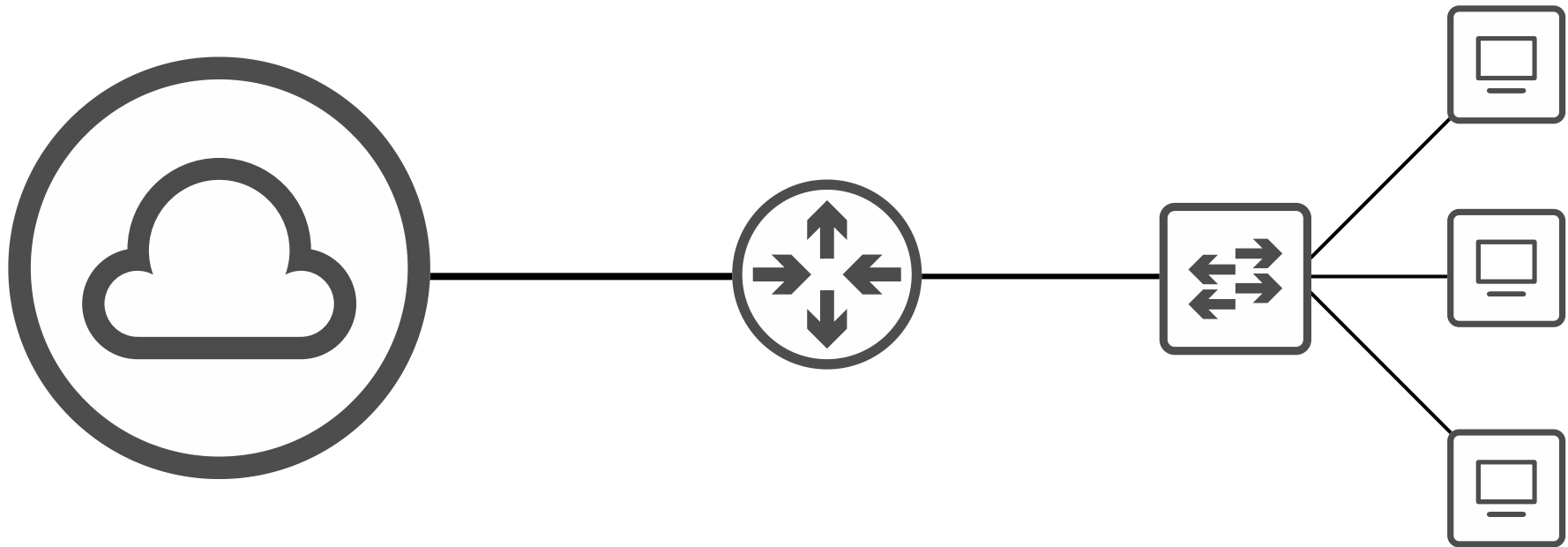


# CCNA

## Virtual Routing & Forwarding

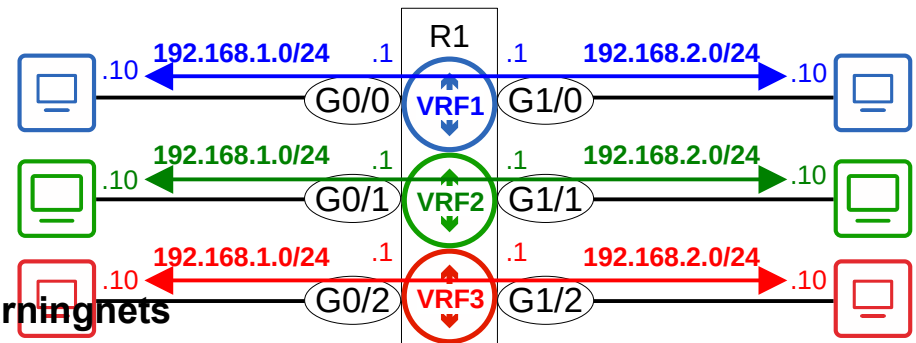


# Things we'll cover

- Intro to VRF
- VRF Configuration

# VRF

- **Virtual Routing & Forwarding** is used to divide a single router into multiple virtual routers.
  - Similar to how VLANs are used to divide a single switch (LAN) into multiple virtual switches (VLANs).
- It does this by allowing a router to build multiple separate routing tables.
  - Interfaces (Layer 3 only) & routes are configured to be in a specific **VRF** (aka *VRF Instance*).
  - Router interfaces, SVIs & routed ports on multilayer switches can be configured in a VRF.
- Traffic in one VRF cannot be forwarded out of an interface in another VRF.
  - As an exception, *VRF Leaking* can be configured to allow traffic to pass between VRF's.
- VRF is commonly used to facilitate MPLS.
  - The kind of VRF we are talking about is **VRF-lite** (VRF without MPLS).
- VRF is commonly used by service providers to allow one device to carry traffic from multiple customers.
  - Each customer's traffic is isolated from the others.
  - Customer IP addresses can overlap without issues.



# VRF Configuration

```
SPR1(config)# interface g0/0
SPR1(config-if)# ip address 192.168.1.1 255.255.255.252
SPR1(config-if)# no shutdown
```

```
SPR1(config-if)# interface g0/1
SPR1(config-if)# ip address 192.168.11.1 255.255.255.252
SPR1(config-if)# no shutdown
```

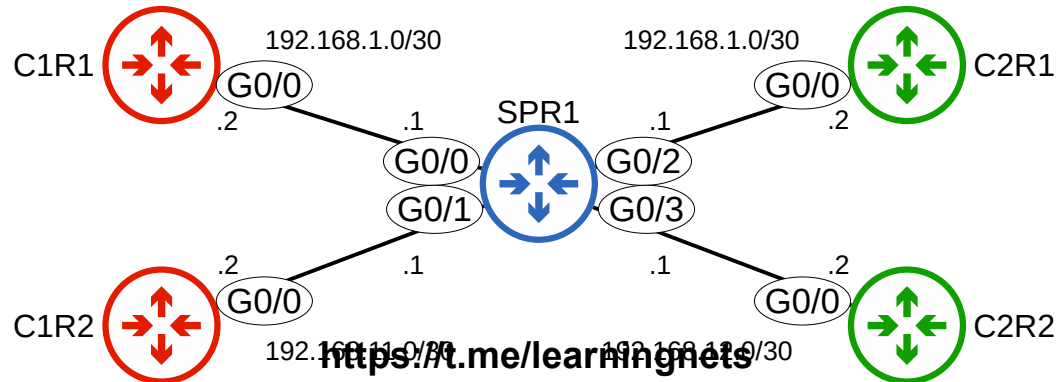
```
SPR1(config-if)# interface g0/2
SPR1(config-if)# ip address 192.168.1.1 255.255.255.252
% 192.168.1.0 overlaps with GigabitEthernet0/0
```

```
SPR1(config-if)# ip address 192.168.1.2 255.255.255.252
% 192.168.1.0 overlaps with GigabitEthernet0/0
```

G0/2 cannot use IP address 192.168.1.1 because it is in the same subnet as G0/0 (in this case it's the exact same IP address).

Even if the IP address is different, G0/2 cannot be configured in the same subnet as G0/0.

Without the use of VRF, two interfaces on the same router cannot be in the same subnet.



# VRF Configuration

```
SPR1(config)# ip vrf CUSTOMER1
SPR1(config-vrf)# ip vrf CUSTOMER2
SPR1(config-vrf)# do show ip vrf
```

Name	Default RD	Interfaces
CUSTOMER1	<not set>	
CUSTOMER2	<not set>	

```
SPR1(config-vrf)# interface g0/0
SPR1(config-if)# ip vrf forwarding CUSTOMER1
% Interface GigabitEthernet0/0 IPv4 disabled and address(es) removed due to enabling VRF CUSTOMER1
SPR1(config-if)# ip address 192.168.1.1 255.255.255.252
```

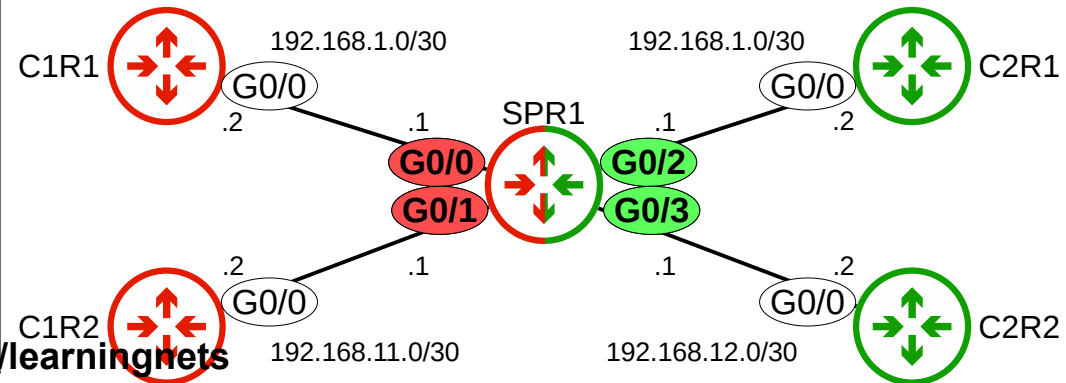
```
SPR1(config-if)# interface g0/1
SPR1(config-if)# ip vrf forwarding CUSTOMER1
% Interface GigabitEthernet0/1 IPv4 disabled and address(es) removed due to enabling VRF CUSTOMER1
SPR1(config-if)# ip address 192.168.11.1 255.255.255.252
```

```
SPR1(config-if)# interface g0/2
SPR1(config-if)# ip vrf forwarding CUSTOMER2
SPR1(config-if)# ip address 192.168.1.1 255.255.255.252
SPR1(config-if)# no shutdown
SPR1(config-if)# interface g0/3
SPR1(config-if)# ip vrf forwarding CUSTOMER2
SPR1(config-if)# ip address 192.168.12.1 255.255.255.252
SPR1(config-if)# no shutdown
SPR1(config-if)# do show ip vrf
```

Name	Default RD	Interfaces
CUSTOMER1	<not set>	Gi0/0 Gi0/1
CUSTOMER2	<not set>	Gi0/2 Gi0/3

1. Create VRFs:  
SPR1(config)# ip vrf name
2. Assign interfaces to VRFs:  
SPR1(config-if)# ip vrf forwarding name

If an interface has an IP address configured, the IP address will be removed when you assign the interface to a VRF.



# VRF Configuration

```

SPR1# show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PFR
  
```

Gateway of last resort is not set

```

SPR1# show ip route vrf CUSTOMER1
  
```

Routing Table: CUSTOMER1  
!output omitted

```

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/30 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0
192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.11.0/30 is directly connected, GigabitEthernet0/1
L    192.168.11.1/32 is directly connected, GigabitEthernet0/1
  
```

```

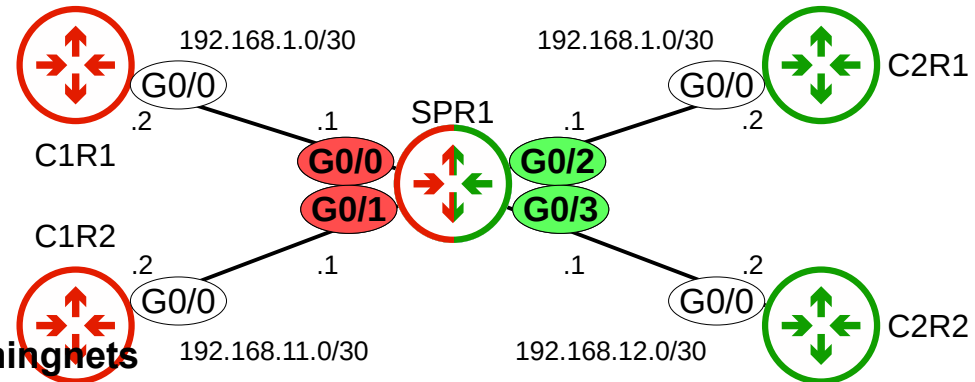
SPR1# show ip route vrf CUSTOMER2
  
```

Routing Table: CUSTOMER2  
!output omitted

```

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/30 is directly connected, GigabitEthernet0/2
L    192.168.1.1/32 is directly connected, GigabitEthernet0/2
192.168.12.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.12.0/30 is directly connected, GigabitEthernet0/3
L    192.168.12.1/32 is directly connected, GigabitEthernet0/3
  
```

**show ip route** displays the *global routing table*.  
 \*All of SPR1's interfaces are configured in VRFs, so nothing displays here.  
 \*You can have a mix of interfaces using and not using VRFs.



# VRF Configuration

```
SPR1# ping 192.168.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

```
SPR1# ping vrf CUSTOMER1 192.168.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

```
SPR1# ping vrf CUSTOMER1 192.168.11.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.11.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

```
SPR1# ping vrf CUSTOMER1 192.168.12.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.12.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

```
SPR1# ping vrf CUSTOMER2 192.168.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

```
SPR1# ping vrf CUSTOMER2 192.168.12.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.12.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

C1R1

C2R1

```
SPR1# show ip route vrf CUSTOMER1
```

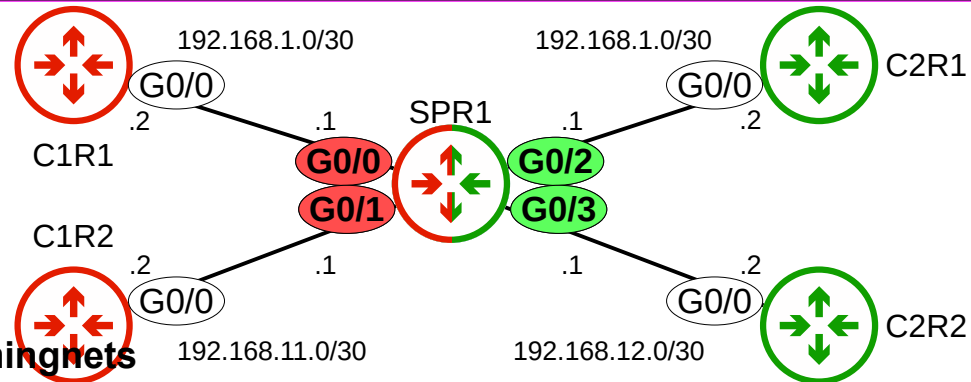
```
Routing Table: CUSTOMER1
!output omitted
```

```
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/30 is directly connected, GigabitEthernet0/0
L    192.168.1.1/32 is directly connected, GigabitEthernet0/0
192.168.11.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.11.0/30 is directly connected, GigabitEthernet0/1
L    192.168.11.1/32 is directly connected, GigabitEthernet0/1
```

```
SPR1# show ip route vrf CUSTOMER2
```

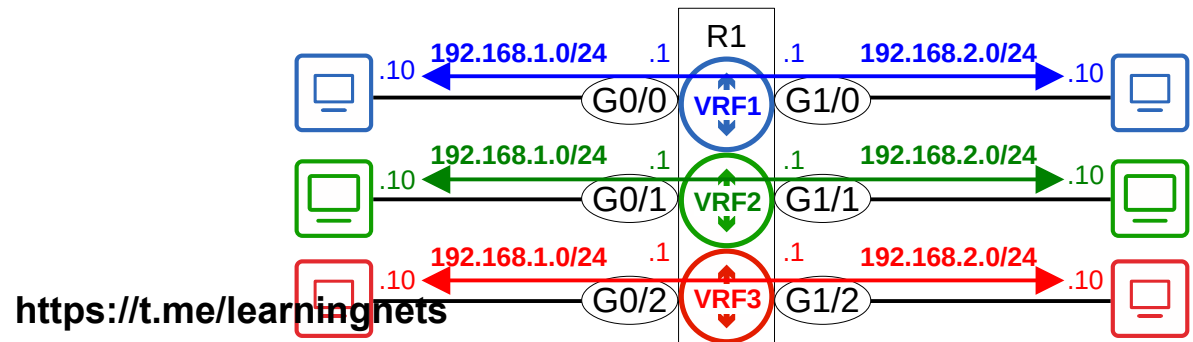
```
Routing Table: CUSTOMER2
!output omitted
```

```
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.1.0/30 is directly connected, GigabitEthernet0/2
L    192.168.1.1/32 is directly connected, GigabitEthernet0/2
192.168.12.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.12.0/30 is directly connected, GigabitEthernet0/3
L    192.168.12.1/32 is directly connected, GigabitEthernet0/3
```



# Things we covered

- Intro to VRF
- VRF Configuration



You issue the following commands on R1's G0/0 interface:

```
R1(config)# interface g0/0
R1(config-if)# ip address 192.168.1.1 255.255.255.252
R1(config-if)# ip vrf forwarding VRF1
```

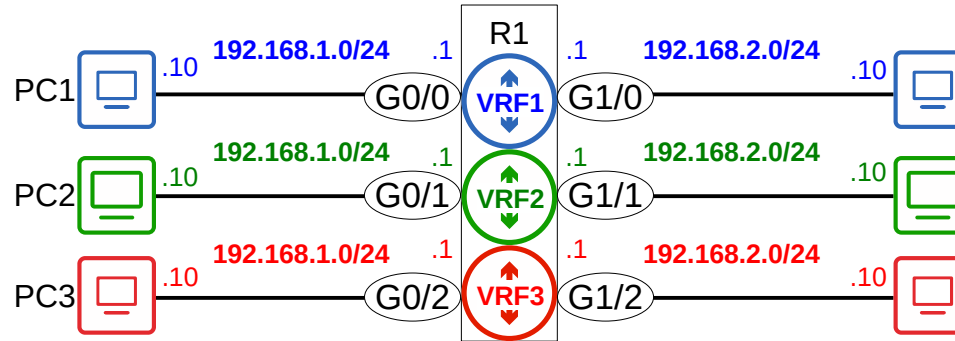
However, after issuing **show ip interface brief** you notice that G0/0 does not have an IP address. Why is that?

- a) You must use the command **ip address 192.168.1.1 255.255.255.252 vrf VRF1**.
- b) The IP address was removed by the **ip vrf forwarding VRF1** command.
- c) You must use **show ip route vrf VRF1** to view the IP address.
- d) VRF1 doesn't exist yet.

```
R1(config)# interface g0/0
R1(config-if)# ip address 192.168.1.1 255.255.255.252
R1(config-if)# ip vrf forwarding VRF1
% Interface GigabitEthernet0/0 IPv4 disabled and address(es) removed due to enabling VRF VRF1
```

# Quiz 2

Examine the network below. If you issue the command `ping 192.168.1.10` on R1, which device will respond?



- a) PC1
- b) PC2
- c) PC3
- d) No device will respond.

Which of the following statements about VLANs and VRFs are true? (select three)

- a) VRFs divide routers up by creating separate broadcast domains.
- b) VLANs divide switches up by creating separate MAC address tables.
- c) VRFs divide routers up by creating separate routing tables.
- d) VLANs divide switches up by creating separate broadcast domains.
- e) VRFs can only be configured on routers.
- f) Router interfaces in different VRFs can have the same IP address.