Using Data Models

Using data models involves three tasks:

- Obtain Data Models, on page 1
- Enable Protocol, on page 2
- Manage Configurations using Data Model, on page 6

Obtain Data Models

The data models are available in the mgbl pie software package. Installing a package on the router installs specific features that are part of that package. Cisco IOS XR software is divided into various software packages to select the features to run on the router. Each package contains components that perform a specific set of router functions, such as routing, security, and so on.

Pre-requisites:

Ensure that the mgbl pie software image is loaded in the router.

1. Verify that the data models are available using `netconf-monitoring request`.

   ```xml
   <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="101">
   <get>
   <filter type="subtree">
   <schemas/>
   </netconf-state>
   </filter>
   </get>
   </rpc>
   
   All IOS XR and System Admin YANG models are displayed.
   
   The YANG models can be retrieved from the router without logging into the router using `get-schema` command:

   Get Schema List (data will be used in step 2).

   ```xml
   <get>
   <filter type="subtree">
   <schemas/>
   </netconf-state>
   </filter>
   </get>
   </rpc>
All the models on the router are displayed.

TRACE: 2016/06/13 11:11:42 transport.go:104: Reading from connection
TRACE: 2016/06/13 11:11:42 gnc_main.go:587: Session established (Id: 1009461378)
TRACE: 2016/06/13 11:11:42 session.go:117:
Response: #143589
<rpc-reply message-id="16a79f87-1d47-4f7a-a16a-9405e6d865b9" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data>
      <schemas>
        <schema>
          <identifier>Cisco-IOS-XR-crypto-sam-oper</identifier>
          <version>2015-01-07</version>
          <format>yang</format>
          <location>NETCONF</location>
        </schema>
        <schema>
          <identifier>Cisco-IOS-XR-crypto-sam-oper-sub1</identifier>
          <version>2015-01-07</version>
          <format>yang</format>
          <location>NETCONF</location>
        </schema>
        <schema>
          <identifier>Cisco-IOS-XR-snmp-agent-oper</identifier>
          <version>2015-10-08</version>
          <format>yang</format>
          <location>NETCONF</location>
        </schema>
      </schemas>
    </netconf-state>
  </data>
</rpc-reply>
#143589

For more information about structure of data models, see YANG Module.

What To Do Next:
Enable the protocol to establish connection between the router and the client application.

Enable Protocol

The router communicates with the client application using protocols. On the router and client application, enable a communication protocol based on the requirement:

- NETCONF
- gRPC

For more information about protocols, see Communication Protocols.
Enable NETCONF over SSH Protocol

NETCONF is an XML-based protocol used over Secure Shell (SSH) transport to configure a network. The client applications use this protocol to request information from the router, and make configuration changes to the router.

For more information about NETCONF, see NETCONF Protocol.

Pre-requisites:

• Software package k9sec pie is installed on the router.
• Software package mgbl pie is installed on the router.
• Crypto keys are generated.

To enable the NETCONF protocol, complete these steps:

1. Enable NETCONF protocol over an SSH connection.

```bash
ssh server v2
ssh server netconf
netconf agent tty
netconf-yang agent ssh
```

The default port number of 830 is used. A different port within the range of 1 to 65535 can be specified if required.

2. Set the session parameters.

```bash
router (config)# netconf-yang agent session { limit value | absolute-timeout value | idle-timeout value }
```

where:

• **limit value**: sets the maximum count for concurrent netconf-yang sessions. The range is from 1 to 1024.
• **absolute-timeout value**: sets the absolute session lifetime, in minutes. The range is from 1 to 1440.
• **idle-timeout value**: sets the idle session lifetime, in minutes. The range is from 1 to 1440.


```bash
router (config)# do show netconf-yang statistics
router (config)# do show netconf-yang clients
```

Example: Enable NETCONF

```bash
config
netconf-yang agent ssh
  ssh server netconf port 830
!"
Example: Verify Configuration Using Statistics

After the NETCONF request is sent, use `do show netconf-yang statistics` command to verify the configuration.

```
do show netconf-yang statistics
Summary statistics  requests| total time| min time per request| max
time per request| avg time per request|
other 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
close-session 4| 0h 0m 0s 3ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
kill-session 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
get-schema 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
get 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
get-config 1| 0h 0m 0s 1ms| 0h 0m 0s 1ms|
  0h Om Os 0ms|
edits-config 3| 0h 0m 0s 2ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
commit 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
cancel-commit 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
lock 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
unlock 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
discard-changes 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
validate 0| 0h 0m 0s 0ms| 0h 0m 0s 0ms|
  0h Om Os 0ms|
```

Example: Verify Configuration Using Clients

```
do show netconf-yang clients
client session ID| NC version| client connect time| last OP time| last OP type| <lock>
22969| 1.1| 0d 0h 0m 2s| 11:11:24| close-session| Yes|
15389| 
```

What To Do Next:

After NETCONF is enabled, use the YANG data models to manage the relevant configurations.

Enable gRPC over HTTP/2 Protocol

Google-defined remote procedure call (gRPC) is an open-source RPC framework. gRPC supports IPv4 and IPv6 address families.

For more information about gRPC, see gRPC Protocol.

Pre-requisite:
• Configure TLS.

Note: It is recommended to configure TLS. Enabling gRPC protocol uses the default HTTP/2 transport with no TLS enabled on TCP. gRPC mandates AAA authentication and authorization for all gRPC requests. If TLS is not configured, the authentication credentials are transferred over the network unencrypted. Enabling TLS ensures that the credentials are secure and encrypted. Non-TLS mode can only be used in secure internal network.

• Software package mgbl pie is installed on the router.

To enable the gRPC protocol, complete these steps:

1. Enable gRPC over an HTTP/2 connection.

   Router# configure
   Router (config)# grpc

2. Enable access to a specified port number.

   Router (config-grpc)# port <port-number>

   The <port-number> range is from 57344 to 57999. If a port number is unavailable, an error is displayed.

3. In the configuration mode, set the session parameters.

   Router (config)# grpc{ address-family | dscp | max-request-per-user | max-request-total | max-streams | max-streams-per-user | no-tls | service-layer | tls-cipher | tls-mutual | tls-trustpoint | vrf }

   where:

   • address-family: set the address family identifier type
   • dscp: set QoS marking DSCP on transmitted gRPC
   • max-request-per-user: set the maximum concurrent requests per user
   • max-request-total: set the maximum concurrent requests in total
   • max-streams: set the maximum number of concurrent gRPC requests. The maximum subscription limit is 128 requests. The default is 32 requests
   • max-streams-per-user: set the maximum concurrent gRPC requests for each user. The maximum subscription limit is 128 requests. The default is 32 requests
   • no-tls: disable transport layer security (TLS). The TLS is enabled by default.
   • service-layer: enable the grpc service layer configuration
   • tls-cipher: enable the gRPC TLS cipher suites
   • tls-mutual: set the mutual authentication
   • tls-trustpoint: configure trustpoint
   • server-vrf: enable server vrf
What To Do Next:
After gRPC is enabled, use the YANG data models to manage the relevant configurations.

Manage Configurations using Data Model

From the client application, use data models to manage the configurations of the router.

Prerequisites

• Software packages k9sec pie and mgbl are installed on the router.
• NETCONF or gRPC protocols are enabled on the client and the router.

To manage configurations using data models, complete these steps:
1. Use a YANG tool to import the data model on the client application.
2. Configure the router by modifying the values of the data model using the YANG tool.

For more information on the values of the data models that can be configured, see Structure of YANG Models.

Example: Configure CDP

In this example, you use the data model for CDP and configure CDP with the values as shown in the table:

<table>
<thead>
<tr>
<th>CDP parameter</th>
<th>Description</th>
<th>Desired value for parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDP Version</td>
<td>Specifies the version used to communicate with the neighboring devices</td>
<td>v1</td>
</tr>
<tr>
<td>Hold time</td>
<td>Specifies the duration for which the receiving device to hold the CDP packet</td>
<td>200 ms</td>
</tr>
<tr>
<td>Timer</td>
<td>Specifies how often the software sends CDP updates</td>
<td>80 ms</td>
</tr>
<tr>
<td>Log Adjacency Table</td>
<td>Logs changes in the adjacency table. When CDP adjacency table logging is enabled, a syslog is generated each time a CDP neighbor is added or removed</td>
<td>enable</td>
</tr>
</tbody>
</table>

1. Download the configuration YANG data model for CDP Cisco-IOS-XR-cdp-cfg.yang from the router. To download the data model, see Obtain Data Models, on page 1.
2. Import the data model to the client application using any YANG tool.
3. Modify the leaf nodes of the data model:
   • enable (to enable cdp)
• holdtime
• timer
• advertise v1 only
• log adjacency

Configure CDP Using NETCONF

In this example, you use the data model for CDP and configure CDP using NETCONF RPC request:

```xml
<edit-config>
  <target>
    <candidate/>
  </target>
  <config xmlns:xc="urn:ietf:params:xml:n:netconf:base:1.0">
    <cdp xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-cdp-cfg">
      <timer>80</timer>
      <enable>true</enable>
      <log-adjacency></log-adjacency>
      <hold-time>200</holdtime>
      <advertise-v1-only></advertise-v1-only>
    </cdp>
  </config>
</edit-config>
```

CDP can also be configured under the interface configuration by augmenting the interface manager. Use the Cisco-IOS-XR-ifmgr-cfg YANG model to configure CDP under the interface configuration.

Configure CDP Using gRPC

In this example, you use the data model for CDP and configure CDP using gRPC MergeConfig RPC request:

```json
{
    "Cisco-IOS-XR-cdp-cfg:cdp": {
        "timer": 50,
        "enable": true,
        "log-adjacency": [null],
        "hold-time": 180,
        "advertise-v1-only": [null]
    }
}
```
CDP can also be configured under the interface configuration by augmenting the interface manager. Use the `Cisco-IOS-XR-ifmgr-cfg` YANG model to configure CDP under the interface configuration.