Data Models Configuration Guide for Cisco NCS 1014, IOS XR Releases 25.x.x

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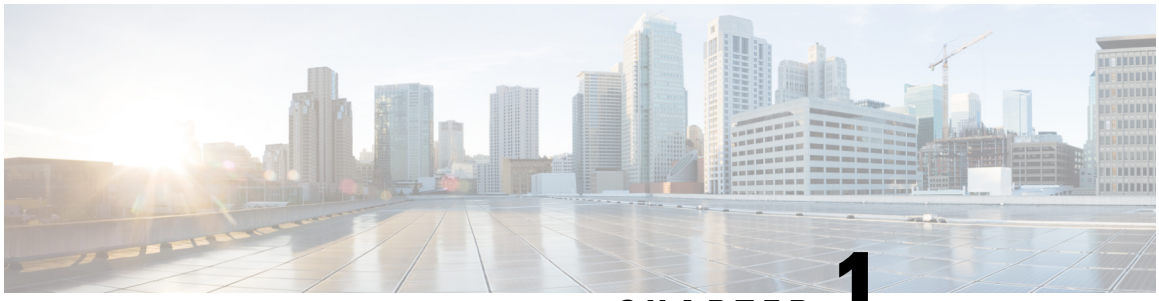
Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

CONTENTS



CHAPTER 1

Data Models

Data Models - Programmatic and Standards-based Configuration

Cisco IOS XR software supports the automation of configuration of multiple routers across the network using Data models. Configuring routers using data models overcomes drawbacks posed by traditional router management techniques.

CLIs are widely used for configuring a router and for obtaining router statistics. Other actions on the router, such as, switch-over, reload, process restart are also CLI-based. Although, CLIs are heavily used, they have many restrictions.

Customer needs are fast evolving. Typically, a network center is a heterogenous mix of various devices at multiple layers of the network. Bulk and automatic configurations need to be accomplished. CLI scraping is not flexible and optimal. Re-writing scripts many times, even for small configuration changes is cumbersome. Bulk configuration changes through CLIs are error-prone and may cause system issues. The solution lies in using data models - a programmatic and standards-based way of writing configurations to any network device, replacing the process of manual configuration. Data models are written in a standard, industry-defined language. Although configurations using CLIs are easier (more human-friendly), automating the configuration using data models results in scalability.

Cisco IOS XR supports the YANG data modeling language. YANG can be used with Network Configuration Protocol (NETCONF) to provide the desired solution of automated and programmable network operations.

YANG model

YANG is a data modeling language used to describe configuration and operational data, remote procedure calls and notifications for network devices. The salient features of YANG are:

- Human-readable format, easy to learn and represent
- Supports definition of operations
- Reusable types and groupings
- Data modularity through modules and submodules

- Supports the definition of operations (RPCs)
- Well-defined versioning rules
- Extensibility through augmentation

For more details of YANG, refer RFC 6020 and 6087.

NETCONF and gRPC (Google Remote Procedute Call) provide a mechanism to exchange configuration and operational data between a client application and a router and the YANG models define a valid structure for the data (that is being exchanged).

Protocol	Transport	Encoding/ Decoding
NETCONF	SSH	XML
gRPC	HTTP/2	XML, JSON

Each feature has a defined YANG model. Cisco-specific YANG models are referred to as synthesized models. Some of the standard bodies, such as IETF , IEEE and Open Config, are working on providing an industry-wide standard YANG models that are referred to as common models.

Components of Yang model

A module defines a single data model. However, a module can reference definitions in other modules and submodules by using the **import** statement to import external modules or the **include** statement to include one or more submodules. A module can provide augmentations to another module by using the **augment** statement to define the placement of the new nodes in the data model hierarchy and the **when** statement to define the conditions under which the new nodes are valid. **Prefix** is used when referencing definitions in the imported module.

YANG models are available for configuring a feature and to get operational state (similar to show commands)

This is the configuration YANG model for AAA (denoted by - cfg)

```
(snippet)
module Cisco-IOS-XR-aaa-locald-cfg {

  /*** NAMESPACE / PREFIX DEFINITION ***/

  namespace "http://cisco.com/ns/yang/Cisco-IOS-XR-aaa-locald-cfg";


  prefix "aaa-locald-cfg";

  /*** LINKAGE (IMPORTS / INCLUDES) ***/

  import Cisco-IOS-XR-types { prefix "xr"; }

  import Cisco-IOS-XR-aaa-lib-cfg { prefix "a1"; }

  /*** META INFORMATION ***/

  organization "Cisco Systems, Inc.";
          ......................
          ...................... (truncated)
```

This is the operational YANG model for AAA (denoted by -oper)

```
(snippet)
module Cisco-IOS-XR-aaa-locald-oper {

  /*** NAMESPACE / PREFIX DEFINITION ***/

  namespace "http://cisco.com/ns/yang/Cisco-IOS-XR-aaa-locald-oper";


  prefix "aaa-locald-oper";

  /*** LINKAGE (IMPORTS / INCLUDES) ***/

  import Cisco-IOS-XR-types { prefix "xr"; }

  include Cisco-IOS-XR-aaa-locald-oper-sub1 {
    revision-date 2015-01-07;
  }

  /*** META INFORMATION ***/

  organization "Cisco Systems, Inc.";
    ......................
    ...................... (truncated)
```

Note A module may include any number of sub-modules, but each sub-module may belong to only one module. The names of all standard modules and sub-modules must be unique.

Structure of Yang models

YANG data models can be represented in a hierarchical, tree-based structure with nodes, which makes them more easily understandable. YANG defines four nodes types. Each node has a name, and depending on the node type, the node might either define a value or contain a set of child nodes. The nodes types (for data modeling) are:

- leaf node - contains a single value of a specific type
- list node - contains a sequence of list entries, each of which is uniquely identified by one or more key leafs
- leaf-list node - contains a sequence of leaf nodes
- container node - contains a grouping of related nodes containing only child nodes, which can be any of the four node types

Data types

YANG defines data types for leaf values. These data types help the user in understanding the relevant input for a leaf.

Name	Description
binary	Any binary data
bits	A set of bits or flags

Name	Description
boolean	"true" or "false"
decimal64	64-bit signed decimal number
empty	A leaf that does not have any value
enumeration	Enumerated strings
identityref	A reference to an abstract identity
instance-identifier	References a data tree node
int (integer-defined values)	8-bit, 16-bit, 32-bit, 64-bit signed integers
leafref	A reference to a leaf instance
uint	8-bit, 16-bit, 32-bit, 64-bit unsigned intergers
string	Human-readable string
union	Choice of member types

Data Model and CLI Comparison

Each feature has a defined YANG model that is synthesized from the schemas. A model in a tree format includes:

- Top level nodes and their subtrees
- Subtrees that augment nodes in other yang models
- Custom RPCs

The options available using the CLI are defined as leaf-nodes in data models. The defined data types, indicated corresponding to each leaf-node, help the user to understand the required inputs.

gRPC

gRPC is a language-neutral, open source, RPC (Remote Procedute Call) system developed by Google. By default, it uses protocol buffers as the binary serialization protocol. It can be used with other serialization protocols as well such as JSON, XML etc. The user needs to define the structure by defining protocol buffer message types in.*proto* files. Each protocol buffer message is a small logical record of information, containing a series of name-value pairs.

gRPC encodes requests and responses in binary. Although Protobufs was the only format supported in the initial release, gRPC is extensible to other content types. The Protobuf binary data object in gRPC is transported using HTTP/2 (RFC 7540). HTTP/2 is a replacement for HTTP that has been optimized for high performance. HTTP/2 provides many powerful capabilities including bidirectional streaming, flow control, header compression and multi-plexing. gRPC builds on those features, adding libraries for application-layer flow-control, load-balancing and call-cancellation.

gRPC supports distributed applications and services between a client and server. gRPC provides the infrastructure to build a device management service to exchange configuration and operational data between a client and a server in which the structure of the data is defined by YANG models.

Cisco gRPC IDL

The protocol buffers interface definition language (IDL) is used to define service methods, and define parameters and return types as protocol buffer message types.

gRPC requests can be encoded and sent across to the router using JSON. gRPC IDL also supports the exchange of CLI.

For gRPC transport, gRPC IDL is defined in .proto format. Clients can invoke the RPC calls defined in the IDL to program XR. The supported operations are - Get, Merge, Delete, Replace. The gRPC JSON arguments are defined in the IDL.

```
syntax = "proto3";

package IOSXRExtensibleManagabilityService;

service gRPCConfigOper {

    rpc GetConfig(ConfigGetArgs) returns(stream ConfigGetReply) {};

    rpc MergeConfig(ConfigArgs) returns(ConfigReply) {};

    rpc DeleteConfig(ConfigArgs) returns(ConfigReply) {};

    rpc ReplaceConfig(ConfigArgs) returns(ConfigReply) {};

    rpc CliConfig(CliConfigArgs) returns(CliConfigReply) {};

}
```

gRPC Operations

- oper get-config—Retrieves a configuration
- oper merge-config— Appends to an existing configuration
- oper delete-config—Deletes a configuration
- oper replace-config—Modifies a part of an existing configuration
- oper get-oper—Gets operational data using JSON
- oper cli-config—Performs a configuration
- oper showcmdtextoutput

gNOI for BERT

Table 1: Feature History

Feature Name	Release Information	Description
gNOI for BERT	Cisco IOS XR Release 24.4.1	Extensible Manageability Services (EMS) gNOI supports Bit Error Rate Testing (BERT) operations on NCS 1014 for the following remote procedure calls (RPCs): • StartBERT • StopBERT • GetBERTResults gNOI for BERT is a vendor agnostic open configuration method of enabling and testing network links through the Pseudo Random Binary Sequence (PRBS) feature.

gRPC Network Operations Interface (gNOI) defines a set of gRPC-based microservices for executing operational commands on network devices. Extensible Manageability Services (EMS) gNOI is the Cisco IOS XR implementation of gNOI.

gNOI uses gRPC as the transport protocol and the configuration is same as that of gRPC.

From R24.4.10R24.4.1, EMS gNOI supports Bit Error Rate Testing (BERT) operations on NCS 1014 for the following remote procedure calls (RPCs):

- StartBERT
- StopBERT
- GetBERTResults

Start a New BERT Session

StartBERT

Starts a new BERT operation for a set of ports. Each BERT operation is uniquely identified by an ID, which is given by the caller. The caller can then use this ID (as well as the list of the ports) either to stop the BERT operation or get the BERT results, or can perform both BERT operations.

```
rpc StartBERT(StartBERTRequest) returns(StartBERTResponse) {}
```

Request and response messages

```
RPC to 10.127.60.184:57400
RPC start time: 13:59:45.488759
RPC start time: 13:59:45.488777
per_port_request for  startbert  is
 interface {
```

```
  elem {
    name: "terminal-device"
  }
  elem {
    name: "logical-channels"
  }
  elem {
    name: "channel"
    key {
      key: "index"
      value: "4014"
    }
  }
}
prbs_polynomial: PRBS_POLYNOMIAL_PRBS31
test_duration_in_secs: 360

Diag.StartBert Response
test_bert3
[interface {
  elem {
    name: "terminal-device"
  }
  elem {
name: "logical-channels"
  }
  elem {
    name: "channel"
    key {
      key: "index"
      value: "4014"
    }
  }
}
status: BERT_STATUS_OK
]
RPC end time: 13:59:45.816653
RPC end time: 2024-11-05 08:29:45.816739
```

The supported values for **prbs_polynomial** on NCS1014:

- **Trunk Ports** — PRBS7, PRBS13, PRBS23, and PRBS31
- **Client Ports** — PRBS23 and PRBS31

The **StartBERT** RPC can return an error status in any one of the following scenarios:

- When BERT operation is supported on none of the ports specified by the request.
- When BERT is already in progress on any port specified by the request.
- In case of any low-level hardware or software internal errors.

The RPC returns an **OK** status when there is no error situation encountered.

Stop and Delete an Existing BERT Session from the Device

Stops an already in-progress BERT operation on a set of ports. The caller uses the BERT operation ID it previously used when starting the operation to stop it.

StopBERT

```
rpc StopBERT(StopBERTRequest) returns(StopBERTResponse) {}
```

Request and response messages

```
message StopBERTRequest {
RPC to 10.127.60.184:57400
RPC start time: 13:59:27.642444
RPC start time: 13:59:27.642462
per_port_request for  stopbert  is
 interface {
  elem {
    name: "terminal-device"
  }
  elem {
    name: "logical-channels"
  }
  elem {
    name: "channel"
    key {
      key: "index"
      value: "4014"
    }
  }
}

bert_operation_id: "test_bert3"
per_port_requests {
  interface {
    elem {
      name: "terminal-device"
    }
    elem {
      name: "logical-channels"
    }
    elem {
      name: "channel"
      key {
        key: "index"
        value: "4014"
      }
    }
  }
}

message StopBERTResponse {
  bert_operation_id: "test_bert3"
per_port_responses {
  interface {
    origin: "openconfig-terminal-device"
    elem {
      name: "terminal-device"
    }
    elem {
      name: "logical-channels"
    }
    elem {
      name: "channel"
      key {
        key: "index"
        value: "4014"
      }
```

```
    }
  }
  status: BERT_STATUS_OK
}

Diag.StopBert Response

test_bert3
[interface {
  origin: "openconfig-terminal-device"
  elem {
    name: "terminal-device"
  }
  elem {
    name: "logical-channels"
  }
  elem {
    name: "channel"
    key {
      key: "index"
      value: "4014"
    }
  }
}
status: BERT_STATUS_OK
]
RPC end time: 13:59:27.726083
RPC end time: 2024-11-05 08:29:27.726099

}
```

When the **PerPortRequest** field is not configured, then the device stops and deletes BERT sessions on all the ports associated with the BERT ID.

The RPC is expected to return an error status in any one of the following situations:

- When there is at least one BERT operation in progress on a port which cannot be stopped in the middle of the operation (either due to lack of support or internal problems).
- When no BERT operation, which matches the given BERT operation ID, is in progress or completed on any of the ports specified by the request.

The **StopBERT** RPC returns to an **OK** status when there is no error situation is encountered.

Note The BERT operation is considered completed if the device has a record or history of it. Also note that you might receive a stop request for a port which has completed BERT, as long as the recorded BERT operation ID matches the one specified by the request.

Get BERT Statistics for an Existing Session

Gets BERT results during the BERT operation or after the operation completes. The caller uses the BERT operation ID that it previously used when starting the operation to query it. The device stores results for the last BERT based on the required period of time.

GetBERTResults

```
rpc GetBERTResult(GetBERTResultRequest) returns(GetBERTResultResponse) {}
```

Request and response messages

```
message GetBERTResultRequest {
  RPC to 10.127.60.184:57400
RPC start time: 14:00:01.623902
RPC start time: 14:00:01.623919
per_port_request for  getbertresult  is
 interface {
  elem {
    name: "terminal-device"
  }
  elem {
    name: "logical-channels"
  }
  elem {
    name: "channel"
    key {
      key: "index"
      value: "4014"
    }
  }
}

message GetBERTResultResponse {
  test_bert3
[interface {
  elem {
    name: "terminal-device"
  }
  elem {
    name: "logical-channels"
  }
  elem {
    name: "channel"
    key {
      key: "index"
      value: "4014"
    }
  }
}
status: BERT_STATUS_OK
]
RPC end time: 13:59:45.816653
RPC end time: 2024-11-05 08:29:45.816739

}
```

When the **per_port_requests** is ignored, then the device returns results and status for all the ports associated with the BERT ID.

The following table lists the descriptions of BERT results and status.

Table 2: BERT Results and Status

Field	Description
interface	Port in **types.Path** format representing a path in the open configuration interface model.

Field	Description
status	• **BERT_STATUS_OK** denotes that the BERT session is active. • **BERT_STATUS_PORT_NOT_RUNNING_BERT** denotes that BERT is not running as the duration has expired. • **BERT_STATUS_NON_EXISTENT_PORT** denotes that specified port is not found. • **BERT_STATUS_UNSUPPORTED_PRBS_POLYNOMIAL** denotes that PRBS generating polynomial is not supported by the target. • **BERT_STATUS_PORT_ALREADY_IN_BERT** denotes that there is already a BERT running on the specified port. Returns when the StartBERT RPC attempts to initiate BERT on a port that is already in use. • **BERT_STATUS_OPERATION_ID_IN_USE** denotes that the specified BERT operation ID is already in use. This occurs when the StartBERT RPC attempts to use an ID that has already been assigned to an existing BERT operation. • **BERT_STATUS_OPERATION_ID_NOT_FOUND** denotes that the specified BERT operation ID is not recognized. This response is applicable for both StopBERT and GetBERTResult RPCs.
bert_operation_id	BERT operation ID that the port is associated with.
test_duration_in_secs	BERT duration in seconds. Must be a positive number.
prbs_polynomial	The PRBS polynomial value that is configured.
last_bert_start_timestamp	Start operation timestamp in form of a 64-bit value UNIX time, which is the number of seconds elapsed since January 1, 1970 UTC.
repeated last_bert_get_results_timestamp	Timestamp of the last GetBERTResults operation in form of a 64-bit value UNIX time, which is the number of seconds elapsed since January 1, 1970 UTC.
peer_lock_established	Current status of peer lock. Note that there could be a 10-second delay in updating this field.
peer_lock_lost	Indicates if the peer lock is lost anytime after a peer lock is established. This field is only meaningful if **peer_lock_established** field is set.

Field	Description
error_count_per_minute	A list of one-minute historical PM buckets containing bit error counts. Historical buckets are maintained since the StartBERT operation started.
total_errors	Cumulative count of bit errors of the StartBERT operation.

The GetBERTResults RPC can return error status in any one of the following scenarios:

- When no BERT operation, which matches the given BERT operation ID, is in-progress or completed on any of the ports specified by the request.
- When the BERT operation ID does not match the in progress or completed BERT operation on any of the ports specified by the request.

The RPC returns an **OK** status when none of these situations is encountered.

Note The BERT operation is considered as completed only when the device has a record of it.

gNOI Healthz service

Table 3: Feature History

Feature Name	Release Information	Feature Description
gNOI Healthz	Cisco IOS XR Release 25.2.1	The gNOI Healthz sub-functions monitor and manage the state of a device by leveraging telemetry within the network. These sub-functions help determine the device's system state and facilitate the collection of relevant debug logs based on that state, using the OpenConfig Healthz model.

The gNOI Healthz is a gRPC service that focuses on the health checks and monitoring of network devices. It determines whether the nodes of a network are fully functional, degraded, or need to be replaced. The gNOI Healthz process involves:

- Waiting for health status data from various subsystem components
- Inspecting and analyzing health status data to identify any unhealthy entities, and
- Collecting the debug logs of the corresponding unhealthy component

gNOI Healthz, in conjunction with gNMI telemetry, monitors the health of network components.

When a component becomes `HEALTHY` or `UNHEALTHY`, telemetry updates are sent for that health event. For more details about the health event, see gNOI Healthz RPCs. When a system component changes its state to

UNHEALTHY, the intended artifacts (debug logs, core file, and so on) are generated automatically at the time of the health event.

XR health event dampening is enabled by default to manage and stabilize health-event behavior. It works by suppressing excessive state changes or flapping events to ensure the system remains stable.

Supported components

Hardware:

- Rack 0
- 0/RP0/CPU0
- Line cards

See Healthz hardware events list, on page 14.

Device health status updates workflow

This section describes the workflow for monitoring and managing device component health status using gNOI Healthz RPCs and telemetry.

1. The client subscribes to the component's OpenConfig path with an ON_CHANGE request and waits for a health event to occur. When a health event is detected in the device for that component, the client receives a notification. The client monitors these health parameters:
   - **status**: HEALTHY, UNHEALTHY, or UNKNOWN
   - **last-unhealthy**: Timetsamp of last known healthy state
   - **unhealthy-count**: Number of times the particular component is reported unhealthy
2. When the device receives gNOI Healthz RPCs from gNOI client, it performs these actions and responds to the gNOI client.

Table 4: gNOI Healthz RPCs

When the gNOI client sends...	The device...
Get RPC	retrieves the latest set of health statuses that are associated with a specific component and its subcomponents.
List RPC	returns all events that are associated with a device.
Artifact RPC	retrieves specific artifacts that are listed by the target system in the List() or Get() RPC.
Acknowledge RPC	acknowledges a series of artifacts that are listed by the Acknowledge() RPC.
Check RPC	performs intensive health checks that may impact the service, ensuring they are done intentionally to avoid disruptions.

Examples of heath status transmitted through EDT

When a system component becomes unhealthy, the system transmits health state information via telemetry, indicating that the healthz/state/status of the component has transitioned to **UNHEALTHY**. An example EDT notification received by the client is:

```
{
  "source": "10.127.60.184:57400",
  "subscription-name": "default-1748690348",
  "timestamp": 1748690279018280149,
  "time": "2025-05-31T16:47:59.018280149+05:30",
  "prefix": "openconfig:",
  "updates": [
    {
      "Path": "components/component[name=Rack 0]/healthz",
      "values": {
        "components/component/healthz": {
          "state": {
            "last-unhealthy": "1748690279018280149",
            "status": "UNHEALTHY",
            "unhealthy-count": "8"
          }
        }
      }
    }
  ]
}
```

An example of EDT notification received by the client, when a system component becomes healthy:

```
{
  "source": "192.0.1.0:57400",
  "subscription-name": "default-1748690348",
  "timestamp": 1748690408752434448,
  "time": "2025-05-31T16:50:08.752434448+05:30",
  "prefix": "openconfig:",
  "updates": [
    {
      "Path": "components/component[name=Rack 0]/healthz",
      "values": {
        "components/component/healthz": {
          "state": {
            "last-unhealthy": "1748690279018280149",
            "status": "HEALTHY",
            "unhealthy-count": "8"
          }
        }
      }
    }
  ]
}
```

Healthz hardware events list

This table lists the hardware events that can lead to an unhealthy health status.

Table 5: Healthz hardware events list

Alarm Name	OC_COMP	Health Status
FAN-TRAY-ABSENT	Rack 0	Unhealthy

Alarm Name	OC_COMP	Health Status
CPU_NOT_SEATED_PROPERLY_FAILURE	Rack 0	Unhealthy
CPU_PRESENCE_PIN_FAILURE	Rack 0	Unhealthy
CPU-FPGA-PCIE-ERROR	0/RP0/CPU0	Unhealthy
PHY1-MDIO-ACCESS-ERROR	0/RP0/CPU0	Unhealthy
EITU-FPGA-PCIE-ERROR	0/RP0/CPU0	Unhealthy
FAM_FAULT_TAG_LC_METADX1_FAILURE0 **FAM_FAULT_TAG_LC_METADX1_FAILURE1**	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_RAM_FAILURE	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_FPGA_FAILURE	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_BOARD_IO_FAILURE	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_VIRTUAL_WIRE_FAILURE0 **FAM_FAULT_TAG_LC_VIRTUAL_WIRE_FAILURE1**	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_PLL_FAILURE	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_METADX2_FAILURE0 **FAM_FAULT_TAG_LC_METADX2_FAILURE1** **FAM_FAULT_TAG_LC_METADX2_FAILURE2** **FAM_FAULT_TAG_LC_METADX2_FAILURE3** **FAM_FAULT_TAG_LC_METADX2_FAILURE4**	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_CPU_CORRUPTION	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_FPD_FAILURE	Line card Location	Unhealthy
FAM_FAULT_TAG_CRYPTO_HW_FAILURE	Line card Location	Unhealthy
FAM_FAULT_TAG_LC_BOARD_IO1_FAILURE	Line card Location	Unhealthy

Verify device health using gNOI RPCs

Follow these steps to monitor health status telemetry of a device using gNOI healthz RPC.

Procedure

Step 1 Monitor health state of the device.

Example:

```
RP/0/RP0/CPU0:ios#show health status
Wed Jul 24 10:03:29.811 UTC
SNo   Component name                          Health status
----- ------------------------------------- --------------------
1     0_RP0_CPU0-appmgr                     healthy
2     0_RP0_CPU0-ownershipd                 healthy
RP/0/RP0/CPU0:ios#
RP/0/RP0/CPU0:ios#show health status 0_RP0_CPU0-appmgr
Wed Jul 24 10:03:46.859 UTC
Sno   Event Id            Timestamp           Status     Artifacts
----- ------------------- ------------------- ---------- --------------------------------
1     1721815321290718105 Jul 24 10:02:01 UTC healthy    []

2     1721815320614225976 Jul 24 10:02:00 UTC unhealthy  ['/harddisk:/eem_ac_logs/xrhealth
                                                         /artifacts/procmgr_event_20240724
                                                         100205.tar.gz', '/misc/disk1/appm
                                                         gr_8921.by.11.20240724-100159.nod
                                                         e0_RP0_CPU0.09b9c.core.gz']
```

Step 2 Monitor device health with gNOI **Get RPC**.

Example:

```
ios#/auto/appmgr/xrhealth/bin/gnoic -a 192.0.2.184:57400 --insecure -u cisco -p cisco123  healthz
get --path "openconfig:/components/component[name=${OC_COMP}]"
WARN[0000] "192.0.2.184:57400" path     : openconfig:components/component[name=Rack 0]
  status   : STATUS_UNHEALTHY
  id       : 1748850022419622614
  acked    : false
  created  : 2025-06-02 07:40:22.419622614 +0000 UTC
  expires  : 2025-06-09 07:40:22.041962261 +0000 UTC
  artifict :
    - id       : Rack
0-1748850022419622614-704c7b084eb499ade4fb9c8636fd70fc34cb683b344625ee20e46f7b79b312ad
      name     : Rack_0_SYSTEM_HW_ERROR_FAM_FAULT_TAG_FAN_TRAY_ABSENT_20250602131022.tar
      path     :
/harddisk:/eem_ac_logs/xrhealth/artifacts/Rack_0_SYSTEM_HW_ERROR_FAM_FAULT_TAG_FAN_TRAY_ABSENT_20250602131022.tar
      mimeType : application/x-tar
      size     : 30720
      hash     : SHA256(7cc93c4c829f5899552d8bb8449b5e4662f8ffdbd8d43636ef2446871349e613)

================================================================================

  path     : openconfig:components/component[name=Rack 0]
  status   : STATUS_HEALTHY
  id       : 1748698891342716588
  acked    : false
  created  : 2025-05-31 13:41:31.342716588 +0000 UTC
  expires  : 2025-06-07 13:41:31.003427167 +0000 UTC
```

Step 3 Monitor device health with gNOI **Check RPC**.

Example:

```
ios#/auto/appmgr/xrhealth/bin/gnoic -a 192.0.2.184:57400 --insecure -u cisco -p cisco123  healthz
check --path "openconfig:/components/component[name=${OC_COMP}]"
WARN[0000] "192.0.2.184:57400" could not lookup hostname: lookup 198.51.100.10.in-addr.arpa. on
64.104.128.236:53: no such host
target "192.0.2.184:57400":
+-----------------+--------------------+-------------------------------------------+--------+
|   Target Name   |         ID         |                   Path                    |
Status    |              Created At              |
Artifact ID                                 | Artifact Type |
+-----------------+--------------------+-------------------------------------------+--------+
| 192.0.2.184:57400 | 1748850219768107864 | openconfig:components/component[name=Rack 0] |
```

```
STATUS_UNHEALTHY | 2025-06-02 07:43:39.769145114 +0000 UTC |
 Rack 0-1748850219768107864-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c | file
         |
+--------+--------+-------------------+--------+-----------------+-------------------------------------------------------------------+------+
```

On the NCS1014, the Check RPC collects the "show tech ncs10xx" file as an artifact. The artifact is stored in the system directory: /harddisk:/eem_ac_logs/xrhealth/artifacts/.

The Check RPC request typically takes 15-20 minutes to complete.

A CheckRequest for a previous event_id does not overwrite artifacts collected during the event time.

Step 4 Monitor device health with gNOI **List RPC**.

Example:

```
ios#/auto/appmgr/xrhealth/bin/gnoic -a 192.0.2.184:57400 --insecure -u cisco -p cisco123  healthz
list --path "openconfig:/components/component[name=${OC_COMP}]"
WARN[0000] "192.0.2.184:57400" could not lookup hostname: lookup 198.51.100.10.in-addr.arpa. on
64.104.128.236:53: no such host
target "192.0.2.184:57400":
+---------+---------+-------------------+--------+-----------------+-------------------------------------------------------------------+
|     Target Name     |         ID          |                    Path                     |
Status      |              Created At               |
Artifact ID                                       |
+---------+---------+-------------------+--------+-----------------+-------------------------------------------------------------------+
| 192.0.2.184:57400 | 1748690279018280149 | openconfig:components/component[name=Rack 0] |
STATUS_UNHEALTHY | 2025-05-31 11:17:59.018280149 +0000 UTC | Rack 0-
1748690279018280149-12a0fa57b1624baae49f742a791d3017ecf219eeb32fb9187a3f9602d0856ba5 |
| 192.0.2.184:57400 | 1748690408752434448 | openconfig:components/component[name=Rack 0] |
STATUS_HEALTHY   | 2025-05-31 11:20:08.752434448 +0000 UTC   |

| 192.0.2.184:57400 | 1748850022419622614 | openconfig:components/component[name=Rack 0] |
STATUS_UNHEALTHY | 2025-06-02 07:40:22.419622614 +0000 UTC | Rack 0-
1748850022419622614-704c7b084eb499ade4fb9c8636fd70fc34cb683b344625ee20e46f7b79b312ad |
| 192.0.2.184:57400 | 1748850219768107864 | openconfig:components/component[name=Rack 0] |
STATUS_UNHEALTHY | 2025-06-02 07:43:39.769145114 +0000 UTC | Rack 0-
1748850219768107864-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c |
+-------------+-------------+-----------------------------------+-----------+-------------------------+-----------------------


ios#/auto/appmgr/xrhealth/bin/gnoic -a 192.0.2.184:57400 --insecure -u cisco -p cisco123  healthz
list --path "openconfig:/components/component[name=${OC_COMP}]" --acked
WARN[0000] "192.0.2.184:57400" could not lookup hostname: lookup 198.51.100.10.in-addr.arpa. on
64.104.128.236:53: no such host
target "192.0.2.184:57400":
+---------+---------+-------------------+--------+-----------------+-------------------------------------------------------------------+
|     Target Name     |         ID          |                    Path                     |
Status      |              Created At               |
Artifact ID                                       |
+---------+---------+-------------------+--------+-----------------+-------------------------------------------------------------------+
| 192.0.2.184:57400 | 1748350110127223712 | openconfig:components/component[name=Rack 0] |
STATUS_UNHEALTHY | 2025-05-27 12:48:30.127223712 +0000 UTC |
Rack 0-1748350110127223712-3c2027c2f3a0f3b86d7e75ffb394807aab9c87f5d47e153f9c40dc78f66b7227 |
| 192.0.2.184:57400 | 1748350110127223712 | openconfig:components/component[name=Rack 0] |
STATUS_UNHEALTHY | 2025-05-27 12:48:30.127223712 +0000 UTC |
Rack 0-1748350110127223712-067f9b0ef240f92a0b19905306d8dd53dc699574d3720452bde39e630942b8e7 |
| 192.0.2.184:57400 | 1748351569014046087 | openconfig:components/component[name=Rack 0] |
STATUS_HEALTHY   | 2025-05-27 13:12:49.014046087 +0000 UTC |
                                                  |
| 192.0.2.184:57400 | 1748417625250765686 | openconfig:components/component[name=Rack 0] |
STATUS_UNHEALTHY | 2025-05-28 07:33:45.250765686 +0000 UTC |
Rack 0-1748417625250765686-799aebceab6827ec62fa65521ab927738fea2d75f0210d230026c3694831e781 |
| 192.0.2.184:57400 | 1748418605270788333 | openconfig:components/component[name=Rack 0] |
```

```
STATUS_HEALTHY   | 2025-05-28 07:50:05.270788333 +0000 UTC |
                                                           |
```

Step 5 Monitor device health with gNOI **Artifact RPC**.

Example:

```
ios#/auto/appmgr/xrhealth/bin/gnoic -a 192.0.2.184:57400 --insecure -u cisco -p cisco123  healthz
artifact --id "Rack
0-17488502197681078 64-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c"
WARN[0000] "192.0.2.184:57400" could not lookup hostname: lookup 198.51.100.10.in-addr.arpa. on
64.104.128.236:53: no such host
INFO[0003] 192.0.2.184:57400: received file header for artifactID: Rack
0-17488502197681078 64-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c
id:  "Rack 0-17488502197681078 64-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c"
file:  {
  name:  "showtech-dt_healthz-ncs10xx-2025-Jun-02.131340.IST.tgz"
  path:
"/harddisk:/eem_ac_logs/xrhealth/artifacts/showtech-dt_healthz-ncs10xx-2025-Jun-02.131340.IST.tgz"
  mimetype:  "application/octet-stream"
  size:  138887423
  hash:  {
    method:  SHA256
    hash:  "vU5\x85l@\xd32\x1b\xe4\xd5w\xfbc\x07\x18w\x96= \xbc\xd1\x13Y\x94\xba\x1e-w\x1b\xda\xfc"
  }
}

INFO[0003] received 65536 bytes for artifactID: Rack
0-17488502197681078 64-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c
INFO[0007] received 16639 bytes for artifactID: Rack
0-17488502197681078 64-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c
INFO[0007] 192.0.2.184:57400: received trailer for artifactID: Rack
0-17488502197681078 64-348a1a481f4b464d72c2f90648c85d2870525943f601aee745649c1e3fb8102c
INFO[0007] 192.0.2.184:57400: received 138887423 bytes in total
INFO[0007] 192.0.2.184:57400: comparing file HASH
INFO[0007] 192.0.2.184:57400: HASH OK
ios$
```

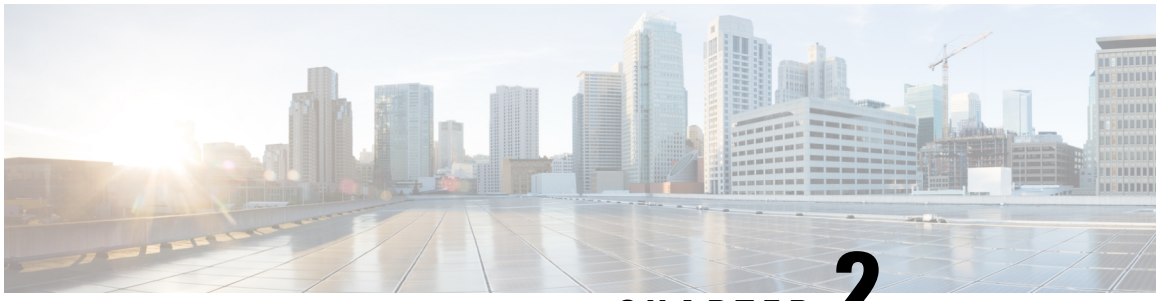
Step 6 Monitor device health with gNOI **Acknowledge RPC**.

Example:

```
ios#/auto/appmgr/xrhealth/bin/gnoic -a 192.0.2.184:57400 --insecure -u cisco -p cisco123  healthz
ack --path "openconfig:/components/component[name=${OC_COMP}]" --id 1748853831199330797
WARN[0000] "192.0.2.184:57400" could not lookup hostname: lookup 198.51.100.10.in-addr.arpa. on
64.104.128.236:53: no such host

target "192.0.2.184:57400":
  path     : openconfig:components/component[name=Rack 0]
  status   : STATUS_UNHEALTHY
  id       : 1748853831199330797
  acked    : true
  created  : 2025-06-02 08:43:51.199330797 +0000 UTC
  expires  : 2025-06-09 08:43:51.019933079 +0000 UTC
  artifict :
    - id       : Rack
0-1748853831199330797-74773059551bb85a0629a6ac8e00aacf3c65af1530033c9d74909194243a2c08
      name     : Rack_0_SYSTEM_HW_ERROR_FAM_FAULT_TAG_FAN_TRAY_ABSENT_20250602141351.tar
      path     :
/harddisk:/eem_ac_logs/xrhealth/artifacts/Rack_0_SYSTEM_HW_ERROR_FAM_FAULT_TAG_FAN_TRAY_ABSENT_20250602141351.tar
      mimeType : application/x-tar
      size     : 30720
      hash     : SHA256(051c2d0325e11ec0efb18521e76a3d53d2f6153813f90f0d240d56769a6f511f)
```

```
ios$
```



CHAPTER 2

Using Data Models

Use Data Models

Figure 1: Workflow for using Data models

The above illustration gives a quick snap shot of how YANG can be used with Netconf in configuring a network device using a client application.

The tasks that help the user to implement Data model configuration are listed here.

1. Load the software image ; the YANG models are a part of the software image. Alternatively, the YANG models can also be downloaded from:

   ```
   https://github.com/YangModels/yang/tree/master/vendor/cisco/xr
   ```

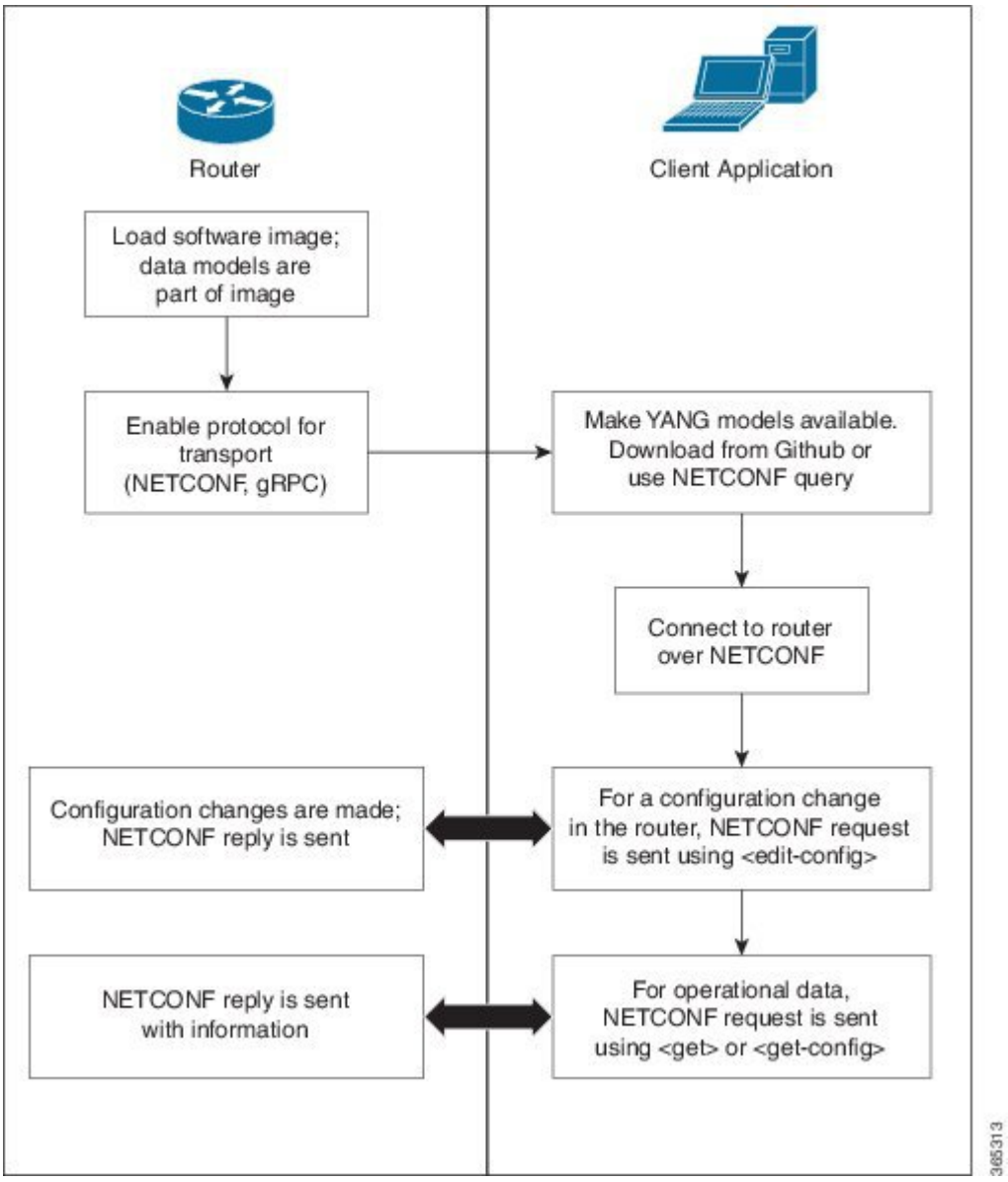
   Users can also query using NETCONF to get the list of models.

   ```
   <?xml version="1.0" encoding="utf-8"?>
   <rpc message-id="100" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <get>
           <filter type="subtree">
               <netconf-state xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-monitoring">

                   <schemas/>
               </netconf-state>
           </filter>
       </get>
   </rpc>
   ```

2. Communication between the router and the application happens by Netconf over SSH. Enable Netconf on the router on a suitable port.
3. From the client application, connect to the router using Netconf over SSH. Run Netconf operations to make configuration changes or get operational data.

Figure 2: Lane Diagram to show the router and client application operations



Enabling Netconf

This task enables Netconf over SSH.

Before you begin

- Install the required packages (k9sec and mgbl)
- Generate relevant crypto keys

Procedure

Step 1 **netconf-yang agent ssh**

Enables the Netconf agent process.

Step 2 **ssh server netconf**

Enables Netconf.

Step 3 **ssh server v2**

Enables SSH on the device and enables Netconf on port 22 if the Netconf agent process is enabled.

What to do next

The **netconf-yang agent session** command enables the user to set session parameters.

```
netconf-yang agent session {limit value |  absolute-timeout value |  idle-timeout value}
```

where,

- **limit** *value*- sets the maximum count for concurrent netconf-yang sessions. Range is 1 to 1024. The default value is 50.
- **absolute-timeout** *value*- sets the absolute session lifetime. Range is 1 to 1440 (in minutes).
- **idle-timeout** *value*- sets the idle session lifetime. Range is 1 to 1440 (in minutes).

Enabling gRPC

Use the following procedure to enable gRPC over HTTPS/2. gRPC supports both, the IPv4 and IPv6 address families (default is IPv4).

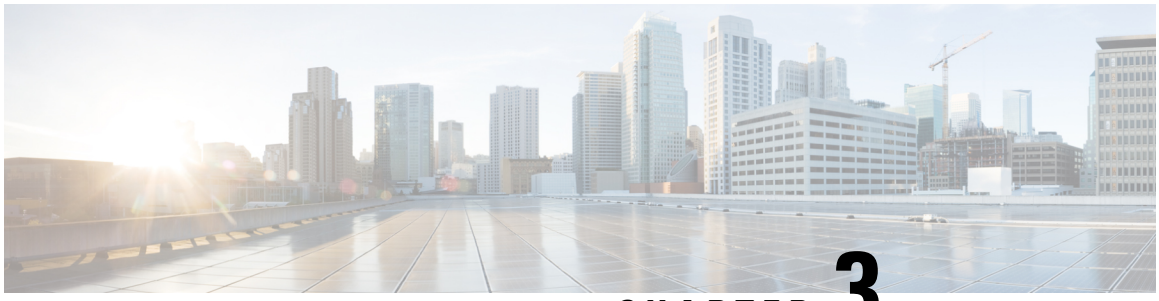
Procedure

Step 1 Install the GO client. For more details on installing the GO client, see https://golang.org/doc/install.

Step 2 Configure the gRPC port, using the **grpc port** command.

```
RP/0/RP0/CPU0:ios(config)#grpc
RP/0/RP0/CPU0:ios(config)#port 57400
RP/0/RP0/CPU0:ios(config)#tls
RP/0/RP0/CPU0:ios(config)#commit
```

Port can range from 57344 to 57999. If a port is unavailable, an error is displayed.



CHAPTER 3

Supported YANG Models in NCS 1014

Supported Yang Models

The following is the list of supported config, oper, and act YANG models for NCS 1014:

Table 6: Native Models

Config Models	Oper Models
Cisco-IOS-XR-osa-linesystem-cfg.yang	Cisco-IOS-XR-osa-hwmod-linesys-oper.yang
Cisco-IOS-XR-controller-ots-cfg.yang	Cisco-IOS-XR-controller-ots-oper.yang
Cisco-IOS-XR-ots-och-cfg.yang	Cisco-IOS-XR-controller-ots-och-oper.yang
Cisco-IOS-XR-controller-oms-cfg	Cisco-IOS-XR-controller-oms-oper.yang
Cisco-IOS-XR-controller-och-cfg	Cisco-IOS-XR-controller-och-oper.yang
Cisco-IOS-XR-controller-osc-cfg.yang	Cisco-IOS-XR-controller-osc-oper.yang
Cisco-IOS-XR-controller-dfb-cfg.yang	Cisco-IOS-XR-controller-dfb-oper.yang
Cisco-IOS-XR-pmengine-cfg.yang	Cisco-IOS-XR-pmengine-oper.yang
Cisco-IOS-XR-olc-cfg.yang	Cisco-IOS-XR-olc-oper.yang
Cisco-IOS-XR-fpd-infra-cfg.yang	
Cisco-IOS-XR-osa-ct-cfg.yang	Cisco-IOS-XR-osa-controller-optics-oper.yang
Cisco-IOS-XR-osa-sp-cfg.yang	Cisco-IOS-XR-osa-hwmod-linesys-oper.yang
Cisco-IOS-XR-osa-cfg.yang	Cisco-IOS-XR-osa-oper.yang
Cisco-IOS-XR-ikev2-cfg.yang	Cisco-IOS-XR-ikev2-oper.yang
Cisco-IOS-XR-controller-optics-cfg.yang	Cisco-IOS-XR-controller-optics-oper.yang

Config Models	Oper Models
Cisco-IOS-XR-ethernet-lldp-cfg.yang	Cisco-IOS-XR-ethernet-lldp-oper.yang
Cisco-IOS-XR-telemetry-model-driven-cfg.yang	Cisco-IOS-XR-telemetry-model-driven-oper.yang
Cisco-IOS-XR-ifmgr-cfg.yang	Cisco-IOS-XR-envmon-oper.yang
Cisco-IOS-XR-fpd-infra-cfg.yang	Cisco-IOS-XR-show-fpd-loc-ng-oper.yang
Cisco-IOS-XR-invproxy-hwmodule-cfg.yang	Cisco-IOS-XR-procfind-oper.yang
Cisco-IOS-XR-syncc-controller-cfg.yang	Cisco-IOS-XR-procthreadname-oper.yang
Cisco-IOS-XR-drivers-media-eth-gl-pfc-wd-cfg.yang	Cisco-IOS-XR-invmgr-oper.yang
Cisco-IOS-XR-drivers-media-eth-cfg.yang	Cisco-IOS-XR-plat-chas-invmgr-ng-oper.yang
Cisco-IOS-XR-drivers-icpe-ethernet-cfg.yang	Cisco-IOS-XR-platform-oper.yang
Cisco-IOS-XR-drivers-media-eth-cfg.yang	Cisco-IOS-XR-invmgr-diag-oper.yang
Cisco-IOS-XR-drivers-media-eth-gl-pfc-wd-cfg.yang	Cisco-IOS-XR-nto-misc-oper.yang
Cisco-IOS-XR-sysmgr-cfg.yang	Cisco-IOS-XR-wd-oper.yang
Cisco-IOS-XR-um-ncs-hw-module-osa-cfg.yang	Cisco-IOS-XR-ledmgr-oper.yang
	Cisco-IOS-XR-shellutil-filesystem-oper.yang
	Cisco-IOS-XR-shellutil-oper.yang
	Cisco-IOS-XR-drivers-media-eth-oper.yang
	Cisco-IOS-XR-mediasvr-linux-oper.yang
	Cisco-IOS-XR-drivers-media-eth-oper.yang
	Cisco-IOS-XR-sysmgr-oper.yang
	Cisco-IOS-XR-procmem-oper.yang
	Cisco-IOS-XR-procfind-oper.yang
Act Models	
Cisco-IOS-XR-upgrade-fpd-ng-act.yang	
Cisco-IOS-XR-shellutil-delete-act.yang	
Cisco-IOS-XR-drivers-media-eth-act.yang	
Cisco-IOS-XR-shellutil-copy-act.yang	
Cisco-IOS-XR-shellutil-copy-act.yang	
Cisco-IOS-XR-drivers-media-eth-act.yang	
Cisco-IOS-XR-sysmgr-act.yang	

Config Models	Oper Models
Cisco-IOS-XR-system-reboot-act	
Cisco-IOS-XR-install-act.yang	
Cisco-IOS-XR-install-augmented-act	
Cisco-IOS-XR-drivers-media-eth-clear-prbs-act.yang	

The following is the list of supported Open Config models:

Table 7: OpenConfig Models

openconfig-platform.yang
openconfig-platform-transceiver.yang
openconfig-terminal-device.yang
openconfig-interfaces.yang
openconfig-system.yang
openconfig-network-instance
openconfig-procmon.yang

See https://cfnng.cisco.com/ios-xr/yang-explorer/view-data-model for the list of Yang models supported by NCS 1014.

Extending Cisco Native Models for OpenConfig Support

Table 8: Feature History

Feature Name	Release Information	Feature Description
Extending Cisco Native Models for OpenConfig Support	Cisco IOS XR Release 24.3.1	The OpenConfig model is completely supported on NCS 1014 chassis, by extending the existing Cisco native model configuration. It supports the Q-margin and Enhanced Q-margin parameters as part of the extended OpenConfig model.

From R24.3.1 onwards, OpenConfig augmentation support is available for NCS 1014. For any configuration parameters that exist in the Cisco native model but are not included in the OpenConfig model, then such parameters can be added to the OpenConfig model by extending the existing Cisco native model.

Benefits of Using OpenConfig Augmentation

OpenConfig augmentation allows NCS 1014 chassis to be fully managed using OpenConfig models.

Purpose of OpenConfig Augmentation for Cisco Native Models

The purpose is to identify errors in signal transmission by including Q margin and Enhanced Q margin values in the OpenConfig model, which requires adding them as extended leaves within the existing open terminal model configuration.

Enabling OpenConfig Augmentation Support for Cisco Native Models

To enable OpenConfig Augmentation support for Cisco native models in the terminal device refer to the given example.

The entry highlighted in bold shows the newly added OpenConfig model as an extension to the existing Cisco native model.

```
module: openconfig-terminal-device
  +--rw terminal-device
     +--rw config
     +--ro state
     +--rw logical-channels
     |  +--rw channel* [index]
     |     +--rw index                          -> ../config/index
     |     +--rw config
     |     |  +--rw index?                  uint32
     |     |  +--rw description?            string
     |     |  +--rw admin-state?            oc-opt-types:admin-state-type
     |     |  +--rw rate-class?             identityref
     |     |  +--rw trib-protocol?          identityref
     |     |  +--rw logical-channel-type?   identityref
     |     |  +--rw loopback-mode?          oc-opt-types:loopback-mode-type
     |     |  +--rw test-signal?            boolean
     |     +--ro state
     |     |  +--ro index?                  uint32
     |     |  +--ro description?            string
     |     |  +--ro admin-state?            oc-opt-types:admin-state-type
     |     |  +--ro rate-class?             identityref
     |     |  +--ro trib-protocol?          identityref
     |     |  +--ro logical-channel-type?   identityref
     |     |  +--ro loopback-mode?          oc-opt-types:loopback-mode-type
     |     |  +--ro test-signal?            boolean
     |     |  +--ro link-state?             enumeration
     |     +--rw otn
     |     |  +--rw config
     |     |  |  +--rw tti-msg-transmit?             string
     |     |  |  +--rw tti-msg-expected?             string
     |     |  |  +--rw tti-msg-auto?                 boolean
     |     |  |  +--rw tributary-slot-granularity?   identityref
     |     |  +--ro state
     |     |  |  +--ro tti-msg-transmit?             string
     |     |  |  +--ro tti-msg-expected?             string
     |     |  |  +--ro tti-msg-auto?                 boolean
     |     |  |  +--ro tributary-slot-granularity?   identityref
     |     |  |  +--ro tti-msg-recv?                 string
     |     |  |  +--ro rdi-msg?                      string
     |     |  |  +--ro errored-seconds?              yang:counter64
     |     |  |  +--ro severely-errored-seconds?     yang:counter64
     |     |  |  +--ro unavailable-seconds?          yang:counter64
     |     |  |  +--ro code-violations?              yang:counter64
     |     |  |  +--ro errored-blocks?               yang:counter64
     |     |  |  +--ro fec-uncorrectable-blocks?     yang:counter64
     |     |  |  +--ro fec-uncorrectable-words?      yang:counter64
     |     |  |  +--ro fec-corrected-bytes?          yang:counter64
     |     |  |  +--ro fec-corrected-bits?           yang:counter64
     |     |  |  +--ro background-block-errors?      yang:counter64
```

```
|     |  |  +--ro pre-fec-ber
|     |  |  |  +--ro instant?    decimal64
|     |  |  |  +--ro avg?        decimal64
|     |  |  |  +--ro min?        decimal64
|     |  |  |  +--ro max?        decimal64
|     |  |  |  +--ro interval?   oc-types:stat-interval
|     |  |  |  +--ro min-time?   oc-types:timeticks64
|     |  |  |  +--ro max-time?   oc-types:timeticks64
|     |  |  +--ro post-fec-ber
|     |  |  |  +--ro instant?    decimal64
|     |  |  |  +--ro avg?        decimal64
|     |  |  |  +--ro min?        decimal64
|     |  |  |  +--ro max?        decimal64
|     |  |  |  +--ro interval?   oc-types:stat-interval
|     |  |  |  +--ro min-time?   oc-types:timeticks64
|     |  |  |  +--ro max-time?   oc-types:timeticks64
|     |  |  +--ro q-value
|     |  |  |  +--ro instant?    decimal64
|     |  |  |  +--ro avg?        decimal64
|     |  |  |  +--ro min?        decimal64
|     |  |  |  +--ro max?        decimal64
|     |  |  |  +--ro interval?   oc-types:stat-interval
|     |  |  |  +--ro min-time?   oc-types:timeticks64
|     |  |  |  +--ro max-time?   oc-types:timeticks64
|     |  |  +--ro esnr
|     |  |     +--ro instant?    decimal64
|     |  |     +--ro avg?        decimal64
|     |  |     +--ro min?        decimal64
|     |  |     +--ro max?        decimal64
|     |  |     +--ro interval?   oc-types:stat-interval
|     |  |     +--ro min-time?   oc-types:timeticks64
|     |  |     +--ro max-time?   oc-types:timeticks64
|     |  +--ro oc-opt-ext:extended
|     |     +--ro oc-opt-ext:state
|     |        +--ro oc-opt-ext:enhanced-q-margin?   decimal64
|     |        +--ro oc-opt-ext:q-margin
|     |           +--ro oc-opt-ext:instant?    decimal64
|     |           +--ro oc-opt-ext:avg?        decimal64
|     |           +--ro oc-opt-ext:min?        decimal64
|     |           +--ro oc-opt-ext:max?        decimal64
|     |           +--ro oc-opt-ext:interval?   Decimal64
|     |           +--ro oc-opt-ext:min-time?   decimal64
|     |           +--ro oc-opt-ext:max-time?   decimal64
|     +--rw ethernet
|     |  +--rw config
|     |  |  +--rw client-als?   enumeration
.....................
.....................

  augment /oc-platform:components/oc-platform:component:
    +--rw optical-channel
       +--rw config
       |  +--rw frequency?             oc-opt-types:frequency-type
       |  +--rw target-output-power?   decimal64
       |  +--rw operational-mode?      uint16
       |  +--rw line-port?             -> /oc-platform:components/component/name
       +--ro state
       |  +--ro frequency?                                  oc-opt-types:frequency-type
       |  +--ro target-output-power?                        decimal64
       |  +--ro operational-mode?                           uint16
       |  +--ro line-port?                                  ->
/oc-platform:components/component/name
       |  +--ro group-id?                                   uint32
       .....................
```

```
      ..................
```

Augmented Model

This is the augmented model configuration.

The entry highlighted in bold shows the newly added OpenConfig model as an extension to the existing Cisco native model.

```
module Cisco-IOS-XR-openconfig-terminal-device-ext{

  namespace "http://cisco.com/ns/yang/"+
        "Cisco-IOS-XR-openconfig-terminal-device-ext";

  prefix oc-opt-ext;

  import openconfig-platform {
          prefix oc-platform;
    }
   import openconfig-terminal-device {
          prefix oc-opt-term;
    }

   organization "Cisco Systems, Inc.";

   contact
    "Cisco Systems, Inc.
     Customer Service

     Postal: 170 West Tasman Drive
     San Jose, CA 95134

     Tel: +1 800 553-NETS

     E-mail: cs-yang@cisco.com";

    description
   "This module is an extension of optical terminal device model
     and contains the definition of extended parameters for Optical
     Channels in order to optimize the AC1200 settings to get the highest
     performance and spectral efficiency.

     This module contains definitions for the following management objects:
     General Parameters
     Submarine Parameters

     Copyright (c) 2013-2023 by Cisco Systems, Inc.
     All rights reserved.";

  revision 2023-05-08 {
      description
          "Addition of baud-rate configuration";
  }

revision 2023-02-28 {
      description
          "Addition of input power lower and upper thresholds parameters and
           Fastpoll enable configuration";
      reference "7.8.1";
  }
 revision 2020-08-30 {
      description
          "IOS XR 6.0 revision";
      reference "7.3.1";
```

```
  }

grouping  terminal-device-optical-channel-ext-info {
     description "Submarine parameters for optical channel";
     leaf optics-cd-min {
         type int32 {
             range "-350000..350000";
         }
         description
             "Select min chromatic dispersion (in units of
             ps/nm)";
     }
     leaf optics-cd-max {
         type int32 {
             range "-350000..350000";
         }
         description
             "Select max chromatic dispersion (in units of
             ps/nm)";
     ..................
     ..................

augment "/oc-platform:components/oc-platform:component/oc-opt-term:optical-channel" {
    container extended {
        description
            "Enclosing container for the list of Subsea parameters";

        container config {
      description
                "Extended Configuration parameters";
            leaf rx-voa-target-power {
               type int32 {
               range "-190..30";
            }
            description "Receive Target Power in increments of 0.1 dBm
                 Default value is -5 dBm";
            }
            leaf rx-voa-fixed-ratio {
               type int32 {
               range "100..1700";
            }
            description "Receive Ratio of Optical Attenuation in
                 increments of 0.01 dB Default value is 15 dB";
            }
            leaf fastpoll-sop-enable {
               type boolean {
            }
            description "Receive Fastpoll status if it is enabled or
                 disabled";
            }
            uses terminal-device-optical-channel-ext-info;
        }

        container state {

            config false;

            description
                "Extended Operational parameters";
     ..................

augment
"/oc-opt-term:terminal-device/oc-opt-term:logical-channels/oc-opt-term:channel/oc-opt-term:otn"
 {
```

```
                container extended {
augment
"/oc-opt-term:terminal-device/oc-opt-term:logical-channels/oc-opt-term:channel/oc-opt-term:otn"
 {
                container extended {
                  config false;
                  container state {
             config false;

        leaf enhanced-q-margin {
           type decimal64 {
           fraction-digits 2;
                   }
           description
             "Enhanced Instantaneous Q-Margin Value";
               }

               container q-margin {
            description
               "Q-Margin value in dB with two decimal precision. Values
               include the instantaneous, average, minimum, and maximum
               statistics. If avg/min/max statistics are not supported,
               the target is expected to just supply the instant value";

                        leaf instant {
              type decimal64 {
                 fraction-digits 2;
            }
            description
               "The instantaneous value of the q-margin (in units of dB).";
            }

                        leaf avg {
              type decimal64 {
                 fraction-digits 2;
            }
            description
               "The arithmetic mean value of the q-margin over the time interval of 10 or
30 sec. (in units of dB).";
            }

                        leaf min {
              type decimal64 {
                 fraction-digits 2;
            }
            description
               "The minimum value of the q-margin over the time interval of 10 or 30 sec.
(in units of dB).";
            }

                        leaf max {
              type decimal64 {
                 fraction-digits 2;
            }
            description
               "The maximum value of the q-margin over the time interval of 10 or 30 sec.
(in units of dB).";
            }
  leaf min-time {
              type decimal64 {
                 fraction-digits 2;
                          }
```

```
            description
               "The absolute time at which the minimum value occurred.
                            The value is the timestamp in nanoseconds relative to
                            the Unix Epoch (Jan 1, 1970 00:00:00 UTC).";
            }

                        leaf max-time {
               type decimal64 {
                  fraction-digits 2;
                              }
            description
               "The absolute time at which the maximum value occurred.
                            The value is the timestamp in nanoseconds relative to
                            the Unix Epoch (Jan 1, 1970 00:00:00 UTC).";
            }
                        leaf interval {
               type decimal64 {
                  fraction-digits 2;
                              }
            description
                "If supported by system, this reports the time interval
                           over which the min/max/average statistics are computed by the
system.";
            }
                }
      }
      description
       "This augment extends the operational data of
                         'terminal-otn-protocol-state'";
   }
description
      "This augment extends the operational data of
                        'terminal-otn-protocol-top'";

}
}
```

Note The CLI appearing in bold is the augmented code added to the existing Cisco native model.

OpenConfig Support for FEC Data

Table 9: Feature History

Feature Name	Release Information	Feature Description
OpenConfig Support for FEC Data	Cisco IOS XR Release 24.3.1	OpenConfig model support is added for Forward Error Correction (FEC) data on the NCS 1014 chassis. It helps in avoiding deviations in the **pre-fec-ber** and **post-fec-ber** leaves for pluggables.

In the NCS 1014 chassis, Forward Error Correction (FEC) is enabled on all 400G pluggables and in 100G deployments. The OpenConfig model allows monitoring of FEC statistics through NetConf and telemetry for the NCS1K14-2.4T-X-K9 card.

Purpose of OpenConfig Support for FEC Data in NCS 1014 Chassis

In the NCS 1014 chassis, Cisco native models do not support the **pre-fec-ber** and **post-fec-ber** containers which are needed for monitoring FEC statistics on the NCS1K14-2.4T-X-K9 card. The OpenConfig model can be used for this purpose by extending the existing native commands.

Benefits of Providing OpenConfig Support for FEC Data in NCS 1014

Enabling OpenConfig model support for FEC data in NCS 1014 avoids deviations in the **pre-fec-ber** and **post-fec-ber** leaves for transceivers across all routing and optical platforms.

Supported FEC Parameters

The instant data and performance monitoring statistics parameters are enabled for supporting FEC on transceivers are:

- min,
- max,
- avg,
- min-time and
- max-time,
- instant.

Enabling OpenConfig Support for FEC Data

To enable OpenConfig operations and telemetry support for FEC data, refer to the example.

The entry highlighted in bold shows the newly added OpenConfig model telemetry support for FEC data.

```
module: openconfig-platform-transceiver
 augment /oc-platform:components/oc-platform:component:
  +--rw transceiver
     +--rw config
      | +--rw enabled? boolean
      | +--rw form-factor-preconf? identityref
      | +--rw ethernet-pmd-preconf? identityref
      | +--rw fee-mode? identityref
     +--ro state
      |  +--ro enabled? boolean
      |  +--ro form-factor-preconf? identityref
      |  +--ro ethernet-pmd-preconf? identityref
      |  +--ro fee-mode? identityref
      |  +--ro present? enumeration
      |  +--ro form-factor?  identityref
      |  +--ro connector-type? identityref
      |  +--ro vendor?    string
      |  +--ro vendor-part?    string
      |  +--ro vendor-rev? string
      |  +--ro ethernet-pmd? identityref
      |  +--ro sonet-sdh-compliance-code? identityref
      |  +--ro otn-compliance-code? identityref
      |  +--ro serial-no? string
      |  +--ro date-code? oc-yang:date-and-time
      |  +--ro fault-condition? boolean
      |  +--ro fee-status? identityref
      |  +--ro fee-uncorrectable-blocks?  yang:counter64
```

```
      |  +--ro fec-uncorrectable-words? yang:counter64
      |  +--ro fec-corrected-bytes? yang:counter64
      |  +--ro fec-corrected-bits? yang:counter64
  +--ro pre-fec-ber
      | +--ro instant? decimal64
      | +--ro avg? decimal&
      | +--ro min? decimal64
      | +--ro max? decimal&
      | +--ro interval? oc-types:stat-interval
      | +--ro min-time? oc-types:timeticks64
      | +--ro max-time?  oc-types:timeticks64
  +--ro post-fec-ber
      | +--ro instant? decimal64
      | +--ro avg? decimal64
      | +--ro min? decimal64
      | +--ro max? decimal64
      | +--ro interval? oc-types:stat-interval
      | +--ro min-time? oc-types:timeticks64
      | +--ro max-time?  oc-types:timeticks64
   +--ro output-power
      | +--ro instant? decimal64
      | +--ro avg? decimal64
      | +--ro max-time? oc-types:timeticks64
   +--ro input-power
      | +--ro instant? decimal64
      | +--ro avg? decimal64
      | +--ro min? decimal64
      | +--ro max? decimal64
      | +--ro interval? oc-types:stat-interval
      | +--ro min-time? oc-types:timeticks64
      | +--ro max-time? oc-types:timeticks64
   +--ro laser-bias-current
      .......
+--ro laser-bias-current
  +--ro instant? decimal64
  +--ro avg? decimal64
  +--ro min? decimal64
  +--ro max? decimal64
  +--ro interval? oc-types:stat-interval
  +--ro min-time? oc-types:timeticks64
  +--ro max-time? oc-types:timeticks64
augment / oc-if:interfaces/oc-if:interface/oc-if:state:
+--ro transceiver? -> /oc-platform:components/component[oc
platform:name=current()/../oc-port:hardware-port]/ocplatform:subcomponents/subcomponent/name
augment / oc-if:interfaces/oc-if:interface/oc-if:state:
+--ro physical-channel* -> /oc-platform:components/component[oc
platform:name=current()/../oc-transceiver:transceiver]/transceiver/physical►
channels/channel/index
```

Instant value example:

```
instant value:
RP/0/RP0/CPU0:N112#sh controllers fourHundredGigEctrlr 0/2/0/1
Operational data for interface FourHundredGigECtrlr0/2/0/1:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled
```

```
    Insert Idle Ingress: Disabled
    Insert Idle Egress: Disabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
           Corrected Codeword Count: 35409983               Valid: True       Start time:
 14:45:53 Mon Aug 19 2024
           Uncorrected Codeword Count: 56                   Valid: True       Start time:
 14:45:53 Mon Aug 19 2024
        PCS:
           Total BIP errors: 0                              Valid: True       Start time:
 14:45:53 Mon Aug 19 2024
           Total frame errors: 0                            Valid: False      Start time:
 14:45:53 Mon Aug 19 2024
           Total Bad SH: 0                                  Valid: False      Start time:
 14:45:53 Mon Aug 19 2024

Autonegotiation disabled.

Operational values:
    Speed: 400Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    Pre FEC BER: 1.5E-09
    Post FEC BER: 0.0E+00
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Output CLI example of pre-fec and post-fec ber parameters:

```
min/max/avg:
RP/0/RP0/CPU0:N112#sh controllers fourHundredGigEctrlr 0/2/0/1 pm current 15-min fec

Ethernet FEC in the current interval [06:00:00 - 06:07:12 Tue Aug 20 2024]

FEC current bucket type : Valid
EC-WORDS : 313148 Threshold : 0 TCA(enable) : NO
UC-WORDS : 0 Threshold : 0 TCA(enable) : NO

MIN AVG MAX Threshold TCA Threshold TCA
(min) (enable) (max) (enable)
PreFEC BER : 8.2E-10 1.7E-09 2.6E-09 0E-15 NO 0E-15 NO
PostFEC BER :0E-15 0E-15 0E-15 0E-15 NO 0E-15 NO

Last clearing of "show controllers ETHERNET" counters 13:52:01
RP/0/RP0/CPU0:N112#
```

EDT enhancements

Table 10: Feature History

Feature Name	Release Information	Release Description
Enhanced EDT notifications for the OpenConfig-platform YANG model	Cisco IOS XR Release 25.2.1	This feature notifies you of deletions and updates for all components removed from or inserted into the system through Event-Driven Telemetry (EDT). These notifications are included under the OpticalChannel component of the EDT output for the sensor path `openconfig-platform:components/component/state`

The Event-Driven Telemetry (EDT) notifications for the `OpenConfig-platform` YANG model have been enhanced to better report system changes through telemetry by including additional notifications for component changes.

The additional notifications available for the telemetry sensor path `"openconfig-platform:components/component/state"` are:

- **Delete Notifications**: Triggered when components are removed from the system.
- **Update Notifications**: Generated when new components are inserted into the system.
- **Change Detection**: Triggered when components are added, removed, or modified. The system detects these changes, updates the inventory database, and sends corresponding EDT notifications. This includes code updates to support these actions.

OpticalChannel component behavior

This enhancement is particularly helpful for the OpticalChannel component that is created whenever Coherent Optics (e.g., CIM8 in NCS1014) is configured.

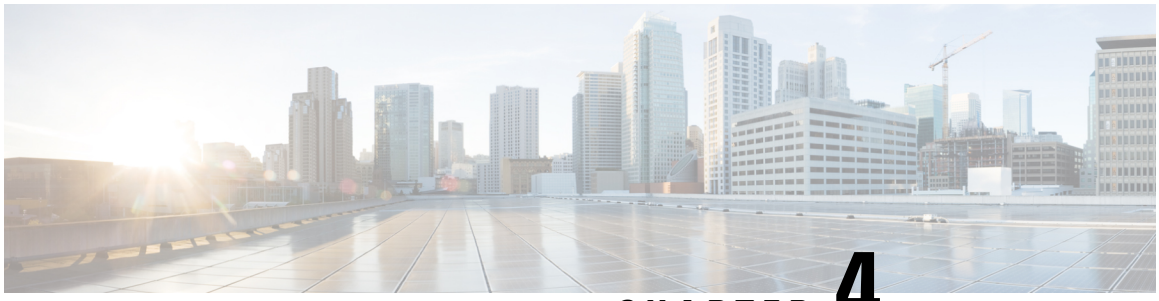
It operates as a child of the Optics0/x/0/x component. Previously, when the configuration was removed or the optics were unplugged, a delete notification was sent only for the Optics0/x/0/x component, while the OpticalChannel component did not receive one.

With this enhancement, a delete notification will now also be sent for the OpticalChannel component when its corresponding configuration is removed or the optics are unplugged.

Benefits

This EDT enhancements have these benefits:

- All changes to system components, such as additions, deletions, and updates, are captured and reported through telemetry in real-time. This ensures a reliable and up-to-date view of the system state.
- By including delete notifications for child components like OpticalChannel, the telemetry system provides a more complete and consistent view of system state changes.



CHAPTER 4

OpenConfig Support for NCS1K14-2.4T-K9 Card

The NCS1K14-2.4T-K9 card is a single slot line card. The card is equipped with six QSFPDD and two CIM-8 ports. This chapter briefs the detail configurations, client and trunk optics, supported OpenConfig models for the NCS1K14-2.4T-K9 card.

Overview

The NCS1K14-2.4T-K9 card is a single slot line card. The card is equipped with six QSFPDD and two CIM-8 ports. You can configure six QSFPDD ports as client and two CIM-8 as trunk.

The NCS1K14-2.4T-K9 card supports both transponder (TXP) and muxponder(MXP) configuration and they can coexist on the same line card.

Supported Operational modes, Optics, and OpenConfig Models

The NCS1K14-2.4T-K9 card supports the following Operational modes, client and trunk optics, and OpenConfig models:

Operational Modes

The following table provides information for Operational modes, config in SliceMode, Slice 0 Client, and Slice 1 Client:

Operational modes	Config in SliceMode	Slice 0 Client	Slice 1 Client
400G	4X100GE	1	4
600G	400GE+2x100GE	1,2	4,5
800G	2x400GE	1,2	4,5

Operational modes	Config in SliceMode	Slice 0 Client	Slice 1 Client
1000G	2x400GE+2x100GE	1,2,3	4,5,6

Client Optics

The following table provides information about PIDs, and related interface, transmit power, transmit wavelength, fiber type, fiber connector, and distance support:

PID	Interface	Transmit power	Transmit wavelength	Fiber type	Fiber connector	Distance support	Description
QDD-400G-FR4-S	400GE	-7.0 to +6.0 dbm per wavelength	1310 nm	Duplex SMF	Duplex LC connector	2km	Only be used as 400GE non-breakout mode
QDD-400G-DR4-S	400GBASE-DR4	-10.1 to +4.0 dbm per wavelength	1310 nm	MPO-12 parallel SMF	12-fiber MPO	500m	Can be used as 4x100GE breakout mode
QDD-400G-AOCxM	400GBASE-AOC	-10.1 to +4.0 dbm per wavelength	850 nm	MMF	AOC	1, 2, 3, 5, 7, 10, 15, 20, 25, and 30 meters	Only be used as 400GE non-breakout mode
QDD-4X100G-LR-S	10Base-LR	–8.2 to +0.5 per wavelength	1310nm	G.652 micron SMF	12-fiber MPO	10km	Can be used in 4x100GE breakout mode as well as 400GE non-breakout mode.

Trunk Optics

Note The transceiver name appears in the new format "Optics *rack*/*slot*/*instance*/*port*" from release 7.11.1.

The following table provides information for PIDs, it's related payloads, trunk ports, and inventory details:

PID	Payload	Trunk Port Number	Inventory Details
CIM8-C-K9	400G, 600G, 800G, and 1000G	0, and 7	`NAME:"Optics0/1/0/0", DESCR: "Cisco CIM8 C K9 Pluggable Optics Module" PID: CIM8-C-K9, VID:VES1,SN:ACA273401DG`

OpenConfig Models

The NCS1K14-2.4T-K9 card supports the following OpenConfig models:

Table 11: Supported OC Models

Model	Feature
openconfig-platform.yang	Inventory and LCMode
openconfig-platform-transceiver.yang	Pluggable Inventory and Operational Data
openconfig-terminal-device.yang	Logical and Optical Channels – Datapath and OperData
openconfig-interface.yang	Optical Interface Enable/Disable (shut/no-shut)
openconfig-system.yang (augumented with openconfig-alarms)	Alarms
openconfig/gnoi/os.proto	Software Upgrade
Openconfig/gnoi/diag.proto	PRBS Testing

Extended Terminal Device Configuration for Baud Rate

The following table provides standard operational-modes for configuring the baud rate:

Table 12: Standard Operational Modes

Mode	FEC	Baud-Rate	Description
4201	SD_15	138.000000	SoftDecision_FEC15:Baud_138.00000000
4202	SD_15	139.000000	SoftDecision_FEC15:Baud_139.00000000
4203	SD_15	140.000000	SoftDecision_FEC15:Baud_140.00000000
4204	SD_15	141.000000	SoftDecision_FEC15:Baud_141.00000000
4205	SD_15	142.000000	SoftDecision_FEC15:Baud_142.00000000
4206	SD_15	100.000000	SoftDecision_FEC15:Baud_100.00000000
4207	SD_15	80.000000	SoftDecision_FEC15:Baud_80.00000000

Mode	FEC	Baud-Rate	Description
4208	SD_15	88.000000	SoftDecision_FEC15:Baud_88.00000000
4209	SD_15	98.000000	SoftDecision_FEC15:Baud_98.00000000
4210	SD_15	108.000000	SoftDecision_FEC15:Baud_108.00000000
4211	SD_15	118.000000	SoftDecision_FEC15:Baud_118.00000000
4212	SD_15	128.000000	SoftDecision_FEC15:Baud_128.00000000
4213	SD_15	110.000000	SoftDecision_FEC15:Baud_110.00000000
4214	SD_15	111.000000	SoftDecision_FEC15:Baud_111.00000000
4215	SD_15	112.000000	SoftDecision_FEC15:Baud_112.00000000
4216	SD_15	113.000000	SoftDecision_FEC15:Baud_113.00000000
4217	SD_15	114.000000	SoftDecision_FEC15:Baud_114.00000000
4218	SD_15	115.000000	SoftDecision_FEC15:Baud_115.00000000

You can use the **extended terminal-device baud rate** to set a new baud rate value compared to the value provided in the **Standard Operational Mode** table.

Note The Optical Channel name appears in the new format "OpticalChannel *rack*/*slot*/*instance*/*port*" from release 7.11.1.

Sample Configuration

```
----------------------------------
Edit config baud-rate
----------------------------------
<edit-config>
  <target>
    <candidate/>
  </target>
  <config>
    <components xmlns="http://openconfig.net/yang/platform">
      <component>

        <name>OpticalChannel0/0/0/0</name>
        <optical-channel xmlns="http://openconfig.net/yang/terminal-device">
        <extended
xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-openconfig-terminal-device-ext">
            <config>
             <baud-rate>15.1234567</baud-rate>
            </config>
       </extended>
      </optical-channel>
     </component>
   </components>
  </config>
</edit-config>
```

Note If both the operating mode and extended baud rate exist, the line card employs the extended baud rate value.

Extended Transceiver Model

The extended transceiver model provides you with the Forward Error Correction (FEC) information for individual physical-channels.

Sample Configuration:

```
"Optics0/1/0/8": {
          "openconfig-platform-transceiver:transceiver": {
            "physical-channels": {
              "channel": {
                "1": {
                  "state": {
                    "index": 1,
                    "input-power": {
                      "avg": 1.64,
                      "instant": 1.6,
                      "interval": 10000000000,
                      "max": 1.72,
                      "max-time": 1649788692425519767,
                      "min": 1.59,
                      "min-time": 1649788694425593293
                    },
                    "laser-bias-current": {
                      "avg": 800,
                      "instant": 800,
                      "interval": 10000000000,
                      "max": 800,
                      "max-time": 1649788690426089532,
                      "min": 800,
                      "min-time": 1649788690426089532
                    },
                    "output-frequency": 228849200,
                    "output-power": {
                      "avg": 1.62,
                      "instant": 1.61,
                      "interval": 10000000000,
                      "max": 1.62,
                      "max-time": 1649788690426089532,
                      "min": 1.62,
                      "min-time": 1649788690426089532
                      }
                    },
                   "extended": {
                      "state": {
                         index: 1
                         "fec-mode": "openconfig-platform-types:FEC_ENABLED",
                         "fec-uncorrectable-words": 0,
                         "fec-corrected-words":0
                              }
                  }
                 }
                }
                }
```

```
  }
}
```

Client Configuration Details

The following table explains the different commands that are used for 100G and 400GE client ports.

Table 13: Configuration Details for 100G and 400GE Client Ports

Client Port	Logical Channel	Trunk ODU	Coherent DSP	Optical Channel
100G	"index":101, "rate-class": "openconfig-transport-types: TRIB_RATE_100G", "description": "Client Logical Channel", "admin-state":"ENABLED", "loopback-mode":"NONE", "trib-protocol": "openconfig-transport-types: PROT_100G_MLG", "logical-channel-type": "openconfig-transport-types: PROT_ETHERNET"	index": 111, "config": { "index": 111, "rate-class": "openconfig-transport-types: TRIB_RATE_100G", "admin-state": "ENABLED", "description": "Trunk-side-ODU", "trib-protocol": "openconfig-transport-types: PROT_ODUFLEX_CBR", "logical-channel-type": "openconfig-transport-types: PROT_OTN"	"index": 212, "config": { "index": 212, "admin-state": "ENABLED", "loopback-mode":"NONE", "description": "Coherent DSP", "rate-class": "openconfig-transport-types: TRIB_RATE_400G", "logical-channel-type": "openconfig-transport-types: PROT_OTN"	"name": "OpticalChannel0/1/0/0", "openconfig-terminal-device: optical-channel": {"config": {"frequency": "193100000", "target-output-power": -700,"operational-mode": 4178, "line-port": "Optics0/1/0/0"

Client Port	Logical Channel	Trunk ODU	Coherent DSP	Optical Channel
400GE	"index": 101, "rate-class": "openconfig-transport-types: TRIB_RATE_400G", "description": "Client Logical Channel", "admin-state": "ENABLED", "loopback-mode": "NONE", "trib-protocol": "openconfig-transport-types: PROT_400GE", "logical-channel-type": "openconfig-transport-types: PROT_ETHERNET"	"index": 211, "config": { "index": 211, "rate-class": "openconfig-transport-types: TRIB_RATE_400G", "admin-state": "ENABLED", "description": "Trunk-side-ODU", "trib-protocol": "openconfig-transport-types: PROT_ODUFLEX_CBR", "logical-channel-type": "openconfig-transport-types: PROT_OTN"	"index":212, "config": { "index": 212, "admin-state": "ENABLED", "loopback-mode":"NONE", "description":"Coherent DSP", "rate-class": "openconfig-transport-types: TRIB_RATE_400G", "logical-channel-type": "openconfig-transport-types: PROT_OTN"	"name": "OpticalChannel0/1/0/0", "openconfig-terminal-device: optical-channel": { "config": { "frequency": "193100000", "target-output-power": -700, "line-port": "Optics0/1/0/0"

Note Trunk payload rate determines the Trib rate.

Sample Configurations

Configuring 400 TXP (Client and Slice)

```
{
 "openconfig-terminal-device:terminal-device": {
  "logical-channels": {
   "channel": [
    {
     "index": 101,
     "config": {
      "index": 101,
      "rate-class": "openconfig-transport-types:TRIB_RATE_400G",
      "admin-state": "ENABLED",
      "description": "Client Logical Channel",
      "trib-protocol": "openconfig-transport-types:PROT_400GE",
      "logical-channel-type": "openconfig-transport-types:PROT_ETHERNET"
     },
     "ingress": {
      "config": {

   "transceiver": "Optics0/1/0/1"
      }
```

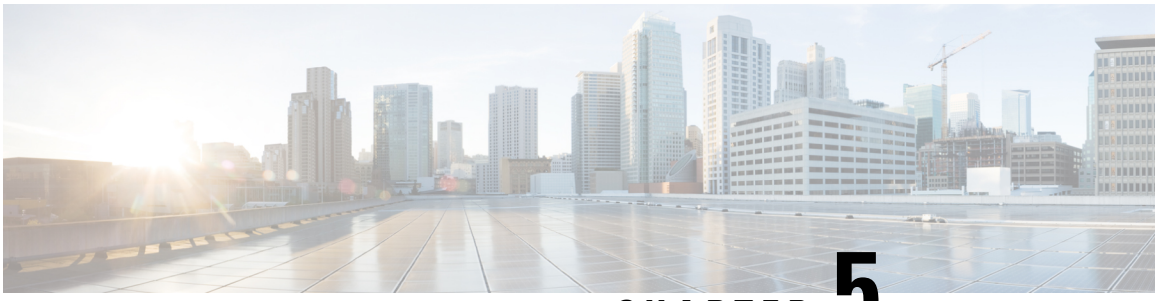
```
 },
 "logical-channel-assignments": {
  "assignment": [
   {
    "index": 1,
    "config": {
     "index": 1,
     "allocation": "400",
     "assignment-type": "LOGICAL_CHANNEL",
     "description": "logical to logical assignemnt",
     "logical-channel": 111
    }
   }
  ]
 }
},
{
 "index": 111,
 "config": {
  "index": 111,
  "rate-class": "openconfig-transport-types:TRIB_RATE_400G",
  "admin-state": "ENABLED",
  "description": "Trunk-side-ODU",
  "trib-protocol": "openconfig-transport-types:PROT_ODUFLEX_CBR",
  "logical-channel-type": "openconfig-transport-types:PROT_OTN"
 },
 "logical-channel-assignments": {
  "assignment": [
   {
    "index": 1,
    "config": {
     "index": 1,
     "allocation": "400",
     "assignment-type": "LOGICAL_CHANNEL",
     "description": "logical to Logical",
     "logical-channel": 30000
    }
   }
  ]
 }
},
{
 "index": 201,
 "config": {
  "index": 201,
  "rate-class": "openconfig-transport-types:TRIB_RATE_400G",
  "admin-state": "ENABLED",
  "description": "Client Logical Channel",
  "trib-protocol": "openconfig-transport-types:PROT_400GE",
  "logical-channel-type": "openconfig-transport-types:PROT_ETHERNET"
 },
 "ingress": {
  "config": {

   "transceiver": "Optics0/1/0/2"
  }
 },
 "logical-channel-assignments": {
  "assignment": [
   {
    "index": 1,
    "config": {
     "index": 1,
     "allocation": "400",
```

```
            "assignment-type": "LOGICAL_CHANNEL",
            "description": "logical to logical assignemnt",
            "logical-channel": 211
           }
          }
         ]
        }
       },
       {
        "index": 211,
        "config": {
         "index": 211,
         "rate-class": "openconfig-transport-types:TRIB_RATE_400G",
         "admin-state": "ENABLED",
         "description": "Trunk-side-ODU",
         "trib-protocol": "openconfig-transport-types:PROT_ODUFLEX_CBR",
         "logical-channel-type": "openconfig-transport-types:PROT_OTN"
        },
        "logical-channel-assignments": {
         "assignment": [
          {
           "index": 1,
           "config": {
            "index": 1,
            "allocation": "400",
            "assignment-type": "LOGICAL_CHANNEL",
            "description": "logical to Logical",
            "logical-channel": 30000
           }
          }
         ]
        }
       },
       {
        "index": 30000,
        "config": {
         "index": 30000,
         "admin-state": "ENABLED",
         "description": "Coherent DSP",
         "logical-channel-type": "openconfig-transport-types:PROT_OTN"
        },
        "logical-channel-assignments": {
         "assignment": [
          {
           "index": 1,
           "config": {
            "index": 1,
            "allocation": "800",
            "assignment-type": "OPTICAL_CHANNEL",
            "description": "logical to optical",

            "optical-channel": "OpticalChannel0/1/0/0"
           }
          }
         ]
        }
       }
      ]
     }
    },
    "openconfig-platform:components": {
     "component": [
      {
```

```
    "name": "OpticalChannel0/1/0/0",
    "openconfig-terminal-device:optical-channel": {
     "config": {
      "line-port": "Optics0/1/0/0"
     }
    }
   }
  ]
 },
 "openconfig-interfaces:interfaces": {
  "interface": [
   {
    "name": "Optics0/1/0/0",
    "config": {
     "name": "Optics0/1/0/0",
     "type": "iana-if-type:opticalChannel",
     "description": "T0",
     "enabled": "true"
    }
   }
  ]
 }
}
```



CHAPTER 5

OpenConfig Support for EDFA2 Card

Table 14: Feature History

Feature Name	Release Information	Feature Description
Enhancement in OC support for EDFA2 card	Cisco IOS XR Release 25.2.1	The EDFA2 card now supports these OpenConfig models for retrieving operational and real-time telemetry data. • `openconfig-channel-monitor.yang` • `openconfig-transport-line-common.yang` In addition to the previously supported operational and telemetry data retrieval, these models now support configuration on the EDFA2 cards. • `openconfig-optical-amplifier.yang` • `openconfig-optical-attenuator.yang` • `openconfig-wavelength-router.yang`

Table 15: Feature History

Feature Name	Release Information	Feature Description
OC support for EDFA2 card	Cisco IOS XR Release 25.1.1	The Open Configuration (OC) support is introduced for the EDFA2 card and the OTDR pluggable. This enables you to retrieve the operational data and real-time telemetry data using these data models: • `openconfig-optical-amplifier.yang` • `openconfig-optical-attenuator.yang` • `openconfig-wavelength-router.yang` • `openconfig/gnoi/OTDR.proto`

EDFA2 card

The EDFA2 line card is an optical amplifier for the NCS1014 Chassis. It functions as a DWDM optical terminal and includes a C-band bidirectional amplifier with channel power control capabilities. This card supports Optical Supervisory Channel (OSC) and Optical Time Domain Reflectometer (OTDR) functionalities.

The card comprises an optical module, pluggable cages for OTDR and OSC, and a DWDM trunk interface. It features integrated management for alarms, performance monitoring, and optical power level control.

Supported OpenConfig Yang models

The NCS1K14-EDFA2 card supports these OpenConfig models:

Note In Release 25.1.1, only MDT is supported, and EDT is not supported. Additionally, only operational data is supported.

Table 16: Supported OC models

Release	Model	Feature
R25.1.1	openconfig-optical-amplifier.yang	State of the optical amplifier.
	openconfig-optical-attenuator.yang	State of the optical attenuator.
	openconfig-wavelength-router.yang	State of the media channels and optical interfaces.
	openconfig/gnoi/OTDR.proto	Initiating forced OTDR scan.
R25.2.1	openconfig-channel-monitor.yang	State of the optical channel monitor.
	openconfig-transport-line-common.yang	State of the optical transport line system.

Supported functions for OpenConfig models

This table highlights the functions supported by the OpenConfig models in releases 25.1.1 and 25.2.1

Table 17: Supported functions for OpenConfig models

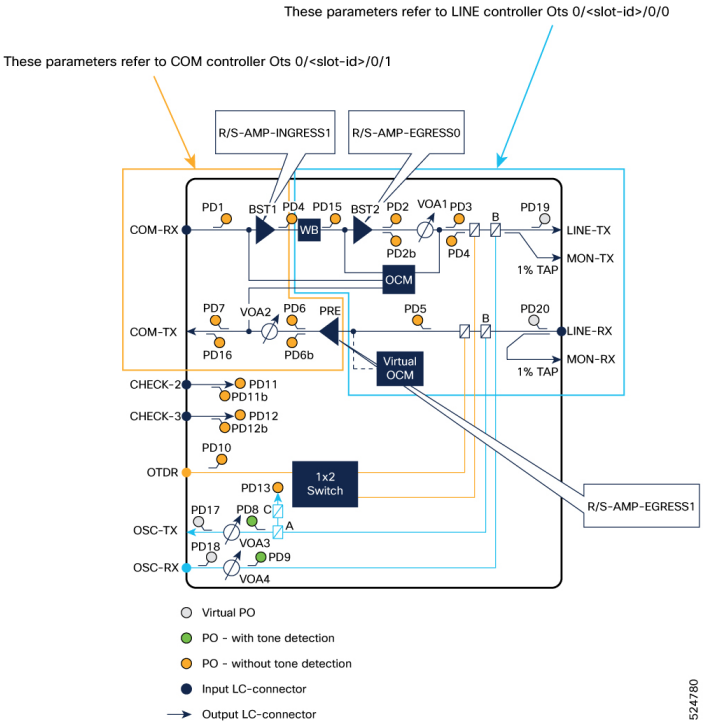
OC model	Operational data support	Configuration support	EDT support
configure-optical-amplifier.yang	R25.1.1	R25.2.1	—
openconfig-optical-attenuator.yang	R25.1.1	R25.2.1	—
openconfig-wavelength-router.yang	R25.1.1	R25.2.1	R25.2.1
openconfig/gnoi/OTDR.proto	R25.1.1	—	—
openconfig-channel-monitor.yang	R25.2.1	—	—
openconfig-transport-line-common.yang	R25.2.1	—	—

Naming conventions

This section describes the naming conventions used in the OpenConfig models supported by the NCS1K14-EDFA2 card.

OpenConfig amplifier model

Figure 3: Optical diagram of NCS1K14-EDFA2 card representing amplifiers



In this optical block diagram, amplifiers are categorized as follows:

- **BST1**: Represented as an ingress amplifier.
- **BST2**: Represented as an egress amplifier.
- **PRE amplifier parameters**: Represented as egress amplifiers.

The naming convention for amplifiers is structured as follows:

`R/S-AMP-<AMP-TYPE>P`

Where:

- **R** stands for Rack.
- **S** stands for Slot.
- **AMP** is the suffix used to denote an amplifier.
- **AMP-TYPE** indicates the type of amplifier.
- **P** stands for Port ID.

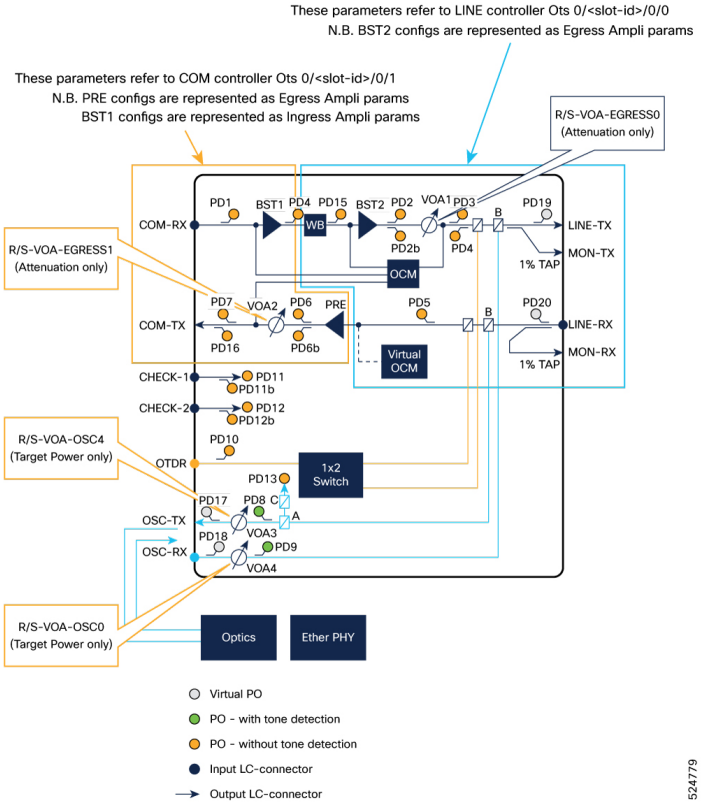
Examples:

- `R/S-AMP-EGRESS0`
- `R/S-AMP-EGRESS1`

- R/S-AMP-INGRESS1

OpenConfig attenuator model

Figure 4: Optical diagram of NCS1K14-EDFA2 card representing attenuators



The naming convention for the attenuator model is as follows:

- R/S-VOA-EGRESS0
- R/S-VOA-EGRESS1
- R/S-VOA-OSC0
- R/S-VOA-OSC4

Where:

- **R** stands for Rack.
- **S** stands for Slot.
- **VOA** indicates a Variable Optical Attenuator.
- The suffix specifies the type and port number, such as **EGRESS** or **OSC**.

OpenConfig wavelength model

Openconfig supplies a 3-byte value called the ‘index’. This value is interpreted as follows:

- **First Byte**: Represents the channel identifier, which can range from 1 to 97.
- **Second and Third Bytes**: Indicate the rack and slot numbers.

Example:

If Openconfig provides an ‘index’ value of "100":

- **Channel Identifier**: 1
- **Node Location Name**: 0/0/NXR0 on the native side

This means the channel identifier is 1, and because the rack and slot are fixed at 0, the location name is formatted as "0/0/NXR0".

OpenConfig channel monitor model

The naming convention for the channel monitor:

- `R/S-CHMON-RX-0`
- `R/S-CHMON-TX-0`
- `R/S-CHMON-RX-1`
- `R/S-CHMON-TX-1`

OpenConfig transport line common model

As safety ports are already modeled in the inventory, the transport line common model will utilize the same `ots R/S/I/P` representation.

Structure of Yang models supported on NCS1K14-EDFA2

This structure describes the leave structure of YANG models supported on NCS1K14-EDFA2 card:

Note The leaves that are in bold are augmented.

Supported leaves for OpenConfig attenuator model

From R25.1.1, these leaves are supported for get-oper and telemetry:

```
+--rw optical-attenuator
     +--rw attenuators
     |  +--rw attenuator* [name]
     |     +--rw name                                   -> ../config/name
     |     +--rw config
     |     |  +--rw name?                              string
     |     |  +--rw target-output-power?               decimal64
     |     |  +--rw attenuation?                       decimal64
     |     +--ro state
     |        +--ro name?                               string
     |        +--ro attenuation-mode?           identityref
     |        +--ro target-output-power?       decimal64
```

```
|        +--ro attenuation?                       decimal64
|        +--ro enabled?                            boolean
|       +--ro component?                      -> /oc-platform:components/component/name

|        +--ro actual-attenuation
|        |  +--ro instant?                          decimal64
|        |  +--ro output-power-total
|        |  +--ro instant?                          decimal64
|        |  +--ro avg?                                decimal64
|        |  +--ro min?                                decimal64
|        |  +--ro max?                               decimal64
|        |  +--ro interval?                          oc-types:stat-interval
|        |  +--ro min-time?                         oc-types:timeticks64
|        |  +--ro max-time?                         oc-types:timeticks64
|        +--ro optical-return-loss
|        |  +--ro instant?                          decimal64
|        |  +--ro avg?                                    decimal64
|        |  +--ro min?                                 decimal64
|        |  +--ro max?                                decimal64
|        |  +--ro interval?                          oc-types:stat-interval
|        |  +--ro min-time?                         oc-types:timeticks64
|        |  +--ro max-time?                        oc-types:timeticks64
```

From R25.2.1, these leaves are supported for NETCONF/GNMI operations, including get, edit-config, and telemetry:

```
+--rw optical-attenuator
     +--rw attenuators
     |  +--rw attenuator* [name]
     |     +--rw name                                   -> ../config/name
     |     +--rw config
     |     |  +--rw name?                              string
     |     |  +--rw attenuation-mode?          identityref
     |     |  +--rw target-output-power?      decimal64
     |     |  +--rw attenuation?                      decimal64
     |     |  +--rw enabled?                            boolean
     |     +--ro state
     |        +--ro name?                               string
     |        +--ro attenuation-mode?           identityref
     |        +--ro target-output-power?       decimal64
     |        +--ro attenuation?                       decimal64
     |        +--ro enabled?                             boolean
     |       +--ro component?                      -> /oc-platform:components/component/name

     |          |        +--ro actual-attenuation
     |        |  +--ro instant?                          decimal64
     |        |        +--ro output-power-total
     |        |  +--ro instant?                          decimal64
     |        |  +--ro avg?                                decimal64
     |        |  +--ro min?                                decimal64
     |        |  +--ro max?                               decimal64
     |        |  +--ro interval?                          oc-types:stat-interval
     |        |  +--ro min-time?                         oc-types:timeticks64
     |        |  +--ro max-time?                         oc-types:timeticks64
     |        +--ro optical-return-loss
     |        |  +--ro instant?                          decimal64
     |        |  +--ro avg?                                decimal64
     |        |  +--ro min?                                decimal64
     |        |  +--ro max?                               decimal64
     |        |  +--ro interval?                          oc-types:stat-interval
     |        |  +--ro min-time?                         oc-types:timeticks64
     |        |  +--ro max-time?                        oc-types:timeticks64
```

```
 +--ro state
     |        +--ro name?                                  string
     |        +--ro target-output-power?       decimal64
     |        +--ro attenuation?                        decimal64
     |        +--ro enabled?                             boolean
     |       +--ro component?                    -> /oc-platform:components/component/name

     |        +--ro actual-attenuation
     |        |  +--ro instant?                           decimal64
     |        +--ro output-power-total
     |        |  +--ro instant?                           decimal64
     |        |  +--ro avg?                                 decimal64
     |        |  +--ro min?                                 decimal64
     |        |  +--ro max?                                decimal64
     |        |  +--ro interval?                           oc-types:stat-interval
     |        |  +--ro min-time?                          oc-types:timeticks64
     |        |  +--ro max-time?                          oc-types:timeticks64
     |        +--ro optical-return-loss
     |        |  +--ro instant?                           decimal64
     |        |  +--ro avg?                                 decimal64
     |        |  +--ro min?                                 decimal64
     |        |  +--ro max?                                decimal64
     |        |  +--ro interval?                           oc-types:stat-interval
     |        |  +--ro min-time?                          oc-types:timeticks64
     |        |  +--ro max-time?                          oc-types:timeticks64
```

Supported leaves for OpenConfig amplifier model

From R25.1.1, these leaves are supported for get-oper and telemetry:

```
|  +--rw amplifier* [name]
     |     +--rw name      -> ../config/name
     |     +--rw config
     |     |  +--rw name?                 string (Amplifier name)
     |     |  +--rw type?                 identityref
     |     |  +--rw target-gain?          decimal64
     |     |  +--rw target-gain-tilt?     decimal64
     |     |  +--rw gain-range?           identityref (LOW: Normal, High: Extended)
     |     |  +--rw amp-mode?             identityref
     |     |  +--rw enabled?              boolean
     |     |  +--rw fiber-type-profile?   identityref
     |     +--ro state
     |        +--ro name?                 string
     |        +--ro type?                 identityref
     |        +--ro target-gain?          decimal64
     |        +--ro target-gain-tilt?     decimal64
     |        +--ro gain-range?           identityref
     |        +--ro amp-mode?             identityref
     |        +--ro enabled?              boolean
     |        +--ro fiber-type-profile?   identityref
     |        +--ro component?            -> /oc-platform:components/component/name
     |        +--ro actual-gain
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
     |        |  +--ro interval?   oc-types:stat-interval
     |        |  +--ro min-time?   oc-types:timeticks64
     |        |  +--ro max-time?   oc-types:timeticks64
     |        +--ro actual-gain-tilt
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
```

```
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro input-power-total
|        |  +--ro instant?    decimal64.
|        |  +--ro avg?        decimal64
|        |  +--ro min?        decimal64
|        |  +--ro max?        decimal64
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro input-power-c-band.
|        |  +--ro instant?    decimal64
|        |  +--ro avg?        decimal64
|        |  +--ro min?        decimal64
|        |  +--ro max?        decimal64
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro output-power-total -→ total tx power
|        |  +--ro instant?    decimal64
|        |  +--ro avg?        decimal64
|        |  +--ro min?        decimal64
|        |  +--ro max?        decimal64
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro output-power-c-band → tx signal power
|        |  +--ro instant?    decimal64
|        |  +--ro avg?        decimal64
|        |  +--ro min?        decimal64
|        |  +--ro max?        decimal64
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro optical-return-loss
|           +--ro instant?    decimal64
|           +--ro avg?        decimal64
|           +--ro min?        decimal64
|           +--ro max?        decimal64
|           +--ro interval?   oc-types:stat-interval
|           +--ro min-time?   oc-types:timeticks64
|           +--ro max-time?   oc-types:timeticks64
+--rw supervisory-channels
   +--rw supervisory-channel* [interface]
      +--rw interface    -> ../config/interface
      +--rw config
      |  +--rw interface?   oc-if:base-interface-ref
      +--ro state
         +--ro interface?           oc-if:base-interface-ref
         +--ro input-power. → Rx power
         |  +--ro instant?    decimal64
         |  +--ro avg?        decimal64
         |  +--ro min?        decimal64
         |  +--ro max?        decimal64
         |  +--ro interval?   oc-types:stat-interval
         |  +--ro min-time?   oc-types:timeticks64
         |  +--ro max-time?   oc-types:timeticks64
         +--ro output-power. → Tx power
         |  +--ro instant?    decimal64
         |  +--ro avg?        decimal64
         |  +--ro min?        decimal64
         |  +--ro max?        decimal64
```

```
            |  +--ro interval?   oc-types:stat-interval
            |  +--ro min-time?   oc-types:timeticks64
            |  +--ro max-time?   oc-types:timeticks64
```

From R25.2.1, these leaves are supported for NETCONF/GNMI operations, including get, edit-config, and telemetry:

```
+-rw optical-amplifier
     +--rw amplifiers
     |  +--rw amplifier* [name]
     |     +--rw name      -> ../config/name
     |     +--rw config
     |     |  +--rw name?                 string
     |     |  +--rw type?                 identityref
     |     |  +--rw target-gain?          decimal64
     |     |  +--rw target-gain-tilt?     decimal64
     |     |  +--rw gain-range?           identityref
     |     |  +--rw amp-mode?             identityref
     |     |  +--rw enabled?              boolean
     |     |  +--rw fiber-type-profile?   identityref
     |     +--ro state
     |        +--ro name?                 string
     |        +--ro type?                 identityref
     |        +--ro target-gain?          decimal64
     |        +--ro target-gain-tilt?     decimal64
     |        +--ro gain-range?           identityref
     |        +--ro amp-mode?             identityref
     |        +--ro enabled?              boolean
     |        +--ro fiber-type-profile?   identityref
     |        +--ro component?            -> /oc-platform:components/component/name
     |        +--ro actual-gain
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
     |        |  +--ro interval?   oc-types:stat-interval
     |        |  +--ro min-time?   oc-types:timeticks64
     |        |  +--ro max-time?   oc-types:timeticks64
     |        +--ro actual-gain-tilt
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
     |        |  +--ro interval?   oc-types:stat-interval
     |        |  +--ro min-time?   oc-types:timeticks64
     |        |  +--ro max-time?   oc-types:timeticks64
     |        +--ro input-power-total
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
     |        |  +--ro interval?   oc-types:stat-interval
     |        |  +--ro min-time?   oc-types:timeticks64
     |        |  +--ro max-time?   oc-types:timeticks64
     |        +--ro input-power-c-band
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
     |        |  +--ro interval?   oc-types:stat-interval
     |        |  +--ro min-time?   oc-types:timeticks64
     |        |  +--ro max-time?   oc-types:timeticks64
     |        +--ro output-power-total -→ total tx power
     |        |  +--ro instant?    decimal64
```

```
|        |  +--ro avg?        decimal64
|        |  +--ro min?        decimal64
|        |  +--ro max?        decimal64
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro output-power-c-band → tx signal power
|        |  +--ro instant?    decimal64
|        |  +--ro avg?        decimal64
|        |  +--ro min?        decimal64
|        |  +--ro max?        decimal64
|        |  +--ro interval?   oc-types:stat-interval
|        |  +--ro min-time?   oc-types:timeticks64
|        |  +--ro max-time?   oc-types:timeticks64
|        +--ro optical-return-loss → OPBRR
|           +--ro instant?    decimal64
|           +--ro avg?        decimal64
|           +--ro min?        decimal64
|           +--ro max?        decimal64
|           +--ro interval?   oc-types:stat-interval
|           +--ro min-time?   oc-types:timeticks64
|           +--ro max-time?   oc-types:timeticks64
+--rw supervisory-channels
   +--rw supervisory-channel* [interface]
      +--rw interface    -> ../config/interface
      +--rw config
      |  +--rw interface?   oc-if:base-interface-ref
      +--ro state
         +--ro interface?            oc-if:base-interface-ref
         +--ro input-power. → Rx power
         |  +--ro instant?    decimal64
         |  +--ro avg?        decimal64
         |  +--ro min?        decimal64
         |  +--ro max?        decimal64
         |  +--ro interval?   oc-types:stat-interval
         |  +--ro min-time?   oc-types:timeticks64
         |  +--ro max-time?   oc-types:timeticks64
         +--ro output-power. → Tx power
         |  +--ro instant?    decimal64
         |  +--ro avg?        decimal64
         |  +--ro min?        decimal64
         |  +--ro max?        decimal64
         |  +--ro interval?   oc-types:stat-interval
         |  +--ro min-time?   oc-types:timeticks64
         |  +--ro max-time?   oc-types:timeticks64

|     +--ro state
      |        +--ro name?                  string
      |        +--ro type?                  identityref
      |        +--ro target-gain?           decimal64
      |        +--ro target-gain-tilt?      decimal64
      |        +--ro gain-range?            identityref
      |        +--ro amp-mode?              identityref
      |        +--ro enabled?               boolean
      |        +--ro fiber-type-profile?    identityref -→
      |        +--ro component?             -> /oc-platform:components/component/name
      |        +--ro actual-gain
      |        |  +--ro instant?    decimal64
      |        |  +--ro avg?        decimal64
      |        |  +--ro min?        decimal64
      |        |  +--ro max?        decimal64
      |        |  +--ro interval?   oc-types:stat-interval
      |        |  +--ro min-time?   oc-types:timeticks64
      |        |  +--ro max-time?   oc-types:timeticks64
```

```
     |        +--ro actual-gain-tilt
     |        |  +--ro instant?    decimal64
     |        |  +--ro avg?        decimal64
     |        |  +--ro min?        decimal64
     |        |  +--ro max?        decimal64
     |        |  +--ro interval?   oc-types:stat-interval
     |        |  +--ro min-time?   oc-types:timeticks64
     |        |  +--ro max-time?   oc-types:timeticks64
...........
 |        +--ro optical-return-loss.
     |           +--ro instant?    decimal64
     |           +--ro avg?        decimal64
     |           +--ro min?        decimal64
     |           +--ro max?        decimal64
     |           +--ro interval?   oc-types:stat-interval
     |           +--ro min-time?   oc-types:timeticks64
     |           +--ro max-time?   oc-types:timeticks64

+--rw supervisory-channels
        +--rw supervisory-channel* [interface]
           +--rw interface    -> ../config/interface
           +--rw config
           |  +--rw interface?   oc-if:base-interface-ref
           +--ro state
              +--ro interface?           oc-if:base-interface-ref
              +--ro input-power. → Rx power
              |  +--ro instant?    decimal64
              |  +--ro avg?        decimal64
              |  +--ro min?        decimal64
              |  +--ro max?        decimal64
              |  +--ro interval?   oc-types:stat-interval
              |  +--ro min-time?   oc-types:timeticks64
              |  +--ro max-time?   oc-types:timeticks64
              +--ro output-power. → Tx power
              |  +--ro instant?    decimal64
              |  +--ro avg?        decimal64
              |  +--ro min?        decimal64
              |  +--ro max?        decimal64
              |  +--ro interval?   oc-types:stat-interval
              |  +--ro min-time?   oc-types:timeticks64
              |  +--ro max-time?   oc-types:timeticks64
```

Supported leaves for OpenConfig Wavelength router model

From R25.1.1, these leaves are supported for get-oper and telemetry:

```
 module: openconfig-wavelength-router
  +--rw wavelength-router
     +--rw media-channels
     |  +--rw channel* [index]
     |     +--rw index                    -> ../config/index
     |     +--rw config
     |     |  +--rw index?                            uint32
     |     |  +--rw lower-frequency?                  oc-opt-types:frequency-type
     |     |  +--rw upper-frequency?                  oc-opt-types:frequency-type
     |     |  +--rw admin-status?                     oc-opt-types:admin-state-type
     |     +--ro state
     |     |  +--ro index?                            uint32
     |     |  +--ro lower-frequency?                  oc-opt-types:frequency-type
     |     |  +--ro upper-frequency?                  oc-opt-types:frequency-type
     |     |  +--ro admin-status?                     oc-opt-types:admin-state-type
     |     |  +--ro oper-status?                      enumeration
     |     +--rw source
     |     |  +--rw config
```

```
|     |  |  +--rw port-name?   -> /oc-platform:components/component/name
|     |  +--ro state
|     |     +--ro port-name?   -> /oc-platform:components/component/name
|     +--rw dest
|     |  +--rw config
|     |  |  +--rw port-name?   -> /oc-platform:components/component/name
|     |  +--ro state
|     |     +--ro port-name?   -> /oc-platform:components/component/name
|    +--rw port-spectrum-power-profiles
|    |  +--rw port* [name]
|    |   |   +--rw name                      -> ../config/name
|    |    |  +--rw config
|    |   |  |  +--rw name?   -> /oc-platform:components/component/name
|    |  |  +--ro state
|    | |  |  +--ro name?   -> /oc-platform:components/component/name
```

From R25.2.1, these leaves are supported for NETCONF/GNMI operations, including get, edit-config, and telemetry:

```
module: openconfig-wavelength-router
 +--rw wavelength-router
    +--rw media-channels
    |  +--rw channel* [index]
    |     +--rw index                     -> ../config/index
    |     +--rw config
    |     |  +--rw index?                           uint32
    |     |  +--rw lower-frequency?                 oc-opt-types:frequency-type
    |     |  +--rw upper-frequency?                 oc-opt-types:frequency-type
    |     |  +--rw admin-status?                    oc-opt-types:admin-state-type
    |     +--ro state
    |     |  +--ro index?                           uint32
    |     |  +--ro lower-frequency?                 oc-opt-types:frequency-type
    |     |  +--ro upper-frequency?                 oc-opt-types:frequency-type
    |     |  +--ro admin-status?                    oc-opt-types:admin-state-type
    |     |  +--ro oper-status?                     enumeration
    +--rw port-spectrum-power-profiles
    |  +--rw port* [name]
    |    |   +--rw name                      -> ../config/name
    |     |  +--rw config
    |    |  |  +--rw name?   -> /oc-platform:components/component/name
    |  |  +--ro state
    | |  |  +--ro name?   -> /oc-platform:components/component/name
    | |  +--rw oc-wave-ext:extended
    |  | |  +--rw config
    |  |  |  |  +--rw oc-wave-ext:regulation-enable?   boolean
    |  |  |   +--ro state
    |  |  |   |  +--rw oc-wave-ext:regulation-enable?   boolean
    |    |  +--rw spectrum-power-profile
    |     |   |  +--rw distribution* [lower-frequency upper-frequency]
    |     |   |  |  +--rw lower-frequency    -> ../config/lower-frequency
     |    |   |  |  +--rw upper-frequency    -> ../config/upper-frequency
     |    |   |  |  +--rw config
     |    |   |  |  |  +--rw lower-frequency?   oc-opt-types:frequency-type
     |     |  |  |  |  +--rw upper-frequency?   oc-opt-types:frequency-type
     |     |  |  |  |  +--rw target-power?      decimal64
     |     |  |  |  +--ro state
     |    |  |   |  |     +--ro lower-frequency?   oc-opt-types:frequency-type
     |    |  |       |     +--ro upper-frequency?   oc-opt-types:frequency-type
     |    |  |       |     +--ro target-power?      decimal64


module: openconfig-wavelength-router
  +--rw wavelength-router
     +--rw media-channels
```

```
|  +--rw channel* [index]
|     +--rw index                      -> ../config/index
|     +--ro state
|     |  +--ro index?                            uint32
|     |  +--ro lower-frequency?                  oc-opt-types:frequency-type
|     |  +--ro upper-frequency?                  oc-opt-types:frequency-type
|     |  +--ro admin-status?                     oc-opt-types:admin-state-type
|     |  +--ro oper-status?                      enumeration
|    +--rw port-spectrum-power-profiles
|  +--rw port* [name]
|   |   +--rw name                       -> ../config/name
|    |  +--rw config
|   |  |  +--rw name?   -> /oc-platform:components/component/name
|  |  +--ro state
| |  |  +--ro name?   -> /oc-platform:components/component/name
| |  +--rw oc-wave-ext:extended
|  |  |  |   +--ro state
|  |  |  |   |  +--rw oc-wave-ext:regulation-enable?   boolean
|   |  +--rw spectrum-power-profile
|    |   |  +--rw distribution* [lower-frequency upper-frequency]
|    |   |  |  +--rw lower-frequency    -> ../config/lower-frequency
 |   |   |  |  +--rw upper-frequency    -> ../config/upper-frequency
 |   |   |  |  +--rw config
 |   |   |  |  |  +--rw lower-frequency?   oc-opt-types:frequency-type
 |    |  |  |  |  +--rw upper-frequency?   oc-opt-types:frequency-type
 |    |  |  |  |  +--rw target-power?      decimal64
 |    |  |  |  +--ro state
 |   |  |  |   |  |     +--ro lower-frequency?   oc-opt-types:frequency-type
 |   |  |    +--ro upper-frequency?   oc-opt-types:frequency-type
 |   |  |    +--ro target-power?      decimal64
```

EDT supported leaf

From R25.2.1, telemetry EDT supports both channel addition and deletion. These OpenConfig leaves are included in the EDT functionality:

- `openconfig-wavelength-router/wavelength-router/media-channels/channel[index]/state/index`
- `openconfig-wavelength-router/wavelength-router/media-channels/channel[index]/state/upper-frequency`
- `openconfig-wavelength-router/wavelength-router/media-channels/channel[index]/state/lower-frequency`

Supported leaves for OpenConfig channel monitor model

From R25.2.1, these leaves are supported for get-oper and telemetry:

```
+--rw channel-monitors
      +--rw channel-monitor* [name]
         +--rw name        -> ../config/name
         +--rw config
         +--ro state
         |  +--ro name?           -> /oc-platform:components/component/name
         |  +--ro monitor-port?   -> /oc-platform:components/component/name
         +--rw channels
            +--ro channel* [lower-frequency upper-frequency]
               +--ro lower-frequency    -> ../state/lower-frequency
               +--ro upper-frequency    -> ../state/upper-frequency
               +--ro state
                  +--ro lower-frequency?   oc-opt-types:frequency-type
                  +--ro upper-frequency?   oc-opt-types:frequency-type
                  +--ro power?             decimal64

        +--ro state
         |  +--ro name?           -> /oc-platform:components/component/name
```

```
|  +--ro monitor-port?   -> /oc-platform:components/component/name
+--rw channels
   +--ro channel* [lower-frequency upper-frequency]
      +--ro state
         +--ro lower-frequency?   oc-opt-types:frequency-type
         +--ro upper-frequency?   oc-opt-types:frequency-type
         +--ro power?             decimal64
```

Supported leaves for OpenConfig transport line common model

From R25.2.1, these leaves are supported for get-oper and telemetry:

```
module: openconfig-transport-line-common
  augment /oc-platform:components/oc-platform:component/oc-platform:port:
    +--rw optical-port
       +--ro state
          +--ro admin-state?         oc-opt-types:admin-state-type
          |  +--ro instant?    decimal64
```

```
module: openconfig-transport-line-common
  augment /oc-platform:components/oc-platform:component/oc-platform:port:
    +--rw optical-port
       +--ro state
          +--ro admin-state?         oc-opt-types:admin-state-type
          |  +--ro instant?    decimal64
```

Sample configurations

This section presents sample configurations and telemetry outputs for the OC models supported on the EDFA2 card.

OpenConfig attenuator model

This is a sample to configure and get operational data using the OC-Attenuator model:

```
{
    "openconfig-optical-attenuator:optical-attenuator": {
       "attenuators": {
           "attenuator": [
               {
                   "name":"0/0-VOA-EGRESS0",
"state":{
                   }
              }


{
    "openconfig-optical-attenuator:optical-attenuator": {
       "attenuators": {
           "attenuator": [
               {
                   "name":"0/0-VOA-OSC0",
                   "state":{
                   }
               }
```

OpenConfig amplifier model

This is a sample to configure and get operational data using the OC-Amplifier model:

```
 <get>
<filter>
```

```
<optical-amplifier xmlns="http://openconfig.net/yang/optical-amplfier">
<amplifiers/>
 <supervisory-channels/>
</optical-amplifier>
</filter>
</get>
```

```
<edit-config>
<target>
<candidate/>
 </target>
<config>
<optical-amplifier xmlns="http://openconfig.net/yang/optical-amplfier">
   <amplifiers>
    <amplifier>
     <name>0/0-AMP-EGRESS0</name>
     <config>
      <name>0/0-AMP-EGRESS0</name>
      <amp-mode>CONSTANT_GAIN</amp-mode>
      <type>EDFA</type>
<fiber-type-profile>SSMF</fiber-type-profile>
      <target-gain>16.00</target-gain>
      <target-gain-tilt>0.00</target-gain-tilt>
      </config>
  <cisco xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-openconfig-optical-amplifier-ext">
      <extended>
       <config>
        <regulation-enabled>true</regulation-enabled>
       </config>
      </extended>
     </cisco>
    </amplifier>
   </amplifiers>
  </optical-amplifier>
</config>
</edit-config>
```

OpenConfig wavelength model

This is a sample to configure and get operational data using the OC-Wavelength model:

```
"openconfig-wavelength-router:wavelength-router": {
  "port-spectrum-power-profiles": {
   "port": [
    {
     "name": "Ots0/0/0/0",
     "Cisco-IOS-XR-openconfig-wavelength-router-ext:extended": {
      "state": {
       "regulation-enable": false
      }
     },
     "state": {
      "name": "Ots0/0/0{
/0"

  },
  "media-channels": {
   "channel": [
    {
     "index": 100,
     "state": {
      "index": 100,
      "lower-frequency": "193950000",
      "upper-frequency": "194050000",
```

```
      "admin-status": "enabled",
      "oper-status": "up"
     }
```

Wavelength router model

This is a sample to configure and get operational data for frequency convention in spectrum-power-profile and distribution for wavelength router model:

```
<edit-config>
<target><candidate/></target>
<config>
    <wavelength-router xmlns="http://openconfig.net/yang/wavelength-router">
      <port-spectrum-power-profiles>
        <port>
          <name>Ots0/0/0/0</name>
            <config>
              <name>Ots0/0/0/0</name>
            </config>
          <spectrum-power-profile>
            <distribution>
              <lower-frequency>191200000</lower-frequency>
              <upper-frequency>196175000</upper-frequency>
<config>
                <lower-frequency>191200000</lower-frequency>
                <upper-frequency>196175000</upper-frequency>
                <target-power xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
nc:operation="create">-1.25</target-power>
              </config>
            </distribution>
          </spectrum-power-profile>
        </port>
      </port-spectrum-power-profiles>
    </wavelength-router>
</config>
</edit-config>
```

```
Request:
<get>
  <filter type="subtree">
    <wavelength-router xmlns="http://openconfig.net/yang/wavelength-router">
      <port-spectrum-power-profiles>
        <port>
          <name>Ots0/0/0/0</name>
          <spectrum-power-profile>
          </spectrum-power-profile>
        </port>
      </port-spectrum-power-profiles>
    </wavelength-router>
  </filter>
</get>
Response:
<?xml version="1.0"?>
<rpc-reply message-id="d78bc8c8-4e99-431b-9a8c-cab3d87e25cc"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
 <data>
  <wavelength-router xmlns="http://openconfig.net/yang/wavelength-router">
   <port-spectrum-power-profiles>
    <port>
     <name>Ots0/0/0/0</name>
     <spectrum-power-profile>
      <distribution>
       <lower-frequency>191200000</lower-frequency>
       <upper-frequency>196175000</upper-frequency>
```

```
       <state>
        <target-power>-1.20</target-power>
        <upper-frequency>196175000</upper-frequency>
        <lower-frequency>191200000</lower-frequency>
       </state>
       <config>
        <target-power>-1.25</target-power>
        <upper-frequency>196175000</upper-frequency>
        <lower-frequency>191200000</lower-frequency>
       </config>
      </distribution>
     </spectrum-power-profile>
    </port>
   </port-spectrum-power-profiles>
  </wavelength-router>
 </data>
</rpc-reply>
```

OpenConfig channel monitor model

This is a sample to get operational data using the OC-Channel monitor model:

```
{
  "openconfig-channel-monitor:channel-monitors": {
                "channel-monitor": [
                        {
                "name": "0/0-CHMON-RX-0",
                "channels":
                {
                    "channel":{}
                }
```

```
{
  "openconfig-channel-monitor:channel-monitors": {
                "channel-monitor": [
                        {
                "name": "0/0-CHMON-TX-0",
                "channels":
                {
                    "channel":{}
                }
```

This is a sample output to get data for single channel:

```
get data xpath:
/channel-monitors/channel-monitor/channels/channel[lower-frequency=191400000][upper-frequency=191406250]/state

Response:
[
  {
    "source": "10.127.126.174:57400",
    "timestamp": 1749368365802571706,
    "time": "2025-06-08T13:09:25.802571706+05:30",
    "updates": [
      {
        "Path":
"openconfig:channel-monitors/channel-monitor[name=0/0-CHMON-RX-0]/channels/channel[lower-frequency=191400000][upper-frequency=191406250]/state",

        "values": {
          "channel-monitors/channel-monitor/channels/channel/state": {
            "lower-frequency": "191400000",
            "upper-frequency": "191406250"
          }
        }
```

```
      },
      {
        "Path":
"openconfig:channel-monitors/channel-monitor[name=0/0-CHMON-TX-0]/channels/channel[lower-frequency=191400000][upper-frequency=191406250]/state",

        "values": {
          "channel-monitors/channel-monitor/channels/channel/state": {
            "lower-frequency": "191400000",
            "power": "-31.30",
            "upper-frequency": "191406250"
          }
        }
      },
      {
        "Path":
"openconfig:channel-monitors/channel-monitor[name=0/0-CHMON-RX-1]/channels/channel[lower-frequency=191400000][upper-frequency=191406250]/state",

        "values": {
          "channel-monitors/channel-monitor/channels/channel/state": {
            "lower-frequency": "191400000",
            "power": "0.00",
            "upper-frequency": "191406250"
          }
        }
      },
      {
        "Path":
"openconfig:channel-monitors/channel-monitor[name=0/0-CHMON-TX-1]/channels/channel[lower-frequency=191400000][upper-frequency=191406250]/state",

        "values": {
          "channel-monitors/channel-monitor/channels/channel/state": {
            "lower-frequency": "191400000",
            "power": "-26.60",
            "upper-frequency": "191406250"
          ]
```


OpenConfig transport line common model

This is a sample output for EDFA2 line interface:


```
{
    "source": "10.127.126.174:57400",
    "timestamp": 1749368046243415426,
    "time": "2025-06-08T13:04:06.243415426+05:30",
    "updates": [
      {
       "Path": "openconfig:components/component[name=Ots0/0/0/0]/port/optical-port/state",

        "values": {
          "components/component/port/optical-port/state": {
            "admin-state": "enabled",
            "input-power": {
              "instant": "-9.65"
                  }
      }
```

gNOI for OTDR

The OTDR gNOI protocol is designed to manage and monitor optical networks. This service is responsible for initiating and controlling OTDR scans, reporting scan results and handling errors during a scan based on the gnoi otdr proto definition.. In Release 25.1.1 OTDR gNOI supports only manual initiation of OTDR.

This table lists the responses received for the OTDR proto and the corresponding OTDR status shown in the CLI and the Cisco-IOS-XR-controller-ots-oper. yang model.

OTDR proto fields	Corresponding OTDR status of OTDR in CLI and native yang model
Error codes corresponding to OTDR initiation	
InitiateError_HARDWARE_FAILURE	OTDR_SCAN_STATUS_COMM_FAILED OTDR_SCAN_STATUS_ERROR
InitiateError_ALREADY_IN_PROGRESS	OPTICS_CERR_OTDR_SCAN_ALREADY_IN_PROGRESS
InitiateError_UNSPECIFIED	OPTICS_CERR_OTDR_SCAN_NOT_SUPPORTED OPTICS_CERR_OTDR_MODULE_NOT_DISCOVERED_OR_INVALID_ERRORS OPTICS_CERR_OTDR_PLUGGABLE_NOT_PRESENT OPTICS_CERR_OTDR_PATCH_CONNECTION_MISSING OPTICS_CERR_OTDR_LOCKED_BY_ANOTHER_ENTITY OTDR_SCAN_STATUS_STOPPED OTDR_SCAN_STATUS_ERROR OTDR_SCAN_STATUS_TIMEOUT OTDR_SCAN_STATUS_OTDR_LOCAL_RES_NOT_AVAILABLE OTDR_SCAN_STATUS_SPAN_RES_FAILED OTDR_SCAN_STATUS_SCAN_NOT_ALLOWED OTDR_SCAN_STATUS_SCAN_UNKNOWN
Status corresponding to OTDR progression	
InitiateProgress_PENDING	OTDR_SCAN_STATUS_WAITING_SPAN_RESERVATION
InitiateProgress_RUNNING	OTDR_SCAN_STATUS_MEASURING OTDR_SCAN_STATUS_DATA_PROCESSING
InitiateProgress_COMPLETE	OTDR_SCAN_STATUS_DATA_READY
OTDR measurements	
total_loss_db	not supported
total_length_m	not supported

OTDR proto fields	Corresponding OTDR status of OTDR in CLI and native yang model
optical_return_loss_db	optical_return_loss
local_path	Sor file
discovered_fiber_type	not supported
average_loss_db_km	not supported
Events	
distance_m	location
loss_db	In case of non-reflective event, loss_db is equivalent to magnitude
Reflection_db	In case reflective event, reflection_db is equivalent to magnitude