为Cisco IOS XE 16.X平台配置NETCONF/YANG

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<u>NETCONF 错误消息</u> <u>RPC 错误示例</u> <u>其他 RPC 错误类型示例</u>

简介

本文档介绍如何在基于Cisco IOS® XE 16.x的平台上配置NETCONF/YANG。

先决条件

要求

从Cisco IOS® XE 16.3.1软件开始支持NETCONF/YANG。

S 注意:使用本文档无需具备NETCONF、YANG或Python脚本编写方面的经验。

使用的组件

本文档中的信息基于以下软件和硬件版本:

在本示例中,运行Cisco IOS XE 16.3.3的单机WS-C3850-12X48U交换机用作NETCONF服务器。 这是已配置的设备并通过NETCONF/YANG从中收集数据(show命令输出)。

笔记本电脑(运行 macOS Sierra 10.12.2 和 Google Chrome 浏览器的 Apple MacBook Pro)用作 NETCONF 客户端。它作为集中式管理平台,使用Yang Explorer应用程序。它是创建YANG格式请 求的设备,这些请求通过NETCONF RPC(远程过程调用)消息发送到Catalyst 3850,以配置和收 集来自Catalyst 3850的数据。

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原 始(默认)配置。如果您的网络处于活动状态,请确保您了解所有命令的潜在影响。

背景信息

本文档中的示例重点介绍使用Catalyst 3850进行的实验室测试,但是,所提供的信息也适用于其他 Cisco IOS XE 16.x平台,例如Cisco ASR 1000系列路由器。

数据模型 - 基于编程和标准的配置及监控

数据模型提供了另一种集中式方法来配置思科设备(而不是使用思科命令行界面 [CLI] 或简单网络 管理协议 [SNMP])并从思科设备收集操作数据(show 命令)。由于数据模型是基于相同过程的标 准,并且还可用于配置或从非思科设备收集数据,因此非常适合支持多个供应商的客户。集中式管 理平台(例如,笔记本电脑)可用于配置多个思科设备或收集数据,并且数据模型架构允许通过 Python脚本自动执行这些程序(另外两个主要优势)。

Yet Another Next Generation (YANG) 数据建模语言 (RFC 6020)

YANG 是一种基于标准的数据建模语言,用于创建设备配置请求或操作(show 命令)数据请求。 它具有类似于人类可读的计算机程序的结构化格式。有多种应用程序可以在集中管理平台(例如 ,笔记本电脑)上运行,以创建这些配置和运营数据请求。

有适用于所有供应商的标准(通用)YANG数据模型(例如,禁用或关闭以太网接口的请求对于思 科和非思科设备可以是相同的),也有便于配置或收集与专有供应商功能相关的运营数据的设备 (本机、供应商特定)数据模型。

网络配置 (NETCONF) 协议 (RFC 6241)

NETCONF是基于标准的可扩展标记语言(XML)编码的协议,它提供传输功能,将YANG格式的配置 或运行数据请求从运行在集中管理平台上的应用程序(例如笔记本电脑)传输到用户希望配置或请 求运行数据(show command)的思科设备。它提供基于事务的服务,例如当配置请求的一部分失败 时中止整个配置请求。NETCONF 使用基于远程过程调用 (RPF) 的简单机制来简化客户端(集中管 理平台脚本或应用)与服务器(思科交换机或路由器)之间的通信。它使用安全外壳 (SSH) 作为跨 网络设备的传输层。一些 NETCONF 操作包括 get、get-config、edit-config 和 rpc。

配置

1. 运行Cisco XE 16.3.3软件以支持NETCONF/YANG数据建模的Catalyst 3850的基本配置

3850-1# show running-config netconf-yang ------> Enable NETCONF/YANG globally. It may take up to 90 username cisco1 privilege 15 password 0 cisco1 ---> Username/password used for NETCONF-SSH access

注意:这是Catalyst 3850上支持NETCONF/YANG数据建模所需的完整配置,但它假设没有全局配置aaa new-model(默认)。如果需要通过配置aaa new-model启用AAA(身份验证、授权和记帐),则至少还需要此配置。您也可以将其扩展为使用AAA和TACACS+或RADIUS配置,但这不在本示例的范围之内。

aaa new-model

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

2. 允许 NETCONF/YANG 系统日志和 SNMP 事件监控所需的其他(可选)配置

必须存在这些snmp-server配置,才能生成系统日志消息的NETCONF通知(RFC 5277 - <u>Tools</u> <u>5277</u>)和任何已配置的SNMP陷阱,以同时生成NETCONF通知。



注意:虽然这些是最低要求,但也可以存在额外的snmp-server enable条目。客户端(集中 管理平台)注册以从服务器(Catalyst 3850)接收NETCONF通知流并发送特定订用RPC(请 参阅配置集中管理平台(笔记本电脑)的第3部分)。

3850-1# show running-config

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

对于Syslog,当Catalyst 3850上的Ciscod生成Syslog消息时,Catalyst 3850上的数据模型接口 (DMI)必须存在此配置,才能生成RFC 5277中定义的NETCONF通知。 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

对于 SNMP 陷阱,必须存在此配置才能生成 NETCONF 通知。在Cisco XE 16.3.1软件中,最多可 以配置10个SNMP陷阱来生成NETCONF通知,但此限制可在未来版本中删除。默认情况下 ,SNMP陷阱的通知生成已启用。要禁止生成SNMP陷阱通知,请使用此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. 本例中使用的 Catalyst 3850 的网络连接配置

在本例中,Catalyst 3850管理接口GigabitEthernet0/0用于连接网络和集中管理平台(可以使用笔记 本电脑)。动态主机配置协议(DHCP)已用于为此接口分配IP地址172.16.167.175。只要笔记本电脑 可以通过网络访问 Catalyst 3850,即可在 Catalyst 3850 上使用备用配置。

3850-1# show running-config vrf definition Mgmt-vrf L 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 YES NVRAM up Vlan1 10.1.1.1 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 YES unset down Fo1/1/1 unassigned down Fo1/1/2 YES unset down unassigned down

unassigned	YES manual	up	up
unassigned	YES unset	up	up
unassigned	YES unset	down	down
unassigned	YES unset	down	down
unassigned	YES unset	down	down
	unassigned unassigned unassigned unassigned unassigned	unassigned YES manual unassigned YES unset unassigned YES unset unassigned YES unset unassigned YES unset	unassignedYES manual upunassignedYES unset upunassignedYES unset downunassignedYES unset downunassignedYES unset downunassignedYES unset down

在Catalyst 3850上验证NETCONF/YANG

1. 在 Catalyst 3850 的命令行界面 (CLI) 中,以下命令可用于确保配置 netconf-yang 后,支持 Catalyst 3850 上的数据模型接口 (DMI) 所需的软件进程即可运行。

3850-1# show platform software yang-management process

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

后续步骤从集中管理平台执行。在本例中,使用一台笔记本电脑(运行macOS Sierra 10.12.2的 Apple MacBook Pro),该笔记本电脑具有对Catalyst 3850的网络访问权限。命令从笔记本电脑的 终端提示符发出。此时,笔记本电脑上未加载特殊应用。

2. 确保集中管理平台(笔记本电脑)可以通过网络访问 Catalyst 3850 (172.16.167.175)。

<#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. 使用此Catalyst 3850配置中的用户名和密码(cisco1/cisco1),验证从集中管理平台(笔记本电脑)到Catalyst 3850(本例中为172.16.167.175)的SSH连接。响应可以是Catalyst 3850的 NETCONF功能的长列表,后跟问候消息。TCP 端口 830 = netconf-ssh。



提示:如果此SSH测试不起作用,请确保笔记本电脑和Catalyst 3850之间的任何防火墙都允 许TCP端口830(请参阅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:validate:1.1</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

配置集中管理平台(笔记本电脑)

1. 在笔记本电脑上安装 Yang Explorer 应用

在本例中,在笔记本电脑(运行 macOS Sierra 10.12.2 和 Google Chrome 浏览器的 Apple MacBook Pro)上使用 Yang Explorer 应用充当集中管理平台。Yang Explorer允许用户执行此操作 :

·从用户界面或命令行上传/编译YANG数据模型 ·生成NETCONF RPC(远程过程调用) ·对实际NETCONF服务器(Catalyst 3850)执行RPC ·将创建的RPC保存到集合,以备以后使用 ·浏览数据模型树并检查YANG的属性

💊 注意:Linux系统也支持YANG Explore应用程序。

2. 使用 Yang Explorer 应用

启动Yang Explorer应用程序-从笔记本电脑上的终端提示符从yang-explorer目录运行./start.sh和命 令。

✤ 注意:请保持打开此终端会话,否则,Yang Explorer应用程序会关闭并且必须重新启动。它还可以用作应用程序活动的控制台日志。

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.

启动杨氏资源管理器GUI -启动杨氏资源管理器应用GUI,并作为访客/访客登录杨氏资源管理器应用GUI在应用GUI主菜单的右上角(请参阅屏幕捕获)。

从Catalyst 3850检索功能。输入Catalyst 3850详细信息(IP地址、用户名/密码、TCP端口830用于 ssh-netconf),然后单击Capabilities从Catalyst 3850软件检索YANG操作功能列表。

提示:此测试还可用于确认NETCONF在集中管理平台(笔记本电脑)上的Yang Explorer应 用程序和Catalyst 3850之间是否正常工作。

\leftrightarrow \rightarrow C (i) localhost:8088/st	tatic/YangExplorer.html			\$
Yang Explorer 0.6.0 (Beta)		🕜 Help 📄 👹 Admin	2 Refresh	💄 guest
Explorer search	Values Oper	Build Collections Manage Models	Property	Value
► &ietf-interfaces		Operations Device Settings	Name	phys- address
		Profile Creste device profile	Node Type	leaf
		Platform other ▼ Hert 172.16.167.175 Port 830	Data Type	yang:phys- address
		Host 172.10.107.175 101 000	Access	read-only
		Username cisco1 Password cisco1	Presence	
		NetConf RestConf R	Key	
		Encoding Console	Mandatory	
		urn:ietf:params:netconf:base:1.0	Default	
		<pre>urn:ietf:params:netconf:base:1.1 urn:ietf:params:netconf:capability:interleave:1.0 urn:ietf:params:netconf:capability:notification:1.0 urn:ietf:params:netconf:capability:validate:1.0 urn:ietf:params:netconf:capability:validate:1.1 urn:ietf:params:netconf:capability:with-defaults:1.0?basic- mode=report-all urn:ietf:params:netconf:capability:writable-running:1.0 urn:ietf:params:netconf:capability:xpath:1.0 http://cisco.com/ns/yang/ned/ios/switching/augs?module=ned-</pre>	Path	ietf- interfaces/ interfaces- state/ interface/ phys- address
Config Oper	+ Add - Delete C	eset Custom RPC Run Save Clear Copy	Description	The interface's

加载 YANG 数据模型 - 可以在管理模型下订用各种 YANG 数据模型。订用 YANG 数据模型后,它 们会显示在左侧的 Explorer 框中。借助这些 YANG 模型,无需具备深入的 YANG 专业知识,即可 利用 Yang Explorer 应用创建 YANG 格式 NETCONF 远程过程调用 (RPC) 消息(发送到 Catalyst 3850,以对其进行配置或从其中检索数据)。下一节"基本NETCONF/YANG操作"中将介绍如何执 行此操作的示例



← → C (i) localhost:80	088/static/YangExplorer.html			☆ 🕅
Yang Explorer 0.6.0 (Beta)		O Help	Admin 🛛	🔁 Refresh 💦 💄 guest
Config Oper		Build Collection Manage Models Workspace Device Select All Showing 5 models ietf-intertype@2014-01-15.yang ietf-intertraces@2013-12-23.lang [subscribed] ietf-interfaces@2013-12-23.lang [subscribed] ietf-interfaces@2010-16-04.yang ietf-yang-types.yang	Property Name Node Type Data Type Access Presence Key Mandatory Default Path Description	Value statistics container read-only ietf-netconf-monitoring/ netconf-state/statistics Statistical data pertainin to the NETCONF server.Statistical data pertaining to the NETCONF server.None ietf-netconf-server.None

3. 订阅 NETCONF 通知(可选)

客户端(集中管理平台)通过发送此YANG格式的NETCONF RPC消息,注册以从服务器(Catalyst 3850)接收NETCONF通知流。Catalyst 3850 以异步方式向订阅 NETCONF 通知的每个客户端发送 这种通知。在完成此任务之前,请确保已在 Catalyst 3850 上进行正确配置,以支持在 Catalyst 3850 上配置 NETCONF/YANG 的 NETCONF 通知(请参阅第 2 部分)。当系统中发生事件时 ,NETCONF 服务器 (Catalyst 3850) 开始向 NETCONF 客户端(集中管理平台)发送事件通知。 这些事件通知可以继续发送,直到NETCONF会话终止或订用因其他原因终止为止。有关订用选项 工具5277的详细信息,请参阅RFC 5277。

为此,您需要将其剪切并粘贴到Yang Explorer应用GUI中作为自定义RPC。

e e filocalhost:8088/static	c/YangExp ×			Mike
\leftrightarrow \rightarrow C $$ localhost:8088/s	static/YangExplorer.html			☆ 🖬 🗄
Yang Explorer 0.6.0 (Beta)		0 H	elp 🔠 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	
		Encoding Console	Path	ietf-netconf-monitoring/ netconf-state/statistics
		<pre><pre><pre><pre><pre></pre></pre></pre></pre></pre>	Description	Statistical data pertaining to the NETCONF server.Statistical data pertaining to the NETCONF server.None
Config Oper Status : Clear completed	+ Add - Delete	C Reset Clear Co	лру	IETF 93

接下来,选Run以通过NETCONF将自定义RPC消息发送到Catalyst 3850。Catalyst 3850 将使用一条 ok 消息进行应答,告知用户操作成功。

Iccalhost:8088/static/Yar	gExp ×				Mike
\leftrightarrow \supset \bigcirc \bigcirc \bigcirc \bigcirc \bigcirc localhost:8088/statio	/YangExplorer.html				☆ 🛛 :
Yang Explorer 0.6.0 (Beta)			O Help	🖶 Admin	😷 Refresh 🛛 💄 guest
Explorer search	Values	0.7	Build Collections Manage Models	Property	Value
▶ Rietf-interfaces			Operations Device Settings	Name	statistics
			Create device profile	Node Type	container
			rione	Data Type	
			Platform other -	Access	read-only
	8088.static/YangEx x xi xi <t< td=""></t<>				
			Username cisco1 Password cisco1	Key	
				Mandatory	
				Default	
			Encoding Console	Path	ietf-netconf-monitoring/
		(<rprc-reply <br="" message-id="urn:uuid:8a3329b6-e30a-4407-91f2-c094fba2a4db">mens" berlief:params:xml:ns:netconf:base:1.0" xmlns:nc="urn:lef:params:xml:ns:netconf:base:1.0"> <ok></ok> </rprc-reply>	Description	Statistical data pertaining to the NETCONF server.Statistical data pertaining to the NETCONF server.None
O Config O Oper	+ Add - Delete C R	leset	Custom RPC Run Save Clear Copy		
Status : Recieved HTTP Result for request: run	i-rpc				IETF 93

注意:本示例中使用的当前版本的Yang Explorer没有查看已接收的NETCONF通知的选项。 它们通常存储在应用程序主菜单中可点击的通知日志中。

NETCONF/YANG 基本操作示例

现在,Catalyst 3850和集中管理平台已配置并开始通信,让我们看一些基本操作示例。

这些示例可以说明,通过NETCONF从Centralized Management Platform (Laptop) Yang Explorer应用发送到Catalyst 3850的YANG格式的NETCONF RPC消息通过Catalyst 3850上的 confd软件进程转换为标准的Cisco IOS CLI。此外,Cisco IOS CLI 数据(show 命令数据)先通过 Catalyst 3850 上的 confd 软件进程转换为 YANG 格式数据,然后再作为 NETCONF RPC 消息发送 到集中管理平台(笔记本电脑)Yang Explorer 应用。这意味着除了使用NETCONF/YANG执行相同 操作外,Catalyst 3850上仍可使用常规CLI来配置交换机并收集show命令数据。

1. 数据检索示例

从 Catalyst 3850 请求接口名称列表

可从Yang Explorer应用程序GUI的左侧Explorer部分选择所需的操作。在本例中,将从 Catalyst 3850 检索接口名称数据,因此先选择 Oper(代表操作),然后在接口名称下拉菜单中选择 getconfig。接下来选择RPC以生成YANG格式(可读)的NETCONF RPC,该RPC需要通过 NETCONF发送到Catalyst 3850,以便从Catalyst 3850检索此数据。



在生成YANG格式的NETCONF RPC消息后,选择Run以将其发送到Catalyst 3850。Catalyst 3850回复YANG格式的(人类可读的)Catalyst 3850接口名称(GigabitEthernet1/1/1、 GigabitEthernet1/1/2等)列表。

€⇒G	U localhost:8088/static/Y	angExplorer.html			\$ M
Yang Explorer 0.6.0 (Beta)					
Explorer	search	Values	Operation	Build Collections Manage Models Property	Value
Rietf-interf	aces			Operations Device Settings Name	name
🔻 🛅 interfa	ces			Node Type	leaf
🔻 🚞 inte	rface			Profile Data Type	string
1 n	ame	<get-config></get-config>		Platform other	road write
🔎 d	escription			Hert 172 16 167 175 Port 930	read-write
🟓 tj	/pe			Presence Presence	
/ e	nabled			Username cisco1 Password cisco1 Key	true
P li	nk-up-down-trap-enable			Mandatory	true
interfac	ces-state			NetConf RestConf RPC Script Capabilities Default	
				Encoding Console	ietf-
		<pre><rpc-reply <data="" message-id="urn:uuid:a9bbdb2d-05c9-49ff-a34d- d670dedc6b7d" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"> <interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces"> <interface> <interface> </interface></interface></interfaces></rpc-reply></pre>	interfaces/ interfaces/ interface/ name		
				<pre>//interface> </pre>	The name of the interface.
🔵 Config 🤇	Oper	+ Add – Dele	te C Reset	Custom RPC Run Save Clear Copy	MAY restrict the

2. 配置示例

关闭 Catalyst 3850 上的以太网接口

从 Yang Explorer 应用 GUI 左侧的 Explorer 部分选择所需的操作。在这种情况下,需要在Catalyst 3850上配置接口(关闭接口),并且选择Config(用于配置),后跟接口下拉菜单下的必需操作参数。接下来选择RPC以生成YANG格式(可读)的NETCONF RPC,该RPC需要通过NETCONF发送到Catalyst 3850以执行配置任务。

← → C ① localhost:8088/static/	YangExplorer.html			\$
Yang Explorer 0.6.0 (Beta)			🔿 Help 🛛 🖉 Admin 📿 Refre	sh 🔒 guest
Explorer	Values	0	Build Collections Manage Models Property	Value
Rietf-interfaces			Operations Device Settings Name	enabled
V 💼 interfaces			Node Typ	e leaf
🔻 🚞 interface			Profile Data Type	boolean
Pname	GigabitEthernet1/0/16		Platform other Access	read-write
 description type 	ianaift:ethernetCsmacd		Host 172.16.167.175 Port 830	
✓ enabled	false		Key	
link-up-down-trap-enable			Username CISCO1 Password CISCO1	,
interfaces-state			NetConf RestConf RPC Script Capabilities	true
			<pre>Encoding Console </pre> <pre></pre>	ietf- interfaces/ interfaces/ interface/ enabled
			<pre><interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf- interfaces"></interfaces></pre>	n This leaf contains the configured, desired
Config Oper	+ Add – Delete C R	eset	Custom RPC Run Save Clear Copy	state of the interface.

在生成YANG格式的NETCONF RPC消息后,选择Run以将其发送到Catalyst 3850。Catalyst 3850 将使用 YANG 格式的(人类可读)消息进行应答,该消息指出配置操作成功 (ok)。



Status : Recieved HTTP Result for request: run-rpc

要确认更改已发生,可以检查配置。可以使用get-config操作(Oper),其中Catalyst 3850回复接口 GigabitEthernet 1/0/16配置已启用= false,这意味着该接口已关闭。

提示:一般来说,当不清楚在Yang Explorer应用程序的Explorer部分中的值可以是什么格式时,可以丢弃YANG格式的Catalyst 3850配置(如图所示),这是一个在尝试修改它们之前确定 它们的好方法。接下来的屏幕的右侧在"属性"和"值"列中提供了这些值的一些说明和依赖关系



在生成YANG格式的NETCONF RPC消息后,选择Run以将其发送到Catalyst 3850。 Catalyst 3850 将使用一条 YANG 格式的消息进行应答,该消息指出接口 GigabitEthernet 1/0/16 配置现在为 "enabled = false",这意味着该接口已关闭。

∠ → C	(angExplorer html				*
	rangExplorer.ntml				× III
Yang Explorer 0.6.0 (Beta)			🖸 Help 🦉 Admin	C 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 •	Access	read-write
description			Hart 172 16 167 175 Port 830	Access	Tead-write
/ type	ianaift:ethernetCsmacd	_		Presence	
enabled			Username cisco1 Password cisco1	Key	
Iink-up-down-trap-enable				Mandatory	
interfaces-state			NetConf RestConf RPC Script Capabilities	Default	
			Encoding Console	Path	ietf-
			<pre><rpc-reply <="" message-id="urn:uuid:cd8460c3-7be3-447a-9940-8305113bf3cb" pre="" wmlne="urn:idf6.parame:wml.netronf:base1.0"></rpc-reply></pre>		interfaces/
			<pre>xmlns nc="urn:ietf:params:xml:ns:netconf:base:1.0"></pre>		interfaces/
			<pre><interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces"></interfaces></pre>		interface
			<pre><interlace> <name>GlgabitEthernet1/0/16</name></interlace></pre>	Description	The list of
			<pre><created></created></pre>		configured
			<pre>ipv4 xmlns="vfn:ietf:params:xml:ns:yang:ietf-ip"/> <ipv6 xmins="urn:ietf:params:xml:ns:yang:ietf-ip"></ipv6></pre>		interfaces
					on the
					device.
					The
Config 🗿 Oper	+ Add - Delete C F	Reset	Custom RPC Run Save Clear Copy		operationa

Catalyst 3850 CLI在上次NETCONF/YANG配置更改前后显示接口配置

下面显示的是在执行上一 Yang Explorer 配置更改操作时 Catalyst 3850 的 CLI 中的输出。接口 GigabitEthernet 1/0/16 在收到 NETCONF RPC 消息之前默认处于未关闭状态,如 Catalyst 3850 上的日志消息所示。在收到包含YANG格式的关闭接口请求的NETCONF RPC消息后,操作完成 ,接口关闭,运行配置被修改以反映这一点。这也展示了 Catalyst 3850 上的 confd 软件进程如何 将收到的 YANG 格式 NETCONF RPC 消息转换为标准 Cisco IOS CLI。这意味着除了使用 NETCONF/YANG执行此操作外,用户仍可使用常规Cisco IOS CLI修改配置并执行show命令。

```
3850-1# show running-config interface gigabitEthernet 1/0/16 □
Building 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 ciscol, t
*Jan 5 17:05:57.335: %LINK-5-CHANGED: Interface GigabitEthernet1/0/16, changed state to administrative1
3850-1# show running-config interface gigabitEthernet 1/0/16
□Building configuration : 49 bytes □
!
```

□interface GigabitEthernet1/0/16 □ shutdown -----> the interface is shutdown now □end

3850-1#



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

在 Catalyst 3850 上保存配置

可以在 Catalyst 3850 上将运行配置保存到启动配置,方法是通过 NETCONF 将以下 YANG 格式的 NETCONF RPC 消息发送到 Catalyst 3850。

可通过将上方消息作为"自定义 RPC"剪切并粘贴到 Yang Explorer 应用中来执行此操作。

← → C D localhost:8088/static/YangExplorer.html	
	☆ 🔟 :
Yang Explorer 0.6.0 (Beta)	🔿 Help 🛛 👙 Admin 🖉 Refresh 🔹 guest
Explorer search Values Duild Collections Manage Models	Property Value
Rietf-interfaces Operations Device Settings	Name enabled
T an interfaces	Node Type leaf
▼□interface Profile Create device p	profile Data Type boolean
Phame Platform other -	Among and with
✓ description	Access read-write
Port 830	Presence
Penabled	Co1 Key
P link-up-down-trap-enable	Mandatory
▶	Default true
Kieff-netconf-monitoring O NetConf RestConf Encoding Consult (7ml version="1.0" encoding="utf-8"?>	RPC Script Capabilities Path ietf-interfaces/ interfaces/interface/ enabled
<rpc message-id="" xmlns="urn:ietf:params:xml:ns:netconf:</td><td>:base:1.0"> tp://cisco.com/yang/cisco-ia"/> Description This leaf contains the configured, desired state of the interface.</rpc>	
	Systems that implement the IF-MIB use the value of this leaf in the 'running' datastore to set
Config Oper + Add - Delete C Reset Custom RPC Run	Save Clear Copy IF-MIB.ifAdminStatus to

选择"运行"以通过NETCONF将自定义RPC消息发送到Catalyst 3850。Catalyst 3850 将使用一条成 功消息进行应答。

									A
Yang Explorer 0.6.0 (Beta)							O Help	嶜 Admin	😋 Refresh 💦 🛔 gu
Explorer search	Values	0 , 7	Build	Collections Manage	e Models			Property	Value
Rietf-interfaces			Operations	Device Settings				Name	enabled
🔻 🚰 interfaces								Node Type	leaf
🔻 🚍 interface			Profile		▼ C ¹	eate device profile		Data Type	boolean
🔎 name			Platform	other	-			A	and write
description								Access	read-write
🔎 type			Host	172.16.167.175	5 Port	830		Presence	
/ enabled			Usernan	ne cisco1	Pass	word cisco1		Key	
link-up-down-trap-enable								Mandatory	
▶ 🚰 interfaces-state								Default	true
Kietf-netconf-monitoring			Net Encoding <pre> </pre>	Conf RestConf Console	n:uuid:lo	RPC Script	Capabilities	Path	ietf-interfaces/ interfaces/interface enabled
		<	xmlns="uu xmlns=nc <resuli successfi <td>rn:ietf:parans:xm ufn:ietf:parans t xmlns="http://c il blv></td><td>l:ns:netc :xml:ns:r isco.com/</td><td>onfibaseil.0" etconfibaseil.0"> 'yang/cisco-ia">Save running-confi</td><td></td><td>Description</td><td>This leaf contains th configured, desired state of the interface.</td></resuli 	rn:ietf:parans:xm ufn:ietf:parans t xmlns="http://c il blv>	l:ns:netc :xml:ns:r isco.com/	onfibaseil.0" etconfibaseil.0"> 'yang/cisco-ia">Save running-confi		Description	This leaf contains th configured, desired state of the interface.
Config Oper	+ Add - Delete	C Reset	Cust	om RPC	Run	Save Clear	Сору		Systems that impler the IF-MIB use the value of this leaf in the 'running' datastore to set IF-MIB ifAdminStati

执行上次NETCONF/YANG配置保存操作后保存的启动配置的Catalyst 3850 CLI显示

启动配置现在与运行配置匹配:

```
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
!
```

从 CLI 配置 Catalyst 3850

如前所述,除了使用NETCONF/YANG执行此操作外,常规Catalyst 3850 CLI仍可用于配置交换机 和收集show命令数据。当使用Catalyst 3850 CLI而不是NETCONF/YANG配置交换机时,新的运行 配置将通过syncfd软件进程与Catalyst 3850上的数据模型接口(DMI)同步。

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#

下次Yang Explorer应用程序在CLI更改后请求接口配置副本时,更改将正确反映在YANG输出中。

- C () localhost:8088/	static/YangExplorer	html			☆ □□
Yang Explorer 0.6.0 (Beta)			O Help 🛛 👹 Adm	in 💭 Refre	sh 🔒 guest
Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
Rietf-interlaces	-		Operations Device Settings	Name	interface
a interfaces				Node Type	list
* interface	<get-config></get-config>		Profis Create device profile	Data Type	
^{je} name	GigabitEthemet1/0	16	Platform other 🔻	Access	read-write
description		/	Hert 17216167171 Port 830	Presence	
enabled	-			Kau	
Ink-up-down-trap-en			Username cisco1 Password cisco1	Mandata	
Tinterfaces-state			NetConf O RestConf	mandatory	
lietf-netconf-monitoring				Default	
			Encoding Console	Path	letf-interfaces/
			<pre><rpo message-id="101" xmlns="urnisetf:params:xmlins:netconf:base:1.0"></rpo></pre>		interfaces/
			<source/> <running></running>		We have
		-		Description	The list of
			<interfaces xmlns="urn:letf:params:xml:ns:yang:letf-interfaces"> <interface></interface></interfaces>		ionerfaces on
			<name>GigabitEthernet1/0/16</name>		the device.
					The
\frown			(/tpc>		operational
cher O com					state of an
Column Contra	+ Add = 0	elete C Reset			interface is

选择"运行"以通过NETCONF将GigabitEthernet1/0/16的RPC get-config消息发送到Catalyst 3850。 Catalyst 3850 将使用 GigabitEthernet1/0/16 接口配置(显示 enabled = true)进行应答。

\leftrightarrow \ni C (i) localhost:8088/static/Yang	gExplorer.html									\$
Yang Explorer 0.6.0 (Beta)							O Help	😁 Admin	C Refresh	🐣 guest
Explorer search	Values		Operations	Davias Cattinas				Property	Value	
► 🥵 cisco-process-cpu		4		Device Settings				Name	interface	
Rcisco-process-memory			Profile	-	Create	device profile		Node Type	e list	
► 🥵 cisco-pw			- Tome					Data Tura		
► 🥵 cisco-self-mgmt			Platform	other 👻				Data Type		
▶ 🥵 cisco-table-map			Hort	172 16 167 178	Port	30		Access	read-write	
► 🥵 cisco-virtual-service			riust	172.10.107.170				Presence		
▶ 🥵 common-mpls-static			Username	cisco1	Password	cisco1		Key		
► 🥵 ietf-diffserv-classifier					_			Mandatory	,	
Rietf-diffserv-policy				-						
🔻 🥵 ietf-interfaces			 NetCon 	f O RestConf		RPC Script	Capabilities	Default		
▼ 🚠 interfaces			Encoding (Console				= Path	ietf-interface:	s/
🔻 💳 interface	<get-config></get-config>		<rpc-reply< td=""><td>message-id="urn:</td><td>uid:832c3</td><td>b3c-71fe-4e63-8bf4-6</td><td>ec981131991"</td><td>-</td><td>interfaces/int</td><td>erface</td></rpc-reply<>	message-id="urn:	uid:832c3	b3c-71fe-4e63-8bf4-6	ec981131991"	-	interfaces/int	erface
🔎 name	GigabitEthernet1/0/16		xmlns="urn: xmlns:nc="u	:ietf:params:xml:: urn:ietf:params:xr	ns:netconf nl:ns:netco	:base:1.0" onf:base:1.0">		Description	n The list of co	nfigured
description			<pre> <data> <interf< pre=""></interf<></data></pre>	faces xmlns="urn:	ietf:param	s:xml:ns:yang:ietf-i	nterfaces">		interfaces on	the
🔎 type			<interstate< td=""><td>erface> ame>GigabitEtherm</td><td>+1/0/16<!--</td--><td>name></td><td></td><td></td><td>device.</td><td></td></td></interstate<>	erface> ame>GigabitEtherm	+1/0/16 </td <td>name></td> <td></td> <td></td> <td>device.</td> <td></td>	name>			device.	
🔎 enabled		0	<ty type">ianai</ty 	ype xmlns:ianaift	"urn:ietf	:params:xml:ns:yang:	iana-if-		The operation	nal state of
link-up-down-trap-enable			<er< td=""><td>habled>false<td>oled></td><td>waling:wangiiotf-in"</td><td>15</td><td></td><td>an interface i</td><td>s available</td></td></er<>	habled>false <td>oled></td> <td>waling:wangiiotf-in"</td> <td>15</td> <td></td> <td>an interface i</td> <td>s available</td>	oled>	waling:wangiiotf-in"	15		an interface i	s available
► 🔤 interfaces-state			<ip< td=""><td>ov6 xmlns="urn:iet</td><td>f:params:</td><td>xml:ns:yang:ietf-ip"</td><td>1></td><td></td><td>in the</td><td></td></ip<>	ov6 xmlns="urn:iet	f:params:	xml:ns:yang:ietf-ip"	1>		in the	
► 😤 ietf-key-chain			<td>rfaces></td> <td></td> <td></td> <td></td> <td></td> <td>/interfaces-st</td> <td>ate/</td>	rfaces>					/interfaces-st	ate/
Rietf-netconf-monitoring			 <td></td> <td></td> <td></td> <td></td> <td></td> <td>interface list.</td> <td>If the</td>						interface list.	If the
▶ Relietf-routing									configuration	of a
			Custom	RPC Run	Sav	e Clear	Сору		system-contro	olled

Status : Recieved HTTP Result for request: run-rpc

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3. 通过 GET 请求操作检查哪些 SNMP MIB 操作数据可用

NETCONF GET操作可返回的SNMP MIB数据不可由用户配置。所有受支持的SNMP MIB转换成 YANG数据模型定义的结构化数据,都是Catalyst 3850上的Cisco XE软件的一部分。要了解GET请 求中有哪些MIB数据可用,提供了三个选项。所有支持的MIB都可以在功能响应中包含smv2。

第 1 项. 可以在Yang Explorer应用程序GUI中选择Capabilities按钮。Catalyst 3850 将使用包含 smiv2 MIB 条目的功能列表进行应答。

• • • Iocalhost:8088/	/static/YangExp ×				Mike
\leftrightarrow \ni C () localhost:80	88/static/YangExplorer.htm	nl			☆ 🛛 :
Yang Explorer 0.6.0 (Beta)			O Help	🚰 Admin	🍞 Refresh 🛛 🚨 guest
Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
► Rietf-interfaces			Operations Device Settings	Name	name
			Create device profile	Node Type	leaf
			Profile	Data Type	netconf-datastore-type
			Platform other -	Access	read-only
			Host 172.16.167.175 Port 830	Presence	
			Hereane cisco1 Password cisco1	Кеу	true
				Mandatory	true
				Default	
			NetConf RestConf RestConf Capabilities Encoding Console urnifet fiparane sml sml ne syance sen v2 i SNMP-FRAMEWORK-MIB?module=SNMP-FRAMEWORK-	Path	ietf-netconf-monitoring/ netconf-state/datastores/ datastore/name
Config Oper	+ Add	- Deiete C Reset	MIB&:revision=2002-10-14 urnietfiparams:unins:yang:smlv2:SNMP-PROXY-MIB?module=SNMP-PROXY- MIB&:revision=2002-10-14 urnietfiparams:unins:yang:smlv2:SNMPv2-MIB?module=SNMPv2-MRGET- MIB&:revision=2002-10-14 urnietfiparams:unins:yang:smlv2:SNMPv2-MIB?module=SNMPv2- Urnietfiparams:unins:yang:smlv2:SNMPv2-TC?module=SNMPv2-TC urnietfiparams:unins:yang:smlv2:SNMPv2-TC?module=SNMPv2-TC urnietfiparams:unins:yang:smlv2:SNMPv2-TC?module=SNMPv2-TC urnietfiparams:unins:yang:smlv2:TC?Mbku-MIB?module=CP- MIB&:revision=2005-02-18 urnietfiparams:unins:yang:smlv2:UDP-MIB?module=UDP- MIB&:revision=2005-5-20 urnietfiparams:unins:yang:smlv2:VPN-TC-STD-MIB?module=VPN-TC-STD- MIB&:revision=2005-11-15	Description	Name of the datastore associated with this list entry.Name of the datastore associated with this list entry.None
O coming O oper	+ Add	- Delete C Reset	Kuri Save Crear Copy		
Status : Recieved HTTP Result for n	equest: get-cap				IETF 93

第 2 项. 此YANG格式的NETCONF RPC消息可以通过NETCONF发送到Catalyst 3850以检索功能 列表,其中包括可用的smiv2 MIB模型。

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

可通过将上方消息作为自定义 RPC 剪切并粘贴到 Yang Explorer 应用中来执行此操作。

loca	Ihost:8088/static/YangExp ×				Mike
← → C () lo	calhost:8088/static/YangExplorer.h	tml			☆ 🛯 🗄
Yang Explorer 0.	6.0 (Beta)		🙃 Help 🛛 👹 🖉	Admin 🕄	Refresh 🔒 guest
Explorer search	Values	Operation	Build Collections Manage Models Pro	operty	Value
► Rietf-interfaces			Operations Device Settings Na	ame	name
			No	ode Type	leaf
			Profile Da	ata Type	netconf-datastore-type
			Platform other Ac	cess	read-only
			Host 172.16.167.175 Port 830 Pre	esence	
			Username cisco1 Password cisco1 Ke	ay a	true
			Ma	andatory	true
			De NatCarf Cart Cart	əfault	
			Encoding Console	ith	ietf-netconf-monitoring/ netconf-state/datastores/
			<pre>rxml version="1.0" encoding="utf-8"?></pre>		datastore/name
			<pre><rpc kmlns="urn:left;parans:kml:ns:netconf:base:1.0" message-id=""> <get> <filter type="subtree"> <form:netconf-state xmlns:ncm="urn:leff;parans:kml:ns:yang:leff-netconf- monitoring"> <form:netconf-state xmlns:ncm="urn:leff;parans:kml:ns:yang:leff-netconf- monitoring"> </form:netconf-state> </form:netconf-state> </filter></get></rpc></pre>	escription	Name of the datastore associated with this list entry.Name of the datastore associated with this list entry.None
			Vrpc>		
Config O Op	er + Add	- Delete C Reset	Custom RPC Run Save Clear Copy		
Status - Clear complete	ы				IFTE 93

Status : Clear completed

选择"运行"以通过NETCONF将自定义RPC消息发送到Catalyst 3850。Catalyst 3850 将使用包含受 支持 smiv2 MIB 的功能列表进行应答。

Yang Explorer 0.6.0 (Beta)			O Help	😁 Admin	🔁 Refresh 🛛 💄 guest
Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
Rietf-interfaces			Operations Device Settings	Name	name
			Create device profile	Node Type	leaf
			Profile	Data Type	netconf-datastore-type
			Platform •	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 attreamprevision=2015=04=2777dapability2 action 2015=04=2777dapability2	Path	ietf-netconf-monitoring/ netconf-state/datastores/ datastore/name
		<pre>MIB&:revision-1994-05-05</pre> //apability/ <capability urniet:parama:xml:ns:yam;smiv2:bridge-mib?<br="">module=BRIDGE-MIB&:revision=2003-01-17//capability/ <capability urniet:parama:xml:ns:yam;smiv2:cisoo-aaa-server-mib?<br="">module=CISOC-AAA-SERVER-MIB&:revision=2003-11-17//capability/ <capability urniet:parama:xml:ns:yam;smiv2:cisoo-baa-server-mib?<br="">module=CISOC-ABA-SESION-MIB&:revision=2003-11-21//capability/ <capability urniet:parama:xml:ns:yam;smiv2:cisoo-bgp-pdlicy-<br="">ACCOUNTING-MIB?module=CISOO-BGP-PDLICY-ACCOUNTING MIB&:revision=2002-07-26//capability/ ccapability/urniet:parama:xml:ns:yam;smiv2:CISOO-BGP4-MIB? module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-bgp4-mib?<br="">module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-bgp4-mib?<br="">module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-bgp4-mib?<br="">module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-bgp4-amib?<br="">module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-cbp+target-mib?<br="">module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-cbp+target-mib?<br="">module=CISCO-BGP4-MIB&revision=2002-06-10</capability><capability urniet:parama:xml:ns:yam;smiv2:cisoo-cbp+target-mib?<br="">module=CISCO-CBP-TARGET-MIB&revision=2006-05-24</capability></capability></capability></capability>	Description	Name of the datastore associated with this list entry.Name of the datastore associated with this list entry.None	

选项 3.可以在 Catalyst 3850 为响应来自集中管理平台(笔记本电脑)的 SSH 连接而返回的 NETCONF 功能和 Hello 消息中查看可用 MIB 模型的列表。

```
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 < \wedgeC > to exit
```

加载其他 YANG 数据模型

此链接包含其他YANG数据模型文件。这些文件允许通过NETCONF/YANG执行与其他Catalyst 3850功能(如配置IPv4单播路由、QoS等)相关的其他操作。

<u>GitHub Yang模型</u>

通过选择standard、ietf、rfc,可以找到适用于所有供应商的标准(常见Internet工程任务组 [IETF])模型。以下链接提供了基于标准的 YANG 数据模型,这些数据模型摘自 IETF 标准组织发 表的 RFC 出版物。

GitHub Yang模型树主标准

可以通过依次选择 vendor、cisco、xe、1632 找到思科原生(设备、供应商特定)模型。以下链接 提供了适用于 Catalyst 3850 的 Cisco IOS XE 软件版本 16.3.2 的专用 YANG 数据模型。

GitHub Yang型号杨树主供应商

(US) https://github.com/YangModels/yang/tree/ma	ster/vendor/cisco/xe/1632	Centre cisco yang models
↔ Code ① Issues 11 ① Pull requ	ests 1 🗏 Projects 0 + Pulse 🔟 Gray	ohs
Branch: master - yang / vendor / cisco	/ xe / 1632 /	Create new file Find file History
gohite Cisco IOS XE 16.3.2 Felease Yang	Models	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
Check-models.sh	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
Cisco-acl-oper.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
Cisco-bfd-state.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
Cisco-bgp-state.yang	Cisco IOS XE 16.3.2 Release Yang Models	2 months ago
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

+ etc...

这些文件可以下载到集中管理平台(笔记本电脑),然后加载到Yang Explorer应用程序。有两种方 法可以做到这一点。第一种方法是单独加载各种 YANG 数据模型文件,第二种方法是批量加载所有 文件。

1. 单独加载各种 YANG 数据模型文件

提示:可以要求<u>rawgit</u>从Github下载文件。要从 Github 下载文件,请选择与相应 YANG 文件 关联的原始按钮。如果提供URL而不是文件下载选项,则可以将URL粘贴到<u>rawgit</u>中,从而提 供生产URL。将此新的生产URL粘贴到浏览器中,它可以提供文件下载选项。

在本例中,cisco-ethernet.yang已从github下载到集中管理平台(笔记本电脑)。以下是将文件加载 到Yang Explorer应用程序GUI中,然后订阅,以便将其加载到工具的Explorer部分的步骤。

〉提示:NETCONF功能可用于确定Catalyst 3850软件支持的数据模型。请参阅配置集中管理平 台(笔记本电脑)的第2节。

$\leftarrow \rightarrow \mathbb{C}$ (i) localhost:8088/st	atic/YangExplorer.html				☆ 🔛
Yang Explorer 0.6.0 (Beta)			Q Help	😁 Admin	🕄 Refresh 💦 💄 guest
Explorer Search Rietf-interfaces	Values	Operation	Build Collection Manage Models Workspace Device Select All Showing 5 models iana-if-type@2014-01-15.yang ietf-interfaces@2013-12-23.yang ietf-interfaces@2013-12-23.yang ietf-interfaces@2010-10-04.yang ietf-yang-types.yang ietf-yang-types.yang ietf-yang-types.yang ietf-yang-types.yang ietf-yang-types.yang	Property Name Node Type Data Type Access Presence Key Mandatory Default Path Description	Value

City Contracts: Display: static; Mangbepterer. Method City So doward, hold to see history City So doward, hold to see history Name Statius Name Statius Display: City So doward, hold to see history Name Statius Browney Upload City So doward, hold to see history Statius Browney Upload City So doward, hold to see history	Iocalhost:8088/static/Y	fangExp ×						Mike
	\leftrightarrow \rightarrow C (i) localhost:8088/sta	tic/YangExplorer.htm	1					☆ 🖬 :
Marine Marine Marine Marine Marine Marine Marine	Click to go forward, hold to see history	2				O ^{treip}	(C)2223) (9120at (- Charait -)
Marked and a base								
 Ander AM Beau of agreed and the agreed Beau of agreed and the agreed Beau of agreed and the agreed Beau of agreed agreed and the agreed Beau of agreed agreed								
Carrier Conservation of A distribution of A dist								
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Name Status Name Status Name Status Name Status Clear Status Browse Upload Browse Upload Clear Status Status Status Status Status <								
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Name Status Ame				Upload Yang		*		
Default Def				Name	St	atus		
Park Addressed by the sub- Browse Upload Clear								
 Browse Upload Clear Browse Upload Clear Browse Browse Upload Clear Browse Browse								
Browse Upload Clear Clea								
Description of package Browse Upload Clear								
Browse Upload Clear which we not be able to								
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Browse Upload Clear Upload Clear					\frown			
addressed to a multicast or broadcast and and addressed to a multicast or broadcast a					Browse	pload Clear		

	static/rangexplorer.ntml				¥ 10
Yang Explorer 0.6.0 (Beta)		\frown	O Help	Admin	😷 Refresh 💦 🔺 gue
Explorer search Rietf-interfaces	Values	Build Collection Manage Models Workspace Device Select All Cisco-ethernet@2016-05-10.yang ima-if_type@2014_01.15.yeng ietf-inet-types.yang ietf-netconf-monitoring@2010-10.0 ietf-yang-types.yang	Showing 6 models <u>filter</u> ubscribed] M4.yang	Property Name Node Type Data Type Access Presence Key Mandatory Default Path Description	Value Image:

2. 一次批量加载所有 YANG 数据模型文件

第5.2.2节也提到了这一过程,即github。

在集中管理平台(笔记本电脑 - 运行 macOS Sierra 10.12.2 的 Apple MacBook Pro)上的终端提示 符下,输入以下内容:

```
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 🗆
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--
```

现在,可以在 Yang Explorer 应用 GUI 中看到所有 Yang 数据模型。单击"订阅"(Subscribe),然后 将其添加到工具的"浏览器"(Explorer)部分时,可以选择与所关注功能相关联的文件。

 提示:NETCONF功能可用于确定Catalyst软件支持的数据模型。请参阅配置集中管理平台 (笔记本电脑)的第2节。

000/21.5.000					Mike
localhost:8088/static/YangExp	× /				Mike
← → C (i) localhost:8088/static/Yan	gExplorer.html				\$
Yang Explorer 0.6.0 (Beta)			Ç Help	😁 Admin	😷 Refresh 🛛 🔮 guest
Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
		_	Workspece Device	Name	
			Select All Showing 79 models	Node Type	
				Data Tupo	
			✓ cisco-acl-oper.yang	- Data Type	
			✓ cisco-oro-state.yang	Access	
			✓ 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-ethernet.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	*	
Status : keceived H i I P Kesuit for module request					IETP 93
O Iocalhost:8088/static/YangExp	×				Mike
$\leftrightarrow \rightarrow \mathbb{C}$ (i) localhost:8088/static/Yan	gExplorer.html				\$
Yang Explorer 0.6.0 (Beta)			Ç Help	😁 Admin	🔁 Refresh 🔒 guest
Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
▶ 🥵 cisco-bfd-state			Workspace Device	Name	
▶ 🥵 cisco-bgp-state			Select All Showing 79 models filter	Node Type	
Rcisco-bridge-domain				Data Type	
► Secisco-cfm-stats			cisco-bfd-state.vang [subscribed]	Access	
Rcisco-checkpoint-archive			cisco-bgp-state.yang [subscribed]	-	
Meisco-efp-stats			cisco-bridge-common.yang	= Presence	
Kcisco-environment			cisco-bridge-domain.yang [subscribed]	Key	
► Kcisco-flow-monitor			cisco-cfm-stats-dev.yang	Mandatory	
• Kcisco-ia			cisco-cfm-stats.yang [subscribed]	Default	
• • • cisco-ip-sla-stats			cisco-checkpoint-archive.kang [subscribed]	Path	
r m cisco-lidp-state			cisco-efp-stats.yang [subscribed]	Description	
Mcisco-memory-stats			cisco-environment.yang (subclicito)	Compton	
▶ & cisco-platform-software			cisco-flow-monitor.yang [subscribed]		
► Rcisco-process-cpu			cisco-ia.yang [subscribed]		
▶ R cisco-process-memory			cisco-ip-sla-stats-dev.yang		
▶ Kcisco-pw			cisco-ip-sla-stats.yang [subscribed]		
▶ Kcisco-self-mgmt			cisco-Ildp-state.yang [subscribed]		
▶ K cisco-table-map			cisco-memory-stats.yang [subscribed]		
► Rcisco-virtual-service			cisco-mpis-twa.yang (subscribed)		
► 🕏 common-mpls-static			v circo confider una	v	

Status : Received HTTP Result for module request

+ Add - Delete C Reset

O Config O Oper

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现在可以完成其他任务,例如生成保存Catalyst 3850上的配置所需的NETCONF/YANG RPC。可通 过在 Yang Explorer 应用左侧的 Explorer 部分中选择 save-conf RPC 来完成此任务。然后,选择

🕹 Add 🛛 Subscribe

RPC以生成YANG格式的NETCONF RPC,该RPC可以通过NETCONF发送到Catalyst 3850以保存 Catalyst 3850上的配置。

\leftrightarrow \rightarrow C () localhost:8088/sta	tic/YangExplorer.html							\$
Yang Explorer 0.6.0 (Beta)						O Help	😁 Admin	🕄 Refresh 💦 💄 guest
Explorer search	Values	Operation	Build	Collections	Manage Models		Property	Value
▶ 🔒 cisco-bfd-state		4	Operations	Device Settin	gs		Name	save-config
eisco-bgp-state							Node Type	rpc
🛚 🥵 cisco-bridge-domain			Profile		Create device profile		Data Type	
• 🕏 cisco-cfm-stats			Platform	other	•		bata type	
• 🕏 cisco-checkpoint-archive							Access	write
• 🕏 cisco-efp-stats		=	Host	172.16.1	67.178 Port 830		Presence	
Rcisco-environment			Usernam	cisco1	Password cisco1		Key	
Kcisco-flow monitor							Mandatory	
Rcisco-ia							Default	
Part eync-from			 NetC 	onf 🔘 Rest	Conf	RPC Script Capabilitie	Death	
▶ 🚰 save-config	<rpc></rpc>		Encoding	Console			Path	cisco-ia/save-config
checkpoint			STDC Bess	age-id="101	" xmlns="urn:ietf:params:xml:n	s:petconf:base:1.0">	Description	Copy the running-confi
► 🏧 revert		\langle	<save-o< td=""><td>onfig xmlns</td><td>="http://cisco.com/yang/cisco-</td><td>ia"/></td><td></td><td>to</td></save-o<>	onfig xmlns	="http://cisco.com/yang/cisco-	ia"/>		to
▶ 🚰 rollback			3/1007					startup-config on the
► 🏧 reset								Element.Copy the
Rcisco-ip-sla-stats								running-config to
Rcisco-Ildp-state								startup-config on the
Rcisco-memory-stats								Network
R cisco-mpls-fwd								Element.None
Rcisco-platform-software								
🛚 🕏 cisco-process-cpu		Ŧ						
Config Oper	+ Add - De	ete C Reset	Custo	om RPC	Run Save	Clear Copy		

选择"运行"以通过NETCONF将自定义RPC消息发送到Catalyst 3850。Catalyst 3850 将使用一条成 功消息进行应答。

	troj rungexprorentritini										~	
Yang Explorer 0.6.0 (Beta)								O Help	😁 Admin	嶜 Admin 🕱 Refresh 🔒		
Explorer search	Values	Operation	Build	Collections	Manage N	lodels			Property	Value		
Rcisco-bfd-state		A	Operatio	ons Device Set	tings				Name	save-confi	9	
🛚 名 cisco-bgp-state				_		_			Node Type	rpc		
🖻 🕵 cisco-bridge-domain			Profi	e	-	Create	device profile		Data Tupo			
🗠 🕵 cisco-cfm-stats			Platf	other	-				Data Type			
Rcisco-checkpoint-archive									Access	write		
🗠 🕏 cisco-efp-stats			Host	172.10	5.167.178	Port 8	130		Presence			
k cisco-environment				circo1		Passwor	d circo1		Key			
Rcisco-flow-monitor			User	cisco1			CISCOT		Mandatory			
🕫 😤 cisco-ia									Default			
▶ 🛅 sync-from			0 N	etConf O R	estConf		RPC	Script Capabilitie	s			
► 🚰 save-config	<rpc></rpc>		Encodin	Concolo					Path	cisco-ia/sa	ve-config	
checkpoint			Lincoun	g Console		11.150.0		2 424-12712-320	Description	Copy the r	unning-config	
▶ 🛅 revert			<rpc-r xmlns=</rpc-r 	urn:ietf:pa	arams:xml:	ns:netconf	:base:1.0"	I=052C15615ad/"		to		
▶ 🛅 rollback		(<res< td=""><td>ilt xmlxs="h</td><td>t:params:x</td><td>co.com/yan</td><td>conf:base:1.0"> cg/cisco-ia">Save</td><td>running-config</td><td></td><td>startup-co</td><td>nfig on the</td></res<>	ilt xmlxs="h	t:params:x	co.com/yan	conf:base:1.0"> cg/cisco-ia">Save	running-config		startup-co	nfig on the	
▶ 🛅 reset			<td>sfulreply></td> <td>></td> <td></td> <td></td> <td></td> <td></td> <td>Network</td> <td>on the</td>	sfulreply>	>					Network	on the	
Cisco-ip-sla-stats										running-co	opy the	
Rcisco-Ildp-state										startup-co	nfig on the	
Acisco-memory-stats										Network		
Acisco-mpls-fwd										Element.N	lone	
Rcisco-platform-software												
R cisco-process-cpu		_										

Status : Recieved HTTP Result for request: run-rpc

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值得注意的 YANG 数据模型

cisco-ia.yang 数据模型

0

以下是 cisco-ia.yang 数据模型的一些 RPC 示例。值得注意的是,因为它们涉及以下操作:保存 Catalyst 3850配置,将Catalyst 3850运行配置同步到本地数据模型接口(DMI)数据存储,以及重置 Catalyst 3850上的DMI接口。

第一步是订阅cisco-ia.yang数据模型,使其显示在YANG Explorer应用程序GUI左侧的Explorer部分

Yang Explorer 0.6.0 (Beta)			O Helo		Admin 🕃	Refresh A guest
planer (sent)	Values	Operation	Build Collections Manage Models		Property	Value
Next-Instraces			Select All Showing 79 models clicco-act-oper.yang clicco-bid state.yang clicco-bid state.yang clicco-bid state.yang clicco-bidge-domain.yang clicco-climitate.yang clicco-climitate.yang clicco-fille-state.yang clicco-limitate.yang clicco-limitate.yang clicco-limitate.yang clico-limitate.yang cli	-	Node Type Data Type Access Presence Key Mandatory Default Path Description	leaf uint16 read-write true true ned/native/router/ ospl/id

在YANG Explorer应用GUI左侧的Explorer部分中展开cisco-ia数据模型后,即可看到各种操作选项 。例如,要使用其中一个可用的cisco-ia.yang数据模型选项,请选择save-config操作,并在选择 RPC按钮时生成关联的RPC。

← → C () localhost:8088/sta	atic/YangExplorer.html			*
Yang Explorer 0.6.0 (Beta)		O Help	😁 Admin	🄁 Refresh 🛛 🐣 guest
Explorer search	Values Operation	Build Collections Manage Models	Property	Value
▶ R cisco-bfd-state		Operations Device Settings	Name	save-config
Rcisco-bgp-state			Node Type	rpc
🕨 🥵 cisco-bridge-domain		Profile Create device profile	Data Tuno	
Rcisco-cfm-stats		Platform other -	Data Type	
🕨 🕵 cisco-checkpoint-archive			Access	write
🕨 🥵 cisco-efp-stats		E Host 172.16.167.178 Port 830	Presence	
🗠 🕵 cisco-environment		Hamme ciccol Password ciccol	Key	
Cisco-flow monitor		Username Ciscol	Mandatory	
• Rcisco-ia			Default	
Pareyne-from		NetConf RestConf Capabilities		
▶ 🚰 save-config	<rpc></rpc>	Encoding Console	Path	cisco-ia/save-config
► checkpoint		Type measure-id-"101" wither"uveriatfinevementaline reteanfibereil ("	Description	Copy the running-config
▶ 츈 revert		<pre><sve-config xmlns="http://cisco.com/yang/cisco-ia"></sve-config></pre>		to
rollback		C/ Epc>		startup-config on the
▶ 🏧 reset				Element Copy the
🖻 🥵 cisco-ip-sla-stats				running-config to
🖻 🥵 cisco-lldp-state				startup-config on the
Rcisco-memory-stats				Network
Rcisco-mpls-fwd				Element.None
Rcisco-platform-software				
Rcisco-process-cpu		w l		
Config O Oper	+ Add - Delete C Res	Custom RPC Run Save Clear Copy		
Status : Recieved HTTP Result for request t	Vide roc	_] [IETE 9

接下来选择运行,以通过 NETCONF 将 RPC 消息发送到 Catalyst 3850。Catalyst 3850 将使用一条成功消息进行应答,告知用户操作成功。

Explorer search	Values	Operation	Build Collections Manage Models	Property	Value
Cisco-bfd-state		4	Operations Device Settings	Name	save-config
Rcisco-bgp-state				Node Type	rpc
Rcisco-bridge-domain			Profile Create device profile	Data Tupo	
Rcisco-cfm-stats			Platform other -	Data Type	
Rcisco-checkpoint-archive				Access	write
Rcisco-efp-stats			Host 172.16.167.178 Port 830	Presence	
R cisco-environment			Userame cisco1 Password cisco1	Key	
Rcisco-flow-monitor				Mandatory	
Rcisco-ia				Default	
▶ 🏧 sync-from			NetConf RestConf RPC Script Capabilities		
▶ 🚰 save-config	<rpc></rpc>		Encoding Console	Path	cisco-ia/save-config
checkpoint			<pre>creativ message.id="uvn.uvid.df0a8485_e625_406e_800f_052e15615ad7"</pre>	Description	Copy the running-con
► 🏧 revert			<pre>xmlns="urn:ief:param:xml:ns:netconf:base:1.0"</pre>		to
▶ 🚰 rollback		(<pre><result xmls="http://cisco.com/yang/cisco-ia">Save running-config</result></pre>		startup-config on the
▶ 🚋 reset			<pre>successful </pre>		Element Copy the
Rcisco-ip-sla-stats					running-config to
Rcisco-Ildp-state					startup-config on the
Rcisco-memory-stats					Network
R cisco-mpls-fwd					Element.None
Rcisco-platform-software					
Rcisco-process-cpu					

下面介绍了各种不同的 cisco-ia.yang 数据模型操作:

sync-from — 此RPC使Catalyst 3850上的NETCONF接口将设备运行配置的NETCONF Datastore表示与设备上的运行配置同步。这两种都存在于Catalyst 3850本身。

此 RPC 的默认行为是执行 sync without-defaults,这会使发送到设备的 show running-config 命令 的输出与 NETCONF 数据存储同步。如果存在 sync-defaults,则 NETCONF 接口还会读取功能代 码提供的默认配置信息。在大多数情况下,不使用此选项。通常,仅当 NETCONF 接口用户希望使 用 NETCONF replace 命令替换设备配置的完整部分时,才会使用此选项。

save-config — 此RPC执行write memory(copy running-config startup-config)命令,将当前设备运行 配置保存到设备启动配置。

```
<?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 -此RPC使NETCONF接口使用Cisco IOSd内置配置存档功能将运行配置保存到非易失性存储。

rollback — 此RPC使NETCONF接口将设备的运行配置回滚到与检查点RPC或设备上保存的任何其 他有效运行配置一起保存的运行配置。

target-urlstring (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)

```
<?xml version="1.0" encoding="utf-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
  <cisco-ia:rollback xmlns:cisco-ia=
     <cisco-ia:target-url>saved-config</cisco-ia:target-url>
     <cisco-ia:verbose>true</cisco-ia:verbose>
    <cisco-ia:nolock>true</cisco-ia:nolock>
     <cisco-ia:revert-on-error></cisco-ia:revert-on-error>
     <cisco-ia:revert-timer>10</cisco-ia:revert-timer>
   </cisco-ia:rollback>
</rpc>
```

revert -此RPC会导致NETCONF接口更改回滚RPC的还原计时器。这将取消定时回滚并立即触发回 滚,或者重置定时回滚的参数。

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:revert xmlns:cisco-ia
     <cisco-ia:now/>
     <cisco-ia:timer>10</cisco-ia:timer>
     <cisco-ia:idle>60</cisco-ia:idle>
   </cisco-ia:revert>
 </rpc>
```

reset - NETCONF接口可以使用此RPC重新启动。如果重新初始化为 true,则 NETCONF 接口将清 除可写入运行数据存储中存在的所有状态信息。如果为 false(默认值),系统将保留 NETCONF 配置数据存储状态信息。

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

Selection Sele 置发送到运行IOS 16.3.3的Catalyst 3850时, Catalyst 3850会将"不支持重置"错误作为RPC回 复返回至集中管理平台(笔记本电脑)。

```
<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:cisco-ia
    <nc:error-message lang="en" xmlns="https://www.w3.org/XML/1998/namespace">Reset not supported</nc:er
    <nc:error-info>
    <nc:error-info>
    <nc:error-info>
    </nc:error-info>
    </nc:error-info>
    </nc:error-info>
    </nc:error-info>
```

ned.yang 数据模型

就思科设备 (Catalyst 3850) 配置而言,网络元素驱动程序 (NED) 数据模型(例如 ned.yang)提供 的功能最强大。下面是一些演示此内容的屏幕截图。

第一步是订用 ned.yang 数据模型,使其显示在 YANG Explorer 应用 GUI 左侧的 Explorer 部分中。



在YANG Explorer应用程序左侧的Explorer部分中滚动可用选项,GUI在ned.yang数据模型中显示可 配置Catalyst 3850功能的长列表。

Yang Explorer 0.6.0 (Beta)			O Help	Admin 🕄	Refresh 🔒 guest
Explorer Jacob	Values	Queration	Build Collections Manage Models	Property	Value
Rcisco-la		A	Operations Device Settings	Name	native
Rietf-interfaces				Node Type	container
Ried ontconf-monitoring			Profile Create device profile	Data Tuna	
Rned			Nation other -	Dem type	
*Enative				Access	read-write
Gevice-model-version			Heet 172.16.167.174 Port 830	Presence	
/ version			Iterest Parment circot	Key	
boot-start-marker				Mandatory	
▶ 🔁 boot				Deducts	
Boot-end-marker		•	The series Control Resolutions	Detent.	
▶ Call-home			Encoding Console	Path	ned/native
* arvice-list				Description	
* Commony					
▶ Cocation					
▶ 🔁 hw-module					
* 🕾 cisp				-	
• E module					
* adomain					
▶ 🔁 parser					
* Eservice		*			

例如,这些屏幕截图演示了在首先向下滚动YANG浏览器应用程序GUI左侧Explorer部分中可用的 ned.yang数据模型配置选项列表后,如何显示Catalyst 3850的OSPF路由配置。ospf 子选项位于 router 选项内。选择 RPC 按钮时,系统将生成关联的 get-config RPC。

Yang Explorer 0.6.0 (Beta)			O Help	Admin 🕄	Refresh guest
Explorer Laurette	Values	One ratio	Build Collections Manage Models	Property	Value
▶ C esmc			Operations Device Settings	Name	ospf
▶ E setup				Node Type	8st
* tod-clock			Profile Create Device profile	Data Type	
* Pretwork-clock			Platform other 👻	Arress	read-write
► El2vpn		_	172 14 147 174 Bot 820	Burner	
Config-I2vpn			Post 172.10.107.174	Presence	
P C Ovpn			Username cisco1 Password cisco1	Key	
mpla				Mandatory	
router			NetConf RestConf Rec Script Capabilities	Default	
P = bgp			Encoding Console	Path	ned/native/router/os
(and	Contractory		<pre>(rpc message-id="101" wnlns="urnitetfinarans:xmlins:retconfibase:1.0")</pre>	Description	Open Shortest Path
- and	-darcounds.		<pre>spet-config> caburce></pre>	1202225200	First (OSPF)Open
West			<running></running>		Shortest Parth First
► address-family		-	<pre><filter></filter></pre>	-	(OSPF)None
* area			 <li< td=""><td></td><td></td></li<>		
► auto-cost					
+ are event-log			<td></td> <td></td>		
► 🖻 bfd					
• Dinterface-id		Ŧ			
Confer O Oner			Custom RPC Run Same Clear Conv		

接下来选择运行,以通过 NETCONF 将 RPC 消息发送到 Catalyst 3850。Catalyst 3850以其 OSPF路由配置作出回应。

Yang Explorer 0.6.0 (Beta)			O Help	Admin 🕃	Refresh 👗 guest
xplorer Juanth	Values	Queration 7	Build Collections Manage Models	Property	Value
► 🗗 esmc	-	4	Operations Device Settings	Name	ospf
► 😂 setup				Norie Type	Lor
▶ 🔁 tod-clock			Profile Create device profile	inde i jpe	
► antwork-clock			Nation other	Data Type	
► C I2vpn				Access	read-write
► Config-I2vpn			Heat 172.16.167.174 Port 830	Presence	
+ ₽ I3vpn				Key	
► 🗗 mpls			Username CISCO1 Password CISCO1	Mandatory	
* 🗗 router				- and a	
▶ 🔤 bgp			NetConf () RestConf RPC Script Capabilities	Default	
► aspfv3		-	Encoding Console	Path	ned/native/router/or
* 😄 capí	<get-config></get-config>		Erpp-reply message-id="urn:uuid:De2c04cf-9119-4e6a-8c05-238ee7f25208"	Description	Open Shortest Path
Pid			<pre>xmins="urn:letf:parama:xml:ns:netconf:base:1.0" xmins:nc="urn:letf:parama:xml:ns:netconf:base:1.0"></pre>		First (OSPF)Open
Pvrl			<pre><data> <native mins="http://cisco.com/ns/yang/med/ios"> </native></data></pre>		Shortest Path First
* address-family			<pre><router> </router></pre>		(OSPF)None
* 🚍 area			<id>1db100</id>		
► auto-cost			<pre></pre>		
* avent-log			<subnets></subnets>		
► 🖻 bíd			«/connected>		
* Dinterface-id		*	<pre>cnetwork></pre>		

以下是 Catalyst 3850 为响应 get-config RPC 操作而返回的 OSPF 路由配置的扩展。

```
<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>
```

通过NETCONF从Catalyst 3850检索的YANG格式的OSPF路由配置是人工可读的,它匹配通过 Catalyst 3850的CLI查看Catalyst 3850配置时所看到的内容。

<#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#

如果需要,ned.yang数据模型也可用于修改OSPF路由配置。在本示例中,通过在Catalyst 3850上 的现有OSPF路由配置中添加新的网络参数,首先在左侧杨氏浏览器应用程序GUI的"浏览器"部分中 输入所需的参数(也输入了OSPF路由器ID 100,但由于浏览器屏幕滚动而未看到),然后生成相 关的YANG格式的RPC,然后按RPC按钮。

Yang Explorer 0.6.0 (Beta)			O Help	🖶 Admin 🖸	Refresh 🔒 guest
plorer surch	Values	Oneration	Build Collections Manage Models	Property	Value
Ø domain-tag			Operations Device Settings	Name	ы
* ast-reroute				Node Type	leaf
* 🚔 graceful-restart			Profile Create device profile	Dan Tana	
▶ 🖻 ignore			Batform other	Lieta rype	uins le
# isp!				Access	reed-write
* Etimit			Heat 172.16.167.174 Peri 830	Presence	
* El local-rib-criteria			themes (sized) Permaned (sized)	Key	true
► 🚰 microloop			Cicol	Mandatory	true
► 🗗 mpis				Defects	
* - seightor	-		MetCorr KestCorr	- Constant	
* = network			Incoding Console	1 Path	ned/native/router/
Plp.	30.30.30.0		<pre><rpc message-id="101" wnlna="urn:ietf:parama:wnl:ns:netconf:base:1.0"> redit=conf:base:1.0"> </rpc></pre>	*	ospora
Prmask	0.0,255.255		<target></target>	Description	
P area	0				
* and	-		<rative xmlra="http://cisco.com/ma/yang/bed/ioa"></rative>		
▶ Prefix-priority		-	<coutor></coutor>		
Prefix-suppression					
# priority			<ip><ip>30.30.00.00/1p></ip></ip>		
▶ Process-min-time			<ares>G</ares> 		
shutdown 🖉				*	

接下来选择运行,以通过 NETCONF 将 RPC 消息发送到 Catalyst 3850。Catalyst 3850 将使用一条 ok 消息进行应答,告知用户操作成功。

Yang Explorer 0.6.0 (Beta)			O Help	Admin 🕄	Refresh 🔒 guest
plorer (search	Values	Queration	Build Collections Manage Models	Property	Value
domain-tag	_		Operations Device Settings	Name	ы
► 🚰 fast-reroute				Node Type	last
* Craceful-restart			Profile Creats device profile		
* Dignore			Batton other w	Data Type	uint16
# isp!				Access	read-write
* Et imit			Host 172.16.167.174 Port 830	Presence	
P local-rib-criteria				Key	true
* 🚰 microloop			Username CISCO1 Password CISCO1	Mandatory	true
* 🖻 mpis					0.00
neighbor			NetConf RestConf RestC	Default	
* = network			Encoding Console	1 Path	ned/native/router/
Plp	30.30.30.0		<rp><rp>reply message-id="urn:uuld:db43b46e-2e77-4808-8fd5-4d58128d3485"</rp></rp>	1	osp6/id
₽ mask	0.0.255.255		<pre>xmlms="urn:ietf:parame:xml:ns:netconf:base:1.0" xmlms:no="urn:ietf:parame:xml:ns:netconf:base:1.0"></pre>	Description	
P area	0		<pre><gx></gx></pre>		
> Bral					
▶ 🚔 prefix-priority					
P prefix-suppression				-	
P priority					
• Process-min-time					
# shutdown					

通过 ned.yang 数据模型修改 OSPF 路由配置的这一 NETCONF/YANG RPC 操作反映在 Catalyst 3850 配置中,如通过 Catalyst 3850 的 CLI 所看到的那样。Catalyst 3850 上还会显示一条系统日志消息,该消息表明已通过 NETCONF 进行配置更改。

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#

有关如何通过 NETCONF/YANG 将运行配置保存到 Catalyst 3850 上的启动配置的详细信息,请参 阅上一节 cisco-ia.yang 数据模型中提到的 save-config 操作。

Python 脚本

从 Yang Explorer 应用 GUI 生成 Python 脚本

Yang Explorer 应用 GUI 还可用于为给定的 NETCONF/YANG 操作生成 Python 脚本。Python 脚本 的一个主要优势是它能够协调和自动执行 NETCONF/YANG 操作。

在本示例中,在集中管理平台(笔记本电脑)上Yang Explorer应用程序GUI左侧的Explorer窗口中 选择了save-config操作。接下来,选择"脚本"按钮以生成Python脚本。然后,可以选择"复制"按钮以 复制脚本,从而将脚本粘贴到一个文件中,该文件可通过Python.py文件扩展保存在集中管理平台 (笔记本电脑)上。在本示例中,(未显示)此文件被命名为example.py。

✤ 注意:在下一个示例中,在GUI中使用Platform type other会导致运行Python脚本时出错。因此,"平台类型更改为csr,因为Cisco CSR路由器也像Catalyst 3850一样运行Cisco IOS XE软件。这避免了错误。

Values Operation Read Node Type Read Post <	← → C ① localhost:8088/s	tatic/YangExplorer.html				* 🖾 8
Englore Values Operation Manage Models Property Value Redisorie Annue Annue Serve-config Name serve-config *** checkpoint *** Profix Cests device profix Name serve-config *** creat *** Profix *** Cests device profix Name serve-config *** creat *** *** Cests device profix Name serve-config *** creat *** *** Cests device profix Name serve-config *** creat *** *** Cests device profix Name serve-config *** creat *** *** Cests write Presence Cests *** *** *** Cests write Presence Cests Kat Cests Cests Mandatory Default Default Serve Cests Serve Cests Cests Kat Cests	Yang Explorer 0.6.0 (Beta)			G Help	Admin 📿 Refr	sh 👗 guest
Redsonie Operations Decessions Name save-config Parto Chom Parto Ceste device profile Node Type Case Type Parto Chom Parto Chom Parto Chom Node Type Case Sevice profile Parto Chom Parto Chom Parto Chom Node Type Case Sevice profile Parto Chom Parto Chom Parto Chom Node Type Case Sevice profile Parto Chom Parto Chom Parto Chom Case Sevice profile Node Type Case Sevice Profile Parto Chom Parto Chom Parto Chom Red Chom	Explorer Subsch	Values	Operation*	Build Collections Manage Models	Property	Value
Importing Import indication	Relaco-la			Operations Device Settings	Name	save-config
Profile Profile Concentration Profile	Sync-from			Caste deuse polite	Node Type	npc
Participant >>> nevart NetConf NetConf Processor NetConf NetConf RestConf NetConf RestConf Encoding Console **** NetConf NetConf RestConf Install ling protion example by yang-explorer (https://github.com/ Nandizory Starup-config Nanticip scriptin Contone Net >	Save-config	erpe>		Profile	Data Type	
+ Strolback + Strolback + Strolback Rest-interfaces Ried-interfaces Sectional flamp synthem dependencies: 	P Streckpoint		_	Plutforn CST -	Access	write
***reset Wername Giscol Pasword Giscol Mandatory Red-necconf-monitoring Red/nouting Image: Script Condition Ref_Script Condition Default Red Med Script Condition Ref_Script Condition Path Casco-ia/save-config Second python example by yang-explorer (https://github.com/ ClasoDevMet/yang-explorer) Installing python dependencies: > pip installiani nocilent Image: Script (save as example.py) Path Casco-ia/save-config Sign argpace import ArgumentParser from argpace import ArgumentParser from nocilent import RPCError Pile installing python example arg from argpace import RPCError Path of the Netword	* Trollback			Host 172.16.167.174 Port 830	Presence	
Rxed-interfaces Image: Citical research research citical research resea	► 🔁 reset			a local burned front	Key	
Ried-netconf-monitoring Image: Console RefCounting State Conf. RefCount RefLocation Default Path Casco-la/save- config Rined Encoding Console State Conf. Path Casco-la/save- config Config Image: State Conf. Path Casco-la/save- config Config Description Config Image: State Conf. Path Casco-la/save- config Config Description Config Image: State Conf. Path Casco-la/save- config Config Description Config Image: State Conf. Path Casco-la/save- config Path Casco-la/save- config Config Image: State Config Path Casco-la/save- config Path Casco-la/save- config Config Image: State Config Path Image: State Config Path Casco-la/save- config Config State Config State Config Image: State Config Path Image: State Config Image: State Config Image: State Config State Config State Config Image: State Config Config Image: State Config Image: State Config State Config State Config State Conf	Rietf-interfaces			Username CISCO1	Mandatory	
Red Incoding Geneale Fince Path cisco-ia/save- config Second python example by yang-explorer intrps://github.com/ CiscoDevMet/yang-explorer) Installing python dependencies: > pip installixsi socilet Path cisco-ia/save- config Nunning script: (save as example.py) > pip installixsi socilet Path cisco-ia/save- config Nunning script: (save as example.py) > python example.py - a 172.16.167.114 -o ciscol -p ciscolport starup config Bio Import ixmi.etree as ET from arguarse import ArgumentParser from neclient import manager from neclient import RPCError contex RPC on the Network	Rief-netconf-monitoring			NetCord RestCord	Default	
**************************************	Kied-routing				a Path	cisco-ia/save-
Second python example by yang-explorer (https://github.com/ CiscoDavMet/yang-explorer) Description Copy the nuning-config to starup-config to starup-config on the Network Nuning script: (save as example.py) > python example.py -a 172.16.167.174 -o ciscol -p ciscolport Description Copy the nuning-config to starup-config on the Network Import Lxml.etree as ET from argparse linport ArgumentParser from noclient import manager from noclient import RPCError on the Network	• Mined			and the second s	12	config
Installing python dependencies: > pip installins noclient Running script: (save as example.py) > python example.py -a 172.16.167.174 -o ciscol -p ciscolport 630 **** inport Lani.etree as ET from argparse import ArgumentParser from neclient import manager from neclient import RPCError ***** Contem RPC			-	Netconf python example by yang-explorer (https://github.com/ CiscoDevMet/yang-explorer)	E Description	Copy the
> pip install lami socileti to Numing scripti (save as example.py) starup.config > python example.py -a 172.16.167.174 -o clacol -p clacolport starup.config 830 """ Inport lami.etree as ET to not be Netword from argparse import ArgumentParser config to from noclient import manager tranup.config from noclient.import RPCError tarup.config Outport Dec. contexter			~	Installing pythom dependencies:		running-config
Buinning script: (save as example.py) > python example.py -a 172.16.167.174 -o clacolport on the Network 830 *** import laml.etree as ET from acguarse import ArgumentParser from neclient.import manager from neclient.import RPCError starup-config to starup-config to star			-	> pip install ixel sociiest		to startup-confin
830 Elemant.Copy Import laml.stree as ET the numing- trom argparse import AngumentParser from argparse import laml.stree config to from neclient.operations Import RPCError starup-config Outpor RPC form the Network				Running script: (save as example.py) > python example.py -a 172.16.167.174 -u ciscol -p ciscolport		on the Network
import Lxml.etree &S ET the numing- from argparse import ArgumentParser config to from neclient.spert long Langer to the numing- from neclient.spert long Langer RPCError to the Network				830		Element.Copy
from argparse import ArgumentParser from noclient.import manager from noclient.opertions import RPCError config to starup-config on the Network				import laml.etree as 87		the running-
from neclient.operations import RPCError starup config				from argparse import ArgumentParser		config to
on the Network				from noclient.operations import RPCError		startup-config
Config Down	Config O Oper		Co Count	Custom RPC Run Sawe Clear Copy		on the Network

以下是生成 Python 脚本然后将其复制并粘贴到集中管理平台(笔记本电脑)上名为 example.py 的 文件的扩展。

✤ 注意:杨氏浏览器应用程序GUI生成的example.py文件开头的注释包括运行Python脚本所需的 步骤。负载包括脚本可以执行的NETCONF/YANG操作。在本例中是 save-config 操作。

```
""" 
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

```
payload = """ □<save-config xmlns</pre>
""
if ___name___ == '___main___':
    parser = ArgumentParser(description='Usage:')
    # script arguments □
    parser.add_argument('-a', '--host', type=str, required=True, □
               help="Device IP address or Hostname") □
    parser.add_argument('-u', '--username', type=str, required=True, □
               help="Device Username (netconf agent username)") □
    parser.add_argument('-p', '--password', type=str, required=True, □
               help="Device Password (netconf agent password)")
    parser.add_argument('--port', type=int, default=830, \square
               help="Netconf agent port") □
    args = parser.parse_args()
    # connect to netconf agent \square
    with manager.connect(host=args.host, □
                port=args.port, □
                username=args.username, □
                password=args.password, □
                timeout=90, □
                hostkey_verify=False, □
                device_params={'name': 'csr'}) as m:
# 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))
```

从集中管理平台(笔记本电脑)运行 Python 脚本

以下是运行Python脚本example.py之前的Catalyst 3850 CLI检查,该脚本可以将运行配置保存到启 动配置。此时,shutdown命令位于接口GigabitEthernet1/0/10的运行配置中,而不是启动配置中。

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
!

在集中管理平台(笔记本电脑)上的常规终端提示符下,首先将 Yang Explorer 应用 GUI 生成的 Python 文件 example.py 复制到笔记本电脑上的 yang-explorer 目录中。

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\$

接下来,在集中管理平台(laptop)上的常规终端提示符下,执行这两个命令,这两个命令是在杨氏浏 览器应用程序GUI生成的example.py文件开头处的注释部分提供的(请参阅上一部分,从杨氏浏览 器应用程序GUI生成Python脚本)。

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

第2条命令通过TCP端口830(netconf-ssh)对IP地址为172.16.167.174的Catalyst 3850运行Python脚 本example.py,用户名/口令为cisco1/cisco1。Catalyst 3850 向集中管理平台(笔记本电脑)发送 RPC 应答,表明 save-config 操作成功。

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

以下是在运行 Python 脚本 example.py 文件之后执行的 Catalyst 3850 CLI 检查,运行该文件会将 运行配置保存到启动配置。由于 save-config NETCONF/YANG 操作成功,现在 shutdown 命令显 示在接口 GigabitEthernet1/0/10 的运行配置和启动配置中。

```
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
!
```

故障排除

本部分提供的信息可用于对配置进行故障排除。

NETCONF 错误消息

NETCONF 协议定义了一组在 NETCONF 客户端(集中管理平台 [笔记本电脑])和服务器设备 (Catalyst 3850) 上的 NETCONF 实施之间交换的操作和消息。常用的 NETCONF 操作包括:

<get>、<get-config>、<edit-config>和 <rpc>

NETCONF 消息内容的格式和其他限制条件由 YANG 数据模型定义。NETCONF 客户端和服务器 通过发送 RPC 进行交互。

如果NETCONF消息的格式有错误,或者消息内容与设备实施的YANG数据模型中的定义不匹配 ,则设备上的NETCONF服务器可能会返回RPC错误。

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

这些 RPC 错误并不表示 NETCONF 接口不工作,而是表示客户端正在尝试执行服务器设备上实施 的 YANG 数据模型不支持的操作。用户必须查看在服务器设备上实施的 YANG 数据模型,以确定 并解决导致这些错误的原因。

RPC 错误示例

在本例中,使用了不正确的接口类型 ianaift:fastEtherFX 来生成 YANG 格式的<edit-config> NETCONF RPC 消息,以通过 NETCONF 发送到 Catalyst 3850。

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Vang Explorer 0.6.0 (Beta)						O Help	Admin	🕆 Refresh 💦 🛔 guest
Explorer search	Values	Oper	Build	Collections Manage N	Aodela	<u>*</u>	Property	Value
Rcisco-process-cpu		4	Operations	Device Settings			Name	enabled
Rcisco-process-memory							Node Type	loaf
Reisco-pw			Profile		Create device profile		Data Tura	hashasa
Rcisco-self-right			Platform	other			Cea type	boolean
Rcisco-table-map				And second as			Access	read-write
Rcisco-virtual-service			Hest	172.16.167.178	Port 830		Presence	
Rcommon-mpls-static			Harrison	circo 1	Parmand circo1	- 1 I	Key	
Rietf-diffserv-classifier		-	Stername	CIRCUT	03001	- 11	Mandatory	
Rief-differv-policy					\frown		Delivite	22
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* 🔤 interface			Level Balan	ne te ville mice		Confidence 1 / At		enabled
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# enabled	latte	2	<int <i< td=""><td>erfaces wains-"ur interface></td><td>niletf:parane:xml:ns:yang:le</td><td>f-interfaces"</td><td></td><td>interface.</td></i<></int 	erfaces wains-"ur interface>	niletf:parane:xml:ns:yang:le	f-interfaces"		interface.
Ink-up-down-trap-enable			-	<name>GigabitEthe <type td="" xmlnarianai<=""><td>rnet1/0/16</td></type></name> ft="urniletf:parama:emlinary	rnet1/0/16	ingiiana-If-		
* 🚰 interfaces-state			type">lata	<pre>ift:fastEtherFX<!-- </re--></pre>	type> cabled>	10000000000		Systems that implement
Rief-key-chain		1	</td <td>interface></td> <td>1.11.10.029</td> <td></td> <td></td> <td>the IF-MIB use the</td>	interface>	1.11.10.029			the IF-MIB use the
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Rietf-routing				IOILLAND .				leaf in the 'running'
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选择Run将RPC消息发送到Catalyst 3850后,Catalyst 3850会回复错误消息。

	Arthonecourt								н
Yang Explorer 0.6.0 (Beta)						O Help		Admin	😋 Refresh 🛛 🛔 guest
Explorer search	Values	Oper	Build C	Collections Manage M	lode's		4	Property	Value
Rcisco-process-cpu		4	Operations 1	Device Settings			_	Name	enabled
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Rcisco-sell-mgmt.			Platform	other			- 11	Late type	bborean
Rcisco-table-map			6		-		- 11	Access	read-write
Rcisco-virtual-service			Host	172.16.167.178	Port 830		- 11	Presence	
Rcommon-mpls-static			W	Caluar	Burnered		- 11	Key	
Rietf-diffserv-classifier		_	Username	Cisco1		cisco1	- 11	Mandatory	
Rietf-diffserv-policy								Defects	W1127
Rietf-Interfaces			NetCon	at 🔿 RestConf	6	RPC Script Capab	litie	Detaut	1750
* 🔐 interfaces			a martine 100				-	Path	ietf-interfaces/
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Prano	GigabitEthernet1/0/16		toretror	-type application	iletfiparans: n4/nc:error=t	<pre>wmlinsinetconfibasei1.0*> ype></pre>			enabled
description		1	Knoterror	r-tag>operation-f	ailed/nc:error-aev	or-tag> writy>	- 11	Description	This leaf contains the
🖉 type	ianalfcfastEtherFX		interfaces"	-path walns:if-" >/pec/edit-confi	urniietfipara g/conflg/ifii	naixmlins/yangiletf- nterfaces/ifilnterface	- 11		configured, desired
@enabled	false		fitrane- o	luabitEthernet1/	0/16*]/lfityp	e pi//www.wi.org/XML/1998/			interface
link-up-down-trap-enable			namespace*)	/interfaces/inte	rface[name='G	agabitEthernet1/0/16*]/ty	pei		anterna da .
* Tinterfaces-state			neierror-me	issage>					Systems that implement
Kietf-key-chain			<nc:bad< td=""><td>i-element>type<td>crbad-element</td><td>s</td><td>- 11</td><td></td><td>the IF-MIB use the</td></td></nc:bad<>	i-element>type <td>crbad-element</td> <td>s</td> <td>- 11</td> <td></td> <td>the IF-MIB use the</td>	crbad-element	s	- 11		the IF-MIB use the
Rietf-netconf-manitoring			<td><01/1/1/2012</td> <td></td> <td></td> <td></td> <td></td> <td>value of this</td>	<01/1/1/2012					value of this
Rietf-routing									leaf in the 'running'
					1		1		datastore to set

以下是 Catalyst 3850 返回的错误。请注意,它包含错误标记"operation-failed",并且与错误相关的 更多详细信息显示"Unsupported - value must be ethernetCsmacd or softwareLoopback"</nc : error-message>。

<#root>

```
<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:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces">/rpc/edit-config/config/if:interfaces
```

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

接下来,让我们修复错误并在发送到Catalyst 3850的RPC消息中指定正确的接口类型 ianift:ethernetCsmacd,以便Catalyst 3850以ok消息而不是错误进行回复。



此时,一旦选择Run将RPC消息发送到Catalyst 3850,Catalyst 3850将回复一条ok消息,以指示操作 成功。

← → C ① localhost.8088/static/Yang	Explorer.html							म
Varg Explorer 0.6.0 (Beta)						Q Help	Mark Admin	🕆 Refresh 🔒 guest
Explorer	Values	Oper	Build	Collections Manage M	fodels	*	Property	Value
Rcisco-process-cpu			Operations	Device Settings			Name	type
Rcisco-process-memory					- Constant of the Constant of the		Node Type	leaf
Rcisco-pw			Profile		Create device profile		Dam Time	identicuel interface.
Rcisco-self-mgmt			Platform	other -			Dem type	broe
Kcisco-table-map							120057.0	- Here
Rcisco-virtual-service			Heet	172.16.167.178	Port 830		Access	reed-write
Rcommon-mpis-static			316	[shown the	Parmanet alarest		Presence	
Ried-diffserv-classifier			Username	CISCO 1	CISCO 1		Кеу	
Ried-diffserv-policy							Mandatory	true
Rietf-interfaces			 NetCor 	of O RestCorf	RPC	cript Capabilitie	Defects	
▼ 🚰 interfaces			A REAL TO	-		2	Liverary rt.	
* 🚍 interface			Encooing []	Lonsene			Path	letf-interfaces/
Phame	GigabitEthernet1/0/16		<rpre>crpc-seply</rpre>	ietf(parama(xol))	uuld:0342d5a3-b2e7-4ad0-1 nainetconfibaseil.0*	77b-a2256ac6eaf3*		interfaces/interface/
description		1	Kok/>	clietfiparameter	nlinsinetconfibaseil.0">		65 0.34	Othe
/ type	lanal/tethemetCamacd	1	<td>m)</td> <td></td> <td></td> <td>Description</td> <td>The type of the</td>	m)			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		1						MAY
Ried netconf-monitoring								initialize the type leaf
Riet-routing		-						with a valid value, e.g.,
O Config () Oper	+ Ant - Delete	C Reset	Custon	RPC Run	Suve Clear	Copy		if it is possible to derive the

提示:不确定正确的Explorer Values格式时,可以在尝试更改其参数之前查看存在的配置。可以使用如图所示的 get-config 操作 (Oper) 来完成此任务。

C C Charabast 0000 state of the	Eveloper bired				
C C C Concernost substanticitiang	explorer.mm				52
Yang Explorer 0.6.0 (Beta)			O Help	Admin 1	🔁 Refresh 🛛 🛔 guest
Explorer Jearch	Values	Oper	Build Collections Manage Models	Property	Value
Rcisco-process-cpu			Operations Device Settings	Name	interface
Rcisco-process-memory			The second se	Node Type	Sat
Rcisco-pw			Profile Create device profile	Page Torne	
Rcisco-self-mgmt			Platform other -	Desi Abe	
Kcisco-table-map				Access	read-write
Rcisco-virtual-service			Hest 172.16.167.178 Port 830	Presence	
Common-mpls-static			Numeral Parment Street	Key	
Rietf-diffserv-classifier		_	Oreviewe Circol	Mandatory	
Rieff-diffserv-policy			\frown	Part In	
Ried-interfaces			NetConf () RestCord Rept Capabilities	- Second	
* 🚰 interfaces	-		Environ County	Path	ietf-interfaces/
*interface	<get-config></get-config>		Local Course	ENGINE ST	interfaces/interface
Prame	GigabitEthemet1/0/16		<pre><pre>cpc measage-td="lui" xmins="urnitetriparamerxmiinsinetconfideseit.u" <get=config></get=config></pre></pre>	Description	The list of configured
description			<pre><source/> <running></running></pre>		interfaces on the
🔎 type	-		<filter></filter>		Osvice.
# enabled			<pre><interfaces <interface="" xmlna="*urmiletf:parame:xmlins:yang:letf-interfaces*"></interfaces></pre>		The operational state of
Fink-up-down-trap-enable	/		<pre><frame/>GlgabitEthernet1/0/164/mane> </pre>		an interface is available
► 🚰 interfaces-state	-				in the
Rietf-key-chain					/interfaces-state/
Riet/-netconf-monitoring			(c/ipc)		interface list, if the
Riet-routing					configuration of a
					system-controlled
Conte O Oper	+ Add - Delete	C Reset	Custom RPC Run Save Clear Copy V		interface cannot be

选择Run将RPC消息发送到Catalyst 3850后,Catalyst 3850会回复YANG格式的接口配置,该配置 显示接口类型为ianaft:ethernetCsmacd。

C C C C Concernos: sossistatectrant	gexplorer.html				R :	
Yang Explorer 0.6.0 (Beta)					🚰 Admin 📿 Refresh 🔒 guest	
Explorer French	Values	Oper	Constitutes Design Sections	Property	Value	
Rcisco-process-cpu			A Department of the second of	Name	interface.	
Rcisco-process-memory			Profile	Node Type	list	
Rcisco-pw				Data Tuno		
Rcisco-self-mgmt			Platform other	Dete Type		
Rcisco-table-map			Heat 172 16 167 178 Port 830	Access	need-write	
Rcisco-virtual-service				Presence		
R common-mpls-static			Username cisco1 Password cisco1	Key		
Ried-diffserv-classifier				Mandatory		
Ried-diffen-policy				0.6.0		
Ried-Interfaces			NetConf RestConf RPC Script Capabilitien	Detaut		
* Chinterfaces			Encoding Console	Path	ietf-interfaces/	
* 🛶 interface	«get-config»		<pre>4<rpr-reply <="" message-id="urn:uuid:832c3b3c-71fe-4e63-8bf4-6ec981131991" pre=""></rpr-reply></pre>		interfaces/interface	
🔎 name	GigabitEthemet1/0/16		<pre>wnlns+"urn:letf:perans:wnl:ns:netconf:base:1.0" wnlns:nc="urn:letf:perans:wnl:ns:netconf:base:1.0"></pre>	Description	The list of configured	
e description			<pre></pre>		interfaces on the	
/ type			<interface> <come>GiosbitEthernet1/0/16</come></interface>		device.	
enabled			<pre>stype xnins:ianaift- Unrelotf:parama:xml:ns:yang:iana-if- type">ianaift:ethernetComande/type></pre>		The poerational state of	
Ink-up-down-trap-enable			<enabled>false</enabled>		an interface is available	
* Enterlaces-state			<pre><ipv6 wnins="urn:letf:parame:wnline:yang:letf-ip"></ipv6></pre>		in the	
Ried-key-chain			<td></td> <td>/interfaces-state/</td>		/interfaces-state/	
Ried-netconf-monitoring					interface list. If the	
Ried-routing					configuration of a	
and the second second			Custom RPC Run Save Clear Copy		system-controlled	

其他 RPC 错误类型示例

1. "使用中"(配置锁定) RPC 错误应答消息

这是对 <edit-config> 请求的 NETCONF 错误响应。<error-tag>表示"使用中"。响应表明,运行 datastore的服务器设备(Catalyst 3850)NETCONF当前已锁定,此时无法执行NETCONF <editconfig>操作。这不表示NETCONF接口实现中出错。如果 NETCONF 客户端在 NETCONF 运行数 据存储正在使用时尝试写入该数据存储,客户端会收到此 RPC 响应。NETCONF客户端可以重试 NETCONF edit-config消息。当设备执行从设备同步内部操作以将NETCONF运行数据存储与设备 IOSd配置同步时,可以收到此响应。

从服务器 (Catalyst 3850) 发送到客户端 (集中管理平台 [笔记本电脑]) 的 NETCONF 响应。

```
<?rml version="1.0" encoding="utf-8"?>
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3">
<rpc-error>
<error-type>application</error-type>
<error-tag>in-use</error-tag>
<error-severity>error</error-severity>
<error-app-tag>config-locked</error-app-tag>
<error-info>
</error-info>
</error-info>
</rpc-error>
```

在本示例中,为未配置的环回接口向Catalyst 3850发送了<edit-config> RPC。由于无法配置 Catalyst 3850 上不存在的接口,因此系统返回了错误。

```
<?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>
</rpc-error>
</rpc-error>
</rpc-error>
</rpc-reply>
```

3. "缺少数据模型"RPC错误回复消息

如果对Catalyst 3850上不存在的数据模型发出请求,或者对未在数据模型中实现的枝叶发出请求 ,则服务器(Catalyst 3850)以空数据响应进行响应。这是预料之中的现象。

提示:使用NETCONF功能确定Catalyst软件支持的数据模型。请参阅配置集中管理平台(笔记本电脑)的第2节。

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

4. "无效值" RPC错误回复消息

在某些情况下,根据YANG数据模型,NETCONF消息可能包含有效的内容,但是,设备(Catalyst 3850)无法实施请求的内容。当 Catalyst 3850 上的 NETCONF 接口向 IOSd 发送 IOSd 无法成功应 用的配置时,系统会向 NETCONF 客户端返回特定的 RPC 错误响应。

在本例中,在 RPC 消息中向 Catalyst 3850 发送了无效的日志记录缓冲值 bogus。来自 Catalyst 3850 的应答中的错误标记表示值无效。错误消息表明 Catalyst 3850 IOS 解析器无法将日志记录缓 冲的严重性级别配置为 bogus,因为这不是有效值。

```
<?xml version="1.0" encoding="utf-8"?>
  <rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="6">
    <rpc-error>
        <error-type>application</error-type>
        <error-type>application</error-type>
        <error-tag>invalid-value</error-tag>
        <error-severity>error</error-severity>
        <error-message xml:lang="en">inconsistent value: Device refused command "logging buffered bogus" a
    </rpc-error>
```

</rpc-reply>

关于此翻译

思科采用人工翻译与机器翻译相结合的方式将此文档翻译成不同语言,希望全球的用户都能通过各 自的语言得到支持性的内容。

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