Design a Topology

Design a Topology Overview

The design phase is the initial step in creating a network topology. During the design phase, you will perform the tasks described in the following sections.

Topology Nodes and Connections

The topology you design consists of nodes and connection functions. See Navigating Within the Cisco Modeling Labs Client for additional information about how to select and edit nodes and connection functions.

Topology Nodes

Table 1: Node Subtypes

Node Name	Node Type
Cisco IOSv	Router node. Runs a Cisco IOS operating system.
Cisco IOSvL2	Router node. Runs a Cisco IOS Layer 2 operating system.
Server	Server node. Runs a Linux operating system.

Node Name	Node Type
Cisco IOS XRv	Router node. Runs a Cisco IOS XR operating system.
Cisco IOS XRv 9000	Router node. Runs a Cisco IOS XR 9000 operating system. (Available separately.)
Cisco CSR1000v	Router node. Runs a Cisco CSR 1000 operating system. (Available separately.)
Cisco ASAv	Router node. Runs a Cisco ASAv operating system.
Cisco NX-OSv 9000	Router node. Runs a Cisco Nx-OS 9000 operating system.

A node subtype is a virtual machine that runs on top of OpenStack, which itself is running in a Linux virtual machine that is running on top of VMware software. Because the node is virtual, specific hardware is not emulated. For example, there are no power supplies, no fans, no ASICs, and no physical interfaces. For all router nodes, the interface type is a Gigabit Ethernet network interface. A server node has an Ethernet network interface.

You can choose an image and image flavor for each node type. See the ***User Workspace Management*** chapter in the *Cisco Modeling Labs Corporate Edition System Administrator Installation Guide, Release 1.3* for information on how to access the VM Image and the VM Flavor choices. In most cases, you need not select an image and flavor. By default, the node subtype is associated with an image and flavor that runs with the topology.

Table 2: Node VM Images

VM Image Name	Used For
server	Server node
CSR1000v	Cisco CSR1000 node
IOSv	Cisco IOS node
IOSvL2	Cisco IOS Layer 2 node
IOS XRv	Cisco IOS XR node
IOS XRv 9000	Cisco IOS XR 9000 node
AVAv	Cisco AVAv node
Nx-OSv 9000	Cisco NX-OSv 9000 node

Table 3: Node VM Flavors

VM Flavor Name	Used For
m1_tiny	Linux server
m1_small	Linux server
m1_medium	Linux server
m1_large	Linux server
m1_xlarge	Linux server
server	Linux server
CSR1000v	Cisco CSR 1000 node
IOS XRv	Cisco IOS XR node
IOS XRv 9000	Cisco IOS XR 9000 node
IOSv	Cisco IOS node
IOSvL2	Cisco IOS Layer 2 node
AVAv	Cisco AVA node
NX-OSv 9000	Cisco NX-OS 9000 node

Each Linux flavor provides a different amount of memory and CPU allocated to the server.

Connection Functions

Cisco Modeling Labs provides the connection functions shown in the following table.

Table 4: Connection Functions

Connection Type	Description
Connection	Creates a connection between two interfaces. Interfaces are created in the node to support a connection. Any unused interfaces present are automatically assigned. All the interfaces in router nodes are represented as Gigabit Ethernet interfaces. Multiple parallel connections are supported.

Connection Type	Description
External Router	Creates an external router connection point. When the external router is used in conjunction with a Layer 2 External (Flat) network and IOSv instances, AutoNetkit is able to configure an L2TPv3 tunnel to connect simulations to remote devices in a transparent manner.
Layer 3 External (SNAT)	Creates a Layer 3 external connection point using static network address translation (SNAT). This external connection point allows connections outside of Cisco Modeling Labs to connect to the topology.
Layer 2 External (Flat)	Creates a Layer 2 external connection point using FLAT. This external connection point allows connections outside of Cisco Modeling Labs to connect to the topology.

Create a Topology

Before You Begin

A topology project folder must exist.

There are several methods for creating a topology. These are discussed in the following sections.

Method 1: Create a Topology from the Menu Bar

Step 1 Select a topology project folder.

Step 2 Enter a filename, ensuring that it ends with the extension **.virl**.

Step 3 Click **Finish**.
A filename .virl topology file is created in the selected project folder.

Method 2: Create a Topology from the Projects View

Step 1 Right-click **Projects** view.

Step 2 Choose **New** > **Topology**.

Step 3 Select a topology project folder.

Step 4 Enter a filename, ensuring that it ends with the extension **.virl**.

Step 5 Click **Finish**.
A filename .virl topology file is created in the selected project folder.

Method 3: Create a Topology from the Toolbar

Step 1 Click the **New Topology File** icon in the toolbar.

Step 2 Select a topology project folder.

Step 3 Enter a filename, ensuring that it ends with the extension **.virl**.

Step 4 Click **Finish**.
A filename .virl file is created in the selected project folder.

What to Do Next

Place the nodes.

Place the Nodes on the Canvas

Before You Begin

- A topology file must exist.
- The topology file must be open and the canvas visible in the **Topology Editor**.

Step 1 Click a node type, which is under the **Nodes** heading in the **Palette** view.

Step 2 Click the canvas at each point where you want to place a node. You can also drag the nodes on the canvas to position them. You can then arrange the nodes using several methods:

- Use **Shift-click** to select two or more nodes. Alternatively, click and drag a selection box around two or more nodes. You can also use **Ctrl-click** (Windows) or **Cmd-click** (OS X) to toggle between node selections.

- From the menu bar, use **Edit** > **Grid** > **Distribute Nodes** to arrange the selected nodes vertically, horizontally, or to distribute them on a grid.

  Note The grid is determined dynamically, based on the selected nodes.

What to Do Next

Create connections and interfaces.

Create Connections and Interfaces

Before You Begin

Nodes must be in place on the canvas of the **Topology Editor**.

Step 1 Click **Connection** in the **Tools** view.

Step 2 Click the first node.

Step 3 Click the next node to create the connection.

Note When you connect two nodes, the interfaces are created and named automatically when you choose **File** > **Preferences** > **Topology Editor** > **Associate new connection with interfaces silently** check box. You can view the node interfaces when you double-click the node.

Step 4 Repeat Step 2 and Step 3 until all the connections are in place.

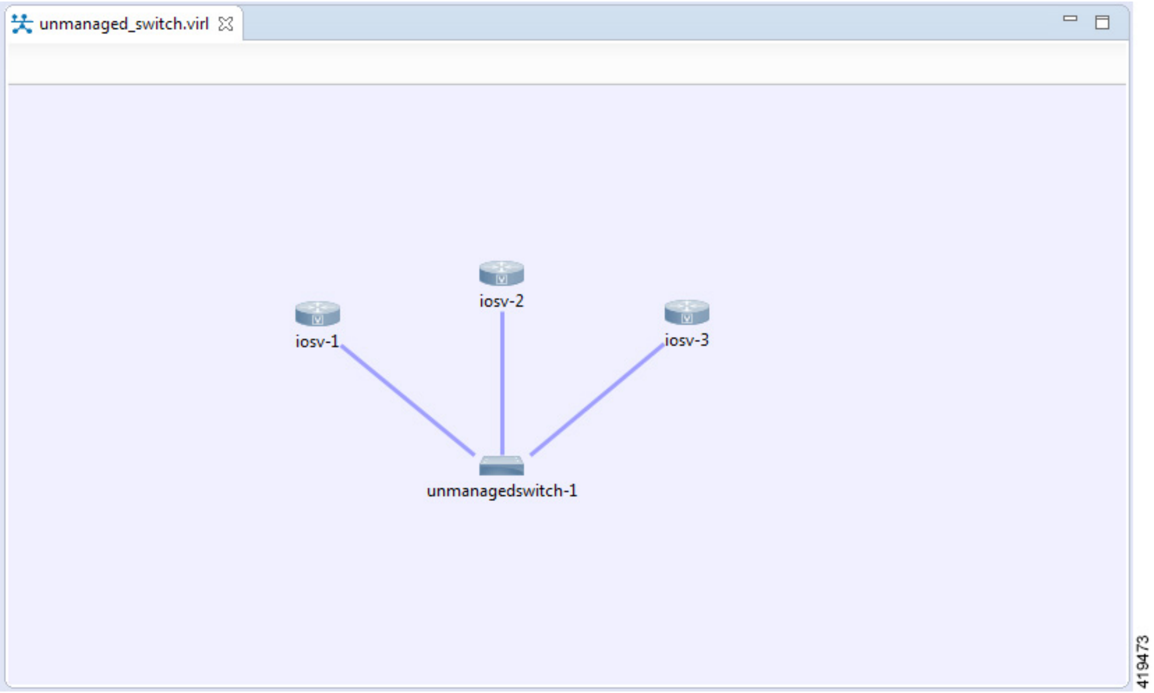
Tip You can create multiple parallel connections between two nodes. When a connection is selected, the **Topology Editor** shows the connection end points and double-clicking a node shows the nodes involved in the connection, all of the interfaces on those nodes, and all the connections between those nodes.

Note Choose **File** > **Export** > **Export Topology Diagram to Image** to capture an image of the current topology on the canvas.

Use Unmanaged Switches

Users have the choice to use either an unmanaged switch or Cisco IOSv layer 2 to provide a switching service. Unmanaged switches are used in place of the multipoint connection which was available in previous versions of Cisco Modeling Labs. For example, in the following figure there are 3 IOSv instances connected to an unmanaged switch. Each of the interfaces on iosv-1, iosv-2, and iosv-3 appear to be on the same subnet for point to point communication through the unmanaged switch.

Figure 1: Using an Unmanaged Switch in a Simple Topology



Unmanaged switch instances use the underlying Linux bridge process running under OpenStack control to provide this connectivity between the various virtual machines. It is a transparent switch.

Before You Begin

A topology file with the extension .virl must exist. Router nodes or server nodes are placed on the canvas. Optionally, connections may exist between nodes.

Step 1 In the **Nodes** view, click **Unmanaged Switch**.

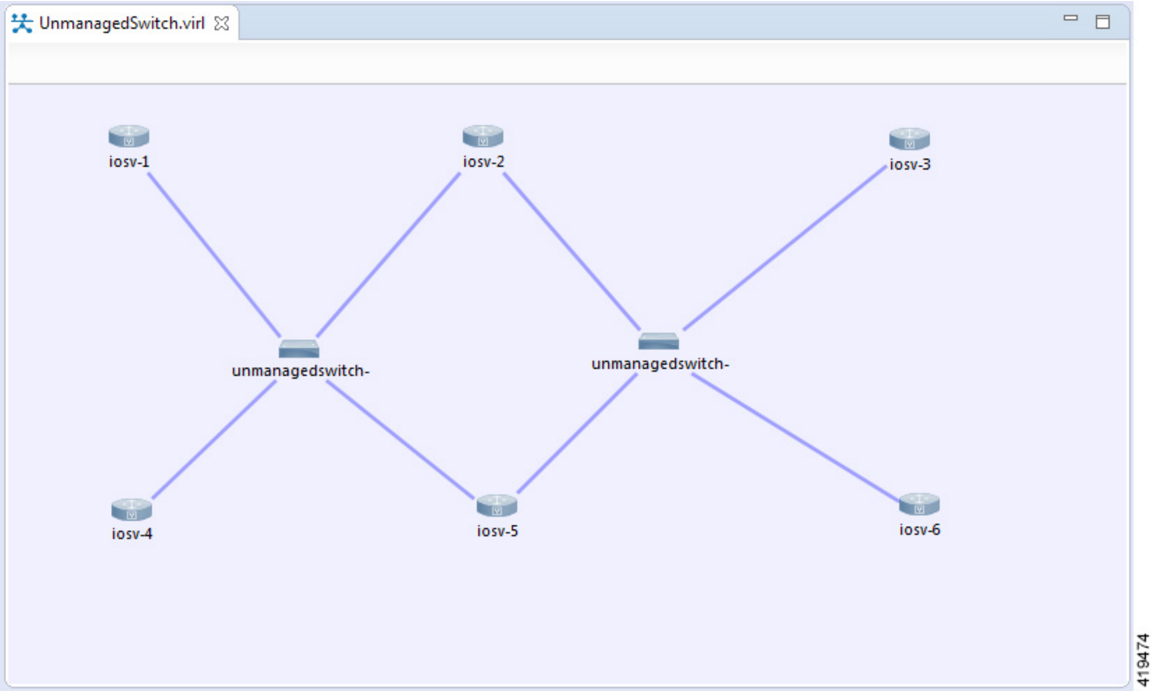
Step 2 Click the area on the canvas where you want the unmanaged switch to appear.

Step 3 In the **Tool** view, click **Connect**.

Step 4 On the canvas, click the unmanaged switch node then click an end node. A connection appears.

Continue clicking unmanaged switch-node combinations until all connections are made.

Figure 2: Using an Unmanaged Switch



The Cisco IOSvL2 Switch Image

The Cisco IOSvL2 switch image is a virtual machine like Cisco IOSv, Cisco IOS XRv, and so on. It runs and is configured in the same way as all other virtual machines. It runs a Cisco IOSv 15.2 switch image.

Note All Cisco IOSvL2 switch images in a topology are counted against the licensed node limit.

A Cisco IOSvL2 switch image provides sixteen Gigabit Ethernet interfaces, reserving interface Gi0/0 for OOB management. It can be configured manually or using AutoNetkit.

Cisco IOSvL2 switch instances can operate in:

- Layer 2 mode
- Layer 3 mode

By default the instances operate in layer 3 mode. However, the primary use of the Cisco IOSvL2 switch image is for switching purposes.

Any routers set up to connect to the Cisco IOSvL2 switch will be in switchport access mode. By default, all routers are placed in VLAN 2. You can specify which VLAN to place a port in by setting a VLAN attribute on the router interface. See Assign VLANs for details on how to do this.

Switch to switch connections configured using AutoNetkit are by default set to operate as an 802.1q trunk.

Use the Cisco IOSvL2 Switch Image

Step 1 In the **Nodes** view, click **IOSvL2**.

Step 2 Click the canvas at each point where you want to place an IOSvL2 node. You can also drag the nodes on the canvas to position them.

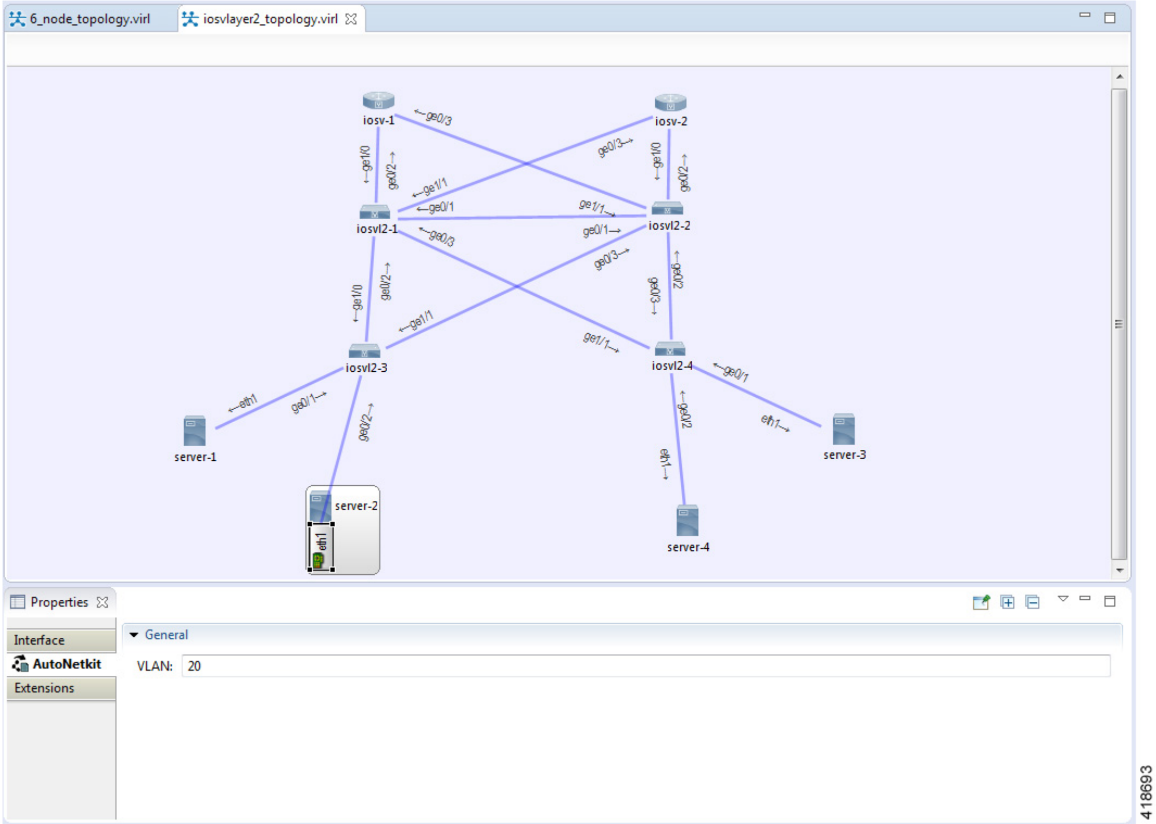
Step 3 Add additional node types as required.

Step 4 Use the **Connect** tool to create connections between the nodes.

Step 5 To specify which VLAN to place a port in, select the interface for the host or router by double-clicking the applicable node.

Step 6 Under **Properties** > **AutoNetkit**, enter a value for the **VLAN** field, as shown.

Figure 3: Setting the VLAN Attribute

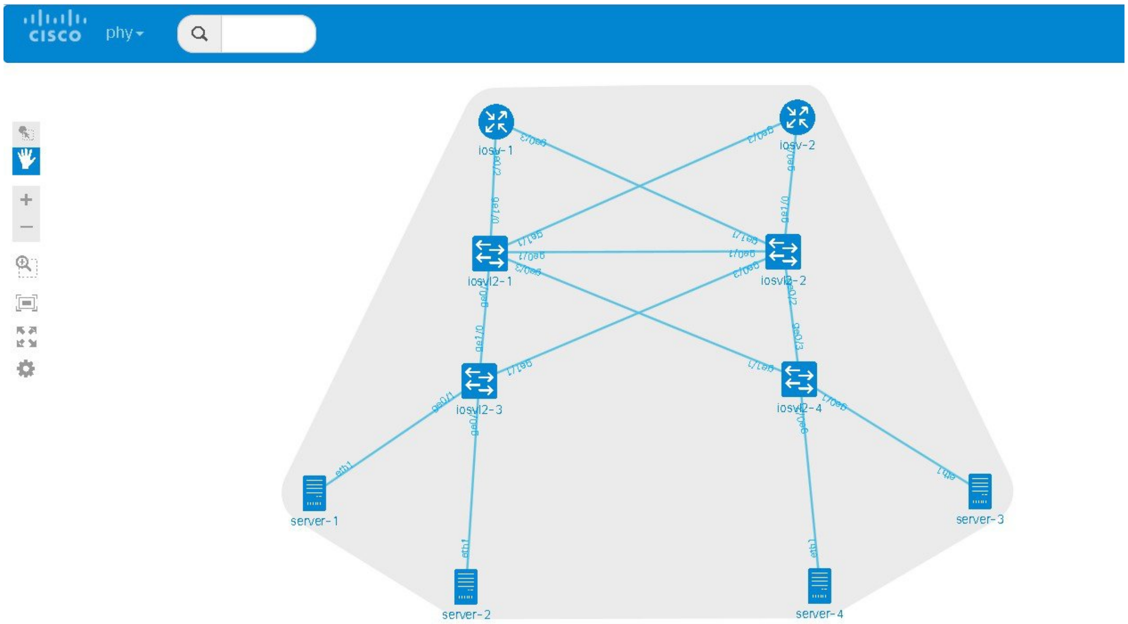


VLAN: 20

Step 7 From the toolbar, click **Build Initial Configurations** to generate a configuration for the topology using AutoNetkit. When prompted to open AutoNetkit visualization, click **Yes**.

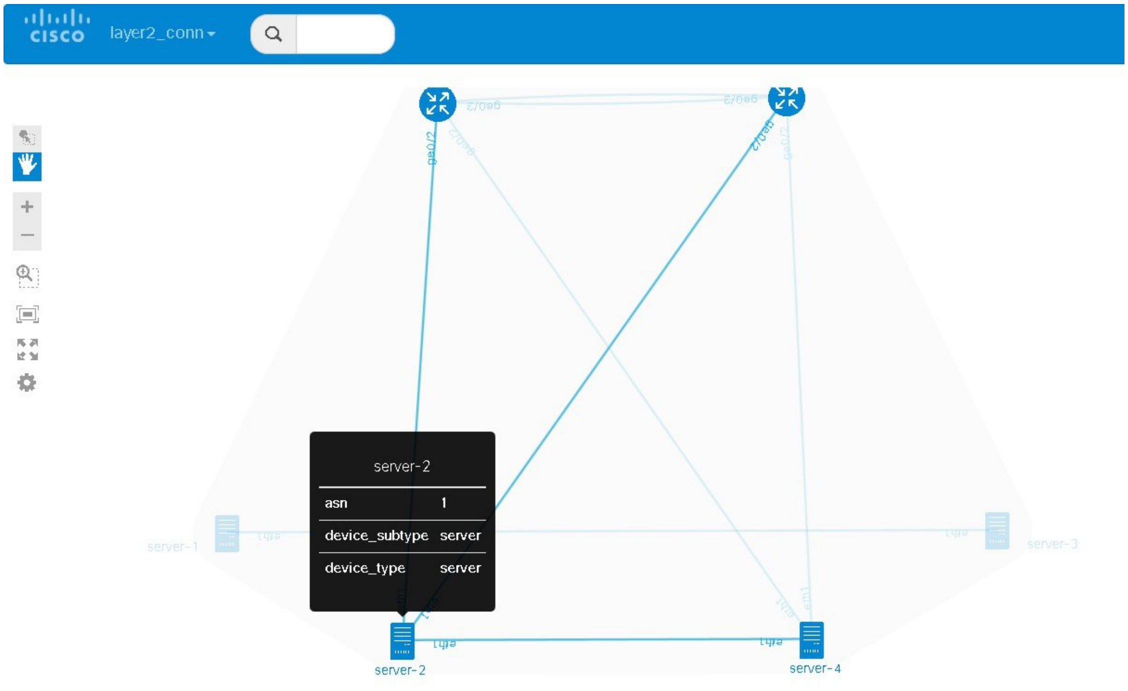
AutoNetkit visualization for the topology opens in a browser window.

Figure 4: AutoNetkit Visualization



Step 8 To view all broadcast domains that are enabled, select **layer2_conn** from the **phy** drop-down list. For example, hovering over server-2 in this example shows the routers and servers that are in the same VLAN. All other devices are greyed out.

Figure 5: Layer 2 Connectivity

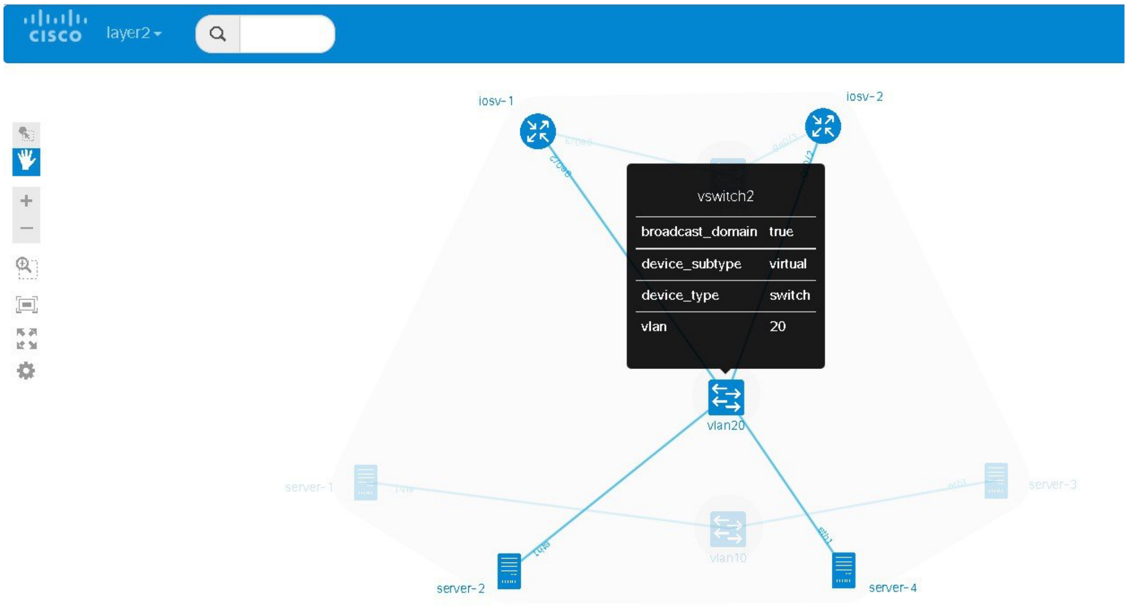


server-2

asn	1
device_subtype	server
device_type	server

Selecting **layer2** from the **phy** drop-down list shows the switches representing the VLANs in place.

Figure 6: Layer 2 Switches

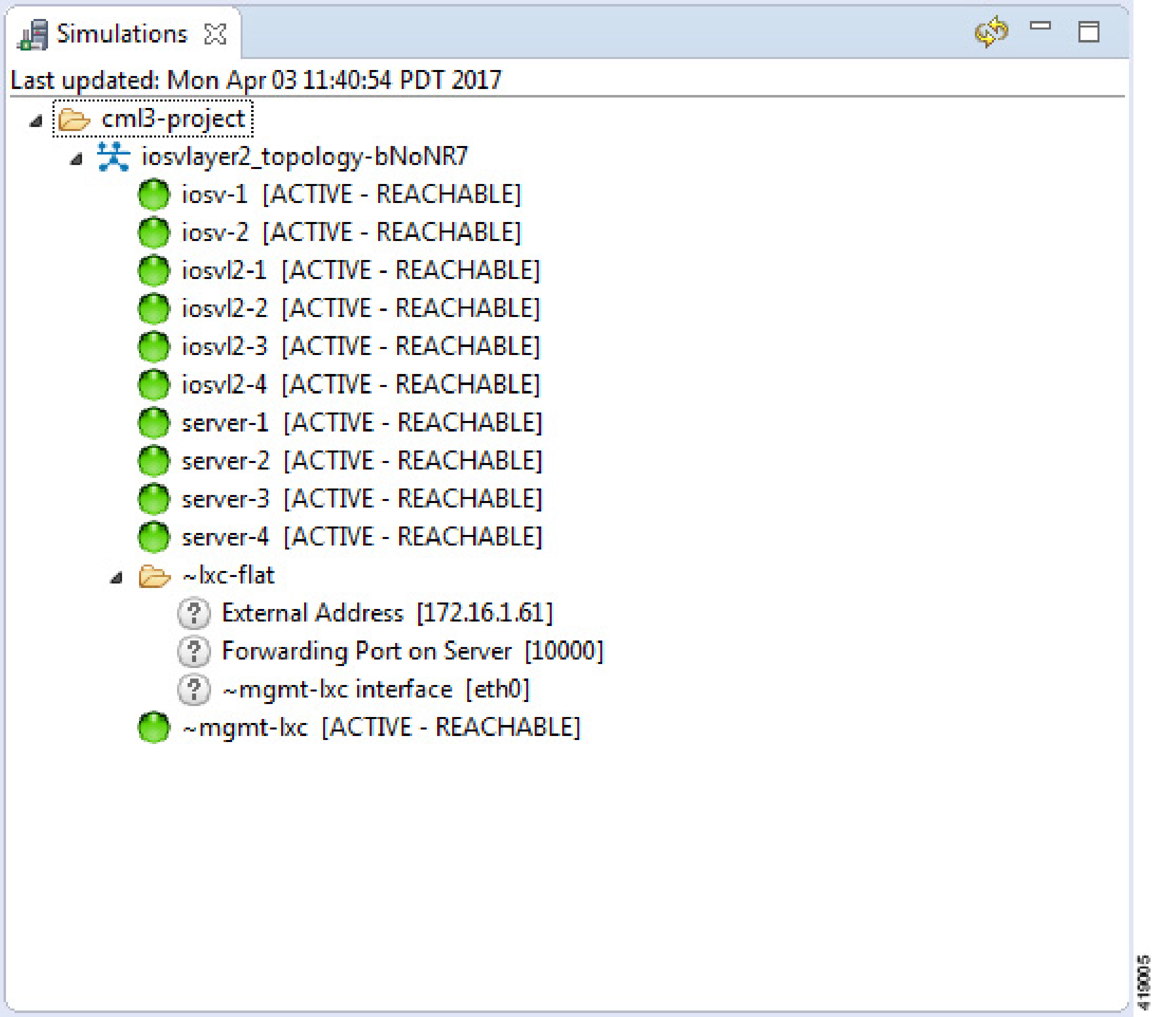


vswitch2

broadcast_domain	true
device_subtype	virtual
device_type	switch
vlan	20

Step 9 In the Cisco Modeling Labs client, click **Launch Simulation** to start the simulation.
The simulation starts and is visible in the **Simulations** view.

Figure 7: Simulation with Cisco IOSvL2 Switch Image



```
Last updated: Mon Apr 03 11:40:54 PDT 2017
cml3-project
  iosvlayer2_topology-bNoNR7
    iosv-1  [ACTIVE - REACHABLE]
    iosv-2  [ACTIVE - REACHABLE]
    iosvl2-1  [ACTIVE - REACHABLE]
    iosvl2-2  [ACTIVE - REACHABLE]
    iosvl2-3  [ACTIVE - REACHABLE]
    iosvl2-4  [ACTIVE - REACHABLE]
    server-1  [ACTIVE - REACHABLE]
    server-2  [ACTIVE - REACHABLE]
    server-3  [ACTIVE - REACHABLE]
    server-4  [ACTIVE - REACHABLE]
    ~lxc-flat
      External Address  [172.16.1.61]
      Forwarding Port on Server  [10000]
      ~mgmt-lxc interface  [eth0]
    ~mgmt-lxc  [ACTIVE - REACHABLE]
```

Docker Container Support

Cisco Modeling Labs provides the ability to integrate Docker images into Cisco Modeling Labs topologies.

Users are able to select docker images from public repositories (such as hub.docker.com) or private repositories. Once downloaded to your Cisco Modeling Labs server, you are able to design a network topology that will include your docker image.

In Cisco Modeling Labs, docker functionality is placed inside another virtual machine, CoreOS; which acts as a host for running docker instances. This is done for two reasons, for security and to constrain and restrict how many instances you have running by putting in place memory controls around the resources utilizations of the various docker instances.

Note You must install the CoreOS virtual machine image. This is available for installation from the Cisco Modeling Labs FileExchange. Please contact cml-info@cisco.com if you require access.

You can have many docker instances but you need to be careful with the amount of memory that docker instances require. Understand that CoreOS is running docker services as well as the docker instances themselves. There is a limit of 22 docker instances running at any one time. This limit is set by the number of interfaces that the KVM supports.

Basic configuration information (interface and routing details) are provided by AutoNetkit using the build initial configurations function. As part of the simulation launch, the CoreOS virtual machine is spun up and the docker instance started within it. The docker instance will appear as if it were directly connected to the other nodes within your simulation. The neighboring devices are unaware of the presence of the CoreOS VM that is hosting the docker instances. Each link that is created in the topology design results in an external tap interface being created on the CoreOS instance. The CoreOS VM is configured to run with 2Gb RAM and 2vCPUs. If the amount of memory is insufficient, it can be adjusted using the **Node Resources/Flavors** function in the **User Workspace Management** interface.

There are thousands of docker images available on public repositories. However, not all images will run on Cisco Modeling Labs (or any other docker deployment), so care must be taken when selecting the image.

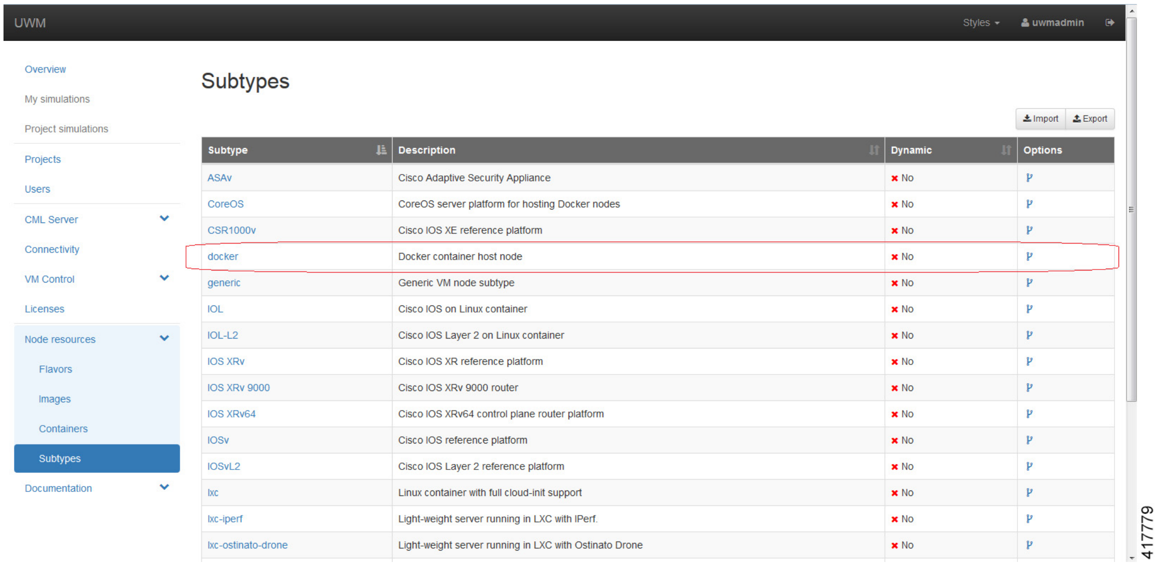
Using Integrated Docker Containers in Cisco Modeling Labs Topologies

To use integrated docker containers in your topologies, complete the following steps.

Step 1 Download the docker image to the Cisco Modeling Labs server.

Step 2 In the User Workspace Management interface, the list of available subtypes is accessed using **Node Resources** > **Subtypes** as shown.

Figure 8: List of Available Subtypes

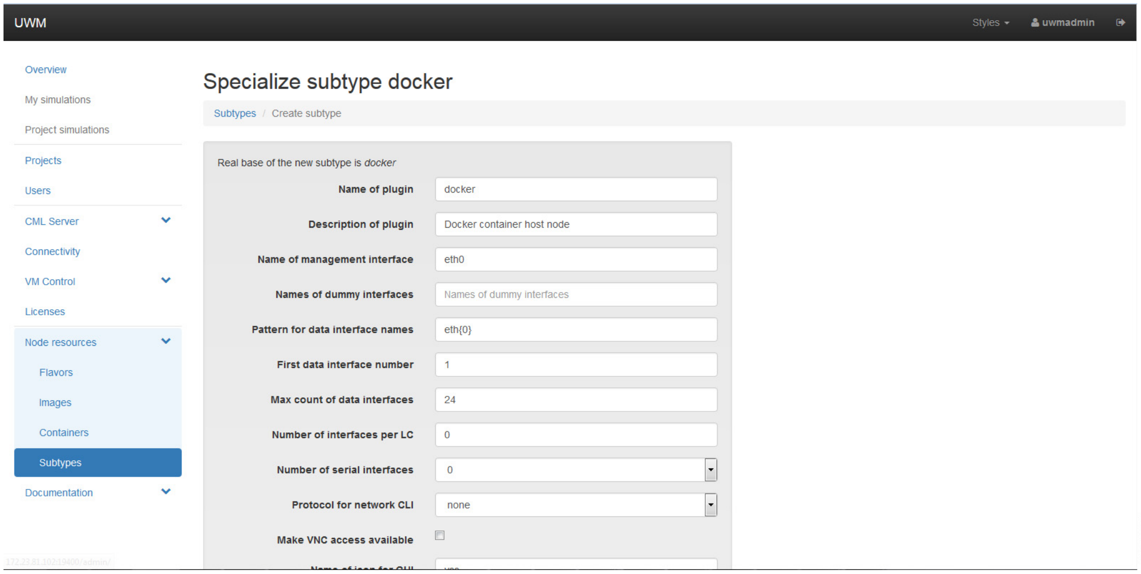


Subtypes

Subtype	Description	Dynamic	Options
ASAv	Cisco Adaptive Security Appliance	✗ No	✎
CoreOS	CoreOS server platform for hosting Docker nodes	✗ No	✎
CSR1000v	Cisco IOS XE reference platform	✗ No	✎
docker	Docker container host node	✗ No	✎
generic	Generic VM node subtype	✗ No	✎
IOL	Cisco IOS on Linux container	✗ No	✎
IOL-L2	Cisco IOS Layer 2 on Linux container	✗ No	✎
IOS XRv	Cisco IOS XR reference platform	✗ No	✎
IOS XRv 9000	Cisco IOS XRv 9000 router	✗ No	✎
IOS XRv64	Cisco IOS XRv64 control plane router platform	✗ No	✎
IOSv	Cisco IOS reference platform	✗ No	✎
IOSvL2	Cisco IOS Layer 2 reference platform	✗ No	✎
lxc	Linux container with full cloud-init support	✗ No	✎
lxc-iperf	Light-weight server running in LXC with IPerf.	✗ No	✎
lxc-ostinato-drone	Light-weight server running in LXC with Ostinato Drone	✗ No	✎

For each docker type that is added, you need to create a subtype using the **Specialize** option to clone the template provided.

Figure 9: Create a Subtype Docker Container



Specialize subtype docker

Subtypes / Create subtype

Real base of the new subtype is *docker*

Name of plugin	docker
Description of plugin	Docker container host node
Name of management interface	eth0
Names of dummy interfaces	Names of dummy interfaces
Pattern for data interface names	eth{0}
First data interface number	1
Max count of data interfaces	24
Number of interfaces per LC	0
Number of serial interfaces	0
Protocol for network CLI	none
Make VNC access available	□

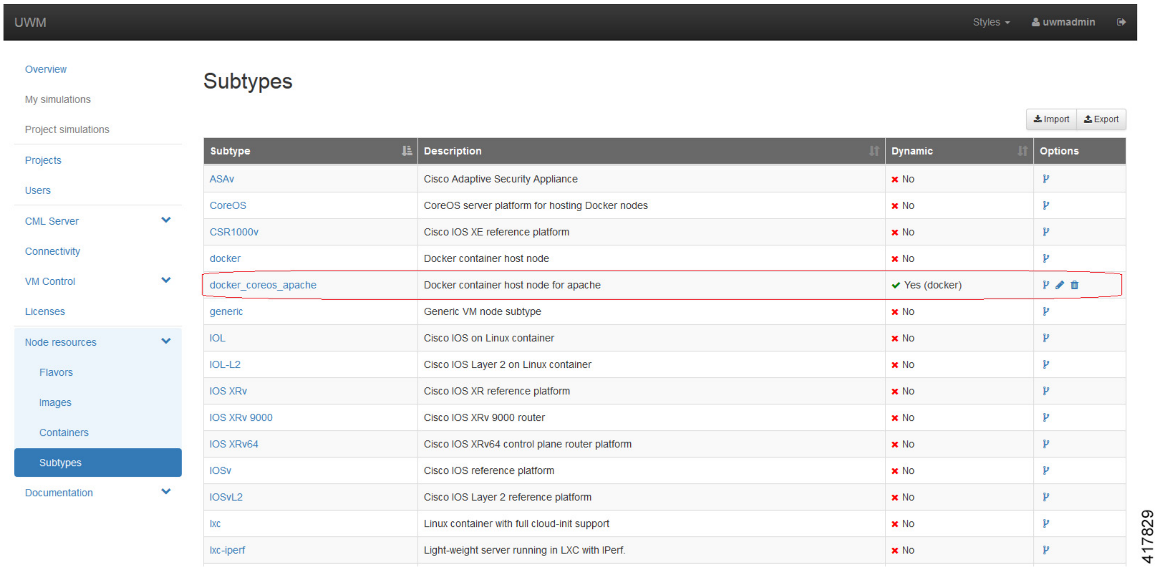
The required fields to complete are:

- Name of plugin
- Name of Default Image
- Arguments for LXc template; docker run CMD

Click **Create**.

The newly created subtype is displayed in the Subtypes list.

Figure 10: Docker Subtype Created



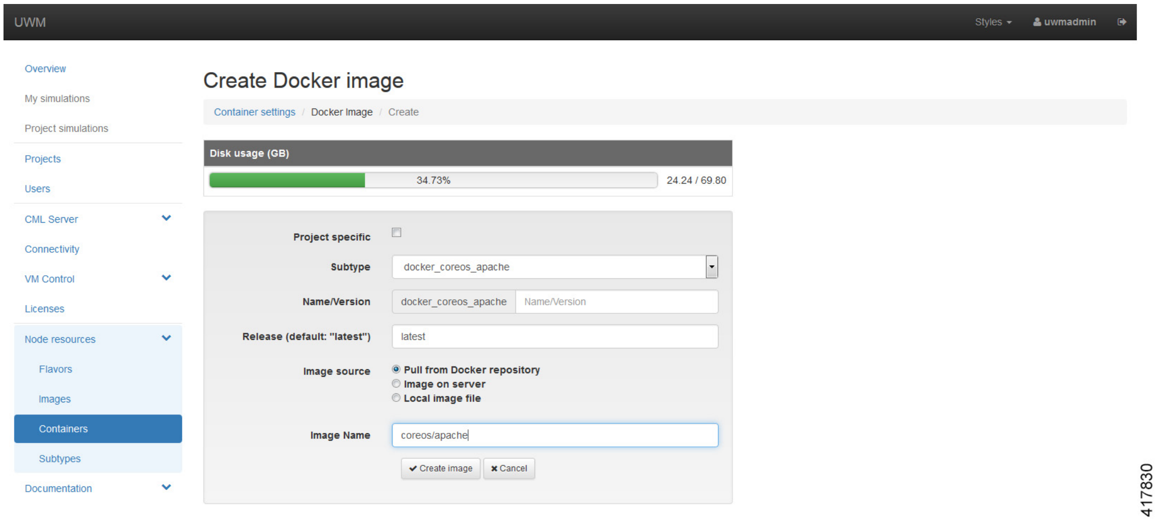
Subtypes

Subtype	Description	Dynamic	Options
ASAv	Cisco Adaptive Security Appliance	✗ No	
CoreOS	CoreOS server platform for hosting Docker nodes	✗ No	
CSR1000v	Cisco IOS XE reference platform	✗ No	
docker	Docker container host node	✗ No	
docker_coreos_apache	Docker container host node for apache	✓ Yes (docker)	
generic	Generic VM node subtype	✗ No	
IOL	Cisco IOS on Linux container	✗ No	
IOL-L2	Cisco IOS Layer 2 on Linux container	✗ No	
IOS XRv	Cisco IOS XR reference platform	✗ No	
IOS XRv 9000	Cisco IOS XRv 9000 router	✗ No	
IOS XRv64	Cisco IOS XRv64 control plane router platform	✗ No	
IOSv	Cisco IOS reference platform	✗ No	
IOSvL2	Cisco IOS Layer 2 reference platform	✗ No	
lxc	Linux container with full cloud-init support	✗ No	
lxc-iperf	Light-weight server running in LXC with IPerf.	✗ No	

Step 3 Under **Node Resources** > **Containers** > **Docker Images**, click **Add**.
Browse the docker repository and search for the applicable image, for example, coreos/apache. Select the option and note down the applicable Docker Pull Command, eg. `docker pull coreos/apache`.

Step 4 In the **Create Docker Image** page, select the newly created docker subtype from the drop-down list.

Figure 11: Create Docker Image



Create Docker image

Container settings / Docker Image / Create

Disk usage (GB): 34.73% 24.24 / 69.80

Project specific ☐

Subtype: docker_coreos_apache

Name/Version: docker_coreos_apache Name/Version

Release (default: "latest"): latest

Image source: ● Pull from Docker repository ○ Image on server ○ Local image file

Image Name: coreos/apache

In the **Image Name** field, enter the docker pull command noted earlier. Click **Create Image**.

The content is now downloaded. The new docker image is displayed in the **Docker Images** list.

Step 5 To add the docker image for use in Cisco modeling Labs topologies, open the Cisco modeling Labs client.

Step 6 Choose **File** > **Preferences** > **Node Subtypes** and click **Fetch from Server**.
The newly created docker image is displayed in the Node Subtypes list. Additionally, the docker image icon is also available from the **Topology Palette** for use in topology design.