YANG Infrastructure

The Polaris Yang Infrastructure 16.3 feature facilitates a programmatic and standards-based way of writing configurations and reading operational data from network devices.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Introduction to Data Models - Programmatic and Standards-based Configuration

The traditional way of managing network devices is by using Command Line Interfaces (CLIs) for configurational (configuration commands) and operational data (show commands). For network management, Simple Network Management Protocol (SNMP) is widely used, especially for exchanging management information between various network devices. Although CLIs and SNMP are heavily used, they have several restrictions. CLIs are highly proprietary, and human intervention is required to understand and interpret their text-based specification. SNMP does not distinguish between configurational and operational data.

The solution lies in adopting a programmatic and standards-based way of writing configurations to any network device, replacing the process of manual configuration. Network devices running on Cisco IOS XE support the automation of configuration for multiple devices across the network using data models. Data models are developed in a standard, industry-defined language, that can define configuration and state information of a network.

Cisco IOS XE supports the Yet Another Next Generation (YANG) data modeling language. YANG can be used with the Network Configuration Protocol (NETCONF) to provide the desired solution of automated and programmable network operations. NETCONF (RFC 6241) is an XML-based protocol that client applications use to request information from and make configuration changes to the device. YANG is primarily used to model the configuration and state data used by NETCONF operations.

In Cisco IOS XE, model-based interfaces interoperate with existing device CLI, Syslog, and SNMP interfaces. These interfaces are optionally exposed northbound from network devices. YANG is used to model each protocol based on RFC 6020.

Note   To access Cisco YANG models in a developer-friendly way, please clone the GitHub repository *https:// github.com/YangModels/yang*, and visit the *vendor/cisco* (*https://github.com/YangModels/yang/tree/master/vendor/cisco*) subdirectory. Models for various release of IOS-XE, IOS-XR, and NX-OS platforms are available here.

NETCONF

NETCONF provides a simpler mechanism to install, manipulate, and delete the configuration of network devices.

It uses an Extensible Markup Language (XML)-based data encoding for the configuration data as well as the protocol messages.

NETCONF uses a simple RPC-based (Remote Procedure Call) mechanism to facilitate communication between a client and a server. The client can be a script or application typically running as part of a network manager. The server is typically a network device (switch or router). It uses Secure Shell (SSH) as the transport layer across network devices.

NETCONF also supports capability discovery and model downloads. Supported models are discovered using the *ietf-netconf-monitoring* model. Revision dates for each model are shown in the capabilities response. Data models are available for optional download from a device using the *get-schema* rpc. You can use these YANG models to understand or export the data model.

For more details, refer RFC 6241.

Configuring NETCONF

Before You Begin

You must configure AAA in the IOS-XE device before configuring the NETCONF as follows:

- **aaa new-model**

- **aaa authentication login default local**

- **aaa authorization exec default local**

You must configure NETCONF-YANG as follows.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **netconf-yang**
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device>` **`enable`**	Enables privileged EXEC mode. - Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device#` **`configure terminal`**	Enters global configuration mode.
Step 3	**netconf-yang** **Example:** `Device (config)#` **`netconf-yang`**	Enables the NETCONF interface on your network device. **Note** After the initial enablement through the CLI, network devices can be managed subsequently through a model based interface. The complete activation of model-based interface processes may require up to 90 seconds.
Step 4	**exit** **Example:** `Device (config)#` **`exit`**	Exits global configuration mode.

Configuring NETCONF Options

Configuring SNMP

Enable the SNMP Server in IOS to enable NETCONF to access SNMP MIB data using YANG models generated from supported MIBs, and to enable supported SNMP traps in IOS to receive NETCONF notifications from the supported traps.

Perform the following steps:

SUMMARY STEPS

1. Enable SNMP features in IOS.

2. After NETCONF-YANG starts, enable SNMP Trap support by sending the following RPC <edit-config> message to the NETCONF-YANG port.

3. Send the following RPC message to the NETCONF-YANG port to save the running configuration to the startup configuration.

DETAILED STEPS

Step 1 Enable SNMP features in IOS.

Example:

```
configure terminal
logging history debugging
logging snmp-trap emergencies
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
!
snmp-server community public RW
snmp-server trap link ietf
snmp-server enable traps snmp authentication linkdown linkup snmp-server enable traps syslog
snmp-server manager
exit
```

Step 2 After NETCONF-YANG starts, enable SNMP Trap support by sending the following RPC <edit-config> message to the NETCONF-YANG port.

Example:

```
<?xml version="1.0" encoding="utf-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <netconf-yang xmlns="http://cisco.com/yang/cisco-self-mgmt">
        <cisco-ia xmlns="http://cisco.com/yang/cisco-ia">
          <snmp-trap-control>
            <trap-list>
              <trap-oid>1.3.6.1.4.1.9.9.41.2.0.1</trap-oid>
            </trap-list>
            <trap-list>
              <trap-oid>1.3.6.1.6.3.1.1.5.3</trap-oid>
            </trap-list>
            <trap-list>
              <trap-oid>1.3.6.1.6.3.1.1.5.4</trap-oid>
            </trap-list>
          </snmp-trap-control>
        </cisco-ia>
      </netconf-yang>
    </config>
```

```
      </edit-config>
</rpc>
```

Step 3   Send the following RPC message to the NETCONF-YANG port to save the running configuration to the startup configuration.

Example:

```
<?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="http://cisco.com/yang/cisco-ia"/>
</rpc>
```

Configuring Operational Data Manager

The NETCONF Operational Data Manager provides the ability to read operational data using YANG models. Each ODM parser polls the specified operational data according to the specified polling interval in milliseconds.

Perform the following steps:

SUMMARY STEPS

1. After NETCONF-YANG starts, send the following RPC <edit-config> message to the NETCONF-YANG port.
2. Send the following RPC message to the NETCONF-YANG port to save the running configuration to the startup configuration.

DETAILED STEPS

Step 1   After NETCONF-YANG starts, send the following RPC <edit-config> message to the NETCONF-YANG port.

Example:

```
<?xml version="1.0" encoding="utf-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <netconf-yang xmlns="http://cisco.com/yang/cisco-self-mgmt">
        <cisco-odm xmlns="http://cisco.com/yang/cisco-odm">
          <polling-enable>true</polling-enable>
          <on-demand-default-time>30000</on-demand-default-time>
          <on-demand-enable>false</on-demand-enable>
          <actions>
            <action-name>parse.showACL</action-name>
            <polling-interval>120000</polling-interval>
            <mode>poll</mode>
          </actions>
          <actions>
            <action-name>parse.showArchive</action-name>
            <polling-interval>120000</polling-interval>
            <mode>poll</mode>
```

```
                    </actions>
                    <actions>
                      <action-name>parse.showEnvironment</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showFlowMonitor</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showInterfaces</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showIpRoute</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showMemoryStatistics</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showPlatformSoftware</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showProcessesCPU</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                    <actions>
                      <action-name>parse.showProcessesMemory</action-name>
                      <polling-interval>120000</polling-interval>
                      <mode>poll</mode>
                    </actions>
                  </cisco-odm>
                </netconf-yang>
            </config>
          </edit-config>
        </rpc>
```

The <edit-config> can be modified to enable or disable specific actions and/or to choose a different update frequency.

Step 2 Send the following RPC message to the NETCONF-YANG port to save the running configuration to the startup configuration.

Example:

```
<?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="http://cisco.com/yang/cisco-ia"/>
</rpc>
```

Additional References

Related Documents

Related Topic	Document Title
YANG data models for various release of IOS-XE, IOS-XR, and NX-OS platforms	Clone the GitHub repository *https://github.com/ YangModels/yang* and visit the *vendor/cisco* (*https://github.com/YangModels/yang/tree/master/vendor/cisco*) subdirectory.

Standards and RFCs

Standard/RFC	Title
RFC 6020	*YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)*
RFC 6241	Network Configuration Protocol (NETCONF)

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for YANG Infrastructure

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for YANG Data Model

Feature Name	Releases	Feature Information
Polaris Yang Infrastructure 16.3	Cisco IOS XE Denali 16.3.1	The Polaris Yang Infrastructure 16.3 feature facilitates a programmatic and standards-based way of writing configurations and reading operational data from network devices. The following commands were introduced or modified: **netconf-yang**.