# **Configure NETCONF/YANG for Cisco IOS XE 16.X Platforms**

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## Introduction

This document describes how to configure NETCONF/YANG on Cisco IOS® XE 16.x based Platforms.

## Prerequisites

## Requirements

NETCONF/YANG is supported as of Cisco IOS® XE 16.3.1 software.

**Note**: No prior experience with NETCONF, YANG, or Python scripting is required in order to use this document.

## **Components Used**

The information in this document is based on these software and hardware versions:

In this example, a stand alone WS-C3850-12X48U switch running Cisco IOS XE 16.3.3 is used as the NETCONF server. This is the device that is configured and from which data (show command output) is collected from via NETCONF/YANG.

A laptop (Apple MacBook Pro running macOS Sierra 10.12.2 and Google Chrome browser) is used as the NETCONF Client. It acts as the centralized management platform and uses the Yang Explorer application. It is the device that creates the YANG formatted requests that are sent to the Catalyst 3850 via NETCONF RPC (Remote Procedure Call) messages to configure and collect data from the Catalyst 3850.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

## **Background Information**

The example given in this document focuses on lab testing with the Catalyst 3850, however, the information provided also applies to other Cisco IOS XE 16.x platforms such as the Cisco ASR 1000 series routers.

## Data Models - Programmatic and Standards Based Configuration and Monitoring

Data models provide an alternate and centralized way to configure Cisco devices (instead of using the Cisco Command Line Interface (CLI) or Simple Network Management Protocol (SNMP)) and to collect operational data (show commands) from Cisco devices. Since the data models are standards based on the same procedure and can be used to configure or collect data from non-Cisco devices as well, it makes them ideal for customers that support multiple vendors. A centralized management platform (for example, a laptop) can be used to configure or collect data from multiple Cisco devices and the data model architecture allows for automating these procedures via Python scripting (two additional key benefits).

## Yet Another Next Generation (YANG) Data Modeling Language (RFC 6020)

YANG is a standards based data modeling language used to create device configuration requests or the requests for operational (show command) data. It has a structured format similar to a computer program that is human readable. Several applications are available that can be run on a centralized management platform (for example, a laptop) to create these configuration and operational data requests.

There are both standard (common) YANG data models that apply to all vendors (for example, a request to disable or shut down an ethernet interface can be identical for both Cisco and non-Cisco devices) as well as device (native, vendor specific) data models that facilitate configuring or collecting operational data associated with proprietary vendor features.

### Network Configuration (NETCONF) Protocol (RFC 6241)

NETCONF is a standard based and Extensible Markup Language (XML) encoded protocol that provides the transport to communicate the YANG formatted configuration or operational data request from an application that runs on a centralized management platform (for example, a laptop) to the Cisco device that a user wishes to configure or request operational (show command) data from. It provides transaction based services such as aborting the entire configuration request when a portion of that configuration request fails. NETCONF uses a simple Remote Procedure Call (RPF) based mechanism to facilitate communication between a client (centralized management platform script or application) and a server (Cisco switch or router). It uses Secure Shell (SSH) as the transport layer across network devices. Some NETCONF operations include get, get-config, edit-config, and rpc.

## Configure

# 1. Basic Configuration of a Catalyst 3850 Running Cisco XE 16.3.3 Software to Support NETCONF/YANG Data Modeling

3850-1# show running-config netconf-yang ------ Inable NETCONF/YANG globally. It may take up to 90

username cisco1 privilege 15 password 0 cisco1 ---> Username/password used for NETCONF-SSH access

**Note**: This is the complete configuration required on the Catalyst 3850 to support NETCONF/YANG Data Modeling but it assumes that no aaa new-model is configured globally (the default) as well. If it is desired to enable AAA (authentication, authorization, and accounting) by configuring aaa new-model, then this configuration is also required at a minimum. You can also expand this to use AAA with a TACACS+ or RADIUS configuration, but this is beyond the scope of this example.

aaa new-model

aaa authorization exec default local -----> Required for NETCONF-SSH connectivity and edit-conf

### 2. Additional (Optional) Configuration to Allow NETCONF/YANG Syslog and SNMP

### **Event Monitoring**

These snmp-server configurations must be present in order to enable the generation of NETCONF notifications (RFC 5277 - <u>Tools 5277</u>) for Syslog messages and for any configured SNMP traps to also generate NETCONF notifications.



**Note**: While these are the minimum required, additional snmp-server enable entries can be present as well. A client (centralized management platform) registers to receive the NETCONF notification stream from a server (Catalyst 3850) and send a specific subscription RPC (see section 3 of Configuring the Centralized Management Platform (Laptop)).

#### 3850-1# show running-config

<pre>snmp-server community <string> RW&gt;</string></pre>	SNMP gateway in DMI requires communi
<pre>netconf-yang cisco-ia snmp-community-string <string>&gt;</string></pre>	Configure the same community string
<pre>snmp-server trap link ietf&gt;</pre>	enable traps for IETF link up/down
<pre>snmp-server enable traps snmp authentication linkdown linkup&gt;</pre>	enable traps for link up/down
<pre>snmp-server enable traps syslog&gt;</pre>	enable traps for Syslog so notificat
<pre>snmp-server manager&gt;</pre>	enable snmp-server

For Syslog, this configuration must be present for the Data Model Interface (DMI) on the Catalyst 3850 to have the ability to generate NETCONF notifications defined in RFC 5277 when Syslog messages are generated by Ciscod on the Catalyst 3850.

```
logging history debugging -----> required for the generation of any NETCONF notification messages fo
logging snmp-trap emergencies ---> configure 1 or more of the following to control which levels of Sys
logging snmp-trap alerts
logging snmp-trap critical
logging snmp-trap errors
logging snmp-trap warnings
logging snmp-trap notifications
logging snmp-trap informational
logging snmp-trap debugging
```

For SNMP traps, this configuration is required to generate NETCONF notifications. In Cisco XE 16.3.1 software, a maximum of 10 SNMP traps can be configured to generate NETCONF notifications, but this restriction can be removed in a future release. Notification generation for SNMP traps is enabled by default. To disable generating SNMP trap notifications, use this CLI, no netconf-yang cisco-ia snmp-trap-control global-forwarding.

```
netconf-yang cisco-ia snmp-trap-control trap-list 10.3.6.1.6.3.1.1.5.3 -----> LinkDown trap
netconf-yang cisco-ia snmp-trap-control trap-list 10.3.6.1.6.3.1.1.5.4 ----> LinkUp trap
netconf-yang cisco-ia snmp-trap-control trap-list 10.3.6.1.4.1.9.9.41.2.0.1 ---> Syslog generated noti
```

#### 3. Network Connectivity Configuration of the Catalyst 3850 Used in this Example

The Catalyst 3850 management interface GigabitEthernet0/0 is used to connect to the network and to the centralized management platform (a laptop can be used) in this example. Dynamic Host Configuration Protocol (DHCP) has been used to assign IP address 172.16.167.175 to this interface. Alternate configurations can be used on the Catalyst 3850 as long as the laptop can reach the Catalyst 3850 on the Network.

```
3850-1# show running-config
vrf definition Mgmt-vrf
!
address-family ipv4
exit-address-family
!
address-family ipv6
exit-address-family
interface GigabitEthernet0/0
vrf forwarding Mgmt-vrf
ip address dhcp
negotiation auto
ip route vrf Mgmt-vrf 0.0.0.0 0.0.0.0 172.16.167.161
3850-1# show ip interface brief
```

Interface	IP-Address	OK? Method	Status	Protocol
Vlan1	10.1.1.1	YES NVRAM	up	up
Vlan10	10.10.10.1	YES NVRAM	up	up
Vlan20	10.20.20.1	YES NVRAM	up	up
GigabitEthernet0/0	172.16.167.175	YES DHCP	up	up
Fo1/1/1	unassigned	YES unset	down	down
Fo1/1/2	unassigned	YES unset	down	down
GigabitEthernet1/0/1	unassigned	YES manual	up	up
GigabitEthernet1/0/2	unassigned	YES unset	up	up
GigabitEthernet1/0/3	unassigned	YES unset	down	down
GigabitEthernet1/0/4	unassigned	YES unset	down	down
GigabitEthernet1/0/5	unassigned	YES unset	down	down

## Verify NETCONF/YANG on the Catalyst 3850

1. From the Command Line Interface (CLI) of the Catalyst 3850, this command can be used to ensure that the software processes required to support the Data Model Interface (DMI) on the Catalyst 3850 run once netconf-yang is configured.

3850-1# show platform software yang-management process

confd : Running
nesd : Running
syncfd : Running
ncsshd : Running
dmiauthd : Running
vtyserverutild : Running
opdatamgrd : Running
ngnix : Running

The next steps are performed from the centralized management platform. In this example, a laptop (Apple MacBook Pro running macOS Sierra 10.12.2) is used that has network access to the Catalyst 3850. The commands are issued from a terminal prompt on the laptop. There is no special application loaded on the laptop at this point.

2. Ensure that the centralized management platform (laptop) can reach the Catalyst 3850 (172.16.167.175) on the network.

<#root>
USER1-M-902T:~ USER1\$ ping 172.16.167.175
PING 172.16.167.175 (172.16.167.175): 56 data bytes
64 bytes from 172.16.167.175: icmp\_seq=0 ttl=247 time=3.912 ms
64 bytes from 172.16.167.175: icmp\_seq=1 ttl=247 time=6.917 ms
64 bytes from 172.16.167.175: icmp\_seq=2 ttl=247 time=4.063 ms
64 bytes from 172.16.167.175: icmp\_seq=3 ttl=247 time=4.371 ms

```
^C
```

3. Verify SSH connectivity to the Catalyst 3850 (172.16.167.175 in this example) from the centralized management platform (laptop) with the username and password (cisco1/cisco1) from this Catalyst 3850 configuration. The response can be a long list of NETCONF capabilities from the Catalyst 3850 followed by a hello message. TCP port 830 = netconf-ssh.

**Tip**: If this SSH test does not work, ensure that any firewall in between the laptop and Catalyst 3850 permits TCP port 830 (reference RFC 4742: <u>Tools 4742</u>).

```
USER1-M-902T:~ USER1$ ssh -s cisco1@172.16.167.175 -p 830 netconf
cisco1@172.16.167.175's password: cisco1
<?xml version="1.0" encoding="UTF-8"?>
<hello xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<capabilities>
<capability>urn:ietf:params:netconf:base:1.0</capability>
<capability>urn:ietf:params:netconf:base:1.1</capability>
<capability>urn:ietf:params:netconf:capability:writable-running:1.0</capability>
<capability>urn:ietf:params:netconf:capability:xpath:1.0</capability>
<capability>urn:ietf:params:netconf:capability:validate:1.0</capability>
<capability>urn:ietf:params:netconf:capability:validate:1.1</capability>
<capability>urn:ietf:params:netconf:capability:rollback-on-error:1.0</capability
--snip--
</capabilities>
<session-id>2870</session-id></ hello>]]>]]>
Use < \wedge C > to exit
```

## **Configure the Centralized Management Platform (Laptop)**

### 1. Install the Yang Explorer Application on a Laptop

In this example, the Yang Explorer application is used on a laptop (Apple MacBook Pro running macOS Sierra 10.12.2, Google Chrome browser) to act as the centralized management platform. Yang Explorer allows the user to do this:

- Upload / Compile YANG data models from User Interface or Command Line
- Build NETCONF RPCs (Remote Procedure Calls)
- Execute RPC against a real NETCONF server (Catalyst 3850)
- Save created RPCs to collections for later use
- Browse data model trees and inspect YANG properties

**Note**: The YANG Explore application is also supported on Linux systems.

#### 2. Use the Yang Explorer Application

Start the Yang Explorer Application - from a terminal prompt on the laptop run the **./start.sh** and command from the yang-explorer directory.

**Note**: Keep this terminal session open, otherwise, the Yang Explorer application can shut down and

where the second second

```
USER1-M-902T:~ USER1$ cd yang-explorer
USER1-M-902T:yang-explorer USER1$ ./start.sh &
Starting YangExplorer server ..
Use http://localhost:8088/static/YangExplorer.html
Performing system checks...
System check identified no issues (0 silenced).
January 19, 2017 - 23:12:20
Django version 1.8.3, using settings 'server.settings'
Starting development server at http://localhost:8088/
Quit the server with CONTROL-C.
```

Launch the Yang Explorer GUI - Launch the Yang Explorer application GUI and log in to the Yang Explorer application GUI as guest/guest in the top right corner of the application GUI main menu (refer to the screencapture).

Retrieve capabilities from the Catalyst 3850. Enter the Catalyst 3850 details (IP address, Username/Password, TCP port 830 for ssh-netconf) and click **Capabilities** to retrieve the YANG operational capabilities list from the Catalyst 3850 software.

**Tip**: This is also a good test to confirm that NETCONF communication works between the Yang Explorer application on the Centralized Management Platform (Laptop) and the Catalyst 3850.



Status : Recieved HTTP Result for request: get-cap

Load Yang Data Models - Various YANG data models can be subscribed to under Manage Models. Once subscribed, they appear in the Explorer box on the left. These YANG models allow the Yang Explorer application to create YANG formatted NETCONF Remote Procedure Calls (RPC) messages (which are sent to the Catalyst 3850 to configure it or retrieve data from it) without the need to have in depth YANG expertise. Examples of how to do this are covered in the next section Basic NETCONF/YANG Operational

Examples:



3. Subscribe to NETCONF Notifications (Optional)

A client (centralized management platform) registers to receive NETCONF notification streams from a server (Catalyst 3850) by sending this YANG formatted NETCONF RPC message. The Catalyst 3850 sends NETCONF notifications asynchronously to each client that subscribes. Before you complete this task, ensure that the correct configuration is in place on the Catalyst 3850 to support NETCONF Notifications (see section 2) of Configuring NETCONF/YANG on the Catalyst 3850. The NETCONF server (Catalyst 3850) begins to send the event notifications to the NETCONF client (Centralized Management Platform) as the events occur within the system. These event notifications can continue to be sent until either the NETCONF session is terminated or the subscription terminates for some other reason. See RFC 5277 for more details related to subscription options Tools 5277.

To do this, you need to cut and paste this into the Yang Explorer application GUI as a Custom RPC.

Iocalhost:8088/static/Y				Mike
$\leftarrow$ $\rightarrow$ C (i) localhost:8088/sta	tic/YangExplorer.html			☆ 🗉 🗄
Yang Explorer 0.6.0 (Beta)		Çî Help	🚰 Admin	🔁 Refresh 🔒 guest
Explorer search	Values	Build Colections Manage Models	Property	Value
► Rietf-interfaces		Operations Device Settings	Name	statistics
		Profile Create device profile	Node Type	container
			Data Type	
		Platform other	Access	read-only
		Host 172.16.167.175 Port 830	Presence	
		Username cisco1 Password cisco1	Key	
			Mandatory	
			Default	
		NetConr     NetConr     NetConr     RPC     Script     Capabili     Encoding     Console	Path	ietf-netconf-monitoring/ netconf-state/statistics
		<pre></pre>	)">	Statistical data pertaining to the NETCONF server.Statistical data pertaining to the NETCONF server.None
O Config O Oper	+ Add - Delete	C Reset Custom RPC Run Save Clear Copy		
Status : Clear completed			[	IETF 93

Next, **Run** is selected in order to send the custom RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with an ok message to let the user know that the operation was successful.

Iocalhost:8088/static/YangExp ×		Mike
$\leftarrow$ $\Rightarrow$ C O localhost:8088/static/YangExplorer.html		☆ 🗉 🗄
Yang Explorer 0.6.0 (Beta)	O Help	🚰 Admin 🔀 Refresh 🔒 guest
Explorer search Values	Build Collections Manage Models	Property Value
► Rietf-interfaces	Operations Device Settings	Name statistics
	Create device profile	Node Type container
	Profile	Data Type
	Platform other -	Access read-only
	Host 172.16.167.175 Port 830	Presence
	Username cisco1 Password cisco1	Кеу
		Mandatory
		- Default
	Encoding Console	Path ietf-netconf-monitoring/
	<rpro-reply <br="" message-id="urn:uuid:8a3329b6-e30a-4407-91f2-c094fba2a4db">winis uncertiparams:xml:ns:netconf:base:1.0" winis:nc="urnietf:params:xml:ns:netconf:base:1.0"&gt; <ok></ok> </rpro-reply>	Description Statistical data pertaining to the NETCONF server.Statistical data pertaining to the NETCONF server.None
Config Oper + Add - Delete C Reset	Custom RPC Run Save Clear Copy	
Status : Recieved HTTP Result for request: run-rpc		IETF 93

**Note**: The current version of Yang Explorer used in this example does not have an option to look at the received NETCONF Notifications. They are typically stored in a clickable Notification log in the main menu of the application.

## **Basic NETCONF/YANG Operational Examples**

Now that the Catalyst 3850 and the Centralized Management Platform are configured and have started to communicate, lets us look at some basic operational examples.

The examples can demonstrate that the YANG formatted NETCONF RPC messages sent via NETCONF from the Centralized Management Platform (Laptop) Yang Explorer application to the Catalyst 3850 are converted to standard Cisco IOS CLI by the confd software process on the Catalyst 3850. Also, Cisco IOS CLI data (show command data) is converted to YANG formatted data by the confd software process on the Catalyst 3850 before it is sent as NETCONF RPC message to the Centralized Management Platform (Laptop) Yang Explorer application. This means that the regular CLI can still be used on the Catalyst 3850 to configure the switch and collect show command data in addition to use NETCONF/YANG to do the same.

### 1. Data Retrieval Example

#### Request a List of Interface Names from the Catalyst 3850

The desired operation can be selected from the left side Explorer section of the Yang Explorer application GUI. In this case, interface name data is to be retrieved from the Catalyst 3850 and so **Oper** (for operation) is selected followed by **get-config** under the interface name drop down. **RPC** is selected next in order to generate the YANG formatted (human readable) NETCONF RPC that is required to be sent to the Catalyst 3850 via NETCONF in order to retrieve this data from the Catalyst 3850.



After the YANG formatted NETCONF RPC message is generated, **Run** is selected in order to send it to the Catalyst 3850. The Catalyst 3850 replies with a YANG formatted (human readable) list of the Catalyst 3850 interface names (GigabitEthernet1/1/1, GigabitEthernet1/1/2, and so on).



## 2. Configuration Example

### Shut Down an Ethernet Interface on the Catalyst 3850

The desired operation is selected from the left side of the Explorer section of the Yang Explorer application GUI. In this case, to configure an interface (shutting down an interface) is required on the Catalyst 3850 and so **Config** (for configuration) is selected, followed by the required operational parameters under the interface drop down menus. **RPC** is selected next in order to generate the YANG formatted (human readable) NETCONF RPC that is required to be sent to the Catalyst 3850 via NETCONF in order to execute the configuration task.

localhost	×				Mike
$\leftrightarrow$ $\ni$ C ( ) localhost:8088/static/Y	angExplorer.html				☆ 🖺 :
Yang Explorer 0.6.0 (Beta)			🕥 Help 🛛 👹 Admin	C Refresh	🐣 guest
Explorer	Values	0	Build Collections Manage Models	Property	Value
Rietf-interfaces			Operations Device Settings	Name	enabled
V call interfaces				Node Type	leaf
▼			Protile	Data Type	boolean
₽ name	GigabitEthernet1/0/16		Platform •	Access	read-write
description	land the share of General		Host 172.16.167.175 Port 830	Presence	
enabled	false			Key	
✓ Ink-up-down-trap-enable	10100		Username cisco1 Password cisco1	Mandatony	
interfaces-state			NetConf RestConf Rec Script Capabilities	Default	10.0
			Encoding Console	Delaurt	true
			<pre></pre>	Fath	interfaces/ interfaces/ interface/ enabled
			<pre><interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf- interfaces"></interfaces></pre>	Description	This leaf contains the configured, desired
Oper	+ Add - Delete C Re	set	Custom RPC Run Save Clear Copy		state of the interface.
Status : Recieved HTTP Result for request type m	pc				IETF 93

After the YANG formatted NETCONF RPC message is generated, **Run** is selected in order to send it to the Catalyst 3850. The Catalyst 3850 replies with a YANG formatted (human readable) message that state that the configuration operation was successful (ok).



In order to confirm that the change took place, the configuration can be checked. A get-config operation

(Oper) can be used where the Catalyst 3850 replies back that the interface GigabitEthernet 1/0/16 configuration has enabled = false now which means that the interface was shut down.

**Tip**: In general, when it is not clear what format the Values can be in the Explorer section of the Yang Explorer application, dumping the YANG formatted Catalyst 3850 configuration, as shown, is a good way to determine what they are before an attempt is made to modify them. The right hand side of the next screens provide some descriptions and dependencies for these values as well in the Property and Value columns.



After the YANG formatted NETCONF RPC message is generated, **Run** is selected in order to send it to the Catalyst 3850. The Catalyst 3850 replies with a YANG formatted message that states that the interface GigabitEthernet 1/0/16 configuration has enabled = false now which means that the interface was shut down.

				A 197
← → C ① localhost:8088/static/	YangExplorer.html			\$
Yang Explorer 0.6.0 (Beta)			🖸 Help 🦉 Admin 📿 Refresh	🔒 guest
Explorer search	Values	0	Build Collections Manage Models Property	Value
Rietf-interfaces			Operations Device Settings Name	interface
🔻 🛅 interfaces			Node Type	list
🔻 🖵 interface	<get-config></get-config>		Profile Data Type	
₽ name	GigabitEthernet1/0/16		Platform other  Access	read-write
description	ianaift:ethernetCsmacd		Host 172.16.167.175 Port 830	
✓ opc			Key	
link-up-down-trap-enable			Mandatory	
► 🚰 interfaces-state			NetConf RestConf RPC Script Capabilities	
			Encoding Console	1-16
			<pre></pre> <pre></pre> <pre></pre> <pre></pre> <pre></pre> <pre>// performation of the set of the</pre>	interfaces/ interfaces/ interface
			<pre><interface></interface></pre>	The list of configured interfaces on the device.
O Config 🧿 Oper	+ Add - Delete C F	eset	Custom RPC Run Save Clear Copy	The operationa

# Catalyst 3850 CLI Display of the Interface Configuration both Before and After the Previous NETCONF/YANG Configuration Change

At the time of the previous Yang Explorer configuration change operation, this is output from the CLI of the Catalyst 3850. Interface GigabitEthernet 1/0/16 was in the default no shutdown state until the NETCONF RPC message is received as seen in the log message on the Catalyst 3850. After the NETCONF RPC message is received that contains the YANG formatted request to shutdown the interface, the operation is completed, the interface is shutdown, and the running configuration is modified to reflect this. This also demonstrates how the confd software process on the Catalyst 3850 converts the received YANG formatted NETCONF RPC message into standard Cisco IOS CLI. This means that a user can still use regular Cisco IOS CLI to modify the configuration and execute show commands in addition to using NETCONF/YANG to do the same.

```
3850-1# show running-config interface gigabitEthernet 1/0/16 □
Building configuration . . .
Current configuration : 39 bytes □
! □
interface GigabitEthernet1/0/16
□end
3850-1# show startup-config | begin 1/0/16
□interface GigabitEthernet1/0/16 □
!
*Jan 5 17:05:55.345: %DMI-5-CONFIG_I:Switch 1 R0/0: nesd: Configured from NETCONF/RESTCONF by cisco1, t
*Jan 5 17:05:57.335: %LINK-5-CHANGED: Interface GigabitEthernet1/0/16, changed state to administrativel
pare 1% changed state to administrativel
```

```
3850-1# show running-config interface gigabitEthernet 1/0/16 

DBuilding configuration...
```

```
Current configuration : 49 bytes 
!
Dinterface GigabitEthernet1/0/16 
shutdown ------> the interface is shutdown now
Dend
```

3850-1#

**Note:** The configuration has not been saved (copied from running configuration to the startup configuration) on the Catalyst 3850 yet.

```
3850-1# show startup-config | begin 1/0/16
interface GigabitEthernet1/0/16
!
```

#### Save the Configuration on a Catalyst 3850

The running configuration can be saved to the startup configuration on the Catalyst 3850 by sending this YANG formatted NETCONF RPC message to the Catalyst 3850 via NETCONF.

This is done when you cut and paste this into the Yang Explorer application as a Custom RPC.

Iocalhost:8088/static/Yan	gExp ×				Mike
$\leftarrow$ $\rightarrow$ C ( ) localhost:8088/static	/YangExplorer.html				☆ 🖬 🗄
Yang Explorer 0.6.0 (Beta)			Q Help	嶜 Admin	🔁 Refresh 🛛 🛔 guest
Explorer search	Values	0.7	Build Collections Manage Models	Property	Value
▼ Rietf-interfaces	2	12	Operations Device Settings	Name	enabled
🔻 🚰 interfaces				Node Type	leaf
V 💭 interface			Profile Create device profile	Data Type	boolean
🎤 name			Platform other 👻	Access	read-write
description					1000-1110
/ type			Host 1/2.16.167.175 Port 830	Presence	
<pre>enabled</pre>			Username cisco1 Password cisco1	Key	
link-up-down-trap-enable		_		Mandatory	
F interfaces-state				Default	true
F Mietf-netconf-monitoring		_	NetConf RestConf RPC Script Capabilities	Path	ietf-interfaces/
			Encoding Console	1	interfaces/interface/
			xml version="1.0" encoding="utf-8"?		enabled
			<pre><rpc message-id="" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"> <cisco-ia:save-config xmlns:cisco-ia="http://cisco.com/yang/cisco-ia"></cisco-ia:save-config></rpc></pre>	Description	This leaf contains the
					configured, desired
					state of the
					interface.
					Systems that implement
					the IF-MIB use the
					value of this
					leaf in the 'running'
					datastore to set
O Config O Oper	+ Add - Delete	C Reset	Custom RPC Run Save Clear Copy		IF-MIB.ifAdminStatus to
Status : Clear completed					IETF 93

**Run** is selected in order to send the custom RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with a successful message.

$\leftarrow \rightarrow C$ (1) localhost:8088/static	(YangExplorer.html			☆ 🖺
Yang Explorer 0.6.0 (Beta)		O Help	嶜 Admin	🕃 Refresh 🛛 🛔 guest
Explorer search	Values	Build Collections Manage Models	Property	Value
Rietf-interfaces		Operations Device Settings	Name	enabled
🔻 🚰 interfaces			Node Type	leaf
🔻 🚞 interface		Profile Create device profile	Data Type	boolean
🔎 name		Platform other -	bata type	
description			Access	read-write
📁 type		Host 172.16.167.175 Port 830	Presence	
/ enabled		Username cisco1 Password cisco1	Key	
link-up-down-trap-enable			Mandatory	
► Tinterfaces-state			Default	true
· Kietf-netconf-monitoring		NetConf     RestConf     Rec     Script     Capabilities     Encoding     Console <pre></pre>	Path	ietf-interfaces/ interfaces/interface/ enabled
		xmlna="urnitetfiparamaixmlinainsticonfibasell.0" xmlna="urnitetfiparamaixmlinainsticonfibasell.0" <result xmlns="http://cisco.com/yang/cisco-ia">Save running-config successfult/result&gt; </result>	Description	This leaf contains the configured, desired state of the interface.
Config Oper	+ 444 - Dates (* 12	ret Custom RPC Run Save Clear Copy	_	Systems that implement the IF-MIB use the value of this leaf in the 'running' datastore to set IF-MIB if AdminStatus to

# Catalyst 3850 CLI Display of the Saved Startup Configuration After the Previous NETCONF/YANG Configuration Save Operation

The startup configuration now matches the running configuration:

```
3850-1# show running-config interface gigabitEthernet 1/0/16
Building configuration...
Current configuration : 49 bytes
!
interface GigabitEthernet1/0/16
shutdown
end
3850-1# show startup-config | begin 1/0/16
interface GigabitEthernet1/0/16
shutdown
!
```

#### Configure the Catalyst 3850 from the CLI

As mentioned previously, the regular Catalyst 3850 CLI can still be used to configure the switch and collect show command data in addition to using NETCONF/YANG to do the same. When the Catalyst 3850 CLI is used instead of NETCONF/YANG to configure the switch, the new running-config is synchronized with the Data Model Interface (DMI) on the Catalyst 3850 via the syncfd software process.

```
3850-1# show running-config interface gigabitEthernet 1/0/16
Building configuration...
Current configuration : 49 bytes
interface GigabitEthernet1/0/16
shutdown
end
3850-1# config t
Enter configuration commands, one per line. End with CNTL/Z.
3850-1(config)# interface gigabitEthernet 1/0/16
3850-1(config-if)#no shutdown
3850-1(config-if)# exit
3850-1(config)# exit
3850-1#
*Jan 24 16:39:09.968: %LINK-3-UPDOWN: Interface GigabitEthernet1/0/16, changed state to down
*Jan 24 16:39:13.479: %SYS-5-CONFIG_I: Configured from console by console
*Jan 24 16:39:15.208: %DMI-5-SYNC_START:Switch 1 R0/0: syncfd: External change to running configuratio
*Jan 24 16:39:43.290: %DMI-5-SYNC_COMPLETE:Switch 1 R0/0: syncfd: The running configuration has been s
3850-1#
```

The next time the Yang Explorer application requests a copy of the interface configuration after the CLI change, the change is reflected properly in the YANG output.

C O localhost:8088/static/	YangExplorer.html			\$ 10
Yang Explorer 0.6.0 (Beta)		🔿 Help 🧻 👹 Adm	n 🕃 Refre	sh 🛔 guest
Explorer Value	es Operation	Build Collections Manage Models	Property	Value
Rietf-interfaces	~	Operations Device Settings	Name	interface
nterfaces		A	Node Type	list
*=interface <get-< td=""><td>config&gt;</td><td>Profie Ceate device profie</td><td>Data Type</td><td></td></get-<>	config>	Profie Ceate device profie	Data Type	
Piname Gigab	sitEthemet1/0/16	Platform other 💌	Access	read-write
■ type		Heat 172.16.167.171 Port 830	Presence	
/ enabled			Кеу	
Ink-up-down-trap-en		Username ciscol Password ciscol	Mandatory	
Tinterfaces-state		NetConf      RestConf     RestConf     RestConf	Default	
ietf-netconf-monitoring		Forming Coracle	Deck.	had been deeper
		<pre>//rec massane-(d="101" value="urn)(of finances values instant (d="101");</pre>	rach	interfaces/
		<pre>cqet-config&gt; capures&gt;</pre>		interface
		<running></running>	Description	The list of
		<filter></filter>		configured
		<interface></interface>		interfaces on
				the device.
		 		The
$\bigcap$				operational
Copfue O Oper )	Add - Delete C Reset	Custom RPC Run Save Clear Copy		scate of an

**Run** is selected in order to send the RPC get-config message for GigabitEthernet1/0/16 to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with the GigabitEthernet1/0/16 interface configuration which shows enabled = true.

← → C (i) localhost:8088/static/Yan	gExplorer.html				\$
Yang Explorer 0.6.0 (Beta)			O Help	😁 Admin	🔁 Refresh 🔹 guest
Explorer search	Values	Oner V		Property	Value
Rcisco-process-cpu		4	Obtanous neuro serreida	Name	interface
Rcisco-process-memory			Profile Create device profile	Node Type	list
► 名cisco-pw				Data Tura	
Rcisco-self-mgmt			Platform •	Data Type	
🗠 🕵 cisco-table-map			Host 172.16.167.178 Port 830	Access	read-write
Rcisco-virtual-service				Presence	
▶ 名common-mpls-static			Username cisco1 Password cisco1	Key	
Rietf-diffserv-classifier				Mandatory	
▶ 😤 ietf-diffserv-policy				Default	
🖲 🥵 ietf-interfaces			RPC Script Capabiliti		
▼ 🔤 interfaces			Encoding Console	≡ Path	ietf-interfaces/
🔻 💳 interface	<get-config></get-config>		<rpc-reply message-id="urn:uuid:832c3b3c-71fe-4e63-8bf4-6ec98113199&lt;/td&gt;&lt;td&gt;đ   ¶&lt;/td&gt;&lt;td&gt;interfaces/interface&lt;/td&gt;&lt;/tr&gt;&lt;tr&gt;&lt;td&gt;🔎 name&lt;/td&gt;&lt;td&gt;GigabitEthernet1/0/16&lt;/td&gt;&lt;td&gt;&lt;/td&gt;&lt;td&gt;&lt;pre&gt;xmlns=" urn:ietf:params:xml:ns:netconf:base:1.0"<br="">xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"&gt;</rpc-reply>	Description	The list of configured
description			<pre><data>     <interfaces ;<="" pre="" xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces"></interfaces></data></pre>		interfaces on the
🔎 type			<interface></interface>		device.
🔎 enabled		0	<type xmlns:ianaift="urn:itf:params:xml:ns:yang:iana-if-&lt;br&gt;type">ianaift:ethernetCsmacd</type>		The operational state of
🔎 link-up-down-trap-enable			<pre><rabled>false</rabled></pre>		an interface is available
▶ 🚰 interfaces-state			<pre><ipv6 xmlns="urn:ietf:params:xml:ns:yang:ietf-ip"></ipv6></pre>		in the
► 名 ietf-key-chain					/interfaces-state/
▶ Kietf-netconf-monitoring			 		interface list. If the
► Kietf-routing		-			configuration of a
			Custom RPC Run Save Clear Copy		system-controlled
Config Oper	+ Add - Delete	C Reset			interface cannot be

**3.** Check What SNMP MIB Operational Data is Available via GET Request Operations

The SNMP MIB data that can be returned with NETCONF GET operations is not user configurable. All

supported SNMP MIBs that are converted into structured data defined by YANG data models are part of the Cisco XE software on the Catalyst 3850. To discover what MIB data is available in GET requests, there are three options stated. All supported MIBs can include smiv2 in the capability response.

Option 1. The **Capabilities** button can be selected in the Yang Explorer application GUI. The Catalyst 3850 replies back with its capability list that contains smiv2 MIB entries.



Option 2. This YANG formatted NETCONF RPC message can be sent to the Catalyst 3850 via NETCONF in order to retrieve the capabilities list which includes available smiv2 MIB models.

This is done when you cut and paste into the Yang Explorer application as a Custom RPC.

•••/	localhost:8088/static/Yan	gExp ×				Mike
${\boldsymbol{\varepsilon}}  \rightarrow  {\boldsymbol{G}}$	localhost:8088/static	/YangExplorer.html				☆ 🛙 :
Yang Exp	lorer 0.6.0 (Beta)			O Help	😁 Admin 🔒	🖰 Refresh 🛛 🔮 guest
Explorer	search	Values	Operation	Build Collections Manage Models	Property	Value
► Rietf-inter	faces			Operations Device Settings	Name	name
				Creste divise prelie	Node Type	leaf
				Profile	Data Type	netconf-datastore-type
				Platform other	Access	read-only
				Host 172.16.167.175 Port 830	Presence	
				Username cisco1 Password cisco1	Key	true
					Mandatory	true
					Default	
				NetCont RestCont RPC Script Capabilities     Encoding Console     Txxl version="1.0" encoding="utf-8"?>	Path	ietf-netconf-monitoring/ netconf-state/datastores/ datastore/name
Config	Oper	+ Add - D	elete C Reset	<pre><rpc message-id="" xmlns="urr:ietf:params:xml:ns:netconf:base:1.0"></rpc></pre>	Description	Name of the datastore associated with this list entry.Name of the datastore associated with this list entry.None
Status : Clear	completed					IETE 93

**Run** is selected in order to send the custom RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with a capability list that includes the smiv2 MIBs supported.

Yang Explorer 0.6.0 (Beta)			🔿 Help 🛛 😤 Admin	😷 Refresh 🛛 🚨 guest
Explorer search	Values	Operation	Build Collections Manage Models Property	y Value
Rietf-interfaces			Operations Device Settings Name	name
			Profile Create device profile Node Ty	rpe leaf
			Data Typ	pe netconf-datastore-type
			Platform other  Access	read-only
			Host 172.16.167.175 Port 830 Presence	Ð
			Username Cisco1 Password cisco1 Key	true
			Mandato	bry true
			Default	
			NetConr RPC Script Capabilities     Path     Encoding Console     attrsampyrevision=zuis=ou=zz	ietf-netconf-monitoring/ netconf-state/datastores datastore/name
		<pre>Ccapability&gt;Urn:let:params:mains:yang:smiv2:BDF04-MIB module=B0F4- MIB&amp;:revision=1994-05-05</pre> Ccapability>urn:let:params:mains:yang:smiv2:BRIDGE=MIB? ccapability>urn:let:params:mains:yang:smiv2:CISCO-AMA-SERVER=MIB? module=CISCO-AMA-SERVER=MIB&:revision=2003-11-17 Ccapability>urn:let:params:mains:yang:smiv2:CISCO-AMA-SESION-MIB? module=CISCO-AMA-SESION-MIB&:revision=2003-11-17 Ccapability>urn:let:params:mains:yang:smiv2:CISCO-AMA-SESION-MIB? module=CISCO-AMA-SESION-MIB&:revision=2003-11-17 Ccapability>urn:let:params:mains:yang:smiv2:CISCO-AMA-SESION-MIB? module=CISCO-AMA-SESION-MIB&:revision=2006-03-21 Ccapability>urn:let:params:main:syang:smiv2:CISCO-BGP=POLICY- ACCOUNTING-MIB/module=CISCO-BGP=POLICY-ACCOUNTING MIB&:revision=2002-07-26 Ccapability>urn:let:params:main:syang:smiv2:CISCO-BGP4-MIB? module=CISCO-BGP4-MIB&:revision=2002-06-10 Ccapability>urn:let:params:main:syang:smiv2:CISCO-BGP4-MIB? module=CISCO-BUR=FILE=MIB&:revision=2002-06-10	ion Name of the datastore associated with this list entry.Name of the datastore associated with this list entry.None	
			module=CISCO-CBP-TARGET-VASSamp;revis.n=2006-05-24	

Option 3. A list of available MIB models can be viewed in the NETCONF capabilities and Hello message returned by the Catalyst 3850 in response to an SSH connection from the Centralized Management Platform (Laptop).

```
USER1-M-902T:~ USER1$ ssh -s cisco1@172.16.167.175 -p 830 netconf
cisco1@172.16.167.175's password: cisco1
<?xml version="1.0" encoding="UTF-8"?>
<hello xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<capabilities>
<capability>urn:ietf:params:netconf:base:1.0</capability>
<capability>urn:ietf:params:netconf:base:1.1</capability>
<capability>urn:ietf:params:netconf:capability:writable-running:1.0</capability>
<capability>urn:ietf:params:netconf:capability:xpath:1.0</capability>
<capability>urn:ietf:params:netconf:capability:validate:1.0</capability>
<capability>urn:ietf:params:netconf:capability:validate:1.1</capability>
<capability>urn:ietf:params:netconf:capability:rollback-on-error:1.0</capability
--snip--
<capability>urn:ietf:params:xml:ns:yang:smiv2:CISCO-CONFIG-MAN-MIB?module=CISCO-CONFIG-MAN-MIB&amp;revi
<capability>urn:ietf:params:xml:ns:yang:smiv2:CISCO-CONTEXT-MAPPING-MIB?module=CISCO-CONTEXT-MAPPING-MI
<capability>urn:ietf:params:xml:ns:yang:smiv2:CISCO-DATA-COLLECTION-MIB?module=CISCO-DATA-COLLECTION-MI
--snip--
</capabilities>
<session-id>2870</session-id></ hello >]]>]]>
Use < AC > to exit
```

## Load Additional YANG Data Models

This link contains additional YANG data model files. These files allow additional operations to be executed via NETCONF/YANG that relates to other Catalyst 3850 features such as to configure IPv4 unicast routing, QoS, and so on.

#### **GitHub Yang Models**

The standard (common, Internet Engineering Task Force (IETF)) models that apply to all vendors can be found by choosing **standard, ietf, rfc**. This provides the standards based YANG data models taken from RFC publications by the IETF standards body.

#### GitHub Yang Models Tree Master Standard

The Cisco native (device, vendor specific) models can be found by selecting **vendor**, **cisco**, **xe**, **1632**. This provides the proprietary YANG data models for Cisco IOS XE software version 16.3.2 for the Catalyst 3850.

GitHub Yang Models Yang Tree Master Vendor

↔ Code ① Issues 11 <sup>(*)</sup> Pull requests	1 III Projects 0 - Pulse du Graphs	
	· Future and Future	
Branch: master - yang / vendor / cisco / xe	/ 1632 /	Create new file Find file History
gohite Cisco IOS XE 16.3.2 Pelease Yang Mod	els	Latest commit 55bd294 on Nov 28, 2016
MIBS	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
README.md	Cisco IOS XE 16.3.2 Release Yang Models	a month ago
Cat3k-netconf-capability.xml	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
ii) check-models.sh	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
i cisco-acl-oper.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
i cisco-bfd-state.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
i cisco-bgp-state.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
i cisco-bridge-common.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
Cisco-bridge-domain.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
Cisco-cfm-stats-dev.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
Cisco-cfm-stats.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
cisco-checkpoint-archive.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago

These files can be downloaded onto the Centralized Management Platform (laptop) and then, in turn loaded into the Yang Explorer application. There are two ways to do this. The first is to load in the various YANG data model files individually, the second is a bulk loading of all the files.

### 1. Load the Various YANG Data Model Files Individually

**Tip:** <u>rawgit</u> can be required to download the files from Github. To download files from github select the **Raw** button associated with the YANG file. If a URL is given instead of a file download option, the URL can be pasted into <u>rawgit</u> which can in turn provide a production URL. Paste this new production URL into a browser and it can provide the file download option.

In this example, cisco-ethernet.yang has already been downloaded from github onto the Centralized Management Platform (laptop). Here are the steps to load the file into the Yang Explorer application GUI and then **Subscribe** to it so that it is loaded into the Explorer section of the tool.

**Tip**: NETCONF capabilities functionality can be used to determine which data models are supported by the Catalyst 3850 software. See section 2. of Configuring the Centralized Management Platform (laptop).

Yang Explorer 0.6.0 (Beta)       Explorer search     Values     Operation       Rietf-interfaces     Build     Collection     Manage Models       Select All     Showing 5 models     Fiter       iana-if-type@2014.01-15.yang     Iana-if-type@2014.01-15.yang	Help 🚰 Admin	🔁 Refresh 🛛 💄 gues
Explorer     Search     Values     Operation       Build     Collection     Manage Models       Workspace     Device       Select All     Showing 5 models       Iman-if-type@2014-01-15.yang	Bernett	
i ietf-inet-types.yang   i ietf-inet-types.yang	Name Node Type Access Presence Key Mandatory Default Path Description	Value

Iocalhost:8088/static/Y	angExp 🗙 📃							Mike
$\leftrightarrow$ $\rightarrow$ C (i) localhost:8088/sta	tic/YangExplorer.htm	al la l						☆ 🔟 :
Click to go forward, hold to see history	2					O Help	- 1000 (C	
				dVana				
			UT 100	u rang		<u>^</u>		
			Name		Status	_		
					<u>_</u>			
				Browse	e Upload	Clear		

• O O Operation           • O Operation            • O Operatio	C       O backhosts8088/static/YangExplorer.html         Yang Explorer 0.60 (Bets)       C I left       Refresh         Kietf-Interfaces       Values       Operation       Build       Collection       Manage Models       Property       Value         Splorer 0.60 (Bets)       Values       Operation       Build       Collection       Manage Models       Property       Value         Kietf-Interfaces       Value       Operation       Build       Collection       Manage Models       Filter       Node Type       Access       Collection       Node Type       Access       Collection	Mike					localhost:8088/static/YangExp 3	•••
Vargeborer Casheth       Values       Operation       Build       Collection       Manage Models       Property       Value       Name         * Retel-interfaces       Solue:1.All       Showing 6 models       There       Name	Yang Explorer 0.6.0 (Bits)       Yalues       Operation       Build       Collection       Manage Models       Property       Value	☆ 🕅 :	\$			YangExplorer.html	C O localhost:8088/static/Yang	$\boldsymbol{\varepsilon} \; \rightarrow \; \boldsymbol{G}$
Explorer       Image Models       Property       Values <ul> <li>Midd Collection</li> <li>Manage Models</li> <li>Device</li> <li>Stowing &amp; models</li> <li>St</li></ul>	Explorer       Values       Operation       Build       Collection       Manage Models       Property       Value         * Rietf-interfaces       Image Models       Select All       Showing 6 models       None	💄 guest	🚰 Admin 😂 Refresh 🔒 g	O Help			; Explorer 0.6.0 (Beta)	Yang Expl
			Property     Value       Name	todels Showing 6 models <i>litter</i> yang yang [subscribed] 10-10-04.yang	Operation	Values	er Search	Explorer (

### 2. Bulk Load of All the YANG Data Model Files at Once

This procedure is also mentioned in section 5.2.2 here: github.

From a terminal prompt on the centralized management platform (laptop - Apple MacBook Pro running macOS Sierra 10.12.2):

```
USER1-M-902T:~ USER1$ cd yang-explorer □
USER1-M-902T:yang-explorer USER1$ cd server □
USER1-M-902T:server USER1$ python manage.py bulkupload --user guest --git https://github.com/YangModels
Git upload .. □
Cloning into '/Users/USER1/yang-explorer/server/data/session/tmpk7V406'...
□remote: Counting objects: 5610, done. □
remote: Total 5610 (delta 0), reused 0 (delta 0), pack-reused 5610 \ \square
Receiving objects: 100% (5610/5610), 11.80 MiB | 2.34 MiB/s, done. □
Resolving deltas: 100% (3159/3159), done. 🗆
Checking out files: 100% (3529/3529), done.
□Cleaning up /Users/USER1/yang-explorer/server/data/session/tmpk7V406 □
Compiling : user: guest, file: /Users/USER1/yang-explorer/server/data/session/tmpHTAEP3/cisco-acl-oper.
DEBUG:root:Compiling session dependency ...
□//anaconda/bin/pyang □
DEBUG:root:Rebuilding dependencies for user guest
□--snip--
```

All of the Yang data models are now seen in the Yang Explorer application GUI. The files associated with the features of interest can be selected when you click **Subscribe** which then adds them into the Explorer section of the tool.

**Tip**: NETCONF capabilities functionality can be used to determine which data models are supported by the Catalyst software. See section 2. of Configuring the Centralized Management Platform (laptop).

← → C (i) localhost:8088/stat	tic/YangExplorer.html					
Yang Explorer 0.6.0 (Beta)	ac, rangexplorer.num		O Help	Admin	C Refresh	H R stiles
Tang Explorer 0.0.0 (Deca)		-			e Ken esti	- Sues
xplorer search	Values	Operation	Build Collections Manage Models	Property	Value	
			Warlapere Device	Name		
			Showing 79 models filter	Node Type		
			Cisco-acl-oper.vang	Data Type		
			✓ cisco-bfd-state.yang	Access		
			✓ cisco-bgp-state.yang	-		
			✓ cisco-bridge-common.yang	= Presence		
			✓ cisco-bridge-domain.yang	Key		
			✓ cisco-cfm-stats-dev.yang	Mandatory		
			✓ cisco-cfm-stats.yang	Default		
			✓ cisco-checkpoint-archive.yang	Path		
			✓ cisco-efp-stats.yang	Description		
			Cisco-environment.yang	Description		
			Cisco-fermernet.yang			
			✓ cisco-ia.yang			
			✓ cisco-ip-sla-stats-dev.yang			
			✓ cisco-ip-sla-stats.yang			
			✓ cisco-Ildp-state.yang			
			✓ cisco-memory-stats.yang			
			✓ cisco-mpls-fwd.yang			
			✓ cisco-odm.yang	_		
			Seisen sent dave una			
Config Oper	+ Add - Dele	te C Reset	▲ Add Subscribe Un-Subscribe Delete Graph			IE
Config Oper atus : Received HTTP Result for module re localhost:8088/static/Y	+ Add - Delet	te C Reset	Add Subscribe Un-Subscribe Delete Graph			IE
Config Oper atus : Received HTTP Result for module m localhost:8088/static/Y -  C O localhost:8088/sta Yang Explorer 0.6.0 (Beta)	+ Add - Dele	te C Reset	Add Subscribe Un-Subscribe Delete Graph	Admin	C Refresh	iE ☆
Config Oper atus : Received HTTP Result for module re ■ ● P Iocalhost:8088/static/Y → C O Iocalhost:8088/static/Y Yang Explorer 0.6.0 (Beta)	+ Add - Dele	te C Reset	Add Subscribe Un-Subscribe Delete Graph	Admin	C Refresh	iE ☆ La gue
Config       Oper         atus : Received HTTP Result for module in         Image: Second Strate         Image: Second Strat         Image: S	+ Add - Dete	C Reset	Add Subscribe Un-Subscribe Delete Graph	Admin Property	C Refresh Value	iE Å
Config Oper atus : Received HTTP Result for module in atus : Received HTTP Result for module in Coalhost:8088/static/Y Coalhost:8088/static/Y Yang Explorer 0.6.0 (Beta) xplorer	+ Add - Dole	C Reset	Add Subscribe Un-Subscribe Delete Graph      Graph	Admin  Property Name	C Refresh Value	iE Å gue
Config Oper atus : Received HTTP Result for module re atus : Received HTTP Result for module re Collocalhost:8088/static/V Collocalhost:8088/static/V Collocalhost:8088/static/V Ang Explorer 0.6.0 (Beta) xplorer search R cisco-bfd-state R cisco-bgp-state	+ Add - Dole	C Reset	Add Subscribe Un-Subscribe Delete Graph	Admin	C Refresh	iE ជំ
Config Oper atus : Received HTTP Result for module re localhost:80886/static/V localhost:80886/static/V Colocalhost:80886/static/V Ang Explorer 0.6.0 (Beta) xplorer Search R cisco-brid-state R cisco-brid-state R cisco-brid-state R cisco-brid-state	+ Add - Dole	C Reset	Add Subscribe Un-Subscribe Delete Graph  C Help  Build Collections Manage Models  Workspace Device Select All Showing 79 models Filter  cisco-acl-oper,yang	Admin  Property Name Node Type Data Type	C Refresh Value	iE ਨੇ
Config Oper atus : Received HTTP Result for module in atus : Received HTTP Result for module in book in the second sec	+ Add - Dole request angEx: × Values Values	C Reset	Add Subscribe Un-Subscribe Delete Graph      Graph	Admin  Property Name Node Type Data Type Access	C Refresh Value	ाह ्रे ट्र
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Other tasks can now be completed such as to generate the NETCONF/YANG RPC required to save the configuration on the Catalyst 3850. This is done when you select the **save-conf** RPC in the Explorer section

on the left hand side of the Yang Explorer application. Then, **RPC** is selected to generate the YANG formatted NETCONF RPC that can be sent to the Catalyst 3850 via NETCONF to save the configuration on the Catalyst 3850.

localhost:8088/static/Ya	IngExp X G how to che	eck "netconf notifica ×								Mike
← → C (i) localhost:8088/stati	ic/YangExplorer.html									Ĥ i
Yang Explorer 0.6.0 (Beta)								O Help	📑 Admin	🔁 Refresh 🛛 💄 guest
Explorer search	Values	Operation	Build	Collections	Manage Models				Property	Value
▶ Rcisco-bfd-state		A	Operations	Device Settin	ngs				Name	save-config
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R cisco-bridge-domain			Profile		•	Create device p	profile		Data Tura	
▶ 🕏 cisco-cfm-stats			Platform	a other	-				Data Type	
▶ 🥵 cisco-checkpoint-archive									Access	write
▲ cisco-efp-stats		=	Host	172.16.1	167.178 F	ort 830			Presence	
Rcisco-environment			Usernas	cisco1	F	assword	co1		Key	
Cisco-flow monitor			Caerna	Ciscor	]	Cist			Mandatory	
▼ Rcisco-ia									Default	
Perc-trom			O Net	Conf 🔘 Res	tConf		RPC	Script Capabiliti	is Duil	
▶ 🚰 save-config	<rpc></rpc>		Encoding	Console					Path	cisco-ia/save-contig
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▶ 🚰 rollback			S/Ipc>							startup-config on the
▶ 🛅 reset										Element.Copy the
cisco-ip-sla-stats										running-config to
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cisco-memory-stats										Network
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Cisco-platform-software										
Rcisco-process-cpu		Ŧ								
O Config O Oper	+ Add - Del	lete C Reset	Cust	om RPC	F	tun	Save	Clear Copy		
Status : Recieved HTTP Result for request ty	pe rpc									IETF 93

**Run** is selected to send the custom RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with a successful message.

∠ → C	tic/VangExplorer.html					با
	uc/rangexplorer.num					н
Yang Explorer 0.6.0 (Beta)					🔿 Help 🏻 😁 Admin	🔁 Refresh 🛛 💄 guest
Explorer search	Values	Operation	Build Collections	Manage Models	Property	Value
▶ 🔒 cisco-bfd-state		<u></u>	Operations Device Settin	ngs	Name	save-config
Rcisco-bgp-state					Node Ty	pe rpc
Acisco-bridge-domain			Profile	Create device profile	Data Tun	
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Rcisco-checkpoint-archive					Access	write
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🔻 🥵 cisco-ia					Default	,
► 🚰 sync-from			<ul> <li>NetConf O Res</li> </ul>	stConf RPC	Script Capabilities	
► 🚰 save-config	<rpc></rpc>		Encoding Canada		Path	cisco-ia/save-config
checkpoint			Chrooling Console		Description	on Copy the running-config
► 🚰 revert			<pre>crpc-reply message- mlns="urn:ietf:par</pre>	<pre>'id="urn:uuid:df9a8485-e635-406e-899f-052c1 rams:xml:ns:netconf:base:1.0"</pre>	.5615ad7"	to
▶ 🚰 rollback			<pre>result xmlxs="ht</pre>	params:xml:ns:netconf:base:1.0"> tp://cisco.com/yang/cisco-ia">Save running	g-config	startup-config on the
▶ 🚰 reset			uccessful /rpc-reply>			Network
Rcisco-ip-sla-stats						Element.Copy the
▶ 🥵 cisco-lldp-state						startup-config on the
Rcisco-memory-stats						Network
▶ 🥵 cisco-mpls-fwd						Element.None
R cisco-platform-software						
Rcisco-process-cpu		-				
		•	-			

Status : Recieved HTTP Result for request: run-rpc

## **Notable YANG Data Models**

### cisco-ia.yang Data Model

Here are some RPC examples for the cisco-ia.yang data model. They are notable since they involve operations such as to save the Catalyst 3850 configuration, to synchronize the Catalyst 3850 running-config to the local Data Model Interface (DMI) data store, and reset the DMI interface on the Catalyst 3850.

The first step is to **Subscribe** to the cisco-ia.yang data model so that it appears in the Explorer section on the left of the YANG Explorer application GUI.



Once the cisco-ia data model is expanded in the Explorer section on the left of the YANG Explorer application GUI, the various operational options are seen. As an example, to use one of the available cisco-ia.yang data model options, the **save-config** operation is selected and the associated RPC is generated when you select the **RPC button**.

$\leftrightarrow$ $\rightarrow$ C ( localhost:8088/sta	atic/YangExplorer.html				*
Yang Explorer 0.6.0 (Beta)			O Help	😁 Admin	😷 Refresh 🛛 🔮 guest
Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
Rcisco-bfd-state		4	Operations Device Settings	Name	save-config
Rcisco-bgp-state				Node Type	rpc
🖻 🕏 cisco-bridge-domain			Profile Create device profile	Data Tuno	
k cisco-cfm-stats			Platform other -	Data Type	
Acisco-checkpoint-archive				Access	write
k cisco-efp-stats		=	Host 172.16.167.178 Port 830	Presence	
k cisco-environment			Usersen ciscol Password ciscol	Key	
R cisco-flow monitor				Mandatory	
Rcisco-ia				Default	
P Come-from			NetConf RestConf RPC Script Capabilities		
▶ 🚾 save-config	<rpc></rpc>		Facodian Console	Path	cisco-ia/save-config
► Checkpoint			<pre>construct = construct = c</pre>	Description	Copy the running-config
► 🚰 revert		$\langle$	<pre><save-config xmlns="http://cisco.com/yang/cisco-ia"></save-config></pre>		to
▶ 🏝 rollback			S/IPC>		startup-config on the
▶ 🏝 reset					Element.Copy the
* 🕏 cisco-ip-sla-stats					running-config to
Rcisco-Ildp-state					startup-config on the
Rcisco-memory-stats					Network
Rcisco-mpls-fwd					Element.None
Rcisco-platform-software					
Rcisco-process-cpu					
Config Oper	+ Add - Delete	C Reset	Custom RPC Run Save Clear Copy	1	
Status : Recieved HTTP Result for request t	type rpc				IETF 9

Next, **Run** is selected in order to send the RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with a successful message to let the user know the operation was successful.

Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
Rcisco-bfd-state		4	Operations Device Settings	Name	save-config
Rcisco-bgp-state				Node Type	roc
Rcisco-bridge-domain			Profile Create device profile	Den Terr	
R cisco-cfm-stats			Platform other	Data Type	
Rcisco-checkpoint-archive				Access	write
Rcisco-efp-stats			Host 172.16.167.178 Port 830	Presence	
Rcisco-environment			Remard size 1	Key	
Rcisco-flow-monitor			Username CISCO1	Mandatory	
R cisco-ia				Defects	
► 🏧 sync-from			NetConf RestConf RPC Script Capabilities	Default	
▶ 🚰 save-config	<rpc></rpc>		Encoding Council	Path	cisco-ia/save-config
▶ 🚰 checkpoint			Circoung Console	Description	Copy the running-cont
► 🚰 revert			<pre><rpc-reply <="" message-id="urn:uuid:df9a8485-e635-406e-899f-052c15615ad7" pre="" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"></rpc-reply></pre>		to
▶ 🚰 rollback			<pre>xnlns:nc="vrn:ietf:params:xml:ns:netconf:base:1.0"&gt;     <result xmls="http://cisco.com/yang/cisco-ia">Save running-config</result></pre>		startup-config on the
▶ 🚰 reset			successful 		Network
Rcisco-ip-sla-stats					Element.Copy the
Rcisco-Ildp-state					startup-config on the
Rcisco-memory-stats					Network
Rcisco-mpls-fwd					Element.None
Rcisco-platform-software					
Rcisco-process-cpu		-			
				1	

All of the various cisco-ia.yang data model operations are described here:

sync-from - This RPC causes the NETCONF interface on the Catalyst 3850 to synchronize the NETCONF datastore representation of the device running configuration with the running configuration on the device. Both of these exist on the Catalyst 3850 itself.

The default behavior of this RPC is to perform a sync without-defaults which causes the output of a **show running-config** command sent to the device to be synced with the NETCONF datastore. If sync-defaults is present, the NETCONF interface also reads the default configuration information provided by feature code. In most cases this option is not used. Typically this would only be used if the NETCONF interface user wanted to use the **NETCONF replace** commands to replace complete sections of the device configuration.

```
<?xml version="1.0" encoding="utf-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
        <cisco-ia:sync-from xmlns:cisco-ia/>
        <cisco-ia:sync-defaults/>
        </cisco-ia:sync-from>
        </rpc>
```

save-config - This RPC executes a write memory (copy running-config startup-config) command to save the current device running configuration to the device startup-configuration.

```
<?xml version="1.0" encoding="utf-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
<cisco-ia:save-config xmlns:cisco-ia
</rpc>
```

checkpoint - This RPC causes the NETCONF interface to save the running configuration to non-volatile storage using the Cisco IOSd built-in configuration archive feature.

```
<?xml version="1.0" encoding="utf-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
<cisco-ia:checkpoint xmlns:cisco-ia
</rpc>
```

rollback - This RPC causes the NETCONF interface to rollback the running-configuration of the device to a running configuration that was saved with the checkpoint RPC or any other valid running configuration saved on the device.

target-url	string (name of the saved checkpoint file)
verbose?	Boolean (show detail during rollback process)
nolock?	Boolean (lock configuration)
revert-on-error?	Empty (if error occurs during rollback, leave running unchanged)
revert-timer?	int16 (time in seconds before revets to the original configuration)

revert - This RPC causes the NETCONF interface to change the revert-timer from the rollback RPC. This cancels the timed rollback and triggers the rollback immediately, or reset parameters for the timed rollback.

```
now? empty
timer? int16
idle? int16
<?xml version="1.0" encoding="utf-8"?>
  <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
        <cisco-ia:"vert:params:xml:ns:netconf:base:1.0" message-id="">
        <cisco-ia::now/>
        <cisco-ia::idle>60</cisco-ia:timer>
        <cisco-ia::idle>60</cisco-ia::idle>
        </cisco-ia::revert>
        </rpc>
```

reset - The NETCONF interface can be restarted with this RPC. If reinitialize is true, the NETCONF interface clears all the state information that exists in the writable-running datastore. If false (the default) the NETCONF configuration datastore state information is preserved.

Note: Some Cisco platforms or Cisco IOS software versions cannot support all of the given functionality at this time. For example, when you send the previous reset to a Catalyst 3850 running IOS 16.3.3, "Reset not supported" error is returned by the Catalyst 3850 to the Centralized Management Platform (laptop) as an RPC reply.

```
<nc:rpc-error xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0">
<nc:error-type>application</nc:error-type>
<nc:error-tag>operation-failed</nc:error-tag>
```

### ned.yang Data Model

The Network Elements Driver (NED) data models such as ned.yang provide the most power in terms of the Cisco device (Catalyst 3850) configuration. Here are some screencaptures that demonstrate this.

The first step is to **Subscribe** to the ned.yang data model so that it appears in the Explorer section on the left of the YANG Explorer application GUI.

Yang Explorer 0.6.0 (Beta)		O Heb	Me Admin	Refresh 👗 guest
Vang Explorer G&D (Beta) Explorer watch & Cisco-la & Rietf-Interfaces & Rietf-Interfaces & Rietf-Interfaces & Rietf-Interfaces	Values Operation	Build Collections Manage Models      Workspace Device      Select All Showing 79 models (Incomposition)      ned-asr1 k yang      ned-asr1 k yang	Admin     Property     Name     Node Type     Deta Type     Access     Presence     Key     Mandatory     Default     Path     Description	Refresh guest Value cspf list read-write ned/native/router/osp Open Sporect Bab
Config 📀 Oper	+ Add - Dulete C Reset	policy-types.yang     tal#-acm.yang     tal#-di-axtensions.yang     tal#-common.emonitoring.yang     tai#-common.yang     tai#-confid-monitoring.yang     tai#-meta-axtensions.yang     tai#-metconf-monitoring.yang     tai#-webul.yang     tai#-webul.yang     tai#-webul.yang		First (OSPF)Open Shortest Path First (OSPF)None

Scrolling through the available options in the Explorer section on the left side of the YANG Explorer application, GUI shows a long list of configurable Catalyst 3850 features in the ned.yang data model.

Yang Explorer 0.6.0 (Beta)			O Help	🖬 Admin 🛛 🕄	Refresh 🔒 guest
Explorer Junited	Values	Oneration*	Build Collections Manage Models	Property	Value
Rcisco-la		4	Operations Device Settings	Name	native
Rietf-interfaces				Node Type	container
Riad optionf-monitoring			Profile Create device profile	Data Trans	
Rned			Nation other.	Ciera (ype	
*Enative				Access	read-write
device-model-version			Heet 172.16.167.174 Port 830	Presence	
P version			Numeral Street	Key	
boot-start-marker			Username Ciscol	Mandatory	
▶ 🔁 boot				Delate	
Doot-end-marker		+	Birc Script Capabilities	Deterat	
▶ an call-home			Encoding Console	Path.	ned/native
* ar service-list				Description	
▶ È memory					
► Cocation					
▶ 🔁 hw-module					
* 🔁 cisp				-	
• Et module					
domain					
Paner .					
* E service		*			

As an example, these screencaptures demonstrate how to display the OSPF routing configuration of the Catalyst 3850 after first scrolling down the list of available ned.yang data model configuration options in the Explorer section on the left side of the YANG Explorer application GUI. The ospf sub-option is located inside of the router option. The associated get-config RPC is generated when you select the **RPC** button.

Yang Explorer 0.6.0 (Beta)			O Help	Admin 🕄	Refresh 📑 guest
Explorer Security	Values	Oneration *	Build Collectone Manage Models Operations Device Settings Create device confile	Name Node Type	Value ospf list
tod-clock     interwork-clock     interwo			Profee Platform	Data Type Access Presence Key Mandatory	read-write
* coupt * coupt * coupt * d	<get-config></get-config>	-	NetConf RestConf     RestConf     Capabilities     Console	Default Path Description	ned/native/router/os Open Shortest Path First (OSPF)Open Shvetest Path First
vrf     *    * address-family     *    *    * address-family     *    *    *    *    *    *    *	~		 <filistr <full(str) <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter> <fouter< fouter=""> <fouter< fouter="" fouter<=""> <fouter< fouter=""> <fouter< fout<="" td=""><td></td><td>(OSPF)None</td></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter<></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></fouter></full(str) </filistr 		(OSPF)None

Next, **Run** is selected in order to send the RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with its OSPF routing configuration.

Yang Explorer 0.6.0 (Beta)			O Help	Admin 🖸	Refresh
xplorer	Values	Queration	Build Collections Manage Models	Property	Value
► C esmc	-	4	Operations Device Settings	Name	ospf
• E setup				Noria Tuna	Let
► Ctod-clock			Profile Create device profile	insis ipe	
► Contwork-clock			Nation other w	Data Type	
► Di2vpn				Access	read-write
► Config-I2vpn			Heet 172.16.167.174 Port 830	Presence	
► Billypn				Key	
► 🗗 mpls			Username CISCO1 Password CISCO1	Mandatory	
* 🗗 router					
▶ 🔐 bgp			NetConf RestConf RPC Script Capabilities	Default	
► 🔤 ospfv3		-	Encoding Console	Path	ned/native/router/os
tqeo 😅 *	<get-config></get-config>		Crpc-reply message-id="urn:uuid:De2c04cf=9119-4e6a=8c05=238ee7f25208"	Description	Open Shortest Path
Pid			whine="urnitetf:parama:whithe:hetconf:base:1.0" whine:no="urnitetf:parama:whithe:netconf:base:1.0">		Finit (OSPF)Open
Pvrl			<pre><data>   <native cisco.com="" los"="" med="" mlns+"http:="" ns="" yang=""></native></data></pre>		Shortest Path First
* address-family			<pre><router> <router></router></router></pre>	-	(OSPF)None
* 🔤 area			<1d>100 1d		
▶ 🚰 auto-cost			<pre></pre>		
* avent-log			<mubneta></mubneta>		
► 📑 bld			<td></td> <td></td>		
* Et interface-id		*	<networkb< td=""><td>*</td><td></td></networkb<>	*	

Here is an expansion of the OSPF routing configuration returned by the Catalyst 3850 in response to the getconfig RPC operation.

```
<rpc-reply message-id="urn:uuid:0e2c04cf-9119-4e6a-8c05-238ee7f25208" xmlns="urn:ietf:params:xml:ns:net</pre>
  <data>
    <native xmlns>
      <router>
        <ospf>
          <id>100</id>
          <redistribute>
            <connected>
              <redist-options>
                <subnets/>
              </redist-options>
            </connected>
          </redistribute>
          <network>
            <ip>10.10.0.0</ip>
            <mask>0.0.255.255</mask>
            <area>0</area>
          </network>
          <network>
            <ip>10.20.0.0</ip>
            <mask>0.0.255.255</mask>
            <area>0</area>
          </network>
          <network>
            <ip>10.100.0.0</ip>
            <mask>0.0.255.255</mask>
            <area>0</area>
          </network>
        </ospf>
      </router>
    </native>
```

</data> </rpc-reply>

The YANG formatted OSPF routing configuration that was retrieved from the Catalyst 3850 via NETCONF is human readable and matches what is seen when you look at the Catalyst 3850 configuration via the Catalyst 3850's CLI.

<#root>

3850-1#

show running-config | section ospf

router ospf 100 redistribute connected subnets network 10.10.0.0 0.0.255.255 area 0 network 10.20.0.0 0.0.255.255 area 0 network 10.100.0.0 0.0.255.255 area 0 3850-1#

If desired, the ned.yang data model can also be used to modify the OSPF routing configuration. In this example, new network parameters are added to the existing OSPF routing configuration on the Catalyst 3850 by first entering the desired parameters in the Explorer section of the Yang Explorer application GUI on the left (OSPF router ID 100 was also input but is not seen due to Explorer screen scrolling) and then generating the associated YANG formatted RPC and hit the **RPC** button.



Next, **Run** is selected in order to send the RPC message to the Catalyst 3850 via NETCONF. The Catalyst 3850 replies back with an ok message to let the user know the operation was successful.

Yang Explorer 0.6.0 (Beta)			O Help	Madmin 🖸	Refresh 💄 guest
ixplorer search	Values	Oneration	Build Collections Manage Models	Property	Value
Ø domain-tag	_	4	Operations Device Settings	Name	ы
► Tast-reroute				Node Type	leaf
* 🚔 graceful-restart			Profile Create device profile		1
+ 🖻 ignore			Battern other	Data Type	uint10
# isp!				Access	read-write
* Et limit			Heat 172.16.167.174 Pert 830	Presence	
P Dical-rib-criteria				Key	true
* anicroloop			Username CISCO1 Peanword CISCO1	Mandatony	true
* 🖻 mpis				in a country	
* 🔤 neighbor			NetConf RestConf RPC Script Capabilitie	Default	
* = network			Encoding Console	Path	ned/native/router/
Pip	30.30.30.0		<rp>c-reply message-id="urn:uuid:cb43b46e-2e77-4808-8fd5-4d58128d3485"</rp>	1	osp6/id
₽ mask	0.0.255.255		<pre>xmlms="urn:ietf:parama:xml:ns:netconf:base:1.0" xmlms:no="urn:ietf:parama:xml:ns:netconf:base:1.0"&gt;</pre>	Description	
Parea	0		<pre><gx></gx></pre>		
* Er ral					
* prefix-priority					
P prefix-suppression					
P priority					
► Process-min-time					
shutdown		7			

This NETCONF/YANG RPC operation to modify the OSPF routing configuration via the ned.yang data model is reflected in the Catalyst 3850 configuration as seen via the Catalyst 3850's CLI. There is also a syslog message on the Catalyst 3850 that indicates that a configuration change was made via NETCONF.

3850-1#

```
*Jan 30 14:13:41.659: %DMI-5-CONFIG_I:Switch 1 R0/0: nesd: Configured from NETCONF/RESTCONF by cisco1,
```

```
3850-1# show running-config | section ospf
router ospf 100
redistribute connected subnets
network 10.10.0.0 0.0.255.255 area 0
network 10.20.0.0 0.0.255.255 area 0
network 10.30.0.0 0.0.255.255 area 0 -----> new line added to OSPF configuration
network 10.100.0.0 0.0.255.255 area 0
3850-1#
```

Refer to the save-config operation mentioned in the previous section cisco-ia.yang Data Model for details on how to save the running-config to the startup-config on the Catalyst 3850 via NETCONF/YANG.

## **Python Scripting**

### Generate a Python Script from the Yang Explorer Application GUI

The Yang Explore application GUI can also be used to generate a Python script for a given NETCONF/YANG operation. A key benefit of Python scripting is that it allows for the orchestration and automation of NETCONF/YANG operations.

In this example, a save-config operation is selected in the Explorer window on the left hand side of the Yang

Explorer application GUI on the centralized management platform (laptop). Next, the **Script** button is selected to generate the Python script. The **Copy** button can then be selected to copy the script so that it can in turn be pasted into a file that can be saved on the centralized management platform (laptop) with a Python .py file extention. For this example, (not shown) this file has been named example.py.

**Note**: In the next example that uses Platform type other in the GUI resulted in an error when running the Python script. As a result, the Platform type was changed to csr since the Cisco CSR router also runs Cisco IOS XE software just as the Catalyst 3850 does. This avoided the error.

← → C ② localhost:8088/st	tatic/YangExplorer.html		\$	13
Yang Explorer 0.6.0 (Bota)			🔉 Help 👹 Admin 💭 Refresh 👗 gu	est.
Explorer search	Values	Operation Build Collections Manage Models	Property Value	
Rcisco-la)		Operations Device Settings	Name save-config	1
Sync-from		Carte device code	Node Type rpc	
save-config	erpes	Profile	Data Type	
<ul> <li>fill checkpoint</li> </ul>		Putton csr *	Access write	
P Tollback		Hest 172.16.167.174 Port 830	Presence	
* Creset			Key	
Rietf-interfaces		Username cisco1 Password cisco1	Mandatory	
Rietf-netconf-monitoring		0.000		
Ried-routing		O NetCont O RestCont	Script Opabilities Densus	
Rned		Encoding Console	Path csco-ia/sav	10-
		<pre>*** Setconf python example by yang-explorer inttps: CiscoDevMet/yang-explorer:     Installing python dependencies:     &gt; pip installiami neclient     Running script: (save as example.py)     &gt; python example.py -a 172.16.167.174 -0 ciscol 830 *** import izml.etree as 8T from argparse import ArgumentParser from neclient import manager from neclient.perstions import RPCError </pre>	<pre>//github.com/ Description Copy the running-cor to startup-con on the Neth Element.Co the running config to startup-con on the Neth</pre>	nfig dig work >py I- vfig work
) Config () Oper	+ Add - Delete	C Reset Custom RPC Run Save	Clear Copy ) On the Nets	HORK ODE

Here is an expansion of the Python script that was generated and then copy and pasted into a file called **example.py** on the centralized management platform (laptop).

**Note**: The comments at the start of the example.py file that was generated by the Yang Explorer application GUI include the steps required to run the Python script. The payload includes the NETCONF/YANG operation that the script can execute. In this example it is a save-config operation.

```
""" 
Netconf python example by yang-explorer (https://github.com/CiscoDevNet/yang-explorer)
Installing python dependencies: 
> pip install lxml ncclient
Running script: (save as example.py) 
> python example.py -a 172.16.167.174 -u ciscol -p ciscol --port 830 
"""
import lxml.etree as ET 
from argparse import ArgumentParser 
from ncclient import manager
from ncclient.operations import RPCError
```

device\_params={'name': 'csr'}) as m:

help="Device Password (netconf agent password)")

```
# execute netconf operation
□try: □
   response = m.dispatch(ET.fromstring(payload)).xml □
   data = ET.fromstring(response) □
except RPCError as e: □
   data = e._raw
# beautify output
□print(ET.tostring(data, pretty_print=True))
```

## Run a Python Script from the Centralized Management Platform (Laptop)

Here is the Catalyst 3850 CLI check before you run the Python script example.py that can save the running-config to the startup-config. At this point, the **shutdown** command is in the running-config but not in the startup-config for interface GigabitEthernet1/0/10.

```
3850-1# show running-config interface gigabitEthernet 1/0/10
Building configuration...
Current configuration : 49 bytes
!
interface GigabitEthernet1/0/10
shutdown
end
3850-1# show startup-config | begin 1/0/10
interface GigabitEthernet1/0/10
!
interface GigabitEthernet1/0/11
!
interface GigabitEthernet1/0/12
!
```

From a regular terminal prompt on the centralized management platform (laptop), the Python file example.py that was generated by the Yang Explorer application GUI is first copied to the yang-explore directory on the laptop.

```
USER1-M-902T:~ USER1$ pwd
 /Users/USER1
USER1-M-902T:~ USER1$ cp /Users/USER1/Desktop/example.py /Users/USER1/yang-explorer
USER1-M-902T:~ USER1$ cd yang-explorer
USER1-M-902T:yang-explorer USER1$ ls -1
 total 112
 -rw-r--r-- 1 USER1 staff 11358 Jan 4 17:59 LICENSE
-rw-r--r-- 1 USER1 staff 13635 Jan 4 17:59 README.md
drwxr-xr-x 12 USER1 staff 408 Jan 4 17:59 YangExplorer
 drwxr-xr-x 7 USER1 staff 238 Jan 4 17:59 default-models
drwxr-xr-x 3 USER1 staff 102 Jan 4 17:59 docs
-rw-r--r-- 1 USER1 staff 72 Jan 4 17:59 env.sh
 -rw-r--r-@ 1 USER1 staff 1990 Jan 30 17:50 example.py
 -rw-r--r-- 1 USER1 staff 207 Jan 4 17:59 requirements.txt
 drwxr-xr-x 11 USER1 staff 374 Jan 5 14:37 server
 -rwxr-xr-x 1 USER1 staff 4038 Jan 4 17:59 setup.sh
-rwxr-xr-x 1 USER1 staff 640 Jan 4 17:59 start.sh
 drwxr-xr-x 5 USER1 staff 170 Jan 4 18:00 v
USER1-M-902T:yang-explorer USER1$
```

Next, from a regular terminal prompt on the centralized management platform (laptop), these two commands are executed which were provided in the comment section at the start of the example.py file that was generated by the Yang Explorer application GUI (refer to the previous section, Generating a Python Script from the Yang Explorer Application GUI).

```
USER1-M-902T: yang-explorer USER1$ pip install lxml ncclient
Collecting lxml
Downloading lxml-3.7.2.tar.gz (3.8MB)
100% |
         3.8MB 328kB/s
Collecting ncclient
Downloading ncclient-0.5.3.tar.gz (63kB)
                                 71kB 3.5MB/s
100% |
Requirement already satisfied: setuptools>0.6 in /Library/Frameworks/Python.framework/Versions/2.7/lib
Collecting paramiko>=1.15.0 (from ncclient)
Downloading paramiko-2.1.1-py2.py3-none-any.whl (172kB)
100% |
                                | 174kB 3.1MB/s
Collecting six (from ncclient)
Using cached six-1.10.0-py2.py3-none-any.whl
Collecting cryptography>=1.1 (from paramiko>=1.15.0->ncclient)
Using cached cryptography-1.7.2-cp27-cp27m-macosx_10_6_intel.whl
Collecting pyasn1>=0.1.7 (from paramiko>=1.15.0->ncclient)
Using cached pyasn1-0.1.9-py2.py3-none-any.whl
Collecting cffi>=1.4.1 (from cryptography>=1.1->paramiko>=1.15.0->ncclient)
Using cached cffi-1.9.1-cp27-cp27m-macosx_10_10_intel.whl
Collecting enum34 (from cryptography>=1.1->paramiko>=1.15.0->ncclient)
Using cached enum34-1.1.6-py2-none-any.whl
```

Collecting ipaddress (from cryptography=1.1->paramiko>=1.15.0->ncclient) Using cached ipaddress-1.0.18-py2-none-any.whl Collecting idna>=2.0 (from cryptography>=1.1->paramiko>=1.15.0->ncclient) Using cached idna-2.2-py2.py3-none-any.whl Collecting pycparser (from cffi>=1.4.1->cryptography>=1.1->paramiko>=1.15.0->ncclient) Downloading pycparser-2.17.tar.gz (231kB) 100% | 235kB 2.6MB/s Installing collected packages: 1xml, six, pycparser, cffi, pyasn1, enum34, ipaddress, idna, cryptograp Running setup.py install for 1xml ... done Running setup.py install for pycparser ... done Running setup.py install for ncclient ... done Successfully installed cffi-1.9.1 cryptography-1.7.2 enum34-1.1.6 idna-2.2 ipaddress-1.0.18 1xml-3.7.2 USER1-M-902T:yang-explorer USER1\$

The 2nd command runs the Python script example.py against the Catalyst 3850 at IP address 172.16.167.174 with the username/password cisco1/cisco1 via TCP port 830 (netconf-ssh). The Catalyst 3850 sends an RPC reply back to the centralized management platform (laptop) that the save-config operation was successful.

USER1-M-902T:yang-explorer USER1\$ python example.py -a 172.16.167.174 -u cisco1 -p cisco1 --port 830
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" xmlns:nc="urn:ietf:params:xml:ns:netconf:bas
 </result>
 </rpc-reply>

USER1-M-902T:yang-explorer USER1

Here is the Catalyst 3850 CLI check after you run the Python script example.py that saved the running-config to the start-up config. The **shutdown** command is now present in both the running-config and the startup-config for interface GigabitEthernet1/0/10 due to the successful save-config NETCONF/YANG operation.

```
3850-1# show running-config interface gigabitEthernet 1/0/10
Building configuration...
Current configuration : 49 bytes
!
interface GigabitEthernet1/0/10
shutdown
end
3850-1# show startup-config | begin 1/0/10
interface GigabitEthernet1/0/10
shutdown
!
interface GigabitEthernet1/0/11
!
interface GigabitEthernet1/0/12
!
interface GigabitEthernet1/0/13
!
```

## Troubleshoot

This section provides information you can use to troubleshoot your configuration.

### **NETCONF Error Messages**

The NETCONF protocol defines a set of operations and messages that are exchanged between the NETCONF Client (Centralized Management Platform (laptop)) and the NETCONF implementation on the Server device (Catalyst 3850). Commonly used NETCONF operations include:

<get>, <get-config>, <edit-config>, and <rpc>

The format and other constraints on the NETCONF message content are defined by YANG data models. The NETCONF Client and Server interact by sending RPCs.

If there is an error in the format of NETCONF message, or the content of the message does not match the definitions in the YANG data models implemented by the device, the NETCONF server on the device can return an RPC error.

```
<error-type>application</error-type>
```

These RPC errors do not indicate that the NETCONF interface is not working, these errors indicate that the client is trying to perform an operation that is not supported by the YANG data models implemented on the server device. Users must review the YANG data models implemented on the server device to identify and resolve the causes for these errors.

#### **RPC Error Example**

In this example an incorrect Interface type ianaift:fastEtherFX is used to generate the YANG formatted <edit-config> NETCONF RPC message to send via NETCONF to the Catalyst 3850.

C O localhost soss/static/rang	pExplorer.html							宜
Vang Explorer 0.6.0 (Beta)						O Help	Madmin	😋 Rofresh 🛛 🛔 guest
Explorer Search	Values	Ope. V	Build	Collections   Manage?	Wodels	4	Property	Value
Rcisco-process-cpu		4	Operations	Device Settings			Name	enabled
Rcisco-process-memory				-			Node Type	leaf
Rcisco-pw			Profile		Create device profile		Pasta Tuna	hostaan
Rcisco-self-right			Platform	other			man ikka	Coordan
Rcisco-table-map			260200				Access	read-write
Rcisco-virtual-service			Hest	172.16.167.178	Port 830		Presence	
Rcommon-mpls-static			1	circa 1	Password cisco1		Key	
Rietf-diffserv-classifier		-	Clemana	ciscoa			Mandatory	
Rietf-differv-policy					$\frown$		Dele 4	220
Rietf-interfaces	140		<ul> <li>NetCo</li> </ul>	nf () RestConf	( HPC )	Script Capabilities	L'ATTRIAT.	
* 😂 interfaces			R Faraday	Consula			Path	ietf-interfaces/
* 🔤 interface			[ crossing ]	and the Millian sector				intenaces/intenace/
Prane	GigabitEthemet1/0/16		Kedit-co	ofig>	- stoiterriparaneixerina	Ine v cont ine perit , v	2000000	
description			<pre><tacpe <pre><tacpe< pre=""></tacpe<></pre></tacpe </pre>	c> ning/>			Description	This leaf contains the
📕 туре	(ianal/t:fastEtherFX)		<ponfi< td=""><td>et&gt; g&gt;</td><td></td><td></td><td></td><td>conguea, desrea</td></ponfi<>	et> g>				conguea, desrea
# enabled	Later	2	<[	erfaces weins-"up nterface>	niletf:parana:xml:ns:yan	grietf-interfaces"		interface.
link-up-down-trap-enable				<name>GigabitEthe</name>	<pre>scnet1/0/16 ift="umiletfiparame:wnl;</pre>	alvangijana-lf-		
* anterfaces-state			type">lata	ift:fastEtherFX </td <td>(type&gt;</td> <td>718033000.00-5</td> <td></td> <td>Systems that implement</td>	(type>	718033000.00-5		Systems that implement
Rietf-key-chain			</td <td>interface&gt;</td> <td>time course</td> <td></td> <td></td> <td>the IF-MIB use the</td>	interface>	time course			the IF-MIB use the
Rietf-netconf-monitoring			<td>10&gt;</td> <td></td> <td></td> <td></td> <td>value of this</td>	10>				value of this
Rietf-routing			<td>onfig&gt;</td> <td></td> <td></td> <td></td> <td>leaf in the 'running'</td>	onfig>				leaf in the 'running'
	and the second second second		III contra				1	datastore to set

Once **Run** is selected to send the RPC message to the Catalyst 3850, the Catalyst 3850 replies with an error message.

								-	_	_	
Yang Explorer 0.6.0 (Beta)							O Help		Admin	C Refresh	guest
Explorer   search	Values	Oper*	Build 0	Collections Manage	Apde's			-	Property	Value	
Reisco-process-cpu		4	Operations	Device Settings					Name	enabled	
Rcisco-process-memory				-					Node Type	leaf	
Rcisco-pw			Profile		Cost	e device profile			Date Trees	heaters	
Rcisco-sell-mgmt.			Platform	other					Lata type	Dorean	
Rcisco-table-map					-				Access	read-write	
Rcisco-virtual-service			Host	172.16.167.178	Port	830			Presence		
Rcommon-mpis-static			W. S	[ sheet	Paume	al chart			Key		
Rietf-diffserv-classifier		-	Username	05001		enco1			Mandatory		
Rietf-diffserv-policy									Defects	1	
Rietf-interfaces			<ul> <li>NetCor</li> </ul>	nf O RestConf		RPC	Script Capabilit		L'ATANK	1100	
* 許 interfaces			Economia 1	Connection			· · · · ·		Path	ietf-interfaces/	2
* 🔤 interface			[ including ] [	Console				= 1		interlaces/interl	100/
Pramo	GigabitEthernet1/0/16		ticretro:	r-type applicatio	n <td>cor-type&gt;</td> <td>netconfibase:1.0"&gt;</td> <td></td> <td></td> <td>enabled</td> <td></td>	cor-type>	netconfibase:1.0">			enabled	
description			Khaterron	r-severity>error+	/hdiereo:	rerror-tag>			Description	This leaf contain	a the
🔎 type	ianaifcfastEtherFX		interest	r-path wnlns:if=' ">/prc/edit-conf:	urniletf	parana:eml: if:interfac	ns:yang:ietf- es/if:interface			configured, des	red
@ enabled	false		fitizane- C	-message lang-"	0/16*1/1:	itype <td>rror-path&gt; .w3.org/XML/1998/</td> <td></td> <td></td> <td>state of the</td> <td></td>	rror-path> .w3.org/XML/1998/			state of the	
Fink-up-down-trap-enable			namespace*	/interfaces/inte	rface[nat	se-'Gigabith	thernet1/0/16*1/type	12		and a reserve to the second	
* 🚰 interfaces-state			neierror-m	essage>	220000					Systems that im	pleme
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Rietf-routing		-								leaf in the 'runn	ng'
				- (	7	_				datastore to set	

Here is the error that was returned by the Catalyst 3850. Notice that it contains an error tag "operation-failed" and further detail that concerns the error says "Unsupported - value must be ethernetCsmacd or softwareLoopback"</nc:error-message>".

```
<nc:rpc-error xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0">
    <nc:error-type>application</nc:error-type>
    <nc:error-tag>operation-failed</nc:error-tag>
    <nc:error-severity>error</nc:error-severity>
    <nc:error-path xmlns:if="urn:ietf:params:xml:ns:yang:ietf-interfaces">/rpc/edit-config/config/if:int
    <nc:error-message lang="en" xmlns="https://www.w3.org/XML/1998/namespace">/interfaces/interface[name
"Unsupported - value must be ethernetCsmacd or softwareLoopback"
```

```
<nc:error-info>
<nc:bad-element>type</nc:bad-element>
</nc:error-info>
</nc:rpc-error>
```

Next, let us fix the error and specify the correct interface type ianaift:ethernetCsmacd in The RPC message sent to the Catalyst 3850 so that the Catalyst 3850 replies with an ok message instead of an error.



This time, once **Run** is selected to send the RPC message to the Catalyst 3850, the Catalyst 3850 replies with an ok message to indicate that the operation was successful.

← → C ④ localhost:8088/static/rang	Explorer.html							立
Yang Explorer 0.6.0 (Beta)						O Help	Madmin (	🖱 Refresh 🔒 guest
Explorer Starts	Values	One T	Build	Collections Manage N	lodels	4	Property	Value
Rcisco-process-cpu			Operations	Device Settings			Name	type
Rcisco-process-memory							Node Type	leaf
Relaco-pw			Profile	2.	Create device profile		Den Tree	Identity and installed
Rcisco-self-mgmt			Platform	other			Data type	Identityret.intertace-
Kcisco-table-map							18667.2	ditra
Rcisco-virtual-service			Heet	172.16.167.178	Port 830		Access	reed-write
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Ried-diffserv-classifier			Username	ciscol	Cisco1	_	Key	
Ried-diffserv-policy							Mandatory	tue
Rietf-interfaces			NetCo	nf 🔘 RestConf	RPC	ript Capabilities	Defects	
* E interfaces			d Sector II	Frank 1		2		10000000
* 🔤 interface			L noond 15	Contente			Path	lett-interfaces/
<i>₽</i> name	GigabitEthernet1/0/16		Crpc-reply	ietf(parama:xnl)	uuld:0342d5a3-b2e7-4ad0-87 nainetoonfibaseil.0*	Tb-a2256a06eaf3		Interfaces/interface/
description		1	spinsind-*	G lietfiparaesis	mlinsinetconfibaseil.0">		46 8.34	Office
/ type	lana?t:ethemetCsmacd	1	<td>42</td> <td></td> <td></td> <td>Description</td> <td>The type of the</td>	42			Description	The type of the
# enabled	false							incertace.
Ink-up-down-trap-enable								When an interface entry
* 🗗 interfaces-state								is created, a server
Rietf-key-chain								MAY
Ried netconf-monitoring								initialize the type leaf
Ried-routing					~			with a valid value, e.g.,
O Config () Oper	+ And - Delay	C'Reset	Custon	n RPC Run	Save Clear	Copy		if it is possible to derive the

**Tip**: When unsure what the correct Explorer Values format can be, the configuration that exists can be looked at before you attempt to make a change to it's parameters. This can be done with the **get-config** operation (Oper) as shown.

C @ localhost:8088/static/%	angExplorer.html			兌
Yang Explorer 0.6.0 (Beta)	Help 🎽 Admin	😅 Refresh 💧 guest		
Explorer search	Values	Open T Build Collections Manage Models	A Property	Value
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Rcisco-process-memory			Node Type	lat
Rcisco-pw		Profile Create device profile	Press Biogra	
Rcisco-self-mgmt		Platform Officer	Deta Type	
Rcisco table-map			Access	read-write
Rcisco-virtual-service		Hest 172.16.167.178 Port 830	Presence	
&common-mpls-static			Key	
Rietf-diffserv-classifier		Username CISCO1 Password CISCO1	Mandaton	
Rietf-diffserv-policy			a training the	
Rietf-interfaces		NetConf () RestConf	Detaut	
* 🗗 Interfaces	$\frown$		a Path	ietf-interfaces/
* 🔤 interlace	<get-config></get-config>	Encoding Conside		interfaces/interface
Prame	GigabitEthemet1/0/16	<pre>icrpc message-id="101" xmlns="urn:ietf:parame:xmlins:netconfibe</pre>	Ase:1.04 Description	The list of configured
elescription		<pre>source&gt;</pre>		interfaces on the
/ type	-			device.
enabled		<pre><interfaces <="" mlns="urn:letf:parame:mslins:yang:letf-inte&lt;br&gt;clare=faces&lt;/pre&gt;&lt;/td&gt;&lt;td&gt;eriaces" td=""><td>The executional state of</td></interfaces></pre>	The executional state of	
Fink-up-down-trap-enable		<pre><frame/>GigabitEthernet1/0/164/name&gt;</pre>		an interface is evailable
► 🚰 interfaces-state	-			in the
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Ried-netconf-monitoring				interface list. If the
Ried-routing				configuration of a
- ( )				system-controlled

Once **Run** is selected to send the RPC message to the Catalyst 3850, the Catalyst 3850 replies with the YANG formatted interface configuration which shows that interface type is ianaift:ethernetCsmacd.

← C @ localhost:8088/static/Yang	jExplorer.html				(1)
Yang Explorer 0.6.0 (Beta)	👹 Admin 📿 Refresh 🔺 s				
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Rciaco-virtual-service				Presence	
Common-mpla-static			Username cisco1 Password cisco1	Key	
Rietf-diffserv-classifier		-		Mandatory	
• Ried-differv-policy				0.6.0	
Ried-interfaces			NetConf RPC Script Capabilit	Cienaux	
* Chinterfaces			Entoding Console	Path	letf-interfaces/
* 🛶 interface	«get-config»		<pre><rpc-reply message-id="urn:uuld:832c3b3c-71fe-4e63-8bf4-6ec98113199&lt;/pre&gt;&lt;/td&gt;&lt;td&gt;57 M&lt;/td&gt;&lt;td&gt;interfaces/interface&lt;/td&gt;&lt;/tr&gt;&lt;tr&gt;&lt;td&gt;&lt;i&gt;P&lt;/i&gt; name&lt;/td&gt;&lt;td&gt;GigabitEthernet1/0/16&lt;/td&gt;&lt;td&gt;&lt;/td&gt;&lt;td&gt;whins=" unritetf:parame:whithernetconf:base:1.0"<br="">whinsinc="unritetf:parame:whithernetconf:base:1.0"&gt;</rpc-reply></pre>	Description	The list of configured
e description			<pre></pre>	× .	interfaces on the
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Ink-up-down-trap-enable			<enabled>false</enabled>		an interface is available
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Ried-key-chain					/interfaces-state/
Ried-netconf-monitoring					interface list. If the
• Ried-routing		1			configuration of a
Config 🧿 Oper	+ Add - Delete	C Reset	Custom RP Run Save Clear Copy		system-controlled interface cannot be

#### **Other RPC Error Type Examples**

1. "In-use" (config-locked) RPC Error Reply Message

This is a NETCONF error response to an <edit-config> request. The <error-tag> indicates "in-use". The response indicates that the server device (Catalyst 3850) NETCONF running datastore is currently locked and the NETCONF <edit-config> operation could not be performed at this time. This does not indicate an error in the NETCONF interface implementation. If a NETCONF client attempts a write to the NETCONF running datastore when the datastore is in use, the client receives this RPC response. The NETCONF client can retry the NETCONF edit-config message. This response can be received when the device is performing a sync-from-device internal operation to synchronize the NETCONF running datastore with the device IOSd configuration.

NETCONF Response from server (Catalyst 3850) to client (Centralized Management Platform (Laptop)).

In this example, an <edit-config> RPC was sent to the Catalyst 3850 for a loopback interface that was not configured. An error was returned since you cannot configure an interface that does not exist on the Catalyst 3850.

```
<?xml version="1.0" encoding="utf-8"?>
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3">
<rpc-error>
<rpc-error>
<rpc-error>
<error-type>application</error-type>
<error-tag>data-missing</error-tag>
<error-severity>error</error-severity>
<error-path xmlns:if="urn:ietf:params:xml:ns:yang:ietf-interfaces">/rpc/edit-config/config/if:inte
<error-message xml:lang="en">/interfaces/interface[name='Loopback1111']/type is not configured</er
</error-info>
</pc-error>
</pc-error>
</pc-error>
</pc-error>
</pc>
```

#### 3. "Missing Data Model" RPC Error Reply Message

If a request is made for a data model that does not exist on the Catalyst 3850 or a request is made for a leaf that is not implemented in a data model, the Server (Catalyst 3850) responds with an empty data response. This is expected behavior.

Tip: Use the NETCONF capabilities functionality to determine which data models are supported by the Catalyst software. See section 2. of Configuring the Centralized Management Platform (laptop).

```
<?xml version="1.0" encoding="utf-8"?>
<data xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"/>
```

4. "Invalid-value" RPC Error Reply Message

In some cases a NETCONF message can contain content that is valid based on the YANG data models, however, the device (Catalyst 3850) is unable to implement what is requested. When the NETCONF interface on the Catalyst 3850 sends configurations to IOSd that IOSd can't successfully apply, a specific RPC error response is returned to the NETCONF Client.

In this example, an invalid logging buffered value of bogus is sent in the RPC message to the Catalyst 3850. The error-tag in the reply from the Catalyst 3850 indicates invalid-value. The error-message indicates that the Catalyst 3850 IOS Parser was unable to configure the logging buffered severity level to bogus since this is not a valid value.

</rpc-error> </rpc-reply>