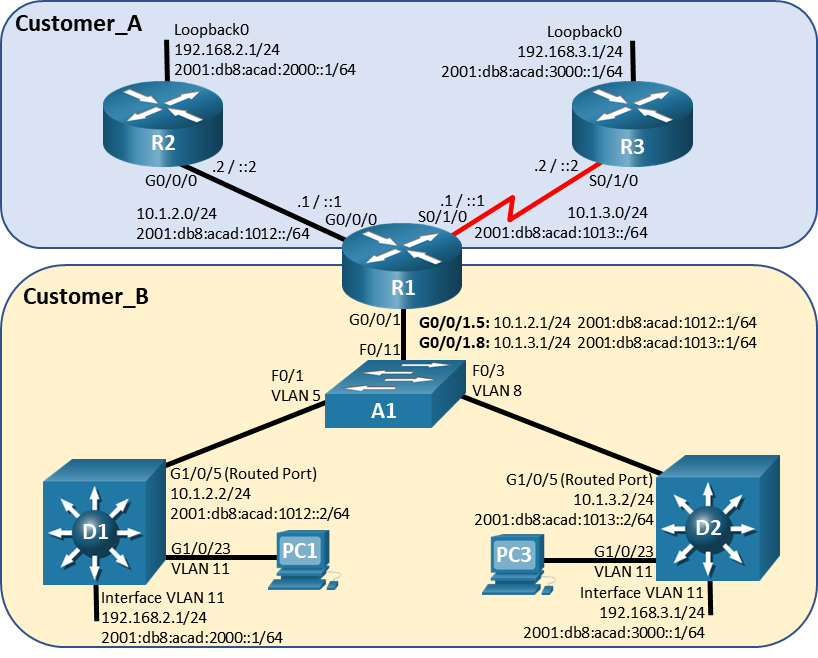
Lab - Implement VRF-Lite

Topology



# Addressing Table

| Device | Interface | IPv4 Address | IPv6 Address | IPv6 Link-Local |
| --- | --- | --- | --- | --- |
| R1 | G0/0/0 | 10.1.2.1/24 | 2001:db8:acad:1012::1/64 | fe80::1:1 |
| R1 | G0/0/1.5 | 10.1.2.1/24 | 2001:db8:acad:1012::1/64 | fe80::1:2 |
| R1 | G0/0/1.8 | 10.1.3.1/24 | 2001:db8:acad:1013::1/64 | fe80::1:4 |
| R1 | S0/1/0 | 10.1.3.1/25 | 2001:db8:acad:1013::1/64 | fe80::1:2 |
| R2 | G0/0/0 | 10.2.3.2/24 | 2001:db8:acad:1023::2/64 | fe80::2:1 |
| R2 | Loopback0 | 192.168.2.1/24 | 2001:db8:acad:2000::1/64 | fe80::2:2 |
| R3 | S0/1/0 | 10.1.3.3/25 | 2001:db8:acad:1013::3/64 | fe80::3:1 |
| R3 | Loopback0 | 192.168.3.1/27 | 2001:db8:acad:3000::1/64 | fe80::3:2 |
| D1 | G1/0/5 | 10.1.2.2/24 | 2001:db8:acad:1012::2/64 | fe80::d1:1 |
| D1 | VLAN 11 | 192.168.2.1/24 | 2001:db8:acad:2000::2/64 | fe80::d1:2 |
| D2 | G1/0/5 | 10.1.3.2/24 | 2001:db8:acad:1013::2/64 | fe80::d2:1 |
| D2 | VLAN 11 | 192.168.3.1/24 | 2001:db8:acad:3000::1/64 | fe80::d2:2 |

# Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Configure and Verify VRF and Interface Addressing

Part 3: Configure and Verify Static Routing for Reachability Inside Each VRF

# Background / Scenario

By default, all interfaces on a router are included in the global routing table. Service providers must be able to virtualize the router, thus creating multiple, virtual routing tables. Virtual Routing and Forwarding (VRF) can do just that. VRF-Lite is VRF without the MPLS component.

In this lab, you will work on R1, playing the part of a service provider router, as it supports two customers who have the same addressing scheme configured. Your task is to deploy VRF-Lite and static routing so that the customers have full reachability within their network.

**Note**: This lab is an exercise in developing, deploying, and verifying VRF-Lite, and does not reflect networking best practices.

**Note**: The routers and switches used with CCNP hands-on labs are Cisco 4221 and Cisco 3650, both with Cisco IOS XE Release 16.9.4 (universalk9 image), and Cisco 2960+ with IOS release 15.2 (lanbase image). Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and the output produced might vary from what is shown in the labs

**Note**: Ensure that the routers and switches have been erased and have no startup configurations. If you are unsure contact your instructor.

**Note**: The PCs used in this lab do not require addressing. They are needed to bring interface VLAN 11 up.

**Instructor Note**: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

# Required Resources

* 3 Routers (Cisco 4221 with Cisco IOS XE Release 16.9.4 universal image or comparable)
* 2 Switches (Cisco 3650 with Cisco IOS XE release 16.9.4 universal image or comparable)
* 1 Switch (Cisco 2960+ with Cisco IOS release 15.2 lanbase image or comparable)
* 2 PCs (Windows with a terminal emulation program, such as Tera Term)
* Console cables to configure the Cisco IOS devices via the console ports
* Ethernet and serial cables as shown in the topology

## Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on all devices.

### Cable the network as shown in the topology.

Attach the devices as shown in the topology diagram, and cable as necessary.

### Configure basic settings for each device.

* + - 1. Console into each device, enter global configuration mode, and apply the basic settings. A command list for each device using the following startup configurations.

Open configuration window

* + - 1. Set the clock on each router to UTC time.
      2. Save the running configuration to startup-config.

Close configuration window

## Configure and Verify VRF and Interface Addressing

In Part 2, you will configure and verify VRF-Lite on R1. The other devices, R2, R3, D1, D2, and A1 require no additional configuration. Once again, the configuration being used here is not meant to represent best practice, but to assess your ability to complete the required configurations.

### On R1, create the required VRFs.

* + - 1. Create the Customer\_A and Customer\_B VRFs, and initialize them for both IPv4 and IPv6. The VRF names are case sensitive.

Open configuration window

R1(config)# **vrf definition Customer\_A**

R1(config-vrf)# **address-family ipv4**

R1(config-vrf-af)# **address-family ipv6**

R1(config-vrf-af)# **exit**

R1(config-vrf)# **vrf definition Customer\_B**

R1(config-vrf)# **address-family ipv4**

R1(config-vrf-af)# **address-family ipv6**

R1(config-vrf-af)# **exit**

* + - 1. Configure interfaces G0/0/0 and S0/1/0 for the Customer\_A network.

R1(config)# **interface g0/0/0**

R1(config-if)# **vrf forwarding Customer\_A**

R1(config-if)# **ip address 10.1.2.1 255.255.255.0**

R1(config-if)# **ipv6 address fe80::1:1 link-local**

R1(config-if)# **ipv6 address 2001:db8:acad:1012::1/64**

R1(config-if)# **no shutdown**

R1(config-if)# **exit**

R1(config)# **interface s0/1/0**

R1(config-if)# **vrf forwarding Customer\_A**

R1(config-if)# **ip address 10.1.3.1 255.255.255.0**

R1(config-if)# **ipv6 address fe80::1:4 link-local**

R1(config-if)# **ipv6 address 2001:db8:acad:1013::1/64**

R1(config-if)# **no shutdown**

R1(config-if)# **exit**

* + - 1. Configure R1 interface G0/0/1 to support the Customer\_B networks. G0/0/1 will be performing inter-VLAN routing between VLANs 5 and 8.

R1(config)# **interface g0/0/1**

R1(config-if)# **no shutdown**

R1(config-if)# **exit**

R1(config)# **interface g0/0/1.5**

R1(config-subif)# **encapsulation dot1q 5**

R1(config-subif)# **vrf forwarding Customer\_B**

R1(config-subif)# **ip address 10.1.2.1 255.255.255.0**

R1(config-subif)# **ipv6 address fe80::1:2 link-local**

R1(config-subif)# **ipv6 address 2001:db8:acad:1012::1/64**

R1(config-subif)# **exit**

R1(config)# **interface g0/0/1.8**

R1(config-subif)# **encapsulation dot1q 8**

R1(config-subif)# **vrf forwarding Customer\_B**

R1(config-subif)# **ip address 10.1.3.1 255.255.255.0**

R1(config-subif)# **ipv6 address fe80::1:3 link-local**

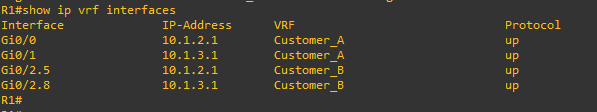
R1(config-subif)# **ipv6 address 2001:db8:acad:1013::1/64**

R1(config-subif)# **end**

### Verify the VRF-Lite configuration.

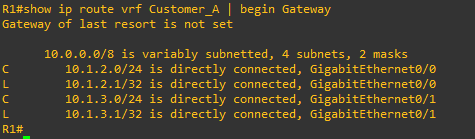
* + - 1. Verify the interface assignments using the **show ip vrf interfaces** command.

R1# **show ip vrf interfaces**

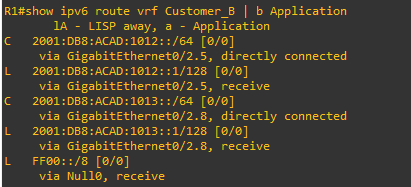


* + - 1. Verify the VRF routing tables with the **show ip route vrf** *vrf\_name* and **show ipv6 route vrf** *vrf\_name* command.

R1# **show ip route vrf Customer\_A | begin Gateway**

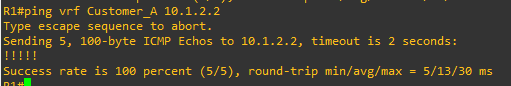


R1# **show ipv6 route vrf Customer\_B**

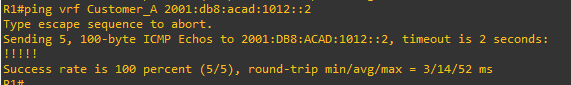


* + - 1. Verify next-hop reachability within each vrf with the **ping vrf** *vrf\_name* **address** command.

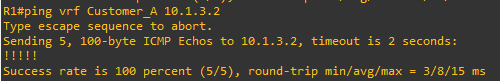
R1# **ping vrf Customer\_A 10.1.2.2**



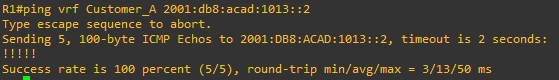
R1# **ping vrf Customer\_A 2001:db8:acad:1012::2**



R1# **ping vrf Customer\_A 10.1.3.2**



R1# **ping vrf Customer\_A 2001:db8:acad:1013::2**



Close configuration window

## Configure and Verify Static Routing for Reachability Inside Each VRF

In Part 3, you will configure static routing so that all networks are reachable within their respective VRFs. At the end of this part, R1 should be able to successfully source a ping from interface loopback0 to R3 interface loopback0, and D1 should be able to successfully source a ping from interface VLAN 11 to D2 interface VLAN 11. Once again, the way these networks are being implemented is not meant to represent best practice, but to assess your ability to complete the required configurations.

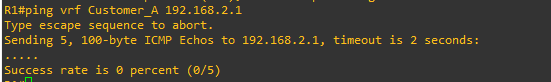
### Verify that distant networks are not reachable within each VRF.

In this step, you will check to make sure that distant networks are not reachable from R1 within each VRF.

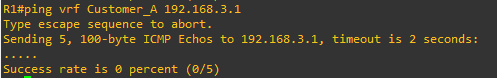
* + - 1. On R1, issue the commands **ping vrf Customer\_A 192.168.2.1** and **ping vrf Customer\_A 192.168.3.1**. Neither should succeed.

Open configuration window

R1# **ping vrf Customer\_A 192.168.2.1**

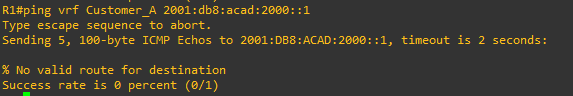


R1# **ping vrf Customer\_A 192.168.3.1**

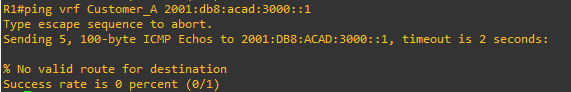


* + - 1. On R1, issue the commands **ping vrf Customer\_A 2001:db8:acad:2000::1** and **ping vrf Customer\_A 2001:db8:acad:3000::1**. Neither should succeed.

R1# **ping vrf Customer\_A 2001:db8:acad:2000::1**

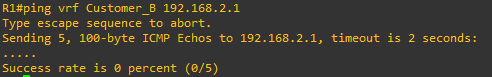


R1# **ping vrf Customer\_A 2001:db8:acad:3000::1**

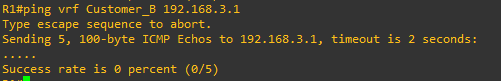


* + - 1. On R1, issue the commands **ping vrf Customer\_B 192.168.2.1** and **ping vrf Customer\_B 192.168.3.1**. Neither should succeed.

R1# **ping vrf Customer\_B 192.168.2.1**

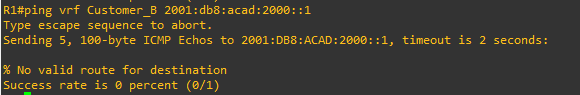


R1# **ping vrf Customer\_B 192.168.3.1**



* + - 1. On R1, issue the commands **ping vrf Customer\_B 2001:db8:acad:2000::1** and **ping vrf Customer\_B 2001:db8:acad:3000::1**. Neither should succeed.

R1# **ping vrf Customer\_B 2001:db8:acad:2000::1**



R1# **ping vrf Customer\_B 2001:db8:acad:3000::1**

### 

### Configure static routing at R1 for each VRF.

In this step, you will configure R1 so that it can reach distant networks in each VRF. The neighbor systems (D1, D2, R2, and R3) have static routes already configured, so as soon as you correctly install these static routes, there will be full reachability within each VRF.

* + - 1. On R1, create static routes for the distant networks in the Customer\_A VRF using the **ip route vrf** *vrf\_name destination\_network next-hop* command.

R1(config)# **ip route vrf Customer\_A 192.168.2.0 255.255.255.0 g0/0/0 10.1.2.2**

R1(config)# **ip route vrf Customer\_A 192.168.3.0 255.255.255.0 s0/1/0 10.1.3.2**

R1(config)# **ipv6 route vrf Customer\_A 2001:db8:acad:2000::/64 g0/0/0 2001:db8:acad:1012::2**

R1(config)# **ipv6 route vrf Customer\_A 2001:db8:acad:3000::/64 s0/1/0 2001:db8:acad:1013::2**

* + - 1. Use the example above to correctly configure fully specified static routes for the Customer\_B network.

R1(config)# **ip route vrf Customer\_B 192.168.2.0 255.255.255.0 GigabitEthernet0/0/1.5 10.1.2.2**

R1(config)# **ip route vrf Customer\_B 192.168.3.0 255.255.255.0 GigabitEthernet0/0/1.8 10.1.3.2**

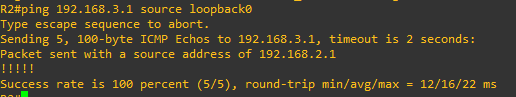
R1(config)# **ipv6 route vrf Customer\_B 2001:DB8:ACAD:2000::/64 GigabitEthernet0/0/1.5 2001:DB8:ACAD:1012::2**

R1(config)# **ipv6 route vrf Customer\_B 2001:DB8:ACAD:3000::/64 GigabitEthernet0/0/1.8 2001:DB8:ACAD:1013::2**

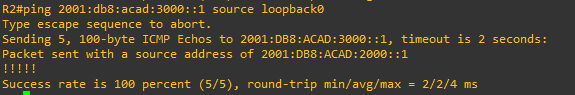
### Verify full reachability within each VRF.

* + - 1. On R2, ping the IPv4 and IPv6 addresses of R3 interface Loopback0 using a source address of R2 interface Loopback0. All pings should be successful.

R2# **ping 192.168.3.1 source loopback0**

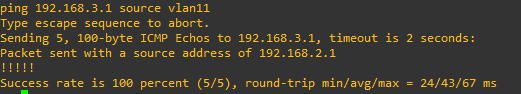


R2# **ping 2001:db8:acad:3000::1 source loopback0**

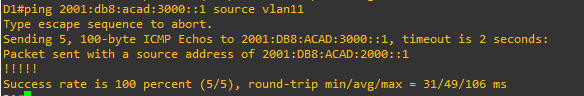


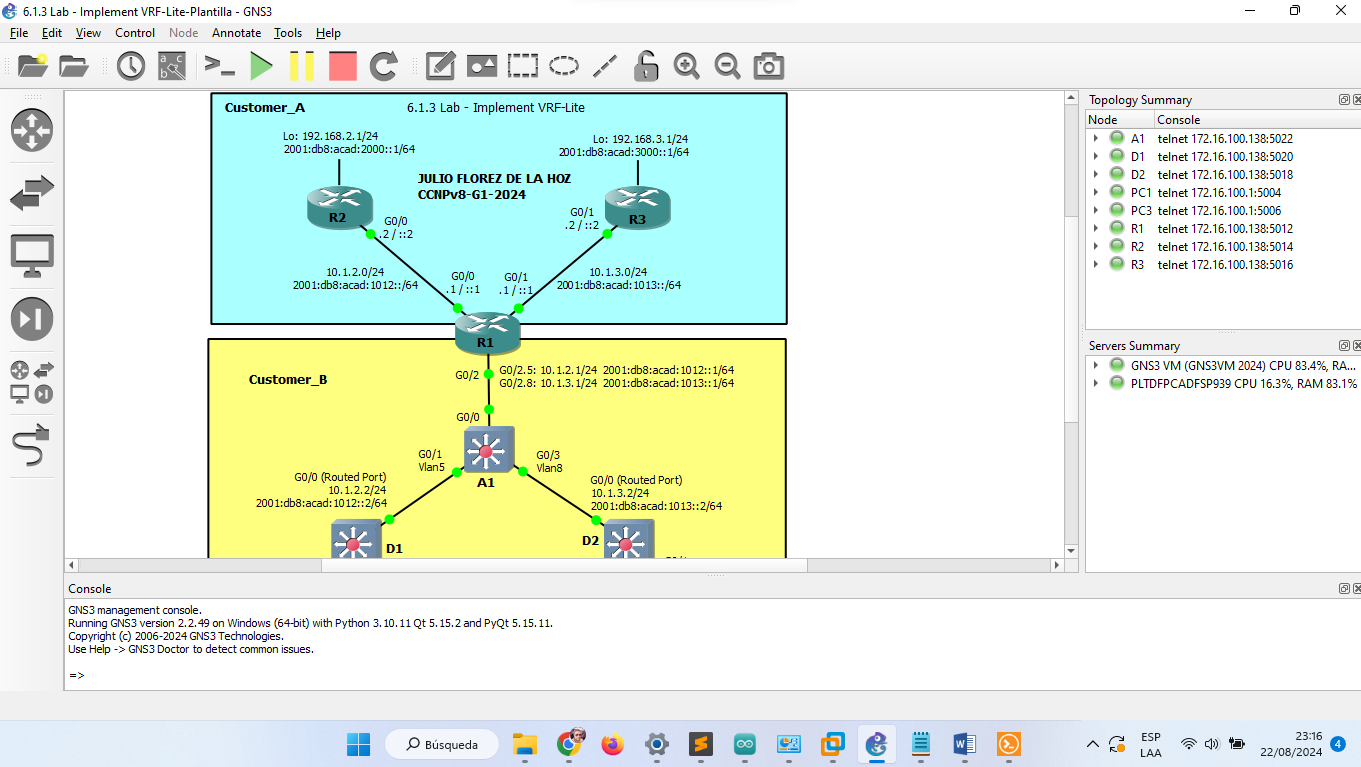
* + - 1. On D1, ping the IPv4 and IPv6 addresses of D2 interface VLAN 11 using a source address of D1 interface VLAN 11. All pings should be successful.

D1# **ping 192.168.3.1 source vlan11**



D1# **ping 2001:db8:acad:3000::1 source vlan11**





Close configuration window

# Router Interface Summary Table

| Router Model | Ethernet Interface #1 | Ethernet Interface #2 | Serial Interface #1 | Serial Interface #2 |
| --- | --- | --- | --- | --- |
| 1800 | Fast Ethernet 0/0 (F0/0) | Fast Ethernet 0/1 (F0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 1900 | Gigabit Ethernet 0/0 (G0/0) | Gigabit Ethernet 0/1 (G0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 2801 | Fast Ethernet 0/0 (F0/0) | Fast Ethernet 0/1 (F0/1) | Serial 0/1/0 (S0/1/0) | Serial 0/1/1 (S0/1/1) |
| 2811 | Fast Ethernet 0/0 (F0/0) | Fast Ethernet 0/1 (F0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 2900 | Gigabit Ethernet 0/0 (G0/0) | Gigabit Ethernet 0/1 (G0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 4221 | Gigabit Ethernet 0/0/0 (G0/0/0) | Gigabit Ethernet 0/0/1 (G0/0/1) | Serial 0/1/0 (S0/1/0) | Serial 0/1/1 (S0/1/1) |
| 4300 | Gigabit Ethernet 0/0/0 (G0/0/0) | Gigabit Ethernet 0/0/1 (G0/0/1) | Serial 0/1/0 (S0/1/0) | Serial 0/1/1 (S0/1/1) |

**Note**: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

End of document