

Lab – Explore YANG Models Using the pyang Tool

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Objectives

Part 1: Install the pyang Python module

Part 2: Download YANG models for the IOS XE

Part 3: Use the pyang command line tool to transform the YANG models

Background / Scenario

YANG models define the exact structure, data types, syntax and validation rules for the content of messages exchanged between a managed device and another system communicating with the device. Working with files using the YANG language can be a bit overwhelming for the level of details in these files.

In this lab, you will learn how to use the open source pyang tool to transform YANG data models from files using the YANG language, into a much more easily human readable format. Using the “tree” view transformation, you will identify what are the key elements of the ietf-interfaces YANG model.

Required Resources

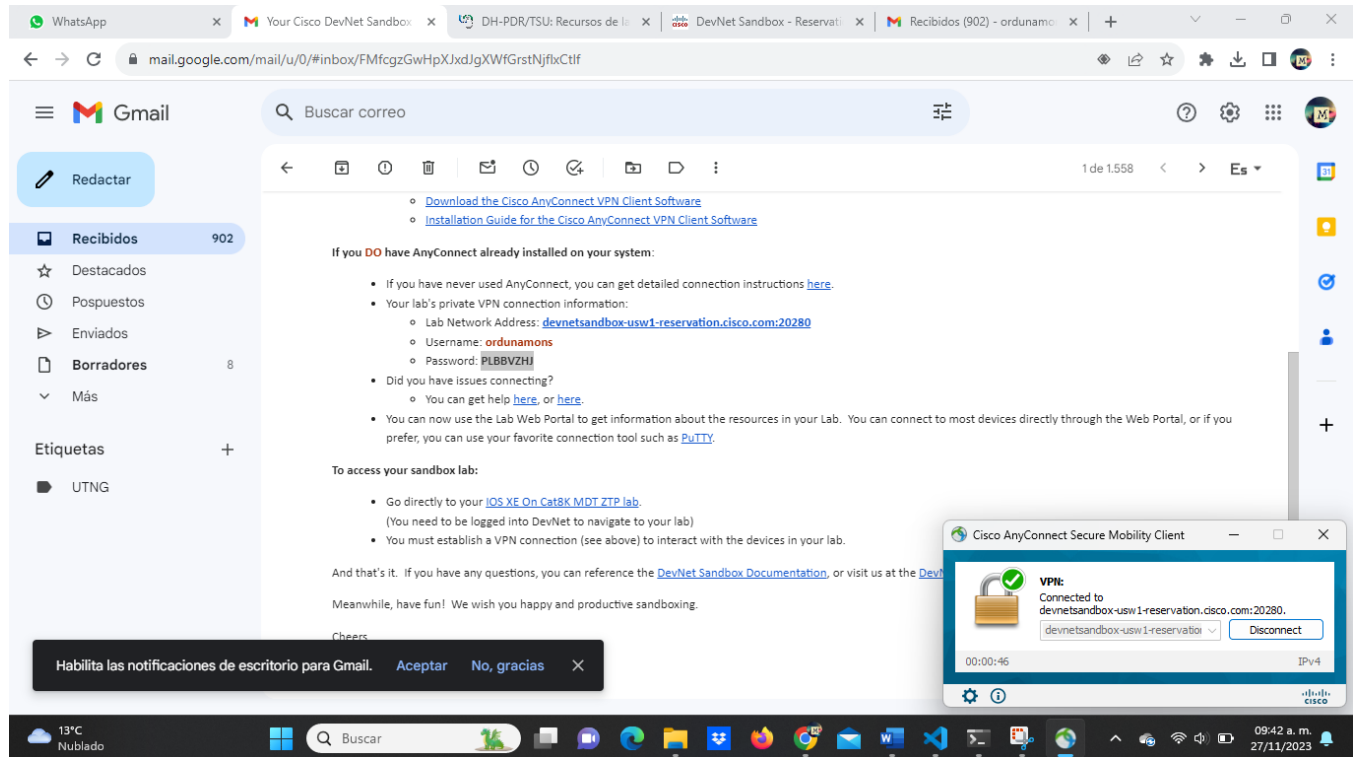
- Access to the Internet
- Python 3.x environment

Instructions

Part 1: Install the pyang Python module

In this part, you will install pyang module into your Python environment. Pyang is a python module that simplifies working with YANG files. The Pyang Python module comes with a pyang command line executable that transforms YANG files into a more human readable format (tree, html, etc.).

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Step 1: Use pip to install pyang.

- Start a new Windows command prompt (cmd).
- Install pyang using pip in the Windows command prompt:

```
pip install --no-binary pyang pyang
```

NOTE: on mac or linux you can simply "pip install pyang" but temporarily on Windows the binary WHL file won't include the Windows executable pyang file.

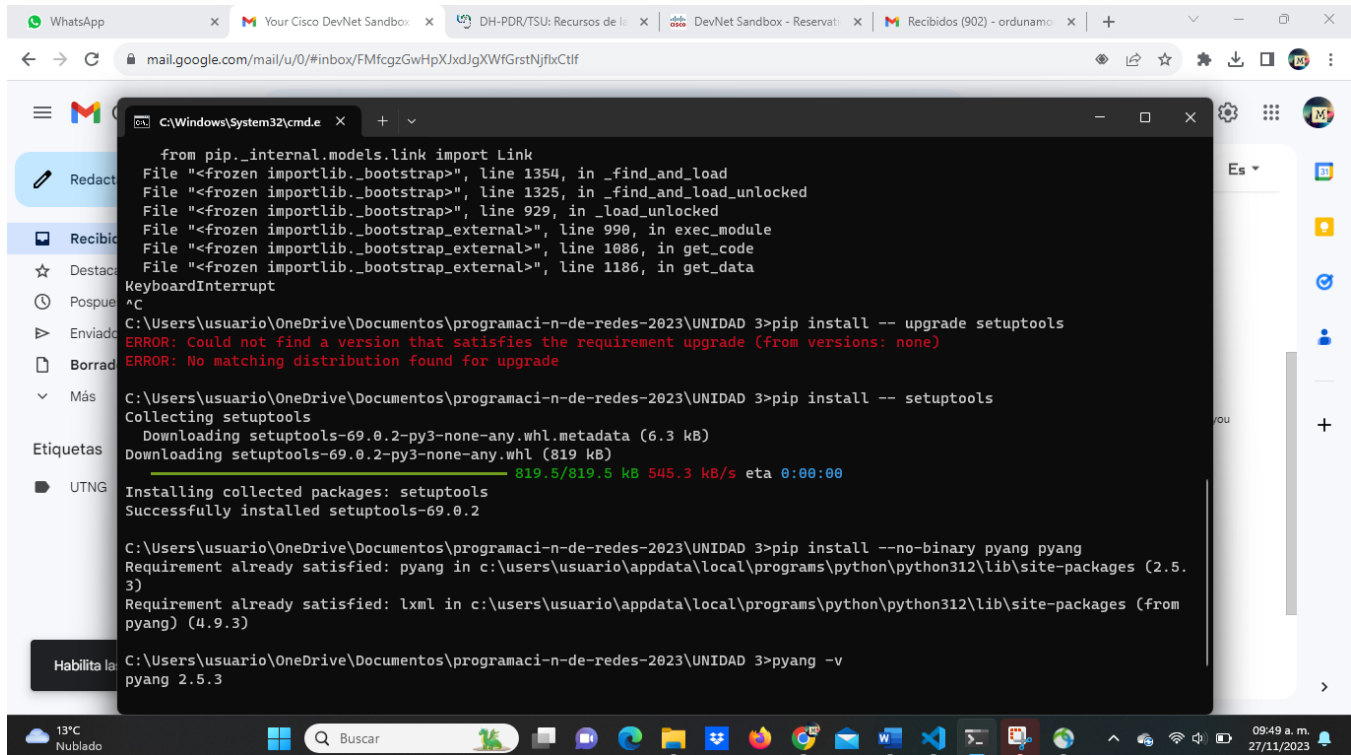
- Verify that pyang has been successfully installed. In the command prompt, type:

```
pyang -v
```

to display the installed pyang version.

Download YANG models for the IOS XE

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```
C:\Windows\System32\cmd.exe
from pip._internal.models.link import Link
File "<frozen importlib._bootstrap>", line 1354, in _find_and_load
File "<frozen importlib._bootstrap>", line 1325, in _find_and_load_unlocked
File "<frozen importlib._bootstrap>", line 929, in _load_unlocked
File "<frozen importlib._bootstrap_external>", line 990, in exec_module
File "<frozen importlib._bootstrap_external>", line 1086, in get_code
File "<frozen importlib._bootstrap_external>", line 1186, in get_data
KeyboardInterrupt
^C
C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pip install -- upgrade setuptools
ERROR: Could not find a version that satisfies the requirement upgrade (from versions: none)
ERROR: No matching distribution found for upgrade

C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pip install -- setuptools
Collecting setuptools
  Downloading setuptools-69.0.2-py3-none-any.whl.metadata (6.3 kB)
  Downloading setuptools-69.0.2-py3-none-any.whl (819 kB)
    819.5/819.5 kB 545.3 kB/s eta 0:00:00
Installing collected packages: setuptools
Successfully installed setuptools-69.0.2

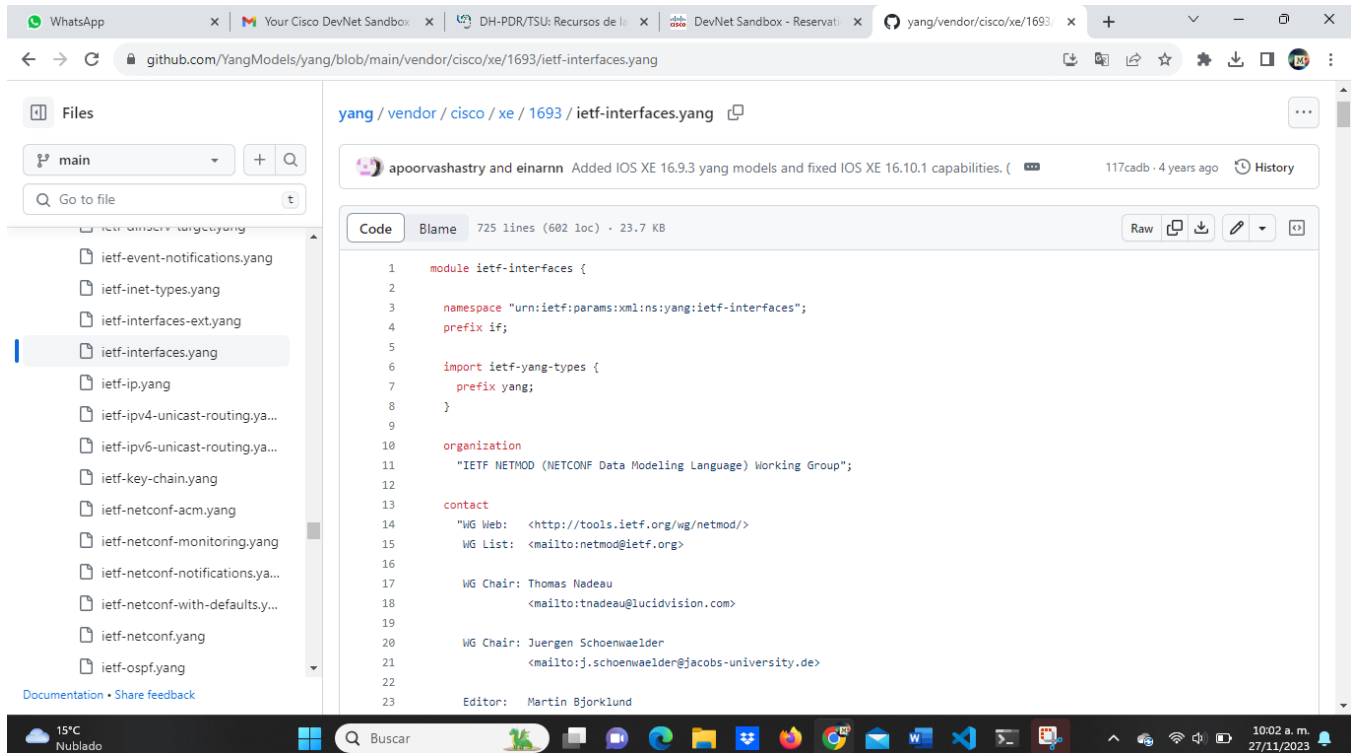
C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pip install --no-binary pyang pyang
Requirement already satisfied: pyang in c:\users\usuario\appdata\local\programs\python\python312\lib\site-packages (2.5.3)
Requirement already satisfied: lxml in c:\users\usuario\appdata\local\programs\python\python312\lib\site-packages (from pyang) (4.9.3)

C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pyang -v
pyang 2.5.3
```

Explore YANG models on the YangModels/yang GitHub repository.

- Using a web browser, navigate to <https://github.com/YangModels/yang>:
- Navigate to the vendor -> cisco -> xe -> 1693 directory. This directory represents all the YANG models that are supported in Cisco operating system IOS XE in version 16.9.3.
- Explore the ietf-interfaces.yang model.

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Step 2: Download the YANG models for the IOS XE VM

- Unpack the YANG models from the official GitHub repo for cisco-xe-1693.zip archive file that contains a snapshot of the files in the GitHub repository.

Part 2: Use the pyang command line tool to transform the YANG models

- Start a Windows command prompt and navigate to the directory with the extracted archive file.
- Use the pyang tool to transform YANG files to a human readable format, for example using the “tree” format transformation:

```
pyang -f tree ietf-interfaces.yang
```

- Explore other YANG modules, for example the Cisco Native model for CDP: Cisco-IOS-XE-cdp.yang

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The screenshot displays a web browser window showing the GitHub repository for the Cisco-IOS-XE-cdp.yang model. The repository is located at `github.com/YangModels/yang/blob/main/vendor/cisco/xen/1693/Cisco-IOS-XE-cdp.yang`. The file is 172 lines (147 loc) and 4.05 KB. The code is as follows:

```
1 module Cisco-IOS-XE-cdp {
2   namespace "http://cisco.com/ns/yang/Cisco-IOS-XE-cdp";
3   prefix ios-cdp;
4
5
6   import Cisco-IOS-XE-native {
7     prefix ios;
8   }
9
10  organization
11    "Cisco Systems, Inc.";
12
13  contact
14    "Cisco Systems, Inc.
15     Customer Service
16
17     Postal: 170 W Tasman Drive
18     San Jose, CA 95134
19
20     Tel: +1 800 553-NETS
21
22     E-mail: cs-yang@cisco.com";
23 }
```

Below the browser window, a Windows command prompt is open, showing the following commands and output:

```
C:\Windows\System32\cmd.e X + v
+--ro in-broadcast-pkts? yang:counter64
+--ro in-multicast-pkts? yang:counter64
+--ro in-discards? yang:counter32
+--ro in-errors? yang:counter32
+--ro in-unknown-protos? yang:counter32
+--ro out-octets? yang:counter64
+--ro out-unicast-pkts? yang:counter64
+--ro out-broadcast-pkts? yang:counter64
+--ro out-multicast-pkts? yang:counter64
+--ro out-discards? yang:counter32
+--ro out-errors? yang:counter32

C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>dir *.yang
El volumen de la unidad C es Windows
El n mero de serie del volumen es: 781E-095B

Directorio de C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3
27/11/2023 10:33 a. m. 4,144 Cisco-IOS-XE-cdp.yang
27/11/2023 10:02 a. m. 24,248 ietf-interfaces.yang
2 archivos 28,392 bytes
0 dirs 885,777,883,136 bytes libres

C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pyang -v
pyang 2.5.3

C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pyang -f tree Cisco-IOS-XE-cdp.yang
Cisco-IOS-XE-cdp.yang:6: error: module "Cisco-IOS-XE-native" not found in search path

C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>
```

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The screenshot displays a lab environment with a text editor and a terminal window.

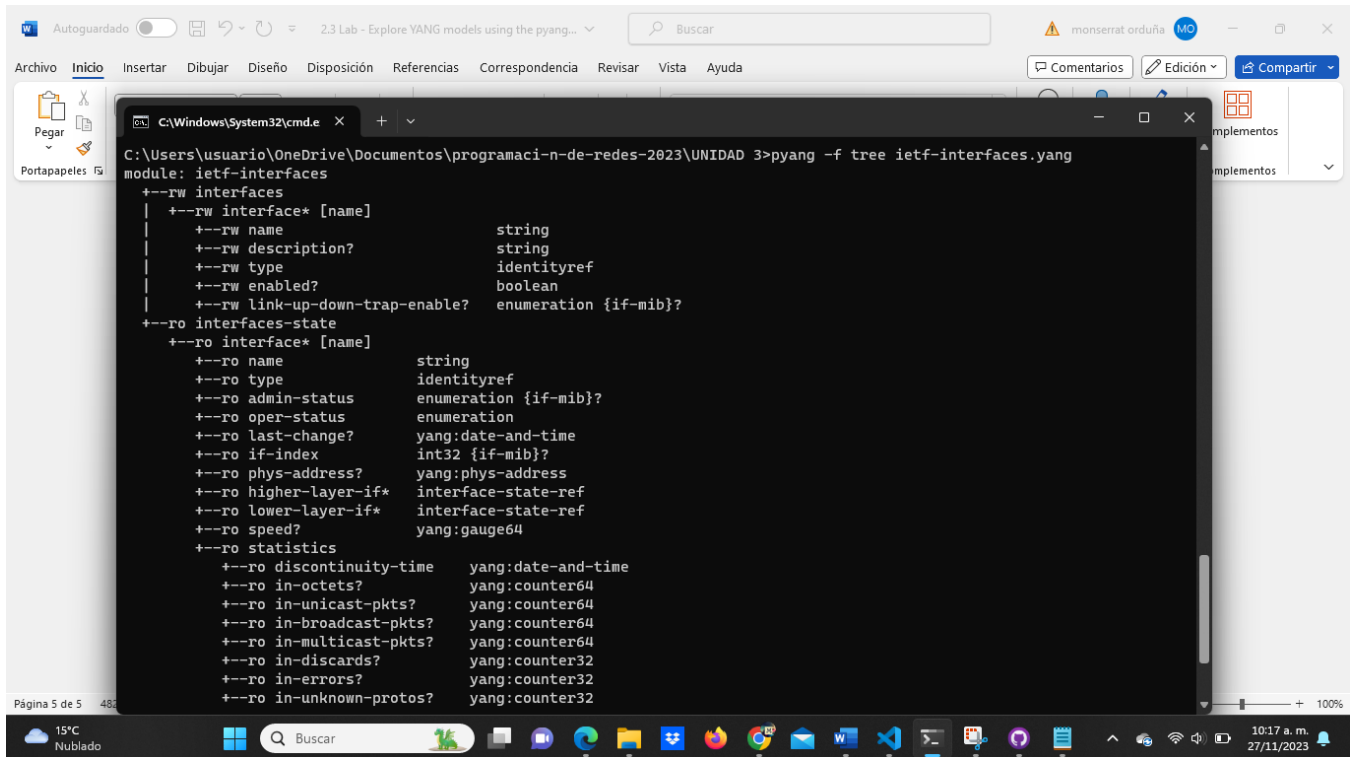
Text Editor (ietf-ir):

```
module ietf-interfaces {  
    namespace "urn:ietf:params:xml:ns:yang:ietf-interfaces";  
    prefix if;  
  
    import ietf-yang-types {  
        prefix yang;  
    }  
  
    organization  
        "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
    contact  
        "WG Web: <http://tools.ietf.org/wg/netmod/>  
        WG List: <mailto:netmod@ietf.org>  
  
        WG Chair: Thomas Nadeau  
            <mailto:tnadeau@lucidvision.com>  
  
        WG Chair: Juergen Schoenwaelder  
            <mailto:j.schoenwaelder@jacobs-university.de>  
  
        Editor: Martin Bjorklund  
            <mailto:mbj@tail-f.com>";  
  
    description  
        "This module contains a collection of YANG definitions for  
        managing network interfaces.  
  
        Copyright (c) 2014 IETF Trust and the persons identified as  
        authors of the code. All rights reserved.  
  
        Redistribution and use in source and binary forms, with or  
        without modification, is permitted pursuant to, and subject
```

Terminal (C:\Windows\System32\cmd.exe):

```
C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>dir *.yang  
El volumen de la unidad C es Windows  
El n mero de serie del volumen es: 781E-095B  
  
Directorio de C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3  
  
27/11/2023 10:02 a. m.          24,248 ietf-interfaces.yang  
1 archivos                    24,248 bytes  
0 dirs 885,807,882,240 bytes libres  
  
C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pyang -v  
pyang 2.5.3  
  
C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pyang -f tree ietf-interfaces.yang  
module: ietf-interfaces  
+--rw interfaces  
|   +--rw interface* [name]  
|   |   +--rw name                string  
|   |   +--rw description?        string  
|   |   +--rw type                 identityref  
|   |   +--rw enabled?             boolean  
|   |   +--rw link-up-down-trap-enable? enumeration {if-mib}?  
+--ro interfaces-state  
+--ro interface* [name]  
|   +--ro name                string  
|   +--ro type                 identityref  
|   +--ro admin-status        enumeration {if-mib}?  
|   +--ro oper-status          enumeration  
|   +--ro last-change?         yang:date-and-time
```

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```
C:\Windows\System32\cmd.exe
C:\Users\usuario\OneDrive\Documentos\programaci-n-de-redes-2023\UNIDAD 3>pyang -f tree ietf-interfaces.yang
module: ietf-interfaces
+--rw interfaces
|   +--rw interface* [name]
|   |   +--rw name                string
|   |   +--rw description?        string
|   |   +--rw type                identityref
|   |   +--rw enabled?            boolean
|   |   +--rw link-up-down-trap-enable? enumeration {if-mib}?
|   +--ro interfaces-state
|   |   +--ro interface* [name]
|   |   |   +--ro name                string
|   |   |   +--ro type                identityref
|   |   |   +--ro admin-status        enumeration {if-mib}?
|   |   |   +--ro oper-status         enumeration
|   |   |   +--ro last-change?        yang:date-and-time
|   |   |   +--ro if-index            int32 {if-mib}?
|   |   |   +--ro phys-address?       yang:phys-address
|   |   |   +--ro higher-layer-if*    interface-state-ref
|   |   |   +--ro lower-layer-if*    interface-state-ref
|   |   |   +--ro speed?              yang:gauge64
|   |   +--ro statistics
|   |   |   +--ro discontinuity-time  yang:date-and-time
|   |   |   +--ro in-octets?          yang:counter64
|   |   |   +--ro in-unicast-pkts?    yang:counter64
|   |   |   +--ro in-broadcast-pkts?  yang:counter64
|   |   |   +--ro in-multicast-pkts?  yang:counter64
|   |   |   +--ro in-discards?        yang:counter32
|   |   |   +--ro in-errors?          yang:counter32
|   |   |   +--ro in-unknown-protos?  yang:counter32
```

- d. Are there any “read only” operation data in the `Cisco-IOS-XE-cdp.yang` model?
- e. Is there any other YANG model that includes operational CDP data?