



External Connectivity in Cisco Modeling Labs

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External Connectivity to a Node

Depending on how the Cisco Modeling Labs environment has been set up by the system administrator, you may have several ways to externally connect to the nodes in a running simulation.

- 1 Bypass the Cisco Modeling Labs client and connect directly to nodes via Out of Band Management IP access using FLAT

If enabled by the system administrator, when designing your virtual network, you can specify that you want all nodes to be configured on a reserved management network. All management interfaces are connected to a shared management network segment known as FLAT. This set up will allow you to bypass the Cisco Modeling Labs client and connect directly via Telnet to the nodes.

- 2 Connecting to external devices using FLAT Inband access

When enabled, you can configure your virtual topologies to connect and pass data-plane and control-plane packets to one or more external devices such as routers or traffic generators during a simulation. Since FLAT is a Layer 2 solution, the IP addresses in your topology are reachable externally. The **L2 External FLAT** tool in the Cisco Modeling Labs client GUI is used to enable this option.



Note

Your simulation continues to be driven through the Cisco Modeling Labs client GUI by communicating with the Cisco Modeling Labs server at its IP address that is bound to the relevant management port.

- 3 Connecting to external devices using SNAT Inband access

As an alternative to Inband access using FLAT, you can set up the Static NAT (SNAT) approach. SNAT is a Layer 3 solution that leverages the use of an internal SNAT router to hide the IP addresses in your topology. This router, internal to the Cisco Modeling Labs server, translates IP addresses inbound and outbound which means that the addressing schemes used on the virtual topology are not propagated outside the virtual network.

When configured, an internal and an external address are assigned to the SNAT-assigned interface on the nodes. For example, configuring 10.11.12.1 as the internal address, and mapping it to 172.16.2.51 externally. Traffic sent to 172.16.2.51 will be translated to the correct internal address and presented to the appropriate node.

The **L3 External SNAT** tool in the Cisco Modeling Labs client GUI is used to enable this option.


Note

Your simulation continues to be driven through the Cisco Modeling Labs client by communicating with the Cisco Modeling Labs server at its IP address that is bound to the relevant management port.

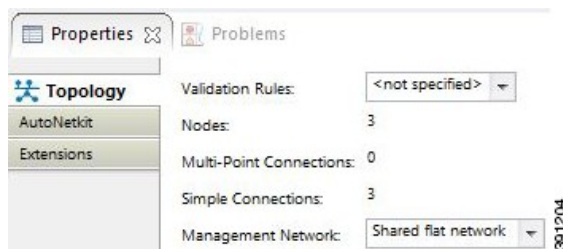
Set Up a FLAT Network for Out of Band (OOB) Management Access

By using an out-of-band (OOB) network connection to the Cisco Modeling Labs simulation, you can connect an external application to the Management port of any router node in the simulated network. All management ports will have an IP address on the OOB network, which is a separate network from the other interface IP addresses.

Before You Begin

- Ensure that you have installed a third-party application for Telnet connections, such as PuTTY.
- Ensure that FLAT connectivity has been enabled by the system administrator.

- Step 1** Log in to the Cisco Modeling Labs client.
- Step 2** Verify you have connectivity to the Cisco Modeling Labs server.
- Step 3** Open the **Design** perspective, if it is not already open.
- Step 4** Open an existing topology or create your network topology. See [Create a Topology](#) for information on how to do this.
- Step 5** Configure the OOB management network.
 - a) Click on the **Topology Editor** canvas.
 - b) Choose **Properties > Topology**.
 - c) Locate **Management Network** and select **Shared flat network** from the drop-down list.



The **Shared flat network** option is what enables the OOB connectivity.

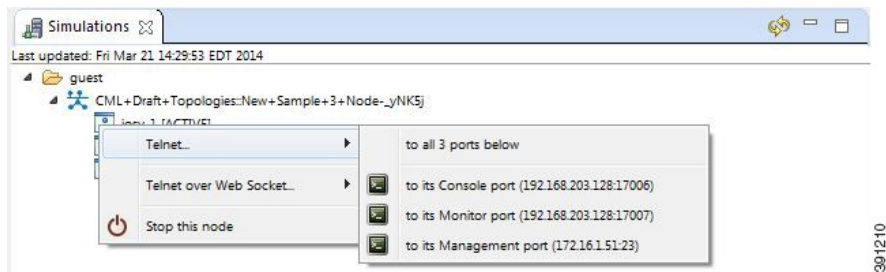
Step 6 From the toolbar, click the **Build Initial Configurations** tool.

Note For the purpose of this task, you may retain the default settings.

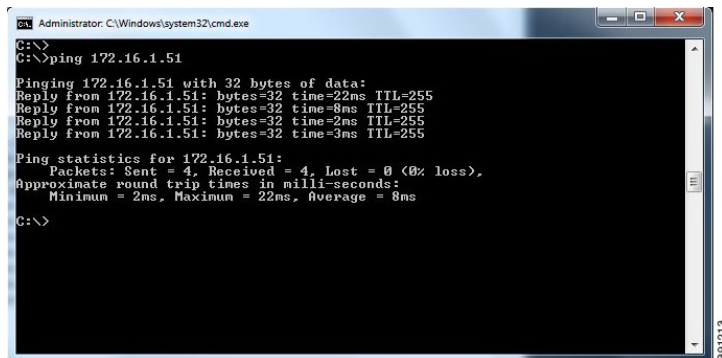
Step 7 After the build phase is completed, initiate the simulation by clicking the **Launch Simulation** tool in the toolbar, and then change to the **Simulation** perspective.

Step 8 (Optional) Enter the **ping** command on the PC to confirm that the management port on a running node can be reached.

a) In the Cisco Modeling Labs client simulation, select a node and display the IP address for its management port. In this example, the IP address for the node management port is 172.16.1.51.



b) In the PC command window, enter the **ping** command to target the node management port identified in Step 8a.



Step 9 (Optional) In the Cisco Modeling Labs client simulation, connect to a console port on a node and confirm the management network IP address exists. Enter the **show ip interface brief** command to display the IP addresses. For this example, use the IP address 172.16.1.51.

Set Up a FLAT Network for Out of Band (OOB) Management Access

```

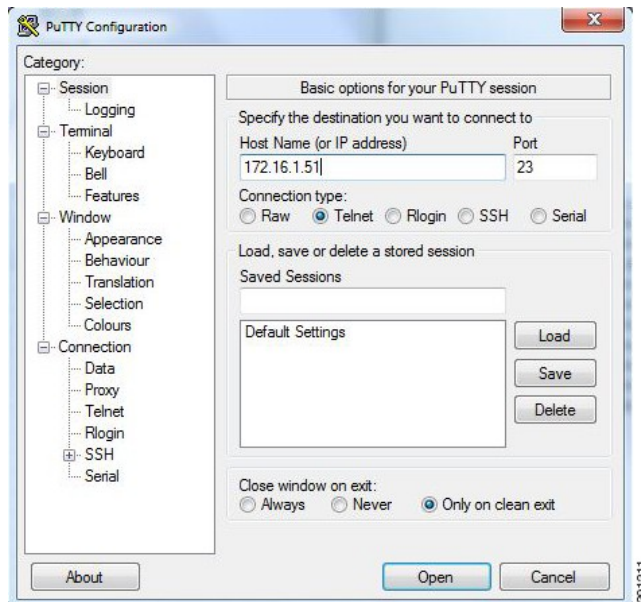
iosv-1>show ip interface brief
Interface              IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0     172.16.1.51     YES NVRAM  up          up
GigabitEthernet0/1     10.0.0.1        YES NVRAM  up          up
GigabitEthernet0/2     10.0.0.5        YES NVRAM  up          up
GigabitEthernet0/3     unassigned      YES unset  up          up
Loopback0              192.168.0.1     YES NVRAM  up          up
iosv-1>

```

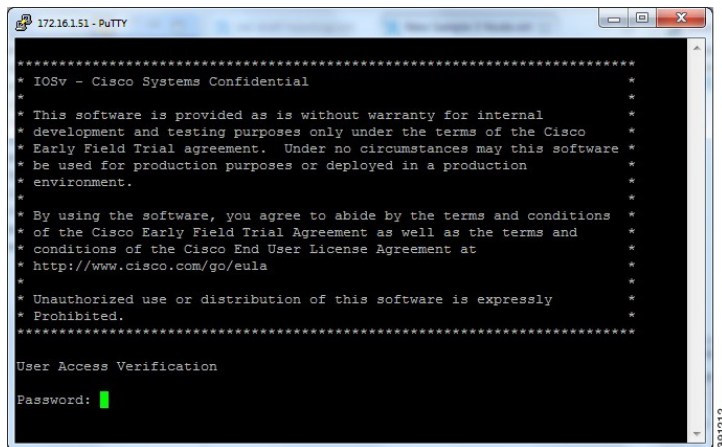
Step 10

Launch and configure a terminal emulator for a Telnet connection to the node management port. In this example, the PuTTY application is used.

- Launch the PuTTY application.
- In the **PuTTY Configuration window**, enter the IP address for a Telnet connection to the management port. In this example, the IP address for the node management port is 172.16.1.51.



- When successful, a Telnet window opens and the router console information is displayed.

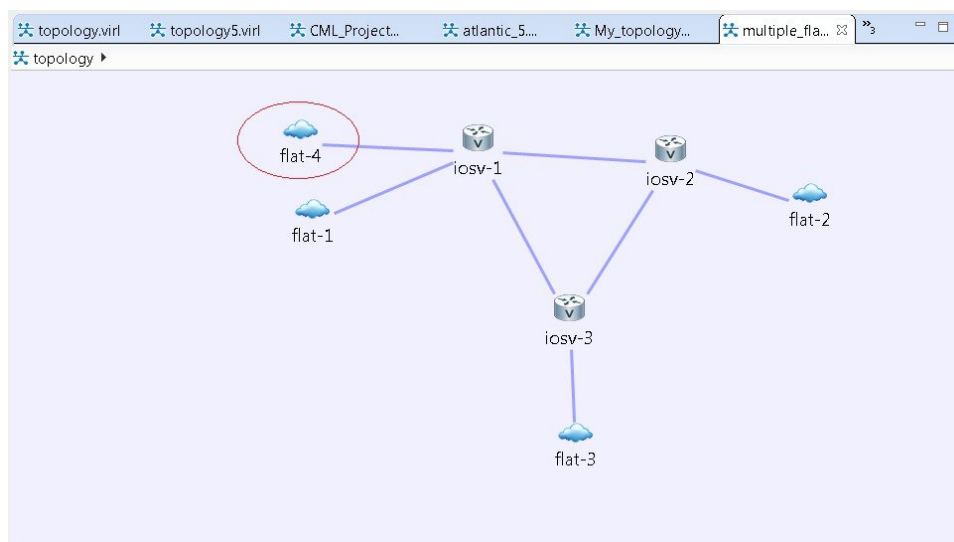


Add an Additional FLAT Network to a Simulation

The following procedure describes how to configure a second FLAT network to your simulation. A FLAT network uses Layer 2 connectivity, in which the IP address information about your virtual network can be viewed externally.

Step 1 With your topology open on the canvas, click the **L2 External (FLAT)** icon to add another FLAT network to your topology, as shown.

Figure 1: Add an Additional FLAT Network



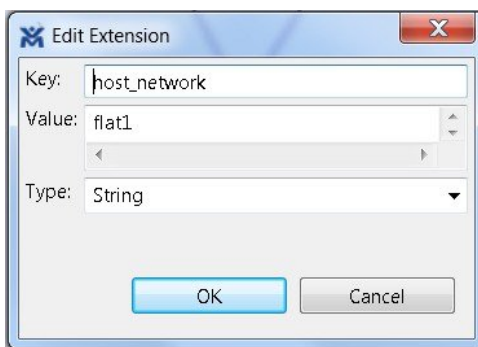
Step 2 Click the FLAT network just added, and in the **Extensions** tab in the **Properties** view, click the **Add new extension** icon.

The **Edit extension** dialog box is displayed.

Step 3 Add the following details for the new extension and click **OK**.

- **Key:** `host_network`
- **Value:** `flat1`
- **Type:** `String`

Figure 2: Edit Extension Dialog Box



Note You must add this new extension for the second FLAT network, as a second interface is not permitted in the same subnet. This FLAT network is in the **flat1** subnet.

Step 4 From the toolbar, click the **Build Initial Configurations** tool.

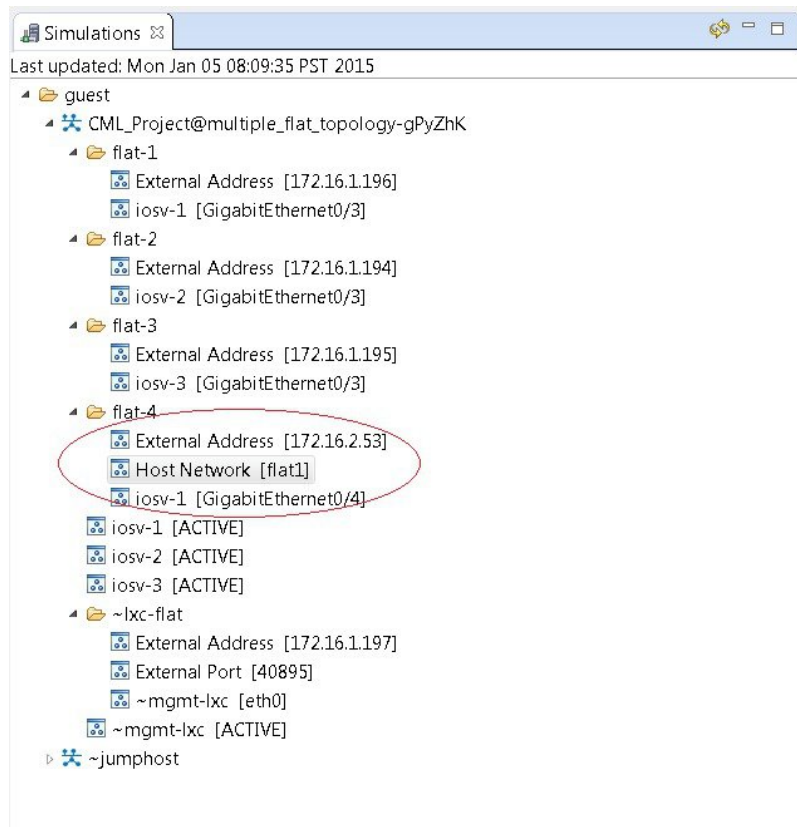
Note For the purpose of this task, you may retain the default settings.

During the simulation phase, the system automatically assigns an IP address to the node interface that is connected to the FLAT cloud.

Step 5 After the build phase is completed, start the simulation by clicking the **Launch Simulation** tool in the toolbar, and then change to the **Simulation** perspective.

The IP addresses assigned to each of the interfaces in the FLAT network and connected to each node, are displayed in the **Simulations** view. These IP addresses are automatically applied to the nodes when they become active.

Figure 3: Flat1 Subnet



Step 6 Regarding the node that has two FLAT network connections, when its state has changed to **[ACTIVE]**, log in to said node.

Step 7 Enter the command `show ip interface bri` to view all interfaces available to the node.

Figure 4: Viewing the FLAT Networks


```

iosv-1 (Management (via LXC)) - guest.CML_Project@multiple_fl... Console
SSH: (guest@172.23.81.12440953 - CONNECTED)

Password:
*****
* IOSv is strictly limited to use for evaluation, demonstration and
* education. IOSv is provided as-is and is not supported by Cisco's
* Technical Advisory Center. Any use or disclosure, in whole or in p
* of the IOSv Software or Documentation to any third party for any
* purposes is expressly prohibited except as otherwise authorized by
* Cisco in writing.
*****
iosv-1>en
Password:
iosv-1#show ip interface bri
Interface                IP-Address      OK? Method Status
-----
GigabitEthernet0/0       10.255.0.3      YES NVRAM  up
GigabitEthernet0/1       10.0.0.9        YES NVRAM  up
GigabitEthernet0/2       10.0.0.13       YES NVRAM  up
GigabitEthernet0/3       172.16.1.196    YES NVRAM  up
GigabitEthernet0/4       172.16.2.53     YES NVRAM  up
Loopback0                192.168.0.1     YES NVRAM  up
iosv-1#

```

You can see that the node has a connection into each of the external FLAT connectivity networks, 172.16.1.196 and 172.16.2.53.

Set Up a FLAT Network for Inband Access

The following procedure describes how to connect your virtual network topology to physical devices that are external to the Cisco Modeling Labs server environment. In this procedure, you will be configuring a FLAT network. A FLAT network uses Layer 2 connectivity in which the IP address information about your virtual network can be viewed externally.

Before You Begin

- Ensure that the system administrator has configured the Cisco Modeling Labs server to allow FLAT connections.
- Ensure that you obtain the IP address of the default gateway from the system administrator.
- Ensure that you have the IP address of the external device to which the nodes will connect.

**Note**

We recommend that you first draw your intended design, and then label the devices with the appropriate IP addresses.

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- Step 1** Log in to the Cisco Modeling Labs client.
- Step 2** Verify you have connectivity to the Cisco Modeling Labs server.
- Step 3** Open the **Design** perspective, if it is not already open.
- Step 4** Open an existing topology or create your network topology. See [Create a Topology](#) for information on how to do this.
- Step 5** Click on the canvas to open the **Topology** tab in the **Properties** view and ensure that **Management Network** displays **<not specified>**.
- Step 6** From the **Palette** view, under **General**, click the **L2 External FLAT** tool, and then click the canvas to add one FLAT cloud network icon to each corresponding node icon on the canvas.
- Step 7** From the **Palette** view, under **Tools**, click the **Connect** tool and connect the **L2 External FLAT** to the desired nodes.
- Note** L2 External FLAT connections can only be assigned to one interface on one node.
- Step 8** From the toolbar, click the **Build Initial Configurations** tool.
- Note** For the purpose of this task, you may retain the default settings.
- The system automatically assigns an IP address to the node interface that is connected to the FLAT cloud during the **Simulation** phase, not the **Build** phase.
- Step 9** After the build phase is completed, start the simulation by clicking the **Launch Simulation** tool in the toolbar, and then change to the **Simulation** perspective.
- Step 10** Log in to the node that is connected to the FLAT network when its state has changed to ACTIVE.
- Step 11** View the IP address assigned to the FLAT network and determine if it is on the same subnet as the gateway IP address provided by your system administrator. The L2 external address for each node can be viewed from the **Simulations** view or from each individual node.
- If yes, continue to Step 12.
 - If no, advise your system administrator and request the correct gateway IP address.
- Step 12** If the external device is on a different subnet, define a default gateway or a broadcast domain that points to the IP address of the gateway that the system administrator supplies.
- Prior to completing this step, if you do a **show route**, you will see that no default gateway is defined in the node. This is the default set up. This step allows you to inform the node what path to take in order to reach the external environment via the gateway. An alternative to defining a gateway or static route, with IOSv devices, is to enable DHCP on the interface used for external connectivity.
- Note** Not all virtual images support DHCP. Check the supported features for the virtual images to determine which ones do support DHCP.
- Step 13** Test the connection by pinging from the node to the external (physical) device. If required, turn on **debug ip icmp** or use the **tracert** command to see the progress through the network.
- Note** You must repeat steps 10-13 for each node that is connected to the FLAT network.

If the ping does not work, confirm with your system administrator that the Cisco Modeling Labs server is configured to support FLAT connectivity and that the gateway IP address you have been provided is correct.

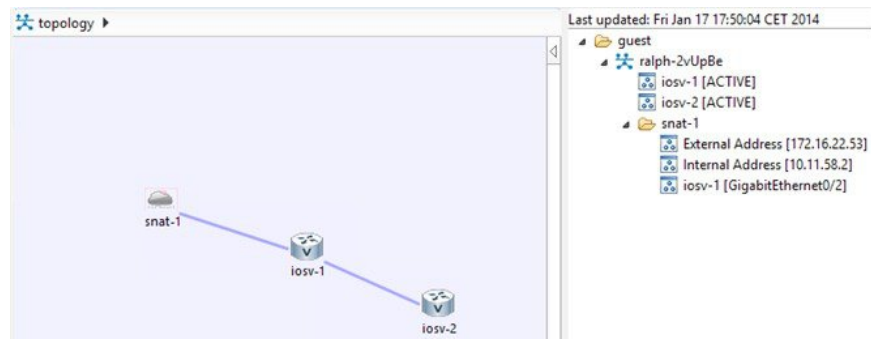
If these items are correct, ping to each of the key devices in the path to determine where the failure occurs and notify your system administrator of the failure source if it is outside your Cisco Modeling Labs environment.

Set Up a SNAT Network for Inband Access

SNAT functionality also allows connected nodes to connect to external devices. Using SNAT, the connectivity occurs at Layer 3 and allows you to hide the simulated virtual network behind a Static NAT address block. The Cisco Modeling Labs server will do a static IP address translation (hence SNAT), translating the private address range allocated to the SNAT 'inside' network into the IP network configured for the SNAT 'outside' network. By default, Cisco Modeling Labs uses an internal gateway function that acts as a SNAT router.

In the example used here, the iosv-1 GE 0/2 interface has two IP addresses. The addresses on the 172.16.22.0 subnet are reachable from the external devices and will be translated to the internal addresses which are on the 10.11.58.0 network.

Figure 5: SNAT Functionality



Using SNAT, the iosv-1 host will have an internal IP address from the 10.11.58.0 infrastructure network on its interface facing the SNAT cloud (10.11.58.2). This will be mapped by the SNAT router for that segment into 172.16.22.53. Assuming that the SNAT interface is connected and there is another host on that segment, such as a gateway, you can now connect to the iosv-1 router via the 172.16.22.53 address.



Note

No default gateway is created on the IOSv router. A static route must be added to the iosv-1 router configuration similar to the following example:

ip route 0.0.0.0 0.0.0.0 10.11.58.1

where 0.0.0.0 0.0.0.0 refers to all destination IP addresses not found in the routing table and 10.11.58.1 refers to the SNAT router.

Before You Begin

- Ensure that the system administrator has configured the Cisco Modeling Labs server to allow SNAT connections.
- Ensure that the system administrator provides you with the internal and external IP addresses of the SNAT router.
- Ensure that you have the IP address to the default gateway.
- Ensure that you have the IP address of the external device to which the nodes will connect.

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- Step 1** Log in to the Cisco Modeling Labs client.
- Step 2** Verify you have connectivity to the Cisco Modeling Labs server.
- Step 3** Open the **Design** perspective, if it is not already open.
- Step 4** Open an existing topology or create your network topology. See [Create a Topology](#) for information on how to do this.
- Step 5** Click on the canvas to open the **Topology** tab in the **Properties** view and ensure that **Management Network** displays **<not specified>**.
- Step 6** From the **Palette** view, under **General**, click the **L3 External SNAT** tool, and then click the canvas to add one SNAT cloud network icon to each corresponding node icon on the canvas.
- Step 7** From the **Palette** view, under **Tools**, click the **Connect** tool and connect the **L3 External SNAT** to the desired nodes.
- Note** L3 External SNAT connections can only be assigned to one interface on one node.
- Step 8** From the toolbar, click the **Build Initial Configurations** tool.
- Note** For the purpose of this task, you may retain the default settings.
- The system automatically assigns the internal and external IP addresses to the node interface that is connected to the SNAT cloud during the **Simulation** phase, not the **Build** phase. Therefore, no assigned addresses are visible at this point.
- Step 9** After the build phase is completed, start the simulation by clicking the **Launch Simulation** tool in the toolbar, and then change to the **Simulation** perspective.
- Step 10** Log in to the node that is connected to the SNAT network when the status of the device has changed to ACTIVE.
- Step 11** Create a static route or define a default gateway for the external connection IP addresses that point to the SNAT router's internal IP address. For example, if the external connections are part of the subnet 172.16.2.0/24, and the SNAT router's internal IP address is 10.11.11.1, then the route statement would be:
- ```
ip route 172.16.2.0 255.255.255.0 10.11.11.1
```
- An alternative to defining a gateway or static route, with IOSv devices, is to enable DHCP on the interface used for external connectivity.
- Note** Not all virtual images support DHCP. Check the supported features for the virtual images to determine which ones do support DHCP.
- Step 12** Test the connection by pinging from the node to the external (physical) device. If required, turn on **debug ip icmp** or use the **tracert** command to see the connectivity between the end points.
- If the ping does not work, confirm with your system administrator that the Cisco Modeling Labs server is configured to support SNAT connectivity and that the gateway IP address you have been provided is correct.

If these items are correct, ping to each of the key devices in the path to determine where the failure occurs and notify your system administrator of the failure source if it is outside your Cisco Modeling Labs environment.

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