

Lab – Setting Up the Lab Environment

Objectives

Part 1 (Option 1): Import the VirtualBox VM with Cisco IOS-XE

Part 1 (Option 2): Setup a Cisco ISR4k router with Cisco IOS-XE

Part 1 (Option 3): Setup a DevNet Sandbox reservation with Cisco IOS-XE

Part 2: Summary and Connection Details

Required Resources

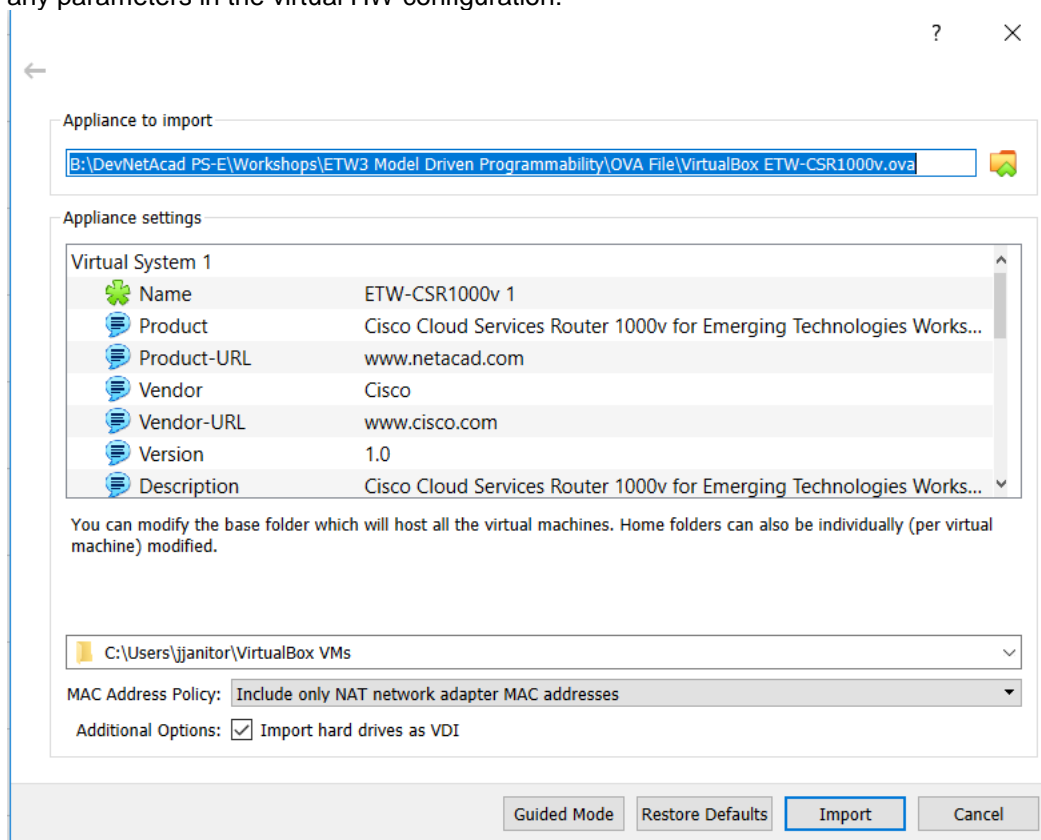
- For Part 1 Option 1:
 - Host computer with at least 4 GB of RAM and 15 GB of free disk space
 - Oracle VirtualBox
- For Part 1 Option 2:
 - Host computer with at least 2GB of RAM
 - Cisco ISR4221 or ISR4321 router with IOS-XE version 16.6 or above.
- For Part 1 Option 3:
 - Host computer with at least 2GB of RAM
 - Internet Connectivity

Part 1: (Option 1) Import the VirtualBox VM with Cisco IOS-XE

Use this option if you do not have access to physical routers capable of running the Cisco IOS-XE operating system (e.g. In the official NetAcad bundles the ISR4221 routers, etc.). In this option the Cisco IOS-XE is running in a virtual machine directly on your x86 computer and requires at least 4GB of RAM.

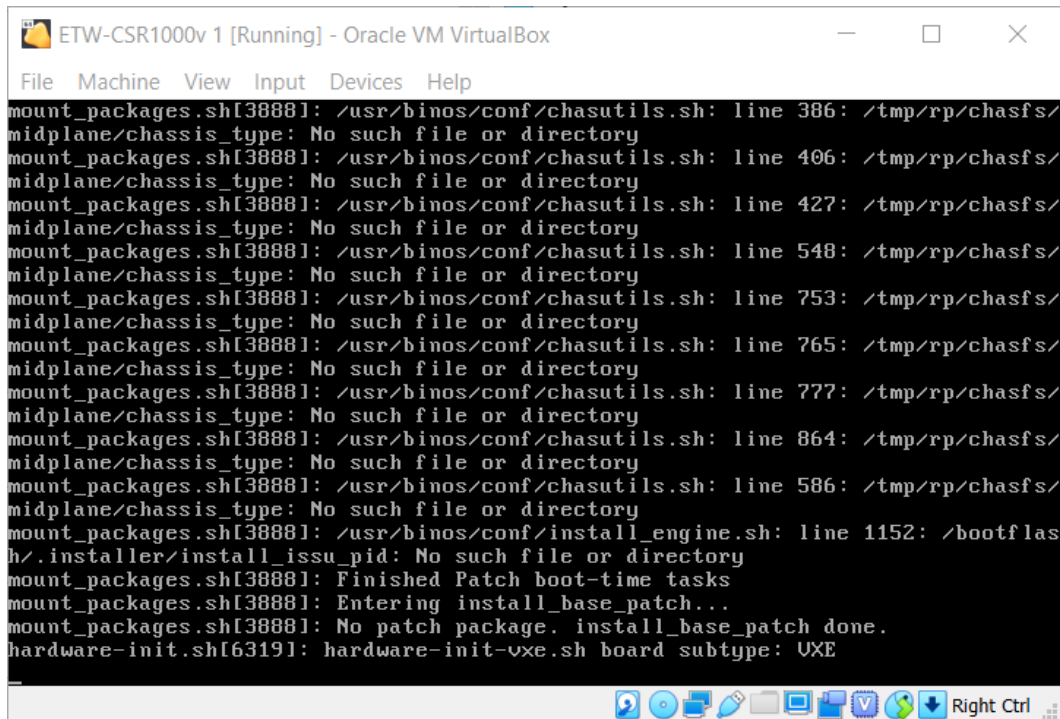
Step 1: Download the VM OVA file

1. Go to the Workshop class on NetAcad.com and navigate to the page *1.0.1.2: Lab - PC Setup for Workshop*.
2. Download the Ch2 ZIP archive that includes the *VirtualBox ETW-CSR1000v.ova* file with the Virtual Machine template.
3. Import the OVA file into your VirtualBox environment. While importing the OVA file, do not change any parameters in the virtual HW configuration:



4. In the directory of the Virtual Machine (e.g. c:\Users\USER\VirtualBox VMs\ETW-CSR1000v) replace the "csr1000v-universalk9-install.iso" ISO file, with the CSR1000v ISO file downloaded from software.cisco.com (e.g. csr1000v-universalk9.XX.XX.XX.iso).
Note: only instructors with a valid Academy Maintenance contract can download files from software.cisco.com.

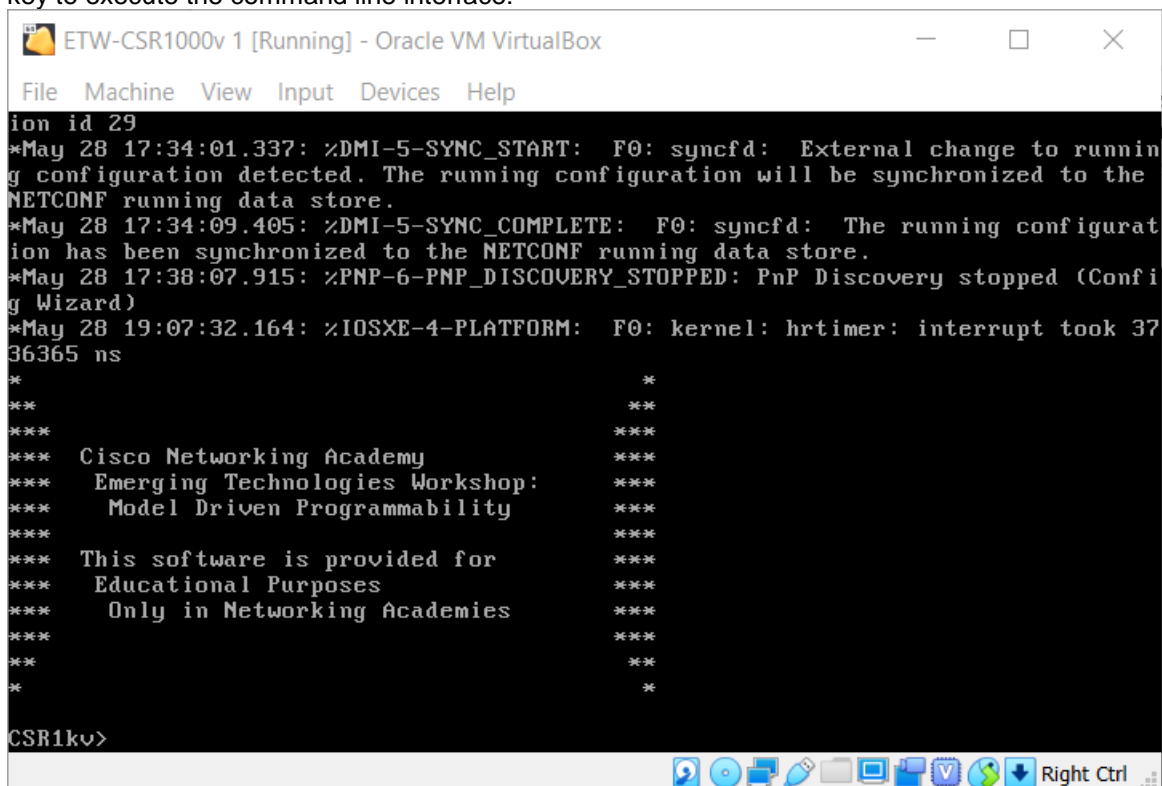
5. Start the Virtual Machine and let it boot for the first time. During the first boot, the CSR1000v ISO file is used to install and setup the Virtual Machine with the Cisco IOS-XE software. The installation takes about 5-7 minutes to complete – please be patient and ignore the warning or error messages that might appear on the screen during the installation process.



```
ETW-CSR1000v 1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 386: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 406: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 427: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 548: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 753: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 765: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 777: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 864: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/chasutils.sh: line 586: /tmp/rp/chasfs/
midplane/chassis_type: No such file or directory
mount_packages.sh[3888]: /usr/binos/conf/install_engine.sh: line 1152: /bootflas
h/.installer/install_issu_pid: No such file or directory
mount_packages.sh[3888]: Finished Patch boot-time tasks
mount_packages.sh[3888]: Entering install_base_patch...
mount_packages.sh[3888]: No patch package. install_base_patch done.
hardware-init.sh[63191]: hardware-init-uxe.sh board subtype: UXE
```

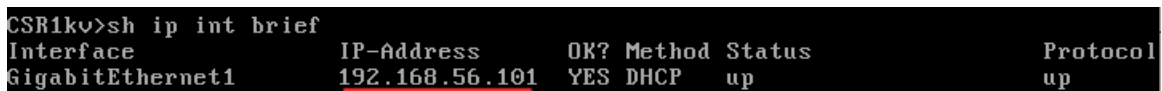
6. Once the installation has been completed, the Virtual Machine will restart and release the ISO file – you can then delete the "csr1000v-universalk9-install.iso" file to free up disk space.

7. The initial boot of the Virtual Machine with Cisco IOS-XE takes about 2-3 minutes. Press the Enter key to execute the command line interface:



```
ion id 29
*May 28 17:34:01.337: %DMI-5-SYNC_START: F0: syncfd: External change to running
configuration detected. The running configuration will be synchronized to the
NETCONF running data store.
*May 28 17:34:09.405: %DMI-5-SYNC_COMPLETE: F0: syncfd: The running configurat
ion has been synchronized to the NETCONF running data store.
*May 28 17:38:07.915: %PNP-6-PNP_DISCOVERY_STOPPED: PnP Discovery stopped (Confi
g Wizard)
*May 28 19:07:32.164: %IOSXE-4-PLATFORM: F0: kernel: hrtimer: interrupt took 37
36365 ns
*
**
***
*** Cisco Networking Academy
*** Emerging Technologies Workshop:
*** Model Driven Programmability
***
*** This software is provided for
*** Educational Purposes
*** Only in Networking Academies
***
**
*
CSR1k0v>
```

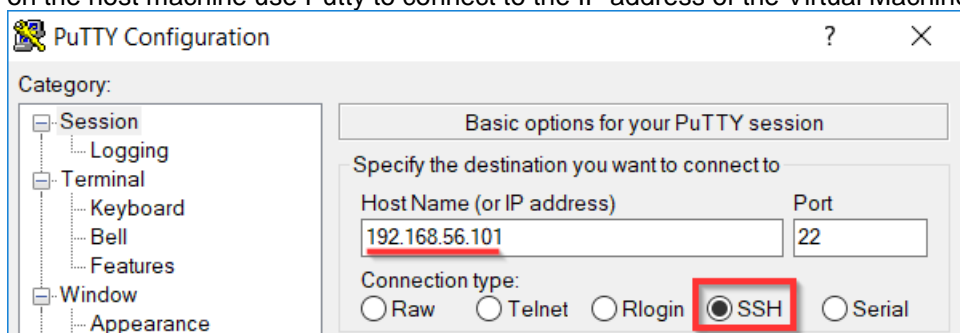
8. The Virtual Machine networking is configured to use the Host-Only network of your host machine. Using the command line interface, enter the “sh ip int brief” command to identify the router’s current IP address:



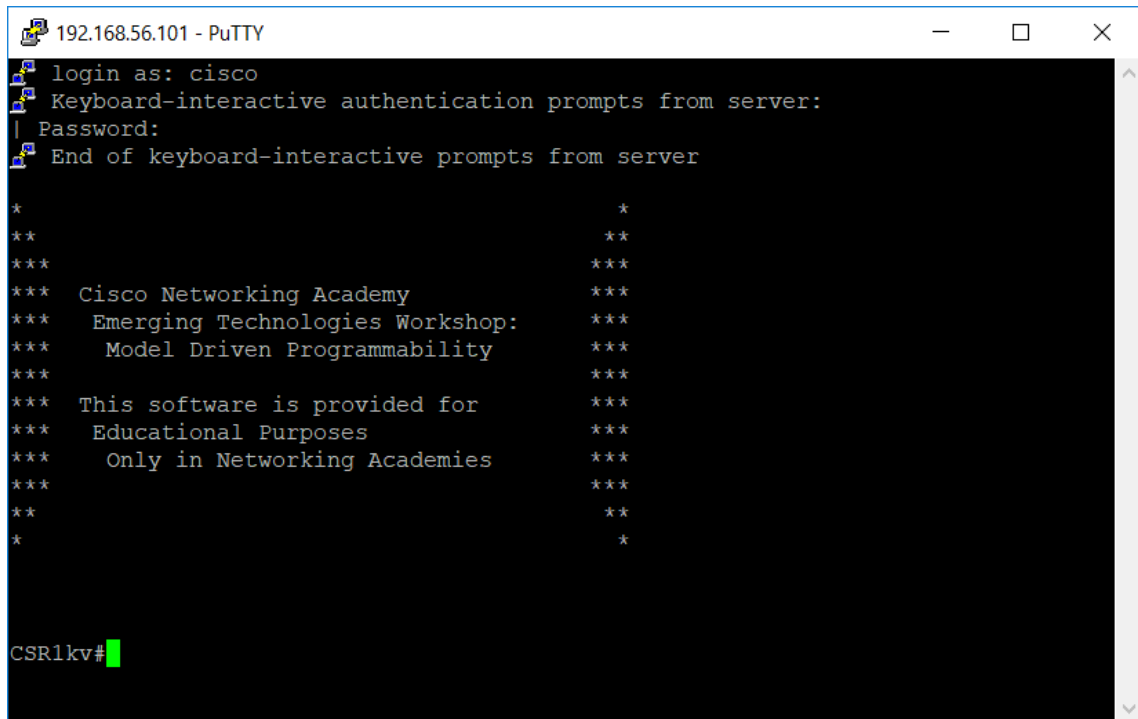
```
CSR1k0v>sh ip int brief
Interface      IP-Address      OK? Method Status      Protocol
GigabitEthernet1 192.168.56.101 YES DHCP    up          up
```

Please take a note of the router’s IP address, for it will be used in the next lab activities.

9. To connect from the host machine to the SSH service of Cisco IOS-XE router in the Virtual Machine, on the host machine use PuTTY to connect to the IP address of the Virtual Machine:



10. The Virtual Machine comes with an initial configuration that enables network programmability lab activities. For example, the NETCONF and RESTCONF API interfaces are pre-configured by default. The default pre-configured privilege 15 level username is `cisco` with the password `cisco123!`



```
192.168.56.101 - PuTTY
login as: cisco
Keyboard-interactive authentication prompts from server:
Password:
End of keyboard-interactive prompts from server

*
**
***
*** Cisco Networking Academy
*** Emerging Technologies Workshop:
*** Model Driven Programmability
***
*** This software is provided for
*** Educational Purposes
*** Only in Networking Academies
***
**
*

CSR1kv#
```

Part 1: (Option 2) Setup a Cisco ISR4k router with Cisco IOS-XE

Use this option if you have physical access to an ISR4221 router in your academy's lab kit. With this option, you can experiment using network programmability APIs with real routers.

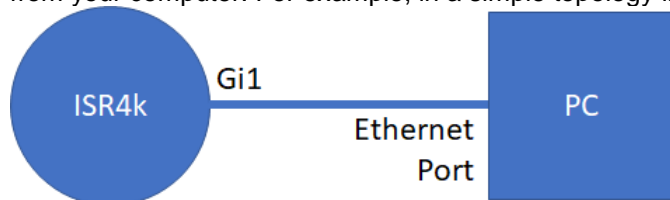
Step 1: Verifying the IOS-XE requirements on the ISR4221 router

1. Using a CLI access to your ISR4221 router, verify using the “show version” command, if the currently running IOS-XE version is at least 16.6.1.
2. If the currently running IOS-XE version is less than 16.6.1, before continuing, upgrade the Cisco IOS-XE version on your router.

Note: Instructors with active NetAcad Maintenance contract can download IOS updates for ISR4221 routers from <https://software.cisco.com/download/home/286310700/type/282046477>.

Step 2: Enable programable API interfaces on the ISR4221 router

1. Configure the GigabitEthernet1 interface with an IP address that is reachable within the lab topology from your computer. For example, in a simple topology like on the figure below:



the configuration on the ISR4221 router could be:

```
interface GigabitEthernet1
  description Link to PC
  ip address 192.168.1.1 255.255.255.0
  no shutdown
```

while the computer could be configured with 192.168.1.2/255.255.255.0 IP address.

2. Verify that you can ping the router's IP address from your computer.
3. Configure the router with the following configuration to enable the NETCONF and RESTCONF API interfaces:

```
hostname ISR4k
ip domain-name etw.netacad.com
crypto key generate rsa modulus 2048
username cisco priv 15 pass cisco123!
```

```
netconf-yang
restconf
ip http secure-server
ip http authentication local
```

```
line vty 0 15
```

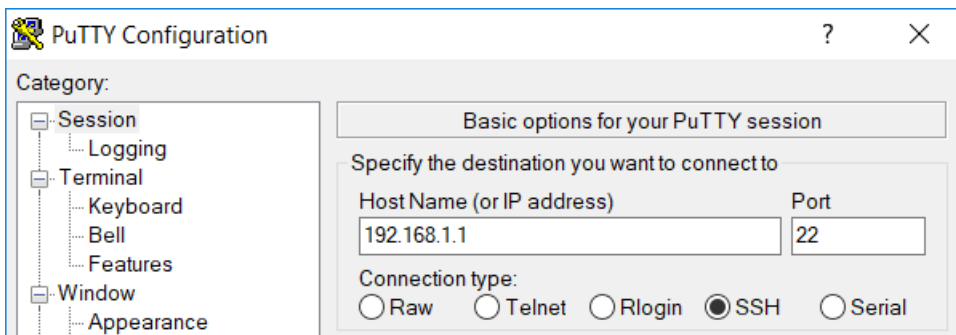
```
login local
```

```
transport input ssh
```

4. The table below summarizes the network services and their respective port numbers running on the ISR4221 router:

Service Name	Port on the ISR4221 router
SSH	22
HTTP	80
HTTPS	443
NETCONF	830

5. To connect from your computer to the SSH service of Cisco IOS-XE on the ISR4221 router, on your computer use Putty to connect to the IP address of your ISR4221 router on port 22:



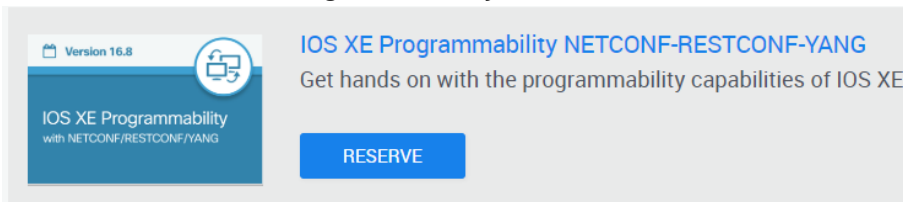
6. As per the configuration from above, the default pre-configured privilege 15 level username is cisco with the password cisco123!

Part 1: (Option 3) Setup a DevNet Sandbox reservation with Cisco IOS-XE

Using this option, you can create your own remotely accessible virtualized Cisco IOS-XE device in the DevNet Sandbox. To access the sandbox environment, first create a Sandbox reservation for a specific timeslot and then using the Cisco Anyconnect VPN client, connect to the remote DevNet Sandbox.

Step 1: Creating a DevNet Sandbox reservation

1. Visit <https://devnetsandbox.cisco.com>
2. Login with using the NetAcad login option
3. Search for the IOS XE Programmability NETCONF-RESTCONF-YANG sandbox:



4. Click on the Sandbox Title or follow the direct link <https://devnetsandbox.cisco.com/RM/Diagram/Index/27d9747a-db48-4565-8d44-df318fce37ad?diagramType=Topology> to enter the sandbox details:

The screenshot shows the DevNet Sandbox interface. The top navigation bar includes 'DEVNET', 'LAB MANAGEMENT', 'DEVNET', 'HELP', and 'TUTORIALS'. The main header shows 'SANDBOX LAB' and 'IOS XE Programmability NETCONF-RESTCONF-YANG'. A 'RESERVE' button is highlighted in the top right. The left sidebar has tabs for 'INSTRUCTIONS', 'COMMANDS', 'NAVIGATOR', 'STYLE', 'BEHAVIOUR', and 'VPN Access'. The 'VPN Access' tab is selected and highlighted with a red box. The main content area shows an 'Overview' section with text about the sandbox environment and a list of supported features. Below the overview is a 'Sandbox Support' section with a link to 'Sandbox Support'. On the right, a network diagram is visible, showing a 'CSR1000v Application' connected to a 'DevBox - NETCONF Application' and a 'VLAN Service VLAN SJ RANGE1'.

Overview:
The "IOS XE Programmability" Sandbox provides an environment where developers and network engineers can explore the programmability options available within IOS XE*. These include:

- Model Driven Programmability with YANG Data Models and NETCONF and RESTCONF**
- Application Hosting with Guest Shell to support running Linux Applications directly at the edge
- Develop and execute Python scripts on-box using Guest Shell
- Day Zero Provisioning with Network Plug and Play (PnP) and Zero Touch Provisioning (ZTP)

* IOS XE is the software running on many platforms from Cisco including switches, routers, gateways, etc. Not all programmability features are available on every platform. Check specific platform documentation for details.

** With IOS XE 16.6+, the RESTCONF implementation in this sandbox is compliant with RFC 8040 Standard.

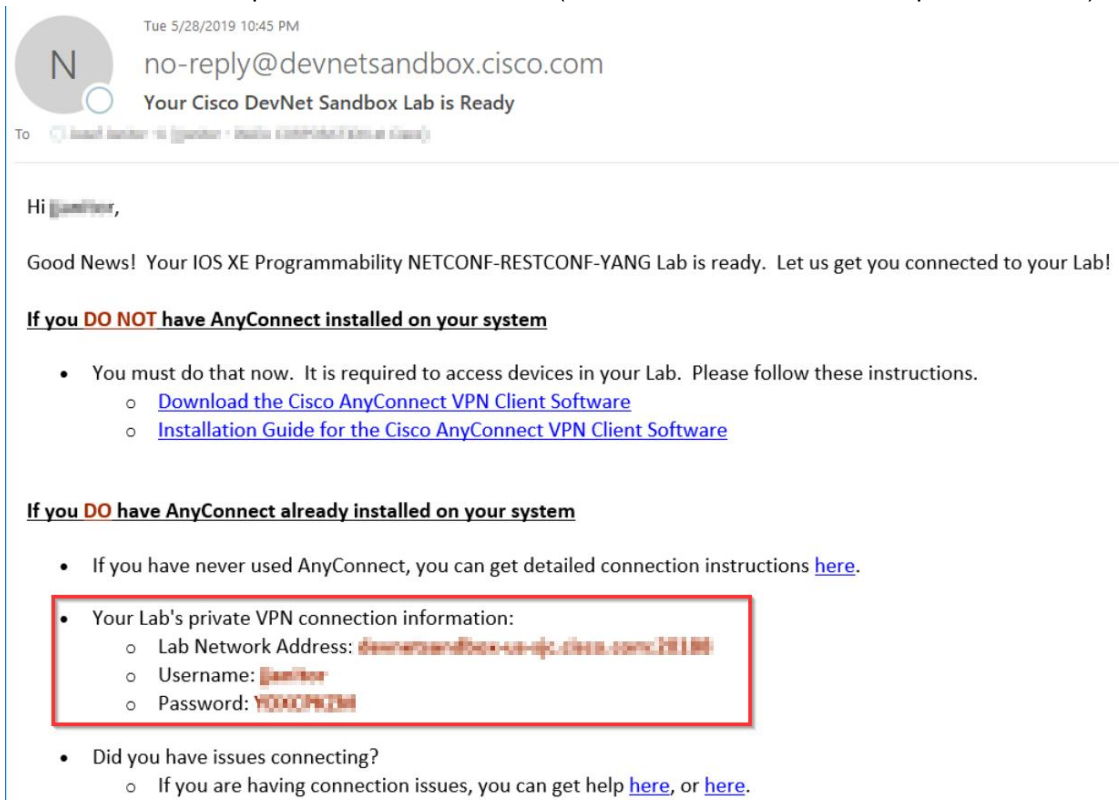
Sandbox Support:
Problems reserving or access the Sandbox environment:

- [Sandbox Support](#)

- Click on the RESERVE button and on the next screen adjust the SCHEDULE section with date and time when you want to play with the Sandbox environment.

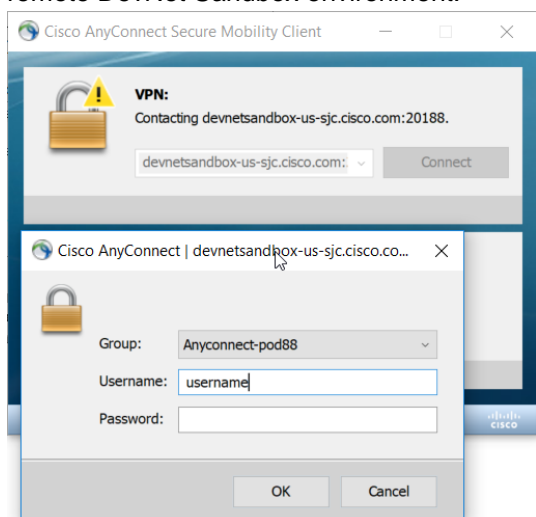
The screenshot shows a 'RESERVE' window with a close button (X) in the top right. Below the title bar, it says 'Current Timezone: (UTC) Coordinated Universal Time'. The main section is titled 'RESERVE' and contains three rows of information: 'SCHEDULE' with a value of '8 hours (From Now until 5/29/2019 4:33 AM)' and subtext 'Requires 10min. setup', 'Planned End 5/29/2019 4:38 AM', and 'Sandbox maximum duration is 1 week'; 'NAME' with the value 'IOS XE Programmability NETCONF-RESTCONF-YANG'; and 'SANDBOX LAB' with the same value. Each row has an edit icon (pencil) to its right. At the bottom right, there are two buttons: 'Reserve' (blue) and 'Cancel' (white).

- After creating a new Sandbox reservation, you should immediately receive an email notification confirming the reservation. In the email notification, you will receive instructions on how to download and use the Cisco AnyConnect VPN client to connect to the remote Sandbox environment.
- Please allow up to 30 minutes for the Sandbox reservation system to send you the final email notification with the specific connection details (VPN remote host, username, password, etc.):



Step 2: Connecting to the DevNet Sandbox reservation using VPN

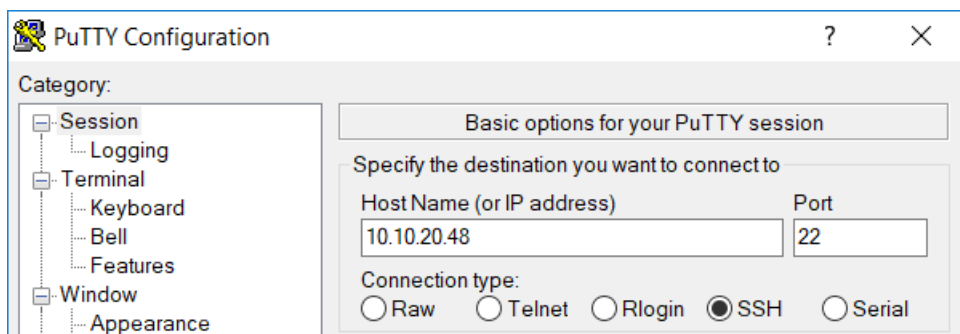
1. Using the VPN credentials from the email, use the Cisco Anyconnect VPN client to connect to the remote DevNet Sandbox environment:



2. Once connected to the VPN, you should be able to ping the Cisco IOS-XE router's IP address: 10.10.20.48
3. The table below summarizes the network services and their respective port numbers running on the remote Cisco IOS-XE router:

Service Name	Port on the ISR4221 router
SSH	22
HTTP	80
HTTPS	443
NETCONF	830

4. To connect from your computer to the SSH service of Cisco IOS-XE on the remote router, on your computer use Putty to connect to the 10.10.20.48 IP address of the router to port 22:



5. The Cisco IOS-XE router in the DevNet Sandbox comes with an initial configuration that enables network programmability lab activities. For example, the NETCONF and RESTCONF API interfaces are pre-configured by default. The default pre-configured privilege 15 level username is `cisco` with the password `cisco_1234!`

Part 2: Summary and Connection Details

The lab activities were designed with the “Local Virtual Machine with IOS-XE” option.

In case of using one of the other lab equipment options, adjust accordingly the hostname or the IP address and the port of the IOS-XE router in the lab activities. Use the table below as a reference:

	Local VM with IOS-XE	DevNet Sandbox	Local ISR4221 Router
Hostname/IP address	The IP address of the ETW-CSR1000v VM. Usually 192.168.56.101. Check using “sh ip int brief” on the VM’s console.	10.10.20.48	Any IP address configured on the ISR4k router reachable from your computer.
Ports	SSH: 22 NETCONF: 830 RESTCONF: 443	SSH: 22 NETCONF: 830 RESTCONF: 443	SSH: 22 NETCONF: 830 RESTCONF: 443
Credentials	L: cisco P: cisco123!	L: cisco P: cisco_1234!	L: cisco P: cisco123!

Examples of required changes (replace “192.168.56.101” and if needed, also the username and password options:):

- Lab 2.2 Part 2c:

```
sshCli = ConnectHandler(
    device_type='cisco_ios',
    host='192.168.56.101',
    port=22,
    username='cisco',
    password='cisco123!'
)
```

- Lab 2.4 Part 1 Step 2b:

Enter the URL for API endpoint: <https://192.168.56.101/restconf/>

- Lab 2.5 Part 1 Step 2:

Create a variable named `api_url` and assign the URL.

```
api_url = "https://192.168.56.101/restconf/data/ietf-interfaces:interfaces"
```