"Fan Rear Exhaust High Flow Cooling\"",
          "vendor_model": "ciena_6500",
          "tid": "XX-01011",
          "aid": "FAN-1-1",
          "clei": "WWW",
          "part_number": "NNN",
          "serial_number": "MMM"
        }
      ]
    }
  ],
  "CARD": [
    {
      "id": "1-1",
      "type": "CARD",
```

```

"desc": "XX-01011/1-1 (OTSC), ctype=\"2x10G OTR 4x XFP\"",
"vendor_model": "ciena_6500",
"tid": "XX-01011",
"aid": "000-1-1",
"clei": "WWW",
"part_number": "MM",
"serial_number": "NNN",
"PORT": [
  {
    "id": "1-1-1",
    "type": "PORT",
    "desc": "XX-01011/1-1-1 (P10GSOEL), ctype=\"OC192
SR1/I64.1 10GBASE-LR/LW OTU2 10GFC 1200SMLLL 1310 nm XFP\"",
    "vendor_model": "ciena_6500",
    "tid": "XX-01011",
    "aid": "UU-1-1-1",
    "clei": "WWW",
    "pluggable": "PLUGGABLE",
    "part_number": "NNNA",
    "serial_number": "MMM"
  },
},

"POWER_SUPPLY": [
  {
    "id": "PWR-1-17-1",
    "type": "POWER_SUPPLY",
    "desc": "XX-01011/MNG-EQPT/PWR-1-17-1 (PWR), ctype=\"Power Card
60A breaker\"",
    "vendor_model": "ciena_6500",
    "tid": "XX-01011",
    "aid": "PWR-1-17-1",
    "clei": "WWWD",
    "part_number": "NNNA",
    "serial_number": "MMM"
  },
],
}
]
}
}

```

Response Parameters

The response contains information on all device inventory modules:

- Device – all device level attributes
- Shelf – one or more shelves
- Fan – fan trays
- Card – all pluggable, line and aggregation cards, including transceivers
- Port – all physical ports
- Power supply – all power modules

Performance Counters

The Crosswork Hierarchical Controller performance API is based on a non-SDO data model authored by Cisco. The SDOs lack a network-level, performance data model allowing NBI access to raw performance counters of managed network objects.

Current performance-counter data models in IETF address the device level, such as ietf-interfaces, whereas network-level data models focus on derived values, e.g., bandwidth. Cisco will implement a standard data model once available from IETF.

The Crosswork Hierarchical Controller data model exposes raw performance counters collected from ports and IP/MPLS LSPs. It is implemented in the form of a YANG RPC where an NBI client may trigger an operation via the RESTCONF NBI to retrieve packet and/or octet counters to derive rate, average, etc.

URIs

You can retrieve the counters for the latest PM interval or for a specific period. The stats can be retrieved for a specific LSP/port/link, all objects, or for a group of objects (set by POST message).

Interface Type	Interface Operation	Request Method	URI
Performance	RPC to retrieve raw performance counters per object type in a time range.	GET	/api/v2/timeseries/stats/
Performance	RPC to retrieve raw performance counters per object type in the latest time range.	GET	/api/v2/timeseries/stats/latest
Performance	RPC to retrieve raw performance counters for specific ports (not one and not ALL the ports)	PUT	/api/v2/timeseries/stats/bulkStatsQuery

Get Performance Latest Stats

Gets the performance stats for the latest period for an object or all objects. You can specify a specific PM type with a specific port/LSP or stream ID.

Request Method

GET

Request URL

api/v2/timeseries/stats/latest

Request Header

Accept: application/yang-data+json

Content-Type: application/yang-data+json

Request Parameters

Parameter Name	Data Type	Value	Description
objGuid	string		The object guid.
pmType	array[string]	DELAY_USEC, MIN_RTT_USEC OCTET_OUT	The PM type.
streamId	numeric		The stream ID.

Request Example

```
GET /api/v2/timeseries/stats/latest?pmType=DELAY_USEC&objGuid=PO/juniper-  
northstar/LGC-LabMX960-02:ae5.0
```

```
GET /api/v2/timeseries/stats/latest?pmType=DELAY_USEC&streamId=3
```

Request Parameters

Parameter Name	Data Type	Value	Description
objGuid	string		The object guid.
timestamp	datetime		The time.
deviceType	string		The device type, for example, ROUTER.
timePeriodSec	numeric		The time in seconds.
pmType	array[string]	DELAY_USEC, MIN_RTT_USEC OCTET_OUT	The PM type.
value	numeric		The performance statistic.
streamId	numeric		The stream ID.

Response Example

```
{  
  "objGuid":  
  "LI/lsp/f66fa3288d396e47/f66fa3288d396e47/f1e815107b715b67/f1e815107b715b67/lsp_161908  
  1766048",  
  "timeStamp": 1622602613000,  
  "deviceType": "ROUTER",  
  "timePeriodSec": 0,  
  "pmType": "OCTET_OUT",  
  "value": 273252081213835,  
  "streamId": 6  
}
```

Get Performance Stats for Period

Gets the performance stats for a specific period for an object or all objects. You can specify a specific PM type with a specific port/LSP or stream ID.

Request Method

GET

Request URL

api/v2/timeseries/stats

Request Header

Accept: application/yang-data+json

Content-Type: application/yang-data+json

Request Parameters

Parameter Name	Data Type	Value	Description
startTimeStamp	datetime		The start of the period.
endTimeStamp	datetime		The end of the period.
objGuid	string		The object guid.
pmType	array[string]	DELAY_USEC, MIN_RTT_USEC OCTET_OUT	The PM type.
streamId	numeric		The stream ID.

Request Example

```
GET /api/v2/timeseries/stats?startTimeStamp=1643793190000&
endTimeStamp=1643878292000&pmTypeDELAY_USEC&objGuid=
PO/r_logical/16f1596a46b13da5/7d82f458ff24bfa3
```

Request Parameters

Parameter Name	Data Type	Value	Description
objGuid	string		The object guid.
Timestamp	datetime		The time.
deviceType	string		The device type, for example, ROUTER.
timePeriodSec	numeric		The time in seconds.
pmType	array[string]	DELAY_USEC, MIN_RTT_USEC OCTET_OUT	The PM type.
Value	numeric		The performance statistic.
streamId	numeric		The stream ID.

Response Example

```
{
```

```
"objGuid": "PO/r_logical/16f1596a46b13da5/7d82f458ff24bfa3",
"timeStamp": 1643874592000,
"deviceType": "ROUTER",
"timePeriodSec": 859,
"pmType": "DELAY_USEC",
"value": 649907,
"streamId": 5
}
{
"objGuid": "PO/r_logical/16f1596a46b13da5/7d82f458ff24bfa3",
"timeStamp": 1643875520000,
"deviceType": "ROUTER",
"timePeriodSec": 928,
"pmType": "DELAY_USEC",
"value": 724091,
"streamId": 5
}
{
"objGuid": "PO/r_logical/16f1596a46b13da5/7d82f458ff24bfa3",
"timeStamp": 1643876484000,
"deviceType": "ROUTER",
"timePeriodSec": 927,
"pmType": "DELAY_USEC",
"value": 69079,
"streamId": 5
}
{
"objGuid": "PO/r_logical/16f1596a46b13da5/7d82f458ff24bfa3",
"timeStamp": 1643877388000,
"deviceType": "ROUTER",
"timePeriodSec": 904,
"pmType": "DELAY_USEC",
"value": 665969,
"streamId": 5
}
```

Send Specific Ports Performance Stats

Gets the performance stats for a specific period for specific ports (not one and not ALL the ports).

Request Method

PUT

Request URL

```
api/v2/timeseries/stats/bulkStatsQuery
```

Request Header

```
Accept: application/yang-data+json
```

```
Content-Type: application/yang-data+json
```

Request Parameters

Parameter Name	Data Type	Description
startTimeStamp	datetime	The start of the period.
endTimeStamp	datetime	The end of the period.
d@ports.json	JSON string	Where ports.json is list of the guides.

Request Example

```
POST
/api/v2/timeseries/stats/bulkStatsQuery?startTimeStamp=1659402468000&endTimeStamp=1659
802468000' -d@ports.json
```

Where request.json is list of the guides:

```
[
  "PO/r_logical/1d80163d31fa18ee/870a15983eafb41f",
  "PO/r_logical/7b4564a1ccb6e4cb/5a52cb94b8d7dbc4"
]
```

Response Parameters

Parameter Name	Data Type	Value	Description
objGuid	string		The object guid.
timeStamp	datetime		The time.
deviceType	string		The device type, for example, ROUTER.
timePeriodSec	numeric		The time in seconds.
pmType	array[string]	DELAY_USEC, MIN_RTT_USEC, OCTET_OUT	The PM type.
value	numeric		The performance statistic.
streamId	numeric		The stream ID.

Response Example

```
[
  {
    "objGuid": "PO/r_logical/7b4564a1ccb6e4cb/5a52cb94b8d7dbc4",
    "timeStamp": 1659608730000,
```

```

    "deviceType": "ROUTER",
    "timePeriodSec": 900,
    "pmType": "MAX_RTT_USEC",
    "value": 481463,
    "streamId": 4
  },
  {
    "objGuid": "PO/r_logical/7b4564a1ccb6e4cb/5a52cb94b8d7dbc4",
    "timeStamp": 1659608730000,
    "deviceType": "ROUTER",
    "timePeriodSec": 900,
    "pmType": "DELAY_USEC",
    "value": 443345,
    "streamId": 4
  },
  {
    "objGuid": "PO/r_logical/7b4564a1ccb6e4cb/5a52cb94b8d7dbc4",
    "timeStamp": 1659608730000,
    "deviceType": "ROUTER",
    "timePeriodSec": 900,
    "pmType": "MIN_RTT_USEC",
    "value": 441197,
    "streamId": 4
  },
  {
    "objGuid": "PO/r_logical/1d80163d31fa18ee/870a15983eafb41f",
    "timeStamp": 1659608735000,
    "deviceType": "ROUTER",
    "timePeriodSec": 900,
    "pmType": "OCTET_OUT",
    "value": 17939855810587,
    "streamId": 4
  }
}

```

Cross Links

Crosswork Hierarchical Controller provides APIs to administer cross links. For more information, see the *Cisco Crosswork Hierarchical Controller Administration Guide*.

The APIs include:

- Get all adjacent cross links
- Validate all cross links
- Validate a cross link

-
- Get all manual cross links
 - Get all manual cross links
 - Get a cross link
 - Add manual cross link to Crosswork Hierarchical Controller
 - Delete a cross link

Note: If the user does not have permission to execute the API, 403 Forbidden is returned. If the wrong credentials are used, 401 Authorization Required is returned.

Get All Adjacent Cross Links

Use this API to return port adjacencies that were discovered using automatic discovery protocols such as LLDP, elements in this list MAY be adjacencies that were not configured and not part of the manual cross list.

Request Method

GET

Request URL

`https://example-host/api/v2/crosslinks/adjacencies`

Request Parameters

None

Response Example

The response contains information on all adjacent cross links. For cross link it returns the following:

- interfaceA – deviceName, interfaceName, type, and guid
- interfaceB – deviceName, interfaceName, type, and guid
- technology (ETH or NMC)
- relatedModelObjectGuid

Validate All Cross Links

Use this API to trigger a validation all cross links. This runs a process to update the model (links and paths) based on the latest state of cross links, router-physical links, eth links, etc. Validating all cross links (and adding a new manual cross link) may update the path of a r-phy link and may even create the r-phy link altogether if it did not exist before. As a result of the new manual cross link, this may find the entire optical circuit from end-to-end.

For an Ethernet link, if there is a conflict between a manually added cross link and a cross link detected from the network, the manually added link is removed from Cisco Crosswork Hierarchical Controller network model. The manual link remains in the manual-links db and is re-added to the network model if the network-discovered link disappears AND the manual link gets a positive validation after there are no more conflicts (this is in contrast to never-conflicted manual links that appear in the network model even without a positive validation).

This API method returns an empty result. Use the [Get All Manual Cross Links](#) method to view the updated state.

Request Method

GET

Request URL

`https://example-host/api/v2/crosslinks/validate`

Request Parameters

None

Response Example

None

Validate a Cross Link

Use this API to trigger a validation of a specific cross link. This API only updates the relevant validation fields of the validated manual cross link without touching the topological model.

Request Method

GET

Request URL

`https://example-host/api/v2/crosslinks/validate/{guid}`

Response Parameters

Parameter Name	Data Type	Description
guid	string	The cross link guid. Use the guid returned by the Get All Manual Cross Links method.

Response Example

The response returns the following for the cross link:

- **guid**: The link guid
- **interfaceA** - deviceName, interfaceName, type, and guid
- **interfaceB** - deviceName, interfaceName, type, and guid
- **technology** (ETH or NMC)
- **relatedModelObjectGuid**
- **additionTimeEpochMillis**
- **description**
- **validated**: Whether the link has been validated.
- **validationResult**: The validation result (VALIDATED_BY_PORT_ADJACENCY, VALIDATED_BY_CORRELATION, NOT_CORRELATED, INCONCLUSIVE, UNKNOWN, or CONFLICT).
- **lastValidationCheck**: The timestamp when the link was last validated.
- **lastConflictTime**: This timestamp is hidden if there was never a conflict. If this is the same as the **lastValidationCheck**, then the manual link is currently in conflict. If **lastValidationCheck** is later

than the **lastConflictTime**, then the manual link was in conflict before but is not in conflict currently. If in addition **validated** is **true**, this manual link appears in the network model.

- **conflicts**: If a link is or was conflicted, the **conflicts** list is populated with one or two conflicting pairs, one pair per each of the manual-link ports.

```
{
  "guid": "23f6e6c340268f068f817f8f9484aa54a2ba92d5d7072efd7940308f8ecc8fa5",
  "interfaceA": {
    "deviceName": "CR2.ATH",
    "interfaceName": "TenGigE0/0/1/13",
    "type": "R_PHYSICAL",
    "guid": "PO/r_physical/8ff611ed7ebcd772/2c4e6530608a213d"
  },
  "interfaceB": {
    "deviceName": "SD2ATH02",
    "interfaceName": "ETH-1-1-8",
    "type": "ETH",
    "guid": "PO/eth/ecf4e9a6bbb76cbc/86cdb5c6379e5c62"
  },
  "technology": "ETH",
  "relatedModelObjectGuid":
  "LI/eth/8ff611ed7ebcd772/2c4e6530608a213d/ecf4e9a6bbb76cbc/86cdb5c6379e5c62",
  "additionTimeEpochMillis": 1666695054475,
  "description": "cross link description",
  "validated": true,
  "validationResult": "VALIDATED_BY_PORT_ADJACENCY",
  "lastValidationCheck": 1668598747209,
  "conflicts": [
    {
      "a": { "deviceName": "dev-name-of-manual-link-interfaceA", "interfaceName":
      "iface-name-of-manual-link-interfaceA" },
      "b": { "deviceName": "dev-name-of-different-than-manual-link-interfaceB",
      "interfaceName": "iface-name-different-than-manual-link-interfaceB" }
    },
    {
      "a": { "deviceName": "dev-name-of-manual-link-interfaceB", "interfaceName":
      "iface-name-of-manual-link-interfaceB" },
      "b": { "deviceName": "dev-name-of-different-than-manual-link-interfaceA",
      "interfaceName": "iface-name-different-than-manual-link-interfaceA" }
    }
  ]
}
```

Get All Manual Cross Links

Use this API to return an array of the manual cross links. The guid returned can be used as a request parameter in the other cross link APIs.

Request Method

GET

Request URL

`https://example-host/api/v2/crosslinks/manual`

Request Parameters

None

Response Example

The response returns an array of cross links with the following:

- guid
- interfaceA - deviceName, interfaceName, type, and guid
- interfaceB - deviceName, interfaceName, type, and guid
- technology (ETH or NMC)
- relatedModelObjectGuid
- additionTimeEpochMillis
- description
- validated
- validationResult (VALIDATED_BY_PORT_ADJACENCY, VALIDATED_BY_CORRELATION, NOT_CORRELATED, INCONCLUSIVE, UNKNOWN, CONFLICT)
- lastValidationCheck
- conflicts

```
{
  "guid": "23f6e6c340268f068f817f8f9484aa54a2ba92d5d7072efd7940308f8ecc8fa5",
  "interfaceA": {
    "deviceName": "CR2.ATH",
    "interfaceName": "TenGigE0/0/1/13",
    "type": "R_PHYSICAL",
    "guid": "PO/r_physical/8ff611ed7ebcd772/2c4e6530608a213d"
  },
  "interfaceB": {
    "deviceName": "SD2ATH02",
    "interfaceName": "ETH-1-1-8",
    "type": "ETH",
    "guid": "PO/eth/ecf4e9a6bbb76cbc/86cdb5c6379e5c62"
  },
}
```

```

    "technology": "ETH",
    "relatedModelObjectGuid":
"LI/eth/8ff611ed7ebcd772/2c4e6530608a213d/ecf4e9a6bbb76cbc/86cdb5c6379e5c62",
    "additionTimeEpochMillis": 1666695054475,
    "description": "cross link description",
    "validated": true,
    "validationResult": "VALIDATED_BY_PORT_ADJACENCY",
    "lastValidationCheck": 1668598747209,
    "conflicts": []
}

```

Get a Cross Link

Use this API to get a manual cross link.

Request Method

GET

Request URL

`https://example-host/api/v2/crosslinks/manual/{guid}`

Request Parameters

Parameter Name	Data Type	Description
guid	string	The cross link guid. Use the guid returned by the Get All Manual Cross Links method.

Response Example

The response returns the following for the cross link:

- guid
- interfaceA - deviceName, interfaceName, type, and guid
- interfaceB - deviceName, interfaceName, type, and guid
- technology (ETH or NMC)
- relatedModelObjectGuid
- additionTimeEpochMillis
- description
- validated: Whether the link has been validated.
- validationResult: The validation result (VALIDATED_BY_PORT_ADJACENCY, VALIDATED_BY_CORRELATION, NOT_CORRELATED, INCONCLUSIVE, UNKNOWN, or CONFLICT).
- lastValidationCheck: The timestamp when the link was last validated.
- lastConflictTime: This timestamp is hidden if there was never a conflict. If this is the same as the **lastValidationCheck**, then the manual link is currently in conflict. If **lastValidationCheck** is later than the **lastConflictTime**, then the manual link was in conflict before but is not in conflict currently. If in addition **validated** is **true**, this manual link appears in the network model.

- conflicts: If a link is or was conflicted, the **conflicts** list is populated with one or two conflicting pairs, one pair per each of the manual-link ports.

```
{
  "guid": "fa6262a2f1202b4bba1dd699cc78b2cf9cc45c826487de6daad69e3fa0cf0a90",
  "interfaceA": {
    "deviceName": "CR2.BCN",
    "interfaceName": "TenGigE0/0/1/8",
    "type": "R_PHYSICAL",
    "guid": "PO/r_physical/b876eefb0f288974/146956e90f8b5b6d"
  },
  "interfaceB": {
    "deviceName": "OTN1MIL01",
    "interfaceName": "1-2-3",
    "type": "ETH",
    "guid": "PO/eth/5979a210307b1e66/fba4016fb0ebde72"
  },
  "technology": "ETH",
  "relatedModelObjectGuid":
  "LI/CL/PO/r_physical/b876eefb0f288974/146956e90f8b5b6d/PO/eth/5979a210307b1e66/fba4016fb0ebde72",
  "additionTimeEpochMillis": 1668597718579,
  "description": "example",
  "validated": false,
  "validationResult": "UNKNOWN",
  "lastValidationCheck": 1668597744370,
  "conflicts": []
}
```

Add Manual Cross Link to Crosswork Hierarchical Controller

Use this API to add a manual cross link to Crosswork Hierarchical Controller.

Request Method

POST

Request URL

<https://example-host/api/v2/crosslinks/manual>

Request Parameters

None

Request Body

Parameter Name	Data Type	Description
interfaceA		Port A

Parameter Name	Data Type	Description
deviceName	string	The device name.
interfaceName	string	The interface name.
interfaceB		Port B
deviceName	string	The device name.
interfaceName	string	The interface name.
technology	string	The technology.
Description	string	The description.

Request Body Example

```
{
  "interfaceA": {
    "deviceName": "CR2.BCN",
    "interfaceName": "TenGigE0/0/1/8"
  },
  "interfaceB": {
    "deviceName": "OTN1MIL01",
    "interfaceName": "1-2-3"
  },
  "technology": "ETH",
  "description": "example"
}
```

Response Example

```
{"guid": "d33ac2ec12c237e3a53bef30aec690e8f1ecff1a9c600c98b406ea9be30e91b7"}
```

Delete a Cross Link

Use this API to delete a manual cross link. The cross link is marked as deleted and is removed when the next validation runs.

Request Method

```
DELETE
```

Request URL

```
https://example-host/api/v2/crosslinks/manual/{guid}
```

Request Parameters

Parameter Name	Data Type	Description
guid	string	The cross link guid. Use the guid returned by the Get All Manual Cross Links method.

Response Example

200 OK

Shared Risk

Crosswork Hierarchical Controller provides APIs to administer shared risk policies and rules.

You can access the Shared Risk API using Swagger: <https://<host>/api/v2/apps/srlg-app/rest/doc>

The APIs include:

- Get a specific policy
- Get all policies
- Create a policy
- Delete a policy
- Change the shared risk type of the policy
- Change a policy type
- Add a new rule to a policy
- Update the rule resources
- Delete a rule from a policy

Get Policies

Use this API to get the list of all the policies. This returns a list of all the policies and their rules.

Request Method

GET

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy`

Request Parameters

None

Response Example

```
{
  "name": "policy-1",
  "shared_risk_types": [
    "Link",
    "Port",
    "Card",
    "Shelf",
    "Device"
  ],
  "policy_type": "MULTIPLE-LINKS",
  "rules": [
    {
      "name": "rule-1",
```

```

    "resources": [
      "LI/eth/000fc44c94a1f2cd/51308dfd752c1574/df753d953c1e1c8f/f8e7b20537ce03b7"
    ]
  },
  {
    "name": "rule99",
    "resources": [
      "inventory[.name=\"CR1.PAR\"]|port|link[.layer=\"R_LOGICAL\"]"
    ]
  }
],
{
  "name": "test",
  "shared_risk_types": [
    "Link",
    "Device",
    "Shelf",
    "Port",
    "Card"
  ],
  "policy_type": "MULTIPLE-LINKS",
  "rules": [
    {
      "name": "rule001",
      "resources": [
        "inventory[.name=\"ILA-SD1EVO01-SD1SEV01-1\"]|port|link[.layer=\"R_LOGICAL\"]"
      ]
    }
  ]
},
{
  "name": "policy-3",
  "shared_risk_types": [
    "Link"
  ],
  "policy_type": "SINGLE-PROTECTED",
  "rules": [
    {
      "name": "rule-99",
      "resources": [

```

```

        "link[.layer=\"R_LOGICAL\"]"
    ]
}
]
}

```

Get a Policy

Use this API to retrieve a policy.

Request Method

GET

Request URL

`https:// example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.

Response Example

```

{
  "name": "policy-1",
  "shared_risk_types": [
    "Link",
    "Port",
    "Card",
    "Shelf",
    "Device"
  ],
  "policy_type": "MULTIPLE-LINKS",
  "rules": [
    {
      "name": "rule-1",
      "resources": [
        "LI/eth/000fc44c94a1f2cd/51308dfd752c1574/df753d953c1e1c8f/f8e7b20537ce03b7"
      ]
    },
    {
      "name": "rule99",
      "resources": [
        "inventory[.name=\"CR1.PAR\"]|port|link[.layer=\"R_LOGICAL\"]"
      ]
    }
  ]
}

```

```
}
```

Create a Policy

Use this API to create a policy.

Request Method

POST

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid . Use the guid returned by the Get Policies method.

Request Body

Parameter Name	Data Type	Description
shared_risk_types	string	Link, Port, Card, Shelf, Device
policy_type	string	SINGLE-PROTECTED or MULTIPLE-LINKS.

Request Body Example

```
{
  "shared_risk_types": [
    "Link"
  ],
  "policy_type": "SINGLE-PROTECTED"
```

Response Example

```
201 Successful Operation
```

Delete Policy

Use this API to delete a policy.

Request Method

DELETE

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.

Response Example

```
200 Successful
```


Update Policy Shared Risk Types

Use this API to change the policy shared risk types.

Request Method

PUT

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}/shared_risk_types`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.

Request Body

Parameter Name	Data Type	Description
shared_risk_types	string	Link, Port, Card, Shelf, Device

Request Body Example

```
{
  "shared_risk_types": [
    "Link"
  ]
}
```

Response Example

200 Successful Operation

Update Policy Type

Use this API to update credentials.

Request Method

PUT

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}/policy-type`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.

Request Body

Parameter Name	Data Type	Description
policy_type	string	SINGLE-PROTECTED or MULTIPLE-LINKS.

Request Body Example

```
{
```

```
    "policy_type": "SINGLE-PROTECTED"
  }
```

Response Example

200 Successful Operation

Add a Rule to a Policy

Use this API to add a rule to a policy. You can use an array of GUIDs and/or an SHQL query to create the rule.

Request Method

POST

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}/rules{ruleName}`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.
ruleName	string	The rule name. Use one of the rule names returned by the Get Policies method.

Request Body

Parameter Name	Data Type	Description
resources	array(string)	A list of GUID links and/or an SHQL query. If you use an SQL query, make sure that the expression is valid and returns a result. See the SQL User Guide. When you pass an SQL query, ensure that you wrap "" with a pair of \s, for example: "link[.layer=\ "R_LOGICAL\ "]"

Request Body Example

```
{
  "resources": [
    "link[.layer=\ "R_LOGICAL\ "]"
  ]
}
```

or

```
{
  "resources": [
    "LI/guid1",
    "LI/guid2"
  ]
}
```

or

```
{
```

```

    "resources": [
      "inventory[.name=\"CR1.PAR\"]|port|link[.layer=\"R_LOGICAL\"]"
    ]
  }
}

```

Response Example

201 Successful Operation

Update a Rule

Use this API to update the rule's resources. You can use an array of GUIDs and/or an SHQL query to create the rule.

Request Method

PUT

Request URL

`https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}/rules{ruleName}`

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.
ruleName	string	The rule name. Use one of the rule names returned by the Get Policies method.

Request Body

Parameter Name	Data Type	Description
resources	array(string)	<p>A list of GUID links and/or an SHQL query.</p> <p>If you use an SQL query, make sure that the expression is valid and returns a result. See the SQL User Guide.</p> <p>When you pass an SQL query, ensure that you wrap "...." with a pair of \s, for example: "link[.layer=\"R_LOGICAL\"]"</p>

Request Body Example

```

{
  "resources": [
    "link[.layer=\"R_LOGICAL\"]"
  ]
}

```

or

```

{
  "resources": [
    "LI/guid1",
    "LI/guid2"
  ]
}

```

or

```
{
  "resources": [
    "inventory[.name=\"CR1.PAR\"]|port|link[.layer=\"R_LOGICAL\"]"
  ]
}
```

Response Example

```
201 Successful Operation
```

Delete a Rule from a Policy

Use this API to delete a rule from a policy.

Request Method

```
DELETE
```

Request URL

```
https://example-host/api/v2/apps/srlg-app/rest/policy/{policyGuid}
/policy/{policyGuid}/rules/{ruleName}
```

Request Parameters

Parameter Name	Data Type	Description
policyGuid	string	The policy guid. Use the guid returned by the Get Policies method.
ruleName	string	The rule name. Use one of the rule names returned by the Get Policies method.

Response Example

```
200 Successful
```

Generic Information Retrieval using SHQL

Crosswork Hierarchical Controller provides a specialized query language designed for network data, called Sedona Hierarchical Query Language (SHQL). SHQL allows users to specify any query and quickly see the results, as well as to save the query for the benefit of others.

SHQL is unique in the way that it allows users to query a multi-layer model using simple keywords. Keywords allow for navigating the model, transitioning from one object type to another, and eliminating the need for complex conditions.

Transitioning is when SHQL allows for retrieving a list of objects and using this to transition to related objects, for example, retrieve all the SITES in the system and then use a language operator “|” (pipe operator) to get all INVENTORY in those sites etc.

For example, all OMSs used by a specific LSP can be retrieved using just a ‘downward’ command that retrieves, for the specified LSP, all links in the specified lower layer.

```
link[.name="my_lsp"] | downward ("OMS")
```

SHQL commands and syntax are described in the *Crosswork Hierarchical Controller SHQL Guide*.

SHQL can be used in the UI application in Crosswork Hierarchical Controller or as REST POST commands.

Request Method

POST

Request URL

https://<server>/api/v2/shql

Request Example

In this example, the query gets the list of OMSs that are the underlay for all LSPs in operational state down.

```
link[.layer="LSP" and .operStatus="DOWN"] | downward | link[.layer="OMS" and .operStatus="DOWN"]
```

Response Example

```
{
  "activeProtectionPriority": null,
  "bidi": true,
  "desc": null,
  "distanceMeters": null,
  "extra": null,
  "guid":
  "LI/oms/af5e85ffc6049e8f/8c290fec341b62da/9bf4b791d3191519/3837d2f977f671bd",
  "inverseLinkId": null,
  "latencyMicros": null,
  "layer": "OMS",
  "name": "SD1BKL01/1-2-5&8 to SD1SLO01/1-3-5&8",
  "operStatus": "DOWN",
  "pathGroupType": "SINGLE_PATH",
  "paths": [
    {
      "guid":
      "PA/oms/af5e85ffc6049e8f/8c290fec341b62da/9bf4b791d3191519/3837d2f977f671bd"
    }
  ],
  "portA": {
    "guid": "PO/oms/af5e85ffc6049e8f/8c290fec341b62da",
    "type": "OMS"
  },
  "portB": {
    "guid": "PO/oms/9bf4b791d3191519/3837d2f977f671bd",
    "type": "OMS"
  },
  "protectionStatus": "N_A",
  "provider": "Topogen",
  "role": "REGULAR",
  "srlgs": null,
  "teMetric": null
}
```

Introducing SQHL

SHQL - The Need

Cisco Crosswork Hierarchical Controller provides valuable information on network structure and enables you to simulate various conditions using several dedicated applications.

You may, however, want to perform your own analytics and view the resulting reports. Querying a multi-dimensional data model is complex and requires deep understanding of the model and advanced dev skills. For example:

- Filter one layer by another
- Get data from different times
- Find anomalies
- Group links by attributes in multiple dimensions

The model data is multi-dimensional and includes:

- Vendors
- Topologies
- Layers
- Domains
- Status
- Time

The SHQL application solves this problem by implementing cross-queries between the layers and dimension tables. It hides data complexity and provides a simple, yet powerful query language that enables you to easily query the model across all these dimensions.

SHQL Overview

The SHQL application enables you to quickly create complex query commands and send them as requests to the Crosswork Hierarchical Controller SHQL REST API. Accessed through your browser, the SHQL application allows you to run queries and view an orderly distribution of results under their relevant column headings. The type and number of columns are based on the properties of the object type displayed.

The application covers every functionality of the query language. Auto-completion context menus allow you to easily select viable object types and their related properties and apply multiple conditions using a range of operands.

SHQL allows you to manipulate the displayed information by transforming the query from one object type to another within the same query command line. Alternatively, you can specify a collection of object types to which all the query items are related.

Note: The term object type used in this guide is defined as an item or group of items that share the same properties.

Crosswork Hierarchical Controller Object Model

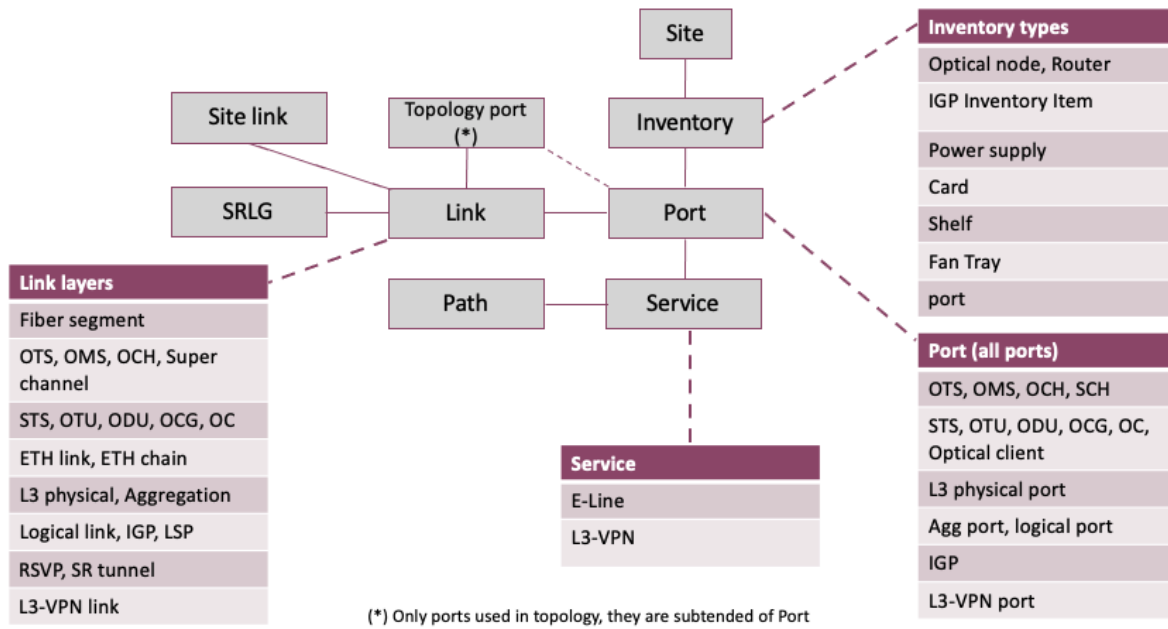


Figure 1. SHQL Object Model

Inventory Types

Table 2. Inventory Types

Inventory	Description
Optical Node	An optical network element that is actively managed. This can be an amplifier, ROADM, transponder, or muxponder.
Router	A distinct instance of a router that has a loopback IP address and physical inventory.
IGP Inventory Item	A logical/virtual router as an instance in router.
Power Supply	A power supply module in an optical node or router.
Card	Any type of pluggable card.
Shelf	A chassis of a router or optical node.
Fan Tray	A pluggable or manageable fan tray unit in an optical node or router.

Link Types

Table 3. Link Types

Inventory	Description
Fiber Segment	A physical fiber line that spans from one DUCT to another and is used as a segment in a fiber link.

Inventory	Description
Fiber	A chain of fiber segments that spans from one optical device to another.
OTS	The logical layer used as an underlay for the OMS link. One OTS link can be created over a fiber link.
OMS	The logical layer used as an underlay for the OCH link. One OMS link can be created over a chain of OTS links.
NMC	A wavelength connection between two ROADMs over one or more OMS links, not connecting to client ports on muxponder.
OCH	A wavelength connection spanning the client port of one OEO device (transponder, muxponder, regenerator) and another. 40 or 80 OCH links can be created on top of an OMS link. An OCH link spans from one client port to another, where the client port is either a TDM or ETH port.
SCH	An OCH that spans from one ROADM device to another and terminates in a device and not in a client port.
STS, OCG, OC	The TDM links that span from one optical device to another, ride on top of OCH links and terminate in TDM client ports
OTU	The underlay link in the OTN layer, used for ODU links. It can ride on top of an OCH.
ODU	The 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.
ETH Link	An ETH L2 link, that spans from one ETH UNI port to another, and rides on top of an ODU link.
ETH Chain	A chain of ETH links.
L3 Physical	An ethernet link (L2 connectivity) between two ETH ports. This is the underlay layer for an IP subnet link between two routers.
Agg	The Link Aggregation Group (LAG) where multiple ETH links are grouped to create higher BW and a resilient link.
Logical Link	A link where two IP subnets are connected over a physical link between two routers.
IGP	The path calculated by the router as the shortest path between two specific nodes. The link between two routers that carries IGP protocol messages. The link represents an IGP adjacency.
Tunnel	The MPLS RSVP, or Segment Routing tunnel created between two routers over IGP links, with or without TE options.
L3-VPN Link	The connection between two sites of a specific L3-VPN (can be a chain of LSP connections or an IGP path).

Crosswork Hierarchical Controller Connection Model

For example: 10GE over 100G OTN link

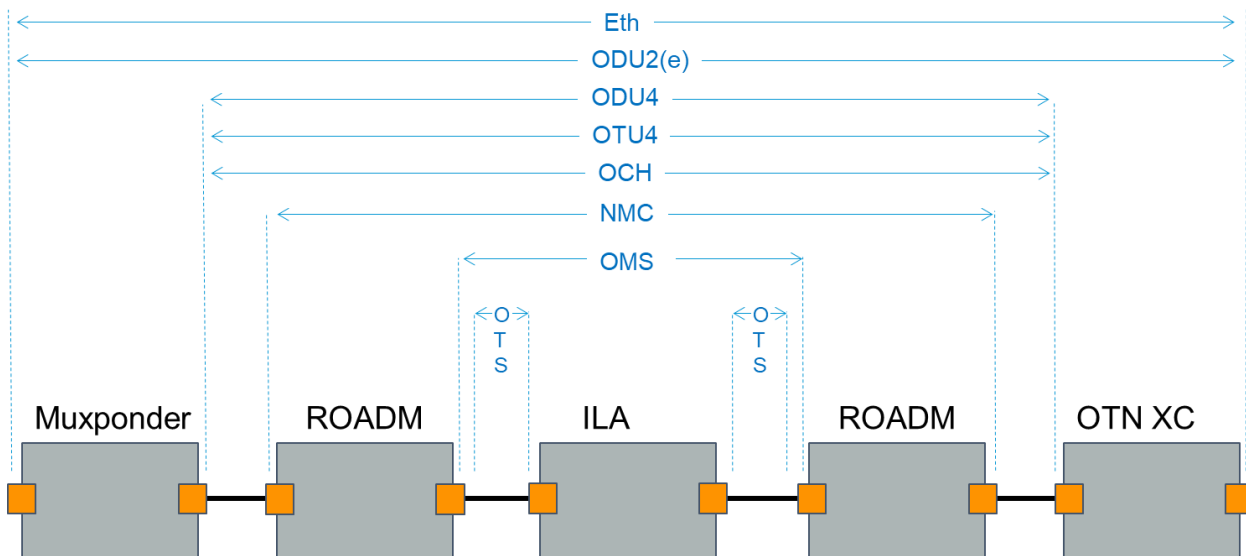


Figure 2.
Connection Model

SQL Example

This example finds if there are shared OMSs between two LSPs.

The screenshot shows the SHQL interface with a query to find shared OMSs between two LSPs. The query is as follows:

```
link[.name="CR2.DUS:CR2.BIL:lsp_0"] | downward | link[.layer="OMS"] as p; link[.name="CR2.DUS:CR1.BIL:lsp_0"] | downward | link[.layer="OMS"] as w; link[.guid in p and .guid in w]
```

The results table shows 9 OMS links:

Guid	Layer	Name	OperStatus	PathGroupType	Paths	PortA
Lj/oms/022fa130aca541bb/38...	OMS	SD1GIR01/1-3-5&8 to SD1PAM...	UP	SINGLE_PATH	[{"guid": "PA/oms/022fa130aca..."}]	PO/oms/022fa130aca541bb/3...
Lj/oms/b0bd0180e1c79218/8...	OMS	SD1BCN01/1-2-5&8 to SD1MA...	UP	SINGLE_PATH	[{"guid": "PA/oms/b0bd0180e1..."}]	PO/oms/b0bd0180e1c79218/...
Lj/oms/b0bd0180e1c79218/0...	OMS	SD1BCN01/1-5-5&8 to SD1GIR...	UP	SINGLE_PATH	[{"guid": "PA/oms/b0bd0180e1..."}]	PO/oms/b0bd0180e1c79218/...
Lj/oms/990aae8f0c12944/38...	OMS	SD1STU01/1-3-5&8 to SD1ZU...	UP	SINGLE_PATH	[{"guid": "PA/oms/990aae8f0c..."}]	PO/oms/990aae8f0c12944/38...
Lj/oms/738790a2aca5de20/0...	OMS	SD1MAR01/1-5-5&8 to SD1MIL...	UP	SINGLE_PATH	[{"guid": "PA/oms/738790a2ac..."}]	PO/oms/738790a2aca5de20/0...

Figure 3.
SHQL Example

Using SHQL

About the SHQL Interface

In your browser, open the SHQL application by clicking its button on the sidebar.

Note: It is recommended that you use Chrome.

Figure 4.
SHQL Application Button

The SHQL application interface is displayed. The field in which you insert your query is empty.

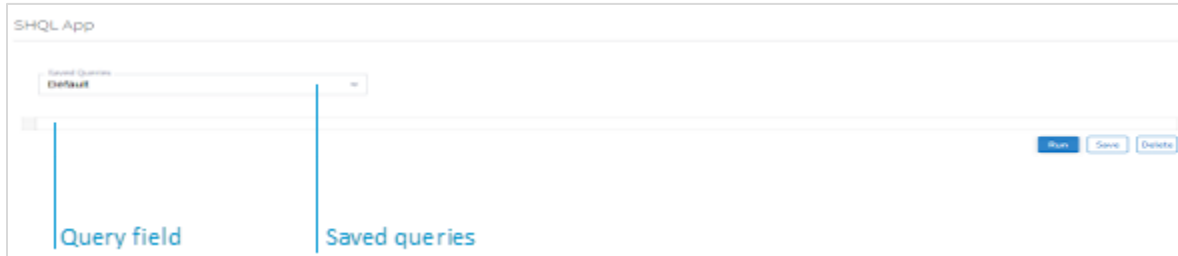


Figure 5.
SHQL Interface

Once you have run a query, you can save it for future use (see Saving Queries).

Running Queries

To run a query:

1. Enter a query command into the **Query** field (see Creating Queries).
2. Click **Run**.

The retrieved data is organized under its related tabs.

Figure 6 shows a list of results under two tabs after running the query, **inventory_item**.

The screenshot shows the SHQL interface with the query 'inventory_item' executed. The results are displayed under the 'Optical Node (463)' tab. The table below shows the first 10 rows of the results.

Guid	Type	Name	Provider	DeviceFamily	DeviceType	ReachabilityStatus	Site	Tags	Vendor	HasRoadm
IN/002d237f16b...	ONE	ILA-SD1EV001-S...	Topogen	ILA	ONE	REACHABLE	ST/002d237f16f...	['Vendor': ['Cien...	Ciena	
IN/02539c320f9...	ONE	ILA-SD2BRA01-S...	Topogen	ILA	ONE	REACHABLE	ST/02539c320f9...	['Vendor': ['Cien...	Ciena	
IN/027e3d88f5b...	ONE	ILA-SD1PRA01-S...	Topogen	ILA	ONE	REACHABLE	ST/027e3d88f5b...	['Vendor': ['Cien...	Ciena	
IN/04346445503...	ONE	ILA-SD1BOR01-S...	Topogen	ILA	ONE	REACHABLE	ST/04346445503...	['Vendor': ['Cien...	Ciena	
IN/05717daa222...	ONE	ILA-SD1FRA01-S...	Topogen	ILA	ONE	REACHABLE	ST/05717daa222...	['Vendor': ['Cien...	Ciena	
IN/05b5b6c8c0a...	ONE	ILA-SD1PAM01-S...	Topogen	ILA	ONE	REACHABLE	ST/05b5b6c8c0a...	['Vendor': ['Cien...	Ciena	
IN/0727496c71b...	ONE	ILA-SD2PRA01-S...	Topogen	ILA	ONE	REACHABLE	ST/0727496c71b...	['Vendor': ['Cien...	Ciena	
IN/07dcb20e3f7...	ONE	ILA-SD2CAR01-S...	Topogen	ILA	ONE	REACHABLE	ST/07dcb20e3f7...	['Vendor': ['Cien...	Ciena	
IN/082ba1fca29...	ONE	ILA-SD1EV001-S...	Topogen	ILA	ONE	REACHABLE	ST/082ba1fca29...	['Vendor': ['Cien...	Ciena	
IN/0975b2257ba...	ONE	ILA-SD1BER01-S...	Topogen	ILA	ONE	REACHABLE	ST/0975b2257ba...	['Vendor': ['Cien...	Ciena	

Figure 6.
Query Screen with Inventory Item Results – Optical Node

SHQL Records fetched at: 12:11:12 06-07-2020

Saved Queries

inventory_item

Run Save Delete Query

RESULTS (546)

Optical Node (463) Router (83)

Guid	Type	Name	Provider	Extra	ManagementIp	ReachabilityStatus	Site	Tags	Vendor
IN/Router/000fc44...	ROUTER	CR1.BEL	Topogen	['is_core': True]	10.40.0.7	REACHABLE	ST/a9bd23d3ed70	['Vendor': ['Cisco']]	Cisco
IN/Router/03a767f...	ROUTER	ER1.LATH	Topogen	['is_core': True]	10.40.0.46	REACHABLE	ST/7aac1877cd8b	['Vendor': ['Huawei']]	Huawei
IN/Router/0529f67...	ROUTER	CR2.COR	Topogen	['is_core': True]	10.40.0.61	REACHABLE	ST/26a779904306	['Vendor': ['Cisco']]	Cisco
IN/Router/0640f5f...	ROUTER	CR1.BUD	Topogen	['is_core': True]	10.40.0.44	REACHABLE	ST/5960073736d5	['Vendor': ['Cisco']]	Cisco
IN/Router/09ac8d...	ROUTER	CR2.LIV	Topogen	['is_core': True]	10.40.0.4	REACHABLE	ST/9354b4a138dd	['Vendor': ['Cisco']]	Cisco
IN/Router/0a1e09e...	ROUTER	CR2.PRA	Topogen	['is_core': True]	10.40.0.27	REACHABLE	ST/6bddd2d5799e	['Vendor': ['Cisco']]	Cisco
IN/Router/0a22a0...	ROUTER	CR1.TLV	Topogen	['is_core': True]	10.40.0.67	REACHABLE	ST/ec8037c4efe39	['Vendor': ['Cisco']]	Cisco
IN/Router/14bc8d...	ROUTER	CR2.MAD	Topogen	['is_core': True]	10.40.0.38	REACHABLE	ST/d5e070604ed5	['Vendor': ['Cisco']]	Cisco
IN/Router/1877a9...	ROUTER	ER1.WAR	Topogen	['is_core': True]	10.40.0.83	REACHABLE	ST/ec803a477b10	['Vendor': ['Huawei']]	Huawei
IN/Router/19694a...	ROUTER	CR1.WAR	Topogen	['is_core': True]	10.40.0.28	REACHABLE	ST/ec803a477b10	['Vendor': ['Cisco']]	Cisco

Figure 7.
Query Screen with Inventory Item Results – Routers

Clicking the ... adjacent to the object in the GUID column displays its properties in JSON format. The .JSON lists the object's properties and their values.

```

JSON
{
  "accessIdentifier": null,
  "children": null,
  "desc": null,
  "deviceFamily": null,
  "deviceType": null,
  "extra": {
    "is_core": true
  },
  "guid": "IN/Router/000fc44c94a1f2cd",
  "managementIp": "10.40.0.7",
  "name": "CR1.BEL",
  "parent": null,
  "provider": "Topogen",
  "reachabilityStatus": "REACHABLE",
  "serialNumber": null,
  "site": {
    "guid": "ST/a9bd23d3ed70"
  },
  "softwareVersion": null,
  "srlgs": null,
  "tags": {
    "Vendor": [
      "Cisco"
    ]
  },
  "topologyId": null,
  "type": "ROUTER",
  "vendor": "Cisco"
}

```

Figure 8.
Inventory Object in .JSON Format

Aborting Queries

When you run a query that takes a long time to return results you can abort the query.

To abort a query:

1. Enter a query command into the **Query** field (see Creating Queries).
2. Click **Run**. If the query will take a long time to return results, an abort option is offered.

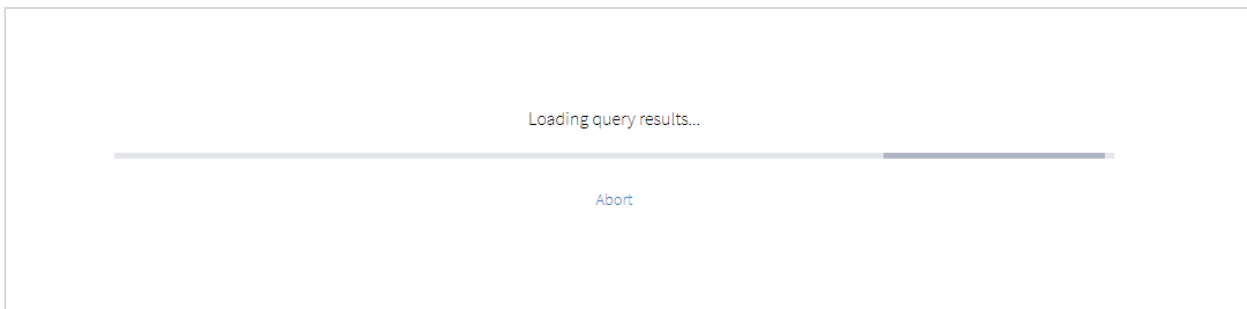


Figure 9.
Abort Query

3. If you want to terminate the query, click **Abort**.

Creating Queries

You can build queries using free text, selecting an item from the auto-completion context menu or using a combination of both. The first item you enter into the **Query** field is an object type.

You can use the auto-completion context menu at any location in the query syntax.

Note: Queries are not case sensitive.

To display an auto-completion context menu:

- Click inside the **Query** field and then do one of the following:
 - **Mac:** Press Command + spacebar
 - **PC:** Press Ctrl + spacebar

The menu appears.

Figure 10 shows the object type auto-completion context menu.

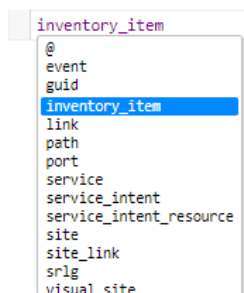



Figure 10.
Auto-completion Context Menu

Selecting an item from the menu displays it in the **Query** field. You can continue to build the query, adding conditions and functions.

Incorrect input - from either free text or context menu selection - is indicated by a red icon . Hovering over the icon indicates why the input is not viable or suggests the expected input.

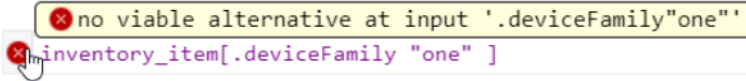


Figure 11.
Input Not Viable

Sometimes, the error is a simple one of syntax, as in Figure 12.

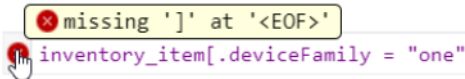


Figure 12.
Syntax Error

Note: It is useful to look at the .JSON file of the queried object type to ascertain what input is viable.

Saving Queries

After creating a query, you can store it in the Saved Queries dropdown menu for repeated use.

To save a query:

1. When you complete writing your query, click **Save As**.

The following dialog box appears.

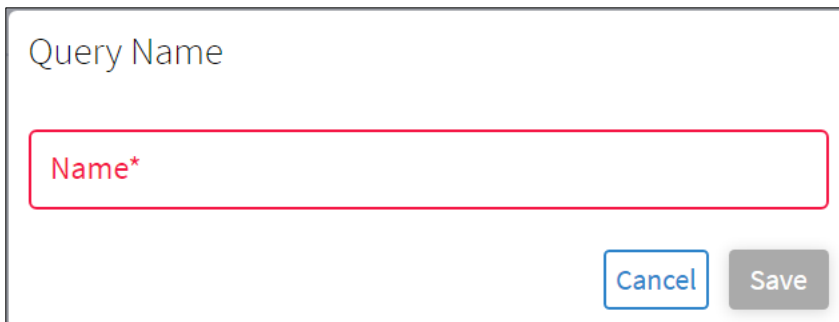


Figure 13.
Query Name Dialog Box

2. Type a name for the query and click **Save**.



Figure 14.
Saved Queries

3. Repeat steps 1 and 2 for every query you want to save.

Deleting Queries

To delete a query:

1. Select a query from the dropdown list of saved queries.

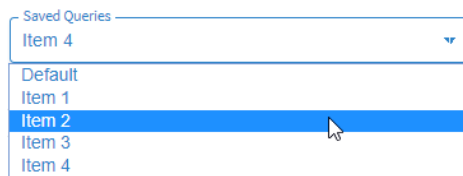


Figure 15.
Deleting Queries

2. Click **Delete**.

The query is removed from the list.

Sorting Columns

Retrieved data is displayed under the relevant column headings.

You can sort the items in ascending or descending order and apply filters to individual columns.

Note: Column management is handled in the same way as other Crosswork Hierarchical Controller tables.

To sort columns:

1. Click a column heading.
An upward pointing arrow appears.

↓ Name	☰
ER1.WAR	
ER1.VAL	
ER1.TLV	
ER1.STO	
ER1.SQY	
ER1.PAR	
ER1.OVE	
ER1.MAN	
ER1.MAD	
ER1.LIS	


Figure 16.
Column Contents in Descending Order

2. Click the arrow to sort the column items in ascending order. Click it again to sort the column items in descending order.

↓ Name	☰
ER1.WAR	
ER1.VAL	
ER1.TLV	
ER1.STO	
ER1.SQY	
ER1.PAR	
ER1.OVE	
ER1.MAN	
ER1.MAD	
ER1.LIS	

Figure 17.
Column Contents in Ascending Order

To filter column contents:

1. In the column heading, click the  Filter icon.
The column heading expands to display filtering options.

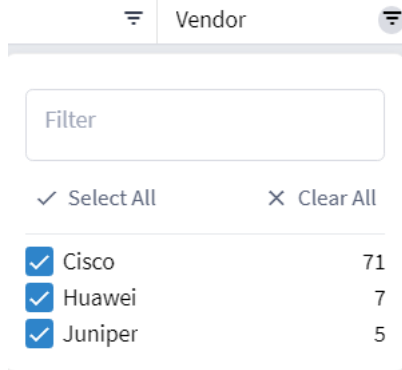


Figure 18.
Filter Column Contents


2. Select an option value or type a pattern into the text box to filter the column contents. The column Filter icon changes to , indicating that a filter is applied to the column.



Figure 19.
Filter Applied to Column

Creating Conditions

You can apply conditions to an object type, using the operands described in the table below.

Conditions are generally not case sensitive. Case must be adhered to only when it's part of a predefined list of values.

Conditions are placed within square brackets([]).

Table 4. Operands

Operand	Numerical	String	Description
!=	ü	ü	Different than.
<	ü		Less than.
<=	ü		Less than or equal to.
=	ü	ü	Equal to.
>	ü		Larger than.
>=	ü		Larger than or equal to.
contains		ü	Partial match.
endswith		ü	Ending with a given pattern.
has			Item in an array. Use to look for an item when the field is a list.

Operand	Numerical	String	Description
in	ü	ü	Matched list of patterns. Use when the field is a single item and the filter contains multiple items.
intersect	ü		Geographical intersection of regions at a specific longitude and latitude. For example: region[.geometry intersect (4.8945398, 52.3666)]
is		ü	Boolean (true / false) and null.
not		ü	Together with is, contains, endswith, startswith, to negate the condition.
startswith		ü	Starting with a given pattern.
xin	ü	ü	Matched lists of patterns for multiple properties.
~		ü	String with a regular expression.

Example 1: Filtering with Operands

Figure 20. retrieves a list of routers with names that begin with CR1.

```
inventory_item [.type = "ROUTER" and .name startswith "CR1."]
```

Figure 20.
Filtering Using Operand

Figure 21 shows the results.

SHQL Records fetched at: 11:25:49 06-11-2020 UTC

Saved Queries

`inventory_item [.type = "ROUTER" and .name startswith "CR1."]`

Run Save As Delete Query

RESULTS (31)

Router (31)

Guid	Type	Name	Provider	Extra	Managementip	ReachabilityStatus	Site	Tags	Vendor
IN/Router/000fc...	ROUTER	CR1.BEL	Topogen	{'is_core': True}	10.40.0.7	REACHABLE	ST/a9bd23d3ed70	{'Vendor': ['Cisco']}	Cisco
IN/Router/0640f...	ROUTER	CR1.BUD	Topogen	{'is_core': True}	10.40.0.44	REACHABLE	ST/5960073736d5	{'Vendor': ['Cisco']}	Cisco
IN/Router/0a22a...	ROUTER	CR1.TLV	Topogen	{'is_core': True}	10.40.0.67	REACHABLE	ST/c8037c4efe39	{'Vendor': ['Cisco']}	Cisco
IN/Router/19694...	ROUTER	CR1.WAR	Topogen	{'is_core': True}	10.40.0.28	REACHABLE	ST/ec803a477b10	{'Vendor': ['Cisco']}	Cisco
IN/Router/1df8a...	ROUTER	CR1.STO	Topogen	{'is_core': True}	10.40.0.77	REACHABLE	ST/3bafd5003f87	{'Vendor': ['Cisco']}	Cisco
IN/Router/2023f...	ROUTER	CR1.ATH	Topogen	{'is_core': True}	10.40.0.47	REACHABLE	ST/7aac1877cd8b	{'Vendor': ['Cisco']}	Cisco
IN/Router/3052d...	ROUTER	CR1.HEL	Topogen	{'is_core': True}	10.40.0.80	REACHABLE	ST/2499da6f5e54	{'Vendor': ['Cisco']}	Cisco
IN/Router/318d...	ROUTER	CR1.VAL	Topogen	{'is_core': True}	10.40.0.63	REACHABLE	ST/ac13481feb5	{'Vendor': ['Cisco']}	Cisco

Figure 21.
Query Results

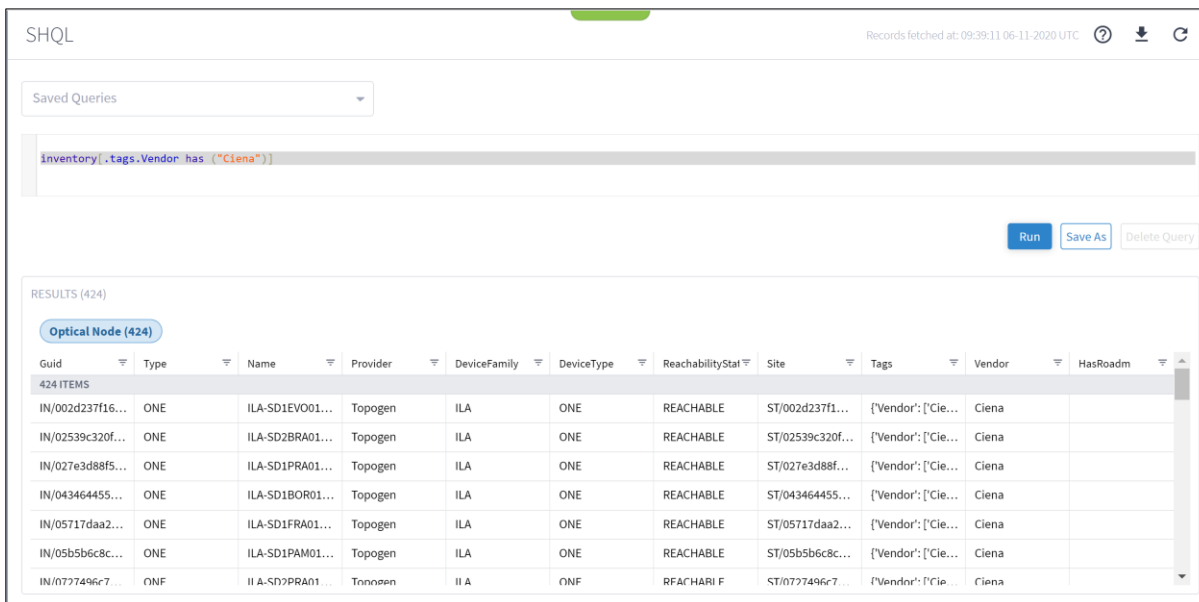
Example 2: Filtering with Operands

Figure 22 retrieves the inventory where the vendor is Ciena.

```
inventory[.tags.Vendor has ("Ciena")]
```

Figure 22.
Filtering Using Operand

Figure 23 shows the results.



SHQL Records fetched at: 09:39:11 06-11-2020 UTC

Saved Queries

```
inventory[.tags.Vendor has ("Ciena")]
```

Run Save As Delete Query

RESULTS (424)

Optical Node (424)

Guid	Type	Name	Provider	DeviceFamily	DeviceType	ReachabilityStat	Site	Tags	Vendor	HasRoadm
424 ITEMS										
IN/002d237f16...	ONE	ILA-SD1EVO01...	Topogen	ILA	ONE	REACHABLE	ST/002d237f1...	['Vendor': ['Cie...	Ciena	
IN/02539c320f...	ONE	ILA-SD2BRA01...	Topogen	ILA	ONE	REACHABLE	ST/02539c320f...	['Vendor': ['Cie...	Ciena	
IN/027e3d88f5...	ONE	ILA-SD1PRA01...	Topogen	ILA	ONE	REACHABLE	ST/027e3d88f...	['Vendor': ['Cie...	Ciena	
IN/043464455...	ONE	ILA-SD1BOR01...	Topogen	ILA	ONE	REACHABLE	ST/043464455...	['Vendor': ['Cie...	Ciena	
IN/05717daa2...	ONE	ILA-SD1FRA01...	Topogen	ILA	ONE	REACHABLE	ST/05717daa2...	['Vendor': ['Cie...	Ciena	
IN/05b5b6c8c...	ONE	ILA-SD1PAM01...	Topogen	ILA	ONE	REACHABLE	ST/05b5b6c8c...	['Vendor': ['Cie...	Ciena	
IN/0777496c7...	ONF	II A-SD2PRA01...	Tnnsen	II A	ONF	RFACHARI F	ST/0777496c7...	['Vendor': ['Cie...	Ciena	

Figure 23.
Query Results

Example 3: Filtering with Operands

Figure 24 looks for links where (port_a.guid = "PO/igp/06c0868cc5601e85/06c0868cc5601e85" and port_b.guid = "PO/igp/c3b0dc2cd3ad6406/c3b0dc2cd3ad6406") or (port_a.guid = "PO/igp/c3b0dc2cd3ad6406/c3b0dc2cd3ad6406" and port_b.guid = "PO/igp/06c0868cc5601e85/06c0868cc5601e85").

```
link[.layer="LSP" and (.portA, .portB) xin (port[.guid = "PO/igp/06c0868cc5601e85/06c0868cc5601e85"], port[.guid = "PO/igp/c3b0dc2cd3ad6406/c3b0dc2cd3ad6406"])]
```

Figure 24.
Filtering Using Operand

Figure 25 shows the results.

SHQL

Records fetched at: 09:36:45 06-11-2020 UTC

Saved Queries

```
link[.layer="LSP" and (.portA, .portB) xin (port[.guid = "PO/igp/06c0868cc5601e85/06c0868cc5601e85"], port[.guid = "PO/igp/c3b0dc2cd3ad6406/c3b0dc2cd3ad6406"])]
```

Run Save As Delete Query

RESULTS (1)

LSP Link (1)

Guid	Layer	Name	OperStatus	PathGroup	Paths	PortA	PortB	Protection	Provider	Role	HoldPriority	LspTechno	SetupPriority	SpeedBps
1 ITEM														
LI/lsp/c3...	LSP	ER1.WAR...	UP	SINGLE_...	[['guid': ...	PO/igp/c...	PO/igp/0...	N_A	Topogen	REGULAR	7	MPLS	7	100000000

Figure 25.
Query Results

Example 4: Filtering with Operands

Figure 26 retrieves and adds up the events captured the day before yesterday (>-2d and <-1d). The .timeStamp property can be used with d (days), h (hours), m (months), M (minutes), S (seconds), y (years) or w (weeks).

```
event[.timeStamp > -5d and .timeStamp < -1d]
```

Figure 26.
Filtering Using Operand

Figure 27 shows the results.

RESULTS (3018)

Event (3018)

Count	Data	Guid	LastUpdate	MachineId	Severity	SubType	TimeStamp	Type	Username
3018 ITEMS									
1	{'msg': 'Start ...	EV/11ec0506...	2021-08-24T1...	nir-nachum-t...	DEBUG	calculation	2021-08-24T1...	visual-model	system
1	{'msg': 'Persis...	EV/11ec0506...	2021-08-24T1...	nir-nachum-t...	INFO	logical-link-p...	2021-08-24T1...	persistor	system
1	{'msg': 'Done ...	EV/11ec0506...	2021-08-24T1...	nir-nachum-t...	INFO	calculation	2021-08-24T1...	visual-model	system
1	{'msg': 'Persis...	EV/11ec0506...	2021-08-24T1...	nir-nachum-t...	INFO	otn-persistor...	2021-08-24T1...	persistor	system
1	{'msg': 'Confli...	EV/11ec0506...	2021-08-24T1...	nir-nachum-t...	WARNING	remove	2021-08-24T1...	dynamic-apps	system
1	{'msg': 'Confli...	EV/11ec0506...	2021-08-24T1...	nir-nachum-t...	WARNING	remove	2021-08-24T1...	dynamic-apps	system

Figure 27.
Query Results

Transforming/Collecting Object Types

You can add an object type to the query command and determine if the data to be retrieved is transformed from one object type to another object type, or if the data reflects a collection of multiple object types and their related items.

- **Transformation:** Add a pipe (|) to the query command before adding the new object type. Transforms the results relating to the previous object type to output for the new object type.
- **Collection:** Add an ampersand (&) to the query command before adding the new object type. Retrieves all the output for all the preceding object types.
- **As:** Add a temporary variable. Enables you to create a query with an object type that is not related to the preceding object type.

The table describes object types and the object types to which they are directly related.

Table 5. Object Types and Properties

Object type	Object type properties
event	N/A
inventory	inventory_item inventory port site srlg
inventory_item	inventory_item inventory port site srlg
link	link path port site link srlg region
path	path link
port	port link inventory_item inventory service srlg
region	site visual site link

Object type	Object type properties
risk_resource	srlg_risk_resource_mtm risk_resource port link inventory_item inventory
service	port service intent
service_intent	service_intent service service_intent_resource
service_intent_resource	service_intent_resource service_intent
site	site inventory item inventory visual site region
site_link	site_link visual_site link
srlg	srlg port link inventory_item inventory
srlg_risk_resource_mtm	srlg_risk_resource_mtm risk_resource port link inventory_item inventory
visual_site	visual_site site_link site region

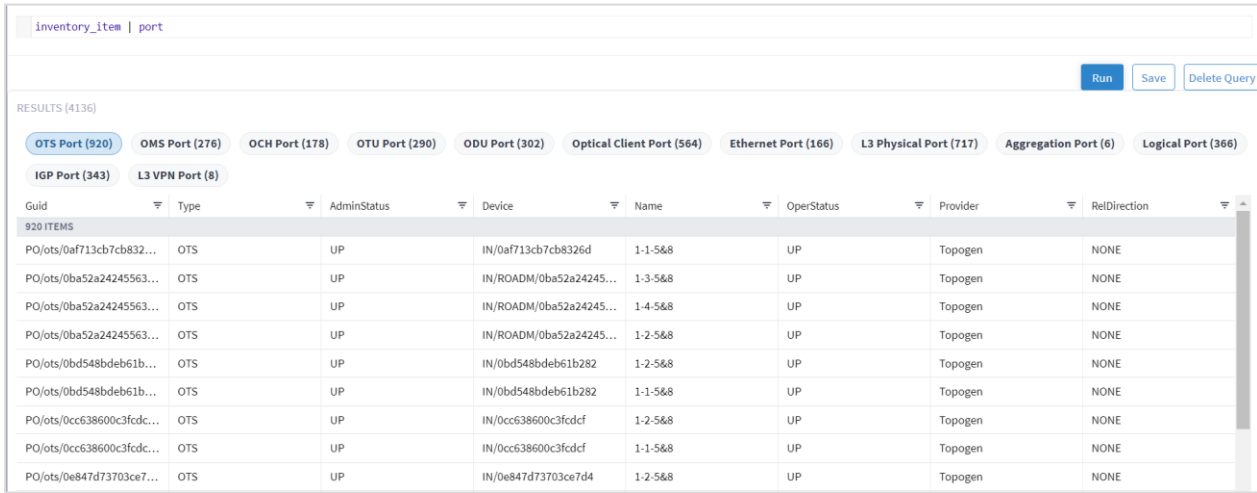
Example: Object Types Transformation

Figure 28. Figure 28 shows a query built to retrieve ports belonging to the object type inventory item. The object types are separated by a pipe (|).

```
inventory_item | port
```

Figure 28.
Query with Object Type Transformation

Figure 29 shows the results.



inventory_item | port

RESULTS (4136)

OTS Port (920) OMS Port (276) OCH Port (178) OTU Port (290) ODU Port (302) Optical Client Port (564) Ethernet Port (166) L3 Physical Port (717) Aggregation Port (6) Logical Port (366)

IGP Port (343) L3 VPN Port (8)

Guid	Type	AdminStatus	Device	Name	OperStatus	Provider	RelDirection
PO/ots/0af713cb7cb832...	OTS	UP	IN/0af713cb7cb8326d	1-1-5&8	UP	Topogen	NONE
PO/ots/0ba52a24245563...	OTS	UP	IN/ROADM/0ba52a24245...	1-3-5&8	UP	Topogen	NONE
PO/ots/0ba52a24245563...	OTS	UP	IN/ROADM/0ba52a24245...	1-4-5&8	UP	Topogen	NONE
PO/ots/0ba52a24245563...	OTS	UP	IN/ROADM/0ba52a24245...	1-2-5&8	UP	Topogen	NONE
PO/ots/0bd548bdeb61b...	OTS	UP	IN/0bd548bdeb61b282	1-2-5&8	UP	Topogen	NONE
PO/ots/0bd548bdeb61b...	OTS	UP	IN/0bd548bdeb61b282	1-1-5&8	UP	Topogen	NONE
PO/ots/0cc638600c3fcd...	OTS	UP	IN/0cc638600c3fcdcf	1-2-5&8	UP	Topogen	NONE
PO/ots/0cc638600c3fcd...	OTS	UP	IN/0cc638600c3fcdcf	1-1-5&8	UP	Topogen	NONE
PO/ots/0e847d73703ce7...	OTS	UP	IN/0e847d73703ce7d4	1-2-5&8	UP	Topogen	NONE

Figure 29.
Transformation Results

Example: Object Types Collection

Figure 30 shows a query built to retrieve sites and the inventory items the sites belong to. The object types are separated by an ampersand (&).

```
inventory_item & site
```

Figure 30.
Query with Object Type Collection

Figure 31 shows the results.

inventory_item & site

Run Save Delete

RESULTS (976)

Site (430) OneInventoryItem (463) RouterInventoryItem (83)

Guid	Type	Name	Provider	DeviceFamily	DeviceType	Site	Vendor	HasRoadm
463 ITEMS								
IN/002d237f16fb8...	ONE	ILA-SD1EVO01-SD1...	Topogen	ILA	ONE	ST/002d237f16fb8...	Ciena	
IN/02539c320f9a3dff	ONE	ILA-SD2BRA01-SD2...	Topogen	ILA	ONE	ST/02539c320f9a3dff	Ciena	
IN/027e3d88f5b57...	ONE	ILA-SD1PRA01-SD1...	Topogen	ILA	ONE	ST/027e3d88f5b57...	Ciena	
IN/043464455031f...	ONE	ILA-SD1BOR01-SD...	Topogen	ILA	ONE	ST/043464455031f...	Ciena	
IN/05717daa222ea...	ONE	ILA-SD1FRA01-SD1...	Topogen	ILA	ONE	ST/05717daa222ea...	Ciena	
IN/05b5b6c8c0a02...	ONE	ILA-SD1PAM01-SD...	Topogen	ILA	ONE	ST/05b5b6c8c0a02...	Ciena	
IN/0727496c71b88...	ONE	ILA-SD2PRA01-SD2...	Topogen	ILA	ONE	ST/0727496c71b88...	Ciena	
IN/07dcb20e3f79b...	ONE	ILA-SD2CAR01-SD2...	Topogen	ILA	ONE	ST/07dcb20e3f79b...	Ciena	
IN/082ba1fca299661	ONE	ILA-SD1EVO01-SD1...	Topogen	ILA	ONE	ST/082ba1fca2996...	Ciena	
IN/0975b2257baf3...	ONE	ILA-SD1BER01-SD1...	Topogen	ILA	ONE	ST/0975b2257baf3...	Ciena	

Figure 31.
Collection Results

Example: As Temporary Variable

Using **As** allows you to use the output of a query as the input in collections.

The following figures demonstrate how to create a query built to support non-related object types using a temporary variable.

Figure 32 shows a query command composed of an object type, link.

```
link[.layer = "R_LOGICAL"]
```

Figure 32.
Query

Figure 33 shows the results.

link[.layer = "R_LOGICAL"]

Run Save Delete

RESULTS (118)

RLogicalLink (118)

Guid	Layer	Name	OperStatus	PathGroupType	Paths	PortA	PortB	ProtectionStatus	Provider	Role
Li/r_logical/0...	R_LOGICAL	10.40.0.45 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.0.41 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.0.34 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.118 to...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.35 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.41 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.34 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.153 to...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.146 to...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR
Li/r_logical/0...	R_LOGICAL	10.40.1.62 to ...	UP	SINGLE_PATH	[{"guid": "PA/Li...	PO/r_logical/...	PO/r_logical/f...	N_A	Topogen	REGULAR

Figure 33.
Query Results

Figure 34 shows how to create a temporary variable using **As**. The variable L appears in the context menu as a valid object type.

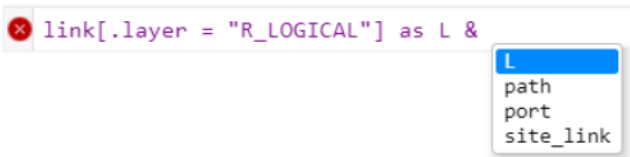


Figure 34.
Adding As

Figure 35 shows how to use the temporary variable L to transform a list of links to their ports, paths and site links.

```
link[.layer = "R_LOGICAL"] as L & L | port & L | path & L | site_link
```

Figure 35.
Query Using as

Figure 36 shows the results.


```
link[.layer = "R_LOGICAL"] as L & L | port & L | path & L |site_link
```

RESULTS (642)

Site Link (170) Logical Port (236) Logical Link (118) Path (118)

Guid	Depth	Layer	Links	Name	SiteA	SiteB	Status	Tags
170 ITEMS								
SL/R_LOGICAL/VS/596...	3	R_LOGICAL	[{"guid": "L/r_logical/0...	BUD - BUC	VS/5960073736d5_0_1...	VS/a1c737928f90_0_1_2	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/839...	2	R_LOGICAL	[{"guid": "L/r_logical/c...	OVE - MAD	VS/839c2694c73e_0_1	VS/d5e070604ed5_0_1	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/ba7...	1	R_LOGICAL	[{"guid": "L/r_logical/c...	BCN - MAD	VS/ba7d24f4bc71_0	VS/d5e070604ed5_0	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/3ba...	1	R_LOGICAL	[{"guid": "L/r_logical/c...	STO - COP	VS/3ba7d5003f87	VS/df8413a1d7a4	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/7aa...	3	R_LOGICAL	[{"guid": "L/r_logical/e...	ATH - BUC	VS/7aac1877cd8b_0_1_2	VS/a1c737928f90_0_1_2	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/26a...	1	R_LOGICAL	[{"guid": "L/r_logical/6...	COR - VAL	VS/26a779904306_0	VS/ac13481febe5_0	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/d5e...	1	R_LOGICAL	[{"guid": "L/r_logical/5...	MAD - PAR	VS/d5e070604ed5	VS/e7df76d7a9cb	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/56c...	2	R_LOGICAL	[{"guid": "L/r_logical/0...	MAN - BEL	VS/56ceb1686268_0_1	VS/a9bd23d3ed70_0_1	NORMAL	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/297...	1	R_LOGICAL	[{"guid": "L/r_logical/8...	BKL - MAN	VS/2971737bd3ba_0	VS/56ceb1686268_0	DOWN	['Vendor': ['Cisco']]
SL/R_LOGICAL/VS/d11...	3	R_LOGICAL	[{"guid": "L/r_logical/d...	LIS - MAD	VS/d11c3fd70e8a_0_1_2	VS/d5e070604ed5_0_...	NORMAL	['Vendor': ['Cisco']]

Figure 36. Results using Temporary Variable

Functions

SHQL provides several functions that allow you to precisely define the quantity, type and network layer of the items to retrieve.

Functions are preceded by a pipe in the query command line.

You can retrieve an item and then specify whether to retrieve related items from either above or below the layer, or from both above and below. These recursive operations are valid for port, link, site, inventory, and visual site.

Using Retrospective plus a timestamp enables you to query a situation that existed before the present time. For example, you can check the status of a site when it was down earlier in the day but in the present is up and running.

In addition, SHQL functions enable you to retrieve data based on free text.

SHQL functions are described in the table below.

Table 6. SHQL Functions

Function	Description
downward	Retrieves items from below the layer of the specified item
upward	Retrieves items from above the layer of the specified item
span	Retrieves items from below and above the layer of the specified item
fts	Free text search. Retrieves items according to the search string you enter.
group_by	Returns query results grouped by property, for example, how many ports have an OperStatus of Up.
retrospective(@)	Retrieves items from the past according to a given timestamp.

Example: downward Function

The following figures demonstrate how to create a query to retrieve items from all layers below a link, according to its GUID.

Figure 37 shows a query command composed of an object type followed by its GUID.

```
link[ .guid = "LI/r_logical/000fc44c94a1f2cd/51308dfd752c1574/fe5f5fda14fc609e/a3b059003ccd1b4d" ]
```

Figure 37.

Query Command

Figure 38 shows the results.

The screenshot shows a query command in a text input field: `link[.guid = "LI/r_logical/000fc44c94a1f2cd/51308dfd752c1574/fe5f5fda14fc609e/a3b059003ccd1b4d"]`. Below the input are buttons for "Run", "Save As", and "Delete". The results section shows "RESULTS (1)" with a filter for "Logical Link (1)". A table displays the following data:

Guid	Layer	Name	OperStatus	PathGroupType	Paths	PortA	PortB	ProtectionStat	Provider	Role
LI/r_logical/000fc44c94a1f2cd/51308dfd752c1574/fe5f5fda14fc609e/a3b059003ccd1b4d	R_LOGICAL	10.40.0.45 to ...	UP	SINGLE_PATH	[[{"guid": "PA/L...	PO/r_logical/...	PO/r_logical/...	N_A	Topogen	REGULAR

Figure 38.

GUID Results

Figure 39 shows nine additional items below the link layer, retrieved after adding the function downward to the command.

The screenshot shows the same query command as Figure 37, but with the word "downward" added at the end: `link[.guid = "LI/r_logical/000fc44c94a1f2cd/51308dfd752c1574/fe5f5fda14fc609e/a3b059003ccd1b4d"] | downward`. The results section shows "RESULTS (79)" with filters for "Fiber Link (1)", "Fiber Segment Link (55)", "OTS Link (4)", "OMS Link (4)", "OCH Link (2)", "OTU Link (2)", "ODU Link (4)", "Ethernet Link (5)", "L3 Physical Link (1)", and "Logical Link (1)". A table displays the following data:

Guid	Layer	DistanceMeters	Name	OperStatus	PathGroupType	Paths	ProtectionStat	Provider	Role
LI/fiber/9c095046015f020c	FIBER	73673	SD1BLA02/1-3...	UP	SINGLE_PATH	[[{"guid": "PA/LI...	N_A	Topogen	REGULAR

Figure 39.

Results with the Function Downward

Example: retrospective Function

Figure 40 shows the query command built to retrieve the situation in the network at a specific time in the past.

You can use different time formats:

- Absolute time: @2019-05-10 10:00:00
- Relative time in the format '-'[0-9]+'[ymwdHMS]: @-10H
- Unix timestamp (ms): @1558610956000

```
@1560680169000 site
```

Figure 40.
@ and Epoch Timestamp

Figure 41 shows the results.

GUID	Latitude	Longitude	Name	Parent
ST/9a52e7b877293e29	51.7320209	-1.2977263	DXF	ST/4c37f0a8d98
ST/9707dda29500ee09	44.3877201	0.0852114	ILA-SD1BOR01-SD1MAR01-0	
ST/e1c348d653e79458	52.5994966	21.4467033	ILA-SD2MIN01-SD2WAR01-5	
ST/aace62ec793f474a	47.3768866	8.541994	ZUR	ST/172e92f2e5f
ST/59becd53818200b0	45.8282135	5.0306429	ILA-SD1LV001-SD1MAR01-2	
ST/44352a2daefd7f53	55.2680552	14.8033629	ILA-SD2MIN01-SD2MCS01-5	
ST/9707dda29500ee09	42.5047920	27.4628261	[BUR]	
ST/9707dda29500ee09	41.9780289	2.157855	ILA-SD1BCN01-SD1GIR01-0	
ST/9707dda29500ee09	49.4824699	19.0547261	ILA-SD2BRAT01-SD2KRA01-2	
ST/9707dda29500ee09	39.4149282	22.4384597	ILA-SD2LAM01-SD2LAR02-0	

Figure 41.
Timestamp Results

Example: group_by Function

Figure 42 shows the query command to group the devices by site (and count them).

```
port |group_by(.device.site)|asc(.count)
```

Figure 42.
group_by

Figure 23 shows the results.

Device.Site	Count
ST/9a52e7b877293e29	2
ST/9707dda29500ee09	2
ST/e1c348d653e79458	2
ST/aace62ec793f474a	2
ST/59becd53818200b0	2
ST/44352a2daefd7f53	2

Figure 43.
group_by Results

History Function

Crosswork Hierarchical Controller keeps records of all changes in the network inventory and topology. The changes are stored as a list of events in an event history table. An event is a record of any resource addition (ADD), deletion (DELETE) or attribute change (UPDATE). The events are linked to the model using the guid as an index to the objects in the model. The events table includes all the details of the changes including the time, resource ID, object type, event type, and the value before and after the change.

A unique implementation was selected in order to include all resources that were in the model at some point in the selected time range in the returned results. Thus, it guarantees that services or links that were subsequently deleted are still found. For example, if you query the table to get events for all services with specific tags for the past two weeks, the results will include the relevant services, including those that no longer exist at the end of the period. For more information, refer to the *Crosswork Hierarchical Controller Network History Guide*.

You can construct a query that uses a standard SHQL query to filter the model, then add the pipe (|) and filter the history table. The history table can be filtered by all the entry attributes:

- Changed object guid
- Changed object type
- Change type (ADD, UPDATE, DELETE)
- Value before
- Value after

The results returned are from the event history table (whereas regular SHQL queries return results from the objects table).

Example: history

Figure 44 shows the query command built to retrieve the events for links between two dates. You can narrow the query results by adding in the history table options, for example, only show UPDATE events, or search for links that went down.

```
@-18d:-17d link | history[.action="UPDATE"]
```

```
@-21d:-13d link | history[.to.operStatus = "DOWN"]
```

Figure 44.

@ and history

Figure 45 shows the results.

Action	Changes	ObjGuid	ObjType	Timestamp
135529 ITEMS				
INSERT		LI/r_logical/f38377d02bd88162/69f91c6c31f4ce6e/5d41...	link	1612994572113
INSERT		LI/fiber_segment/f158ea32d21c2f1d	link	1612994572113
INSERT		LI/r_logical/5ed7163adf3bd5e/7d92f458f24bfa3/5d41...	link	1612994572113
INSERT		LI/r_logical/318dds45085bb78/69f91c6c31f4ce6e/3460...	link	1612994572113
INSERT		LI/fiber_segment/d5ce8140095d788f2	link	1612994572113
INSERT		LI/r_logical/3fe1f91b97e054c1/51308df752c1574/09ac...	link	1612994572113
INSERT		LI/fiber_segment/4e58ae4e65e6e26	link	1612994572113
INSERT		LI/fiber_segment/ebc10f48d59c843e	link	1612994572113
INSERT		LI/fiber_segment/3f493e21cf7ceb90	link	1612994572113
INSERT		LI/fiber_segment/c06826a9b8bd8f5	link	1612994572113
INSERT		LI/fiber_segment/24c685e0fe2a140a	link	1612994572113
INSERT		LI/fiber_segment/09678bf7b96050d7	link	1612994572113
INSERT		LI/fiber_segment/21dacb7f325008be	link	1612994572113
INSERT		LI/fiber_segment/a7c4c8814f4443ef	link	1612994572113
INSERT		LI/fiber_segment/3cd11fb650f541a	link	1612994572113
INSERT		LI/fiber_segment/99a33043b4518d66	link	1612994572113
INSERT		LI/fiber_segment/cbb0a28a1b9c8e1	link	1612994572113
INSERT		LI/fiber_segment/f51hr7>R0A4ad770	link	1612994572113

Figure 45.
History Results

Additional Output Functions

You can add the functions described in the table below to retrieve results and display them in a specific order. Typically, these functions are added at the end of the query command. You can also view specific properties for the query results.

The function order is significant and must appear in the following order:

- fibre talk set > view > operands > asc/desc > limit > after

For example:

- This query is invalid: port | limit(10) | asc(.name)
- This query is valid: port | asc(.name) | limit(10)

Output functions are preceded by a pipe (|).

Table 7. Output Functions

Function	Description
add_counters	Displays the total number per attribute value for the specified object type.
after (GUID)	Displays only the results that follow the item with the specified GUID.
asc (column)	Displays results in ascending natural order
desc (column)	Displays results in descending natural order
group_by	
limit(#)	Limits the number of displayed results
view	Displays the specified properties (with the labels provided) for the query results.

Example: after

Figure 46 shows a query built to retrieve only items that follow the item with the specified GUID.

```
inventory_item | after("IN/Router/0529f67055b6efe0")
```

Figure 46.
After Output Function

Figure 47 shows the results.

Guid	Type	Name	Provider	Extra	ManagementIp	ReachabilitySta	Site	Tags	Vendor
80 ITEMS									
IN/Router/0a22a0ec157648e1	ROUTER	CR1.TLV	Topogen	{'is_core': True}	10.40.0.67	REACHABLE	ST/c8037c4ef...	['Vendor': {'Ci...	Cisco
IN/Router/14bc8dcea3a57f18	ROUTER	CR2.MAD	Topogen	{'is_core': True}	10.40.0.38	REACHABLE	ST/d5e070604...	['Vendor': {'Ci...	Cisco
IN/Router/1877a9950429216f	ROUTER	ER1.WAR	Topogen	{'is_core': True}	10.40.0.83	REACHABLE	ST/ec803a477...	['Vendor': {'H...	Huawei
IN/Router/19694a81a1d0ebed	ROUTER	CR1.WAR	Topogen	{'is_core': True}	10.40.0.28	REACHABLE	ST/ec803a477...	['Vendor': {'Ci...	Cisco
IN/Router/1c8ae4011529613d	ROUTER	ER1.BCN	Topogen	{'is_core': False}	10.40.0.51	REACHABLE	ST/ba7d24f4b...	['Vendor': {'Ci...	Cisco
IN/Router/1df8ab6998bf7fc8	ROUTER	CR1.STO	Topogen	{'is_core': True}	10.40.0.77	REACHABLE	ST/3bafd5003...	['Vendor': {'Ci...	Cisco
IN/Router/2023fd21fb812871	ROUTER	CR1.ATH	Topogen	{'is_core': True}	10.40.0.47	REACHABLE	ST/7aac1877c...	['Vendor': {'Ci...	Cisco
IN/Router/2f29e956db0f0cae	ROUTER	ER1.VAL	Topogen	{'is_core': False}	10.40.0.62	REACHABLE	ST/ac13481fe...	['Vendor': {'Ci...	Cisco
IN/Router/3052d71050f39870	ROUTER	CR1.HEL	Topogen	{'is_core': True}	10.40.0.80	REACHABLE	ST/2499da6f5...	['Vendor': {'Ci...	Cisco
IN/Router/318dd5a50856bb78	ROUTER	CR1.VAL	Topogen	{'is_core': True}	10.40.0.63	REACHABLE	ST/ac13481fe...	['Vendor': {'Ci...	Cisco

Figure 47.
After Output Results

Example 1: add_counters

Figure 48 shows a query built to retrieve the total number of each of the link layers. Adding `| limit (0)` to the query limits the response to the counters only.

```
link | add_counters (.layer) | limit (0)
```

Figure 48.
add_counters Function

Figure 49 shows the results.

Attribute Name	Attribute Value	Counter
14 ITEMS		
layer	ODU	151
layer	FIBER_SEGMENT	19380
layer	LSP	1656
layer	OTS	460
layer	FIBER	432
layer	OTU	145
layer	R_LOGICAL	233
layer	IGP	118
layer	OHS	138
layer	OCH	89
layer	L3_VPN	8
layer	ETH	175
layer	R_AGGREGATE	3
layer	R_PHYSICAL	124

Figure 49.
add_counters Results

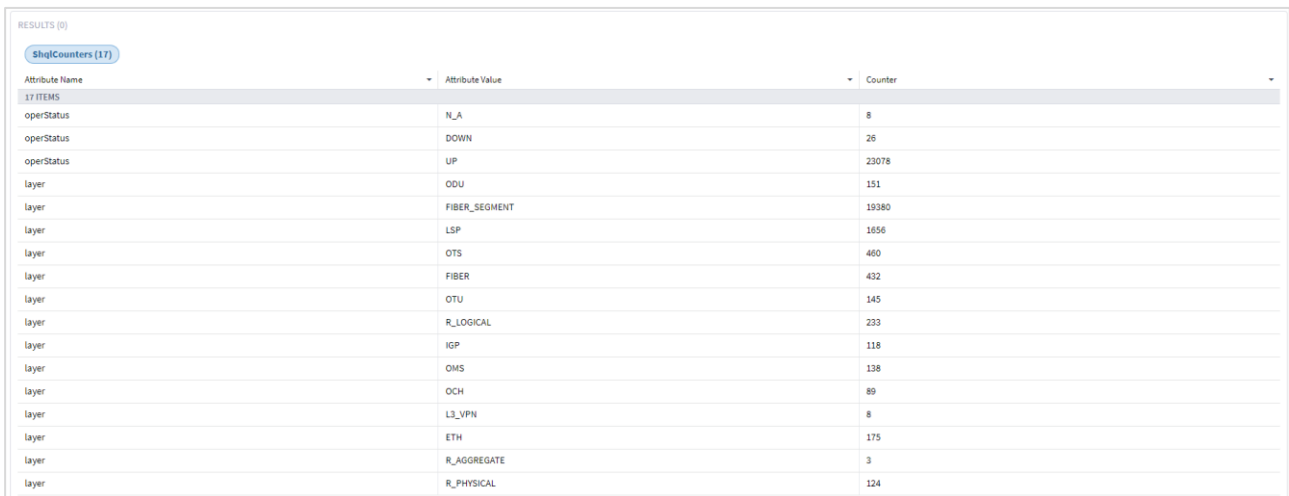
Example 2: add_counters

Figure 50 shows a query built to retrieve the total number of each of the link layers and the total number of links in each of the operational statuses (UP, DOWN or N_A). Adding **| limit (0)** to the query limits the response to the counters only.

```
link | add_counters (.operStatus, .layer) | limit (0)
```

Figure 50.
add_counters Function

Figure 51 shows the results.



Attribute Name	Attribute Value	Counter
17 ITEMS		
operStatus	N_A	8
operStatus	DOWN	26
operStatus	UP	23078
layer	ODU	151
layer	FIBER_SEGMENT	19380
layer	LSP	1656
layer	OTS	400
layer	FIBER	432
layer	OTU	145
layer	R_LOGICAL	233
layer	IGP	118
layer	OMS	138
layer	OCH	89
layer	L3_VPN	8
layer	ETH	175
layer	R_AGGREGATE	3
layer	R_PHYSICAL	124

Figure 51.
add_counters Results

Example 1: view

Figure 52 shows a query built to retrieve the port guid, name, device.name and teMetric for IGP ports.

```
port[.type="IGP"]|view ("guid":.guid, "name":.name, "device":.device.name, "te_metric":.teMetric)
```

Figure 52.
View Output Function

Figure 53 shows the results.

RESULTS (347)

[View \(347\)](#)

Guid	Name	Device	Te_metric
347 ITEMS			
PO/igp/05e94d0bf33ab764/05e94d0bf33ab...	10.40.0.30	CR2.COP	0
PO/igp/05e94d0bf33ab764/f54e0329eb3d8...	10.40.0.166	CR2.COP	40682
PO/igp/05e94d0bf33ab764/fe3d98f432600bd1	10.40.0.189	CR2.COP	0
PO/igp/06c0868cc5601e85/06c0868cc5601e85	10.40.0.21	ER1.PAR	0
PO/igp/06c0868cc5601e85/2bba1a15c5d0800f	10.40.0.106	ER1.PAR	0
PO/igp/06c0868cc5601e85/e7909350ec27b7...	10.40.0.137	ER1.PAR	0

Figure 53.
View Output Results

Example 2: view

Figure 54 shows a query built to retrieve the link guid and the number of paths in the link, when the link is not in a FIBER or FIBER_SEGMENT layer.

```
link[.layer not in ("FIBER", "FIBER_SEGMENT")] | view ("guid": .guid, "number": count(.paths))
```

Figure 54.
View Output Function

Figure 55 shows the results.

RESULTS (3185)

[View \(3185\)](#)

Guid	Number
3185 ITEMS	
LI/eth/000fc44c94a1f2cd/51308dfd752c1574/df753d953c1e1c8f/f8e7b20537ce03b7	0
LI/eth/018c725e75339c6c/1ab9838586d6af43/3ce85abb6ad75831/467d67a8221dfca2	1
LI/eth/0640f5f2a4a4a5b2/51308dfd752c1574/3ce85abb6ad75831/467d67a8221dfca2	0
LI/eth/0640f5f2a4a4a5b2/ad2095e495c117ce/3ce85abb6ad75831/45fbcf353eff8146	0
LI/eth/08a4ce19ff3c89ab/efb8a463377896b8/ab34b1bcb5abd8cd/62cc89608ea94c16	0
LI/eth/08a4ce19ff3c89ab/f8e7b20537ce03b7/ab34b1bcb5abd8cd/efb8a463377896b8	0

Figure 55.
View Output Results

Example 3: view

Figure 56 shows a query built to retrieve the link guid and port names when the link is not in a FIBER or FIBER_SEGMENT layer. The output is limited to 20 entries.

```
link[.layer not in ("FIBER", "FIBER_SEGMENT")] | view("g": .guid, "n-a": .portA.name, "n-b": .portB.name)|limit(20)
```

Figure 56.
View Output Function

Figure 57 shows the results.

RESULTS (20)

View (20)

G	N-A	N-B
20 ITEMS		
LI/r_logical/f38377d02bd88162/69f91c6c31f4ce6e/5d4172c3965d428...	HundredGigE0/1/0/0	HundredGigE0/1/0/0
LI/r_logical/5ed7163adf3b8d5e/7d82f458ff24bfa3/5d4172c3965d428...	TenGigE0/0/0/8	TenGigE0/0/0/4
LI/r_logical/318dd5a50856bb78/69f91c6c31f4ce6e/3460e659c02aefc...	HundredGigE0/1/0/0	HundredGigE0/1/0/0
LI/r_logical/3fe1f91b97e054c1/51308dfd752c1574/09ac8d52042280e...	TenGigE0/0/0/5	TenGigE0/0/0/4
LI/r_logical/94b82c614c0402dc/51308dfd752c1574/f3b3b56ab45fd1...	TenGigE0/0/0/5	TenGigE0/0/0/4
LI/r_logical/050148266f11f3/c6ab544ef5f0e0/f602dfb1373f394c/1ab...	ODU100E	ODU100E

Figure 57.
View Output Results

Example 4: view

Figure 58 shows a query built to count the hops for the specified path.

```
path[.guid="PA/LI/fiber/0d9fe6e5f9bad3c5"] | view("g": .guid, "hops": count(.hops))
```

Figure 58.
View Output Function

Figure 59 shows the results.

RESULTS (1)

View (1)

G	Hops
1 ITEM	
PA/LI/fiber/0d9fe6e5f9bad3c5	57

Figure 59.
View Output Results

Complex Examples

Complex Example 1

The following figures demonstrate how to get OMS links that causes LSPs to fail.

The query command includes the following:

```
site[.name="DUB" ] | inventory_item | port | link[.layer=" LSP" ] as w; site[.name="BEL" ] | inventory_item | port | link[.layer=" LSP" and .guid in w ] | downward(" OMS" ) | link[.layer=" OMS" and .operStatus=" DOWN" ]
```

Get all LSPs between sites DUB and BEL:

- Use | to transform from one object type to another.
- Use alias and in to reduce the list to only those between DUB to BEL.

Down to OMS links and filter by operational state:

- Use 'downward' function.

- Use layer name in function (downward (“OMS”)) to limit the downward to a specific level.

```
site[.name="DUB"] | inventory_item | port | link[.layer="LSP"] as w; site[.name="BEL"] | inventory_item | port | link[.layer="LSP" and .guid in w] | downward("OMS") | link[.layer="OMS" and .operStatus="DOWN"]
```

Figure 60.
Query Results

SHQL Records fetched at: 19:15:04 06-12-2020 UTC

Saved Queries

```
site[.name="DUB"] | inventory_item | port | link[.layer="LSP"] as w; site[.name="BEL"] | inventory_item | port | link[.layer="LSP" and .guid in w] | downward("OMS") | link[.layer="OMS" and .operStatus="DOWN"]
```

Run Save As Delete Query

RESULTS (1)

OMS Link (1)

Guid	Layer	Name	OperStatus	PathGroupType	Paths	PortA	PortB	ProtectionStatus	Provider	Role
LI/oms/af5e85f...	OMS	SD1BKL01/1-2-5...	DOWN	SINGLE_PATH	[{"guid": "PA/oms...	PO/oms/af5e85...	PO/oms/9bf4b7...	N_A	Topogen	REGULAR

Figure 61.
Query Results

Complex Example 2

The following figures demonstrate how to get the current list of OMSs.

The query command includes the following:

```
link[.name="CR1.DUB:CR1.BEL:lsp_0"] | downward | link[.layer="OMS"]
```

Get all OMSs used by specific LSP:

- Get LSP by its name.
- Downward to OMSs used by this LSP.

The query command that includes the following:

```
| link[.name="CR1.DUB:CR1.BEL:lsp_0"] | downward | link[.layer="OMS"]
```

Figure 62.
Query Command

SHQL Records fetched at: 19:54:47 06-12-2020 UTC

Saved Queries

| link[.name="CR1.DUB:CR1.BEL:lsp_0"] | downward | link[.layer="OMS"]

Run Save As Delete Query

RESULTS (12)

OMS Link (12)

Guid	Layer	Name	OperStatus	PathGroupType	Paths	PortA	PortB	ProtectionStatus	Provider	Role
LI/oms/4afa911...	OMS	SD1DUB01/1-2-...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/4afa91...	PO/oms/08a4ce...	N_A	Topogen	REGULAR
LI/oms/7c54f85...	OMS	SD1LIV01/1-2-5...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/7c54f8...	PO/oms/ab34b...	N_A	Topogen	REGULAR
LI/oms/af5e85ff...	OMS	SD1BKL01/1-2-...	DOWN	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/af5e85...	PO/oms/9bf4b7...	N_A	Topogen	REGULAR
LI/oms/aaba827...	OMS	SD1OXF01/1-3-...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/aaba82...	PO/oms/9bf4b7...	N_A	Topogen	REGULAR
LI/oms/9c601df...	OMS	SD1BIR01/1-4-5...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/9c601d...	PO/oms/aaba82...	N_A	Topogen	REGULAR
LI/oms/9c601df...	OMS	SD1BIR01/1-2-5...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/9c601d...	PO/oms/7c54f8...	N_A	Topogen	REGULAR
LI/oms/9c601df...	OMS	SD1BIR01/1-3-5...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/9c601d...	PO/oms/394fa7...	N_A	Topogen	REGULAR
LI/oms/644a90f...	OMS	SD1MAN01/1-3-...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/644a90...	PO/oms/394fa7...	N_A	Topogen	REGULAR
LI/oms/df753d9...	OMS	SD1BEL01/1-2-5...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/df753d...	PO/oms/ae10e0...	N_A	Topogen	REGULAR
LI/oms/9e79f8d...	OMS	SD1IOM101/1-3-...	UP	SINGLE_PATH	[{"guid": "PA/om...	PO/oms/9e79f8...	PO/oms/ae10e0...	N_A	Topogen	REGULAR

Figure 63.
Query Results

If you want to track the LSP path change over time, you can use for example, @-1d:

```
@-1d link[.name="CR1.DUB:CR1.BEL:lsp_0"] | downward | link[.layer="OMS"]
```

Figure 64.
Query Command

Complex Example 3

The following figures demonstrate how to find shared risk between two IP links.

The query command includes the following:

```
link[.name="10.40.0.157 to 10.40.0.158"] | downward | link[.layer="OMS"] as p;
link[.name="10.40.0.154 to 10.40.0.153"] | downward | link[.layer="OMS"] as w; link[.guid in p and .guid in w]
```

Get OMSs of the first IP logical link:

- Filter by link name, downward to its OMSs, and alias it as p.

Get OMSs of the second IP logical link:

- Filter by link name, downward to its OMSs, and alias it as w.

Get all shared OMS links:

- Get links that appear in both groups.

```
link[.name="10.40.0.157 to 10.40.0.158"] | downward | link[.layer="OMS"] as p; link[.name="10.40.0.154 to 10.40.0.153"] | downward | link[.layer="OMS"] as w; link[.guid in p and .guid in w]
```

Figure 65.
Query Command



Figure 66.
Query Results

Complex Example 4

The following figures demonstrate how to find free ports for services in a site.

The query command that includes the following:

site[.name contains "MIL"] | inventory_item | port[.type="ETH"] | link | port as p; site[.name contains "MIL"] | inventory_item | port[.type="ETH" and .guid not in p]

Get all ETH ports of specific site used by links:

- Get site ports, transform to links and then to ports, and alias it as p.

Get all ports that are not in use by links:

- Get site ports, transform to ports, filter out those that appear in p.

site[.name contains "MIL"] | inventory_item | port[.type="ETH"] | link | port as p; site[.name contains "MIL"] | inventory_item | port[.type="ETH" and .guid not in p]

Figure 67.
Query Command

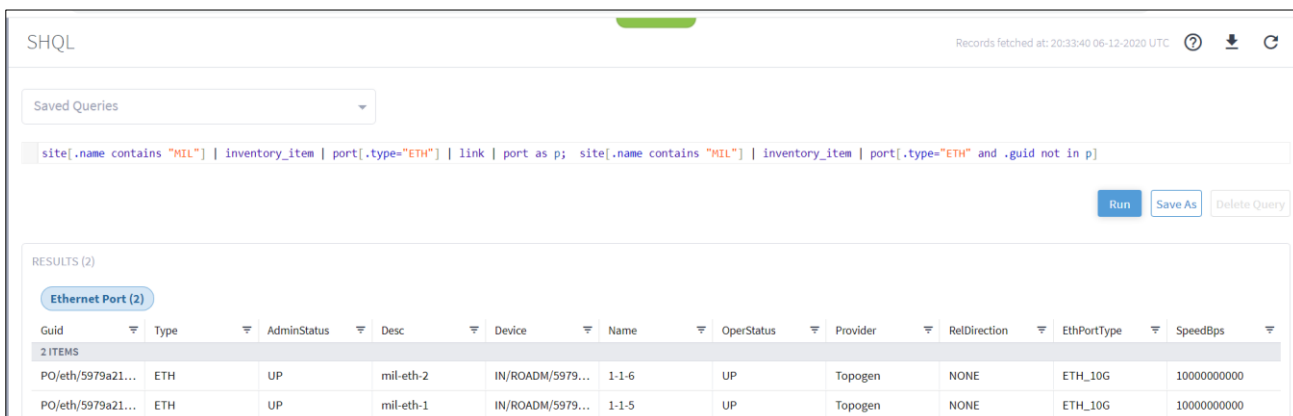


Figure 68.
Query Results

Try It Yourself

Try and create your own complex query.

Figure 69 shows an example that includes:

- Operands
- Transformations
- Collections
- Functions

```
site [.guid = "ST/9354b4a138dd_0_1_2"] | downward | inventory_item | port | link | upward | link[.layer in ("LSP", "E_LINE")] | limit(20) & port & inventory_item & site| upward
```

Figure 69.
Complex Query

Table 8. Breakdown of Complex Query

Item	Type	See...
site	Object type	Object Types and Properties
[.guid = "ST/31105c202abd"]	Condition (operand =)	Operands
downward	Function	SHQL Functions
inventory_item	Transformation object typ	Transforming/Collecting Object Types
port	Transformation object type	Transforming/Collecting Object Types
link	Transformation object type	Transforming/Collecting Object Types
upward	Function	SHQL Functions
link[.layer in ("LSP" , "E_LINE")]	Transformation object type + condition (operand in)	Transforming/Collecting Object Types
limit(20)	Function	Output Functions
& port & inventory_item & site	Collections of object types	Transforming/Collecting Object Types
upward	Function	SHQL Functions

Figure 70 shows the results.

```
site [.guid = "ST/9354b4a138dd_0_1_2"] | downward | inventory_item | port | link | upward | link[.layer in ("LSP", "E_LINE")] | limit(20) & port & inventory_item & site| upward
```

Run Save As Delete Query

RESULTS (58)

Site (20) Router (9) IGP Port (9) LSP Link (20)

Guid	Latitude	Longitude	Name	Parent
20 ITEMS				
ST/a6da17cd217d	51.2277411	6.7734556	DUS	ST/a6da17cd217d_0
ST/9354b4a138dd	53.4083714	-2.9915726	LIV	ST/9354b4a138dd_0
ST/839c2694c73e	43.3619145	-5.8493887	OVE	ST/839c2694c73e_0
ST/a9bd23d3ed70	54.597285	-5.93012	BEL	ST/a9bd23d3ed70_0
ST/ea4a371e85b7	53.3498053	-6.2603097	DUB	ST/ea4a371e85b7_0
ST/9354b4a138dd_0	53.4083714	-2.9915726	LIV	ST/9354b4a138dd_0_1
ST/a6da17cd217d_0	51.2277411	6.7734556	DUS	ST/a6da17cd217d_0_1
ST/839c2694c73e_0	43.3619145	-5.8493887	OVE	ST/839c2694c73e_0_1
ST/a9bd23d3ed70_0	54.597285	-5.93012	BEL	ST/a9bd23d3ed70_0_1
ST/ea4a371e85b7_0	53.3498053	-6.2603097	DUB	ST/ea4a371e85b7_0_1

Figure 70.
Complex Query Results

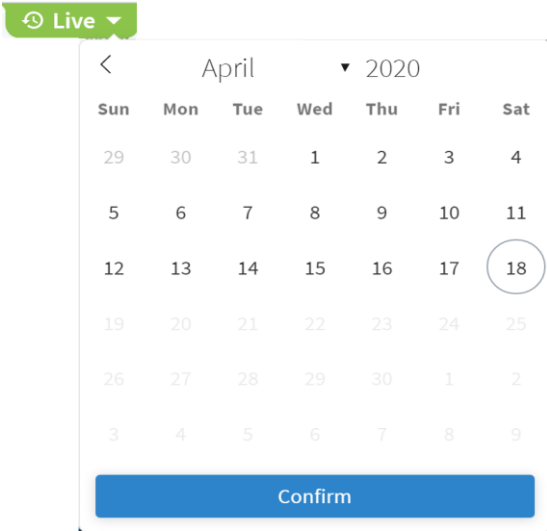
Use Time Machine

The time machine provides a snapshot of the state of the network as it was at a date in the past. In this mode, all applications reflect data and analysis that apply to this point in time.

You can use the time machine query the model as at a date in the past.

To change the model date:

1. In the applications bar in Crosswork Hierarchical Controller, select **SHQL**.
2. Click **Live**, select a date and click **Confirm**.



3. Run the required query.

Object Type Properties

The following sections list all the properties aligned with the different object types.

inventory_item Properties

Table 9. inventory_item properties

inventory_item properties
.accessIdentifier
.cardStatus
.cardType
.children
.childrenPorts
.desc
.deviceFamily
.deviceType
domainName
.equipState
.extra
.formFactor
.guid
.hasRoadm

inventory_item properties

.id

igpType

.isisInfo

.isisInfo.areaAddresses

.isisInfo.instanceIdentifier

.isisInfo.isDiscoveredL1

.isisInfo.isDiscoveredL2

.isisInfo.systemId

.isisInfo.topologyIdentifier

.managementIp

.modelName

.name

.oui

.parent

.partNumber

.pluggability

.provider

.reachabilityStatus

routerId

.serialNumber

.site

.softwareVersion

.supportedLambdas

.supportedPhysicalLayers

.supportedReachabilityMeters

.supportedSpeeds

.tags

.topologyId

.tunableType

.tunedLambda

.type

.vendor

port Properties

Table 10. port properties

port properties
.adminGroups
.adminGroups.groupNumber
.adminGroups.name
.adminStatus
.aggRateBps
.ceInterfaceIp
.cePeRoutingProtocols
.channelNum
.childRole
.containingService
.desc
.device
.egressBandwidthProfile
.egressBandwidthProfile.cbsKb
.egressBandwidthProfile.cir
.egressBandwidthProfile.ebsKb
.egressBandwidthProfile.eir
.egressBandwidthProfile.qosPolicy
.ethPortType
.evcEgressBandwidthProfile
.evcEgressBandwidthProfile.cbsKb
.evcEgressBandwidthProfile.cir
.evcEgressBandwidthProfile.ebsKb
.evcEgressBandwidthProfile.eir
.evcEgressBandwidthProfile.qosPolicy
.evcIngressBandwidthProfilePerEvc
.evcIngressBandwidthProfilePerEvc.cbsKb
.evcIngressBandwidthProfilePerEvc.cir
.evcIngressBandwidthProfilePerEvc.ebsKb

port properties

.evcIngressBandwidthProfilePerEvc.eir
.evcIngressBandwidthProfilePerEvc.qosPolicy
.exportRts
.extra
.guid
.hasServiceEndPointCapability
.id
.ifIndex
.igpInstanceName
.igpMetric
.importRts
.ingressBandwidthProfile
.ingressBandwidthProfile.cbsKb
.ingressBandwidthProfile.cir
.ingressBandwidthProfile.ebsKb
.ingressBandwidthProfile.eir
.ingressBandwidthProfile.qosPolicy
.ipAddress
.isLoopback
.isManagement
.isRouterId
.isStatsDummy
.isisInfo
.isisInfo.isisLevel
.isisInfo.netPrefixMetric
.isisInfo.portType
.lambdaNm
.links
.lowerPorts
.mappedCeTags
.mappedSvlan
mappingType

port properties

.maxLinkBandwidth

.maxReservableLinkBandwidth

.mediaFrameType

.memberCount

.mtuSize

.name

.nonPrimaryIps

.ocType

.oduld

.oduPolarization

.oduType

.operStatus

ospfInfo

.otuType

.packetOpticalDetails

.packetOpticalDetails.availableBandwidth

.parent

.pdhType

.physicalAddress

.portCapabilities

.primaryIp

.protectionType

.provider

.range

.relDirection

.relPort

.rfParams

.routeDistinguisher

.rsvpReservedBandwidthBps

.rsvpStaticBandwidthBps

.spanLoss

.speedBps

port properties
.srPrefixSids
.srlgs
.stsType
.tags
.teMetric
.type
.unreservedLinkBwForPriorityIndex
.upperPorts
.vcatsType
.vlan
.vpnRole
.vrfName
.vtType
.ycableType

link Properties

Table 11. link properties

link properties
.activeProtectionPriority
.adjacencySegmentInfo
.adminGroupConstraints
.bindingSid
.candidatePaths
.color
.deploymentType
.desc
.distanceMeters
.desc
.evcPerformanceProfile
.extra
.geometry
.guid

link properties

.holdPriority

.id

.inverseLinkId

.isApproximated

.isBidi

.isCeVlanCosPreservation

.latencyMicros

.layer

.lineType

.lspTechnology

.mappingStatus

.name

.numberOfFibers

.operStatus

.owner

.pathGroupType

.paths

.portA

.portB

.prefixSegmentInfo

.protectedLayer

.protectionStatus

.provider

.role

.rxLabel

.segmentType

.setupPriority

.sidIndex

.sidLabel

.signalType

.speedBps

.srAdjacencySids

link properties
.srIgs
.tags
.teMetric
.txLabel
.usedByHops
.vclId

site Properties

Table 12. site properties

site properties
.extra
.guid
.id
.latitude
.longitude
.name
.parent

service Properties

Table 13. service properties

service properties
.adminStatus
.anyToAnyOrHubRouteTarget
.containedPorts
.customerDetails
.customerName
.desc
.extra
.guid
.id
.name
.operStatus

service properties
.provider
.serviceIntent
.serviceIntentRelation
.spokeRouteTarget
.tags
.type
.vpnTopology

service_intent Properties

Table 14. service_intent properties

service_intent properties
.adminState
.anyToAnyDetails
.anyToAnyDetails.minimumSites
.anyToAnyDetails.routeTarget
.baseTemplate
.customerName
.dataForNonMultiplexedService
.dataForNonMultiplexedService.ethPortType
.deploymentInfo.lastStatusChangeTimeStamp
.deploymentInfo.operation
.deploymentInfo.phase
.desc
.extra
.guid
.holdPriority
.hubAndSpokeDetails
.hubAndSpokeDetails.hubRouteTarget
.hubAndSpokeDetails.minimumHubSites
.hubAndSpokeDetails.minimumSpokeSites
.hubAndSpokeDetails.spokeRouteTarget
.id

service_intent properties

.ipAddressAllocationPolicy
.isOamPmCollectionEnabled
.isRemoved
.isTemplate
.name
.oduType
.pathComputationSettings
.pathComputationSettings.backupPathOptimization
.pathComputationSettings.includeLinkStates
.pathComputationSettings.mainPathOptimization
.protectionSettings
.protectionSettings.protectionPolicy
.protectionSettings.resourceDiversityFor1Plus1
.protectionSettings.resourceDiversityFor1Plus1.diversifiedResources
.protectionSettings.resourceDiversityFor1Plus1.diversityPolicy
.provider
.qosSettings
.qosSettings.cbsKb
.qosSettings.cir
.qosSettings.ebsKb
.qosSettings.eir
.qosSettings.qosPolicy
.resourceAllocationPolicy
.routeDistinguisher
.setupPriority
.srData
.tunnelType
.type
.underlayTech
.underlayTech.allowedNni
.underlayTech.ipMpls
.underlayTech.ipMpls.allowedNni

service_intent properties
.underlayTech.ipMpls.tunnelResiliency
.underlayTech.ipMpls.tunnelTypes
.underlayTech.mplsTp
.underlayTech.mplsTp.allowedNni
.underlayTech.mplsTp.tunnelResiliency
.underlayTech.mplsTp.tunnelUsageConstraints
.underlayTech.otn
.underlayTech.otn.allowedNni
.underlayTech.otn.serviceTunnelRate
.underlayTech.otn.serviceTunnelType
.underlayTech.selectedTech
.underlayTech.tunnelResiliency
.underlayTech.tunnelTypes
.underlayTech.wdm
.underlayTech.wdm.allowedNni
.vlanManipulation
.vpnTopology

service_intent_resource Properties

Table 15. service_intent_resource Properties

service_intent_resource properties
.constraintCompliance
.extra
.guid
.id
.includeType
.layer1Info
.layer1Info.tunnelRate
.layer2Info
.layer2Info.mappedCeTags
.layer2Info.qos
.layer2Info.qos.cbsKb

service_intent_resource properties
.layer2Info.qos.cir
.layer2Info.qos.ebsKb
.layer2Info.qos.eir
.layer2Info.qos.qosPolicy
.layer3Info
.layer3Info.cePeSettings
.layer3Info.cePeSettings.bgpRoutingDetails
.layer3Info.cePeSettings.bgpRoutingDetails.autonomousSystem
.layer3Info.cePeSettings.bgpRoutingDetails.peeringIp
.layer3Info.cePeSettings.ospfRoutingDetails
.layer3Info.cePeSettings.ospfRoutingDetails.metric
.layer3Info.cePeSettings.ospfRoutingDetails.ospfArea
.layer3Info.cePeSettings.routingMethod
.layer3Info.cePeSettings.staticRoutingDetails
.layer3Info.cePeSettings.staticRoutingDetails.entries.adminPreference
.layer3Info.cePeSettings.staticRoutingDetails.entries.ipPrefix
.layer3Info.cePeSettings.staticRoutingDetails.entries.nextHop
.layer3Info.ipAddress
.layer3Info.I3VpnRole
.order
.protectionRole
.resource
.resourceDiversity
.serviceIntent
.tag
.type

event Properties

Table 16. event properties

event properties
.count
.data

event properties
.guid
.lastUpdate
.machineld
.severity
.subType
.timeStamp
.type
.username

srlg Resource Properties

Table 17. srlg properties

srlg properties
.externalld
.extra
.guid
.id
.name
.ordinal
.provider
.srlgs

path Properties

Table 18. path properties

path properties
.ecmpWeight
.extra
.guid
.hops
.id
.link
.priority
.provider

path properties

.srPathSegments

.tunPortA

.tunPortB

site_link Properties

Table 19. site_link properties

site_link properties

.depth

.guid

.id

.isCrossLink

.layer

.links

.name

.siteA

.siteB

.status

.tags

.utilization

visual_site Properties

Table 20. visual_site properties

visual_site properties

.depth

.guid

.id

.isOnlyAmplifiers

.latitude

.longitude

.name

.oneSize

.parent

visual_site properties

.reachabilityStatus

.routerSize

.site

.tags

inventory Properties

Table 21. inventory properties

inventory properties

.accessIdentifier

.cardStatus

.cardType

.children

.childrenPorts

.desc

.deviceFamily

.deviceType

.equipState

.extra

.formFactor

.guid

.hasRoadm

.isisInfo

.isisInfo.areaAddresses

.isisInfo.instanceIdentifier

.isisInfo.isDiscoveredL1

.isisInfo.isDiscoveredL2

.isisInfo.isisInstanceName

.isisInfo.systemId

.isisInfo.topologyIdentifier

.managementIp

.modelName

.name

inventory properties
.oui
.parent
.partNumber
.pluggability
.ports
.provider
.reachabilityStatus
.routerId
.serialNumber
.site
.softwareVersion
.srCapabilities
.srlgs
.supportedLambdas
.supportedPhysicalLayers
.supportedReacabilityMeters
.supportedSpeeds
.tags
.topologyId
.tunableType
.tunedLambda
.type
.unitType
.vendor

srlg_risk_resource_mtm Properties

Table 22. srlg_risk_resource_mtm properties

srlg_risk_resource_mtm properties
.guid
.id
.inventoryItem
.link

srlg_risk_resource_mtm properties

.port

.provider

.srlg

risk_resource Properties

Table 23. risk_resource properties

risk_resource properties

.inventoryItem

.guid

.provider

.link

.srlg

.port

region Properties

Table 24. region properties

region properties

.geometry

.guid

.id

.name

.overlay

history Properties

Table 25. history properties

history properties

.action

.changes

.objGuid

.objName

.objSubtype

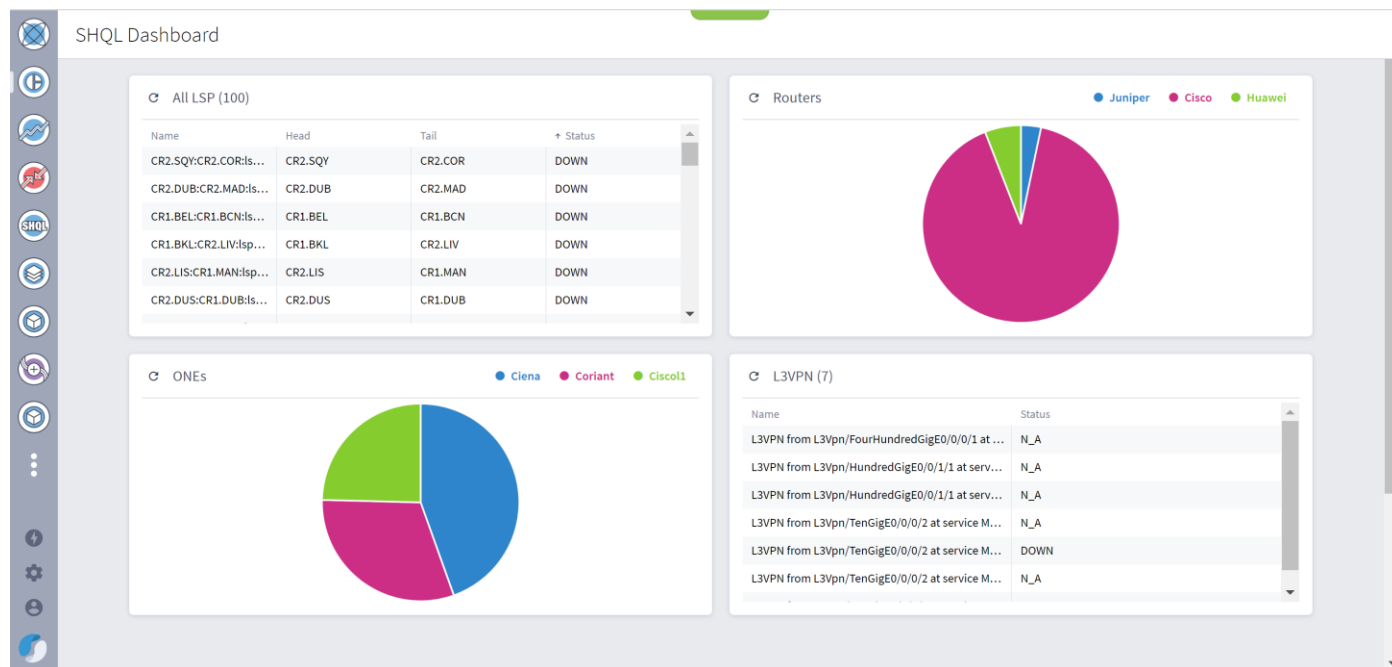
.objType

.timestamp

Creating SHQL Widgets

About SHQL Widgets

You can create customized widgets, rapidly with no development efforts and no software delivery. The widget query runs when opening the SHQL Dashboard application and the widgets are displayed. The widget also has a refresh button to run the query manually.



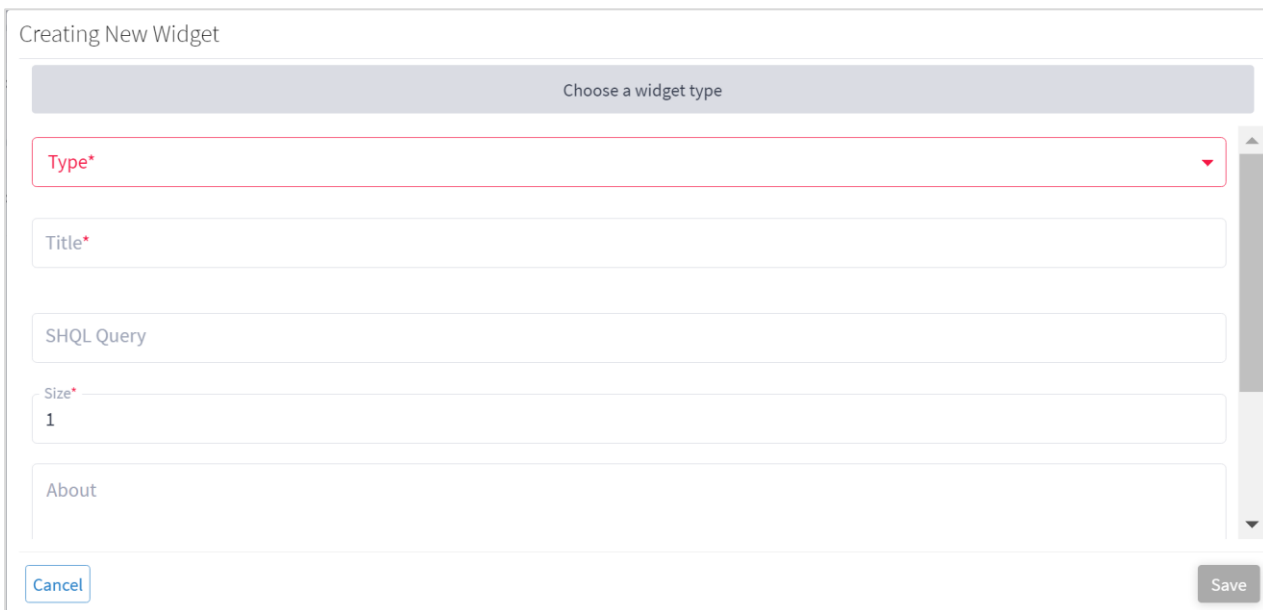
Creating SHQL Widgets

The widget attributes are:

- **Title:** The name of the SHQL widget as it appears in the SHQL Dashboard.
- **Query:** Must be up to 5 views, and limit(100).
- **Visual mode:**
 - **Pie/bar** – when the query contains counters only
 - **Graph** – when the query contains timestamp and counters
 - **Table** – when the query returns a list
- **'About'** text.
- **Optional:** Additional query to be used as a drill down into a widget (can be automatically generated (removing the counter and limit)).

To create an SHQL widget:

1. In the applications bar in Crosswork Hierarchical Controller, select **SHQL Widgets**.
2. Click + New SHQL Widget.



Creating New Widget

Choose a widget type

Type*

Title*

SHQL Query

Size*

1

About

Cancel Save

Figure 71.

Creating New Widget

3. Select the **Type**. This can be **Table**, **Graph**, or **Pie**.

Depending on the type of widget selected, guidance is provided on the SHQL permitted.

Appendix

Glossary

Term	Description
RESTCONF	A protocol based on HTTP for configuring data defined in YANG version 1 or YANG version 1.1 using the datastore concepts defined in the Network Configuration Protocol (NETCONF)

Americas Headquarters

Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters

Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters

Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at <https://www.cisco.com/go/offices>.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: <https://www.cisco.com/go/trademarks>. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)