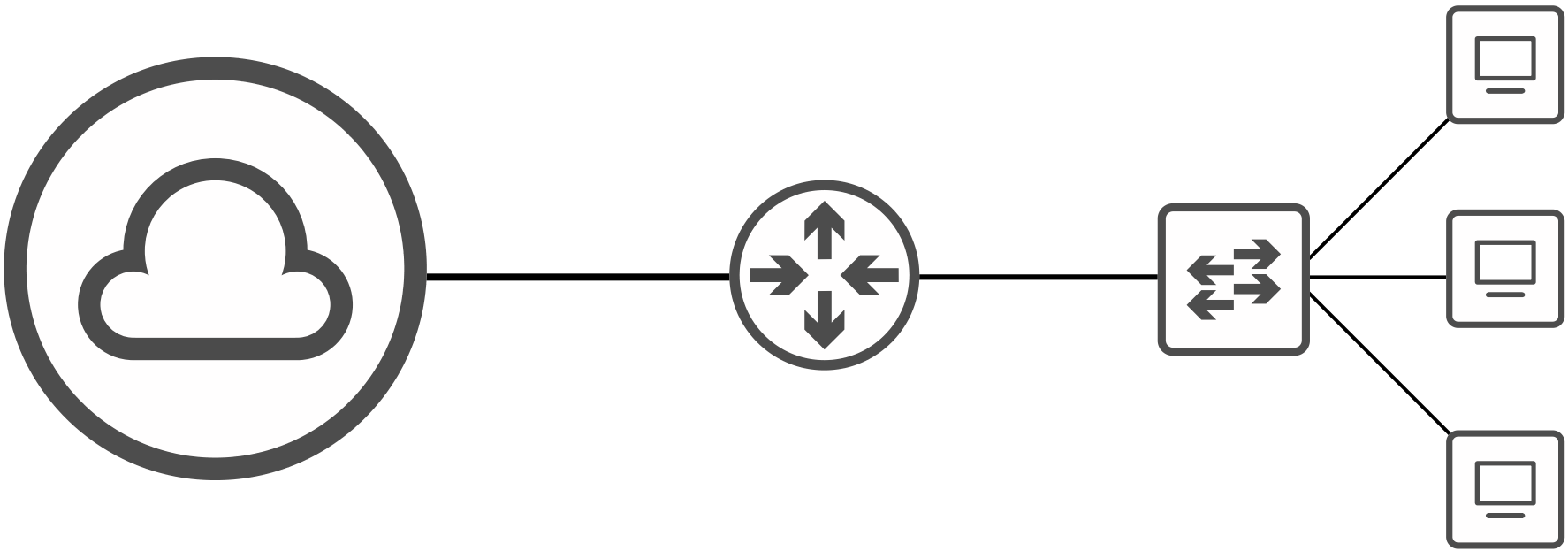
JEREMY'S IT LAB

CCNA

Virtual Routing & Forwarding



Things we'll cover

- Intro to VRF
- VRF Configuration

VRF

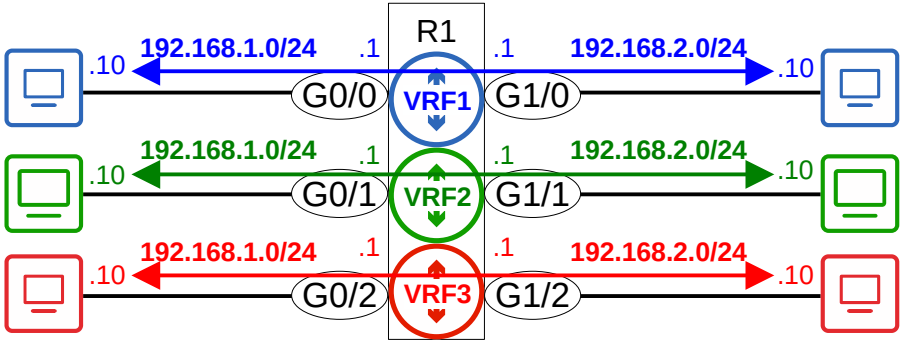
- **Virtual Routing & Forwarding** is used to divide a single router into multiple virtual routers.
  → Similar to how VLANs are used to divide a single switch (LAN) into multiple virtual switches (VLANs).

- 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.



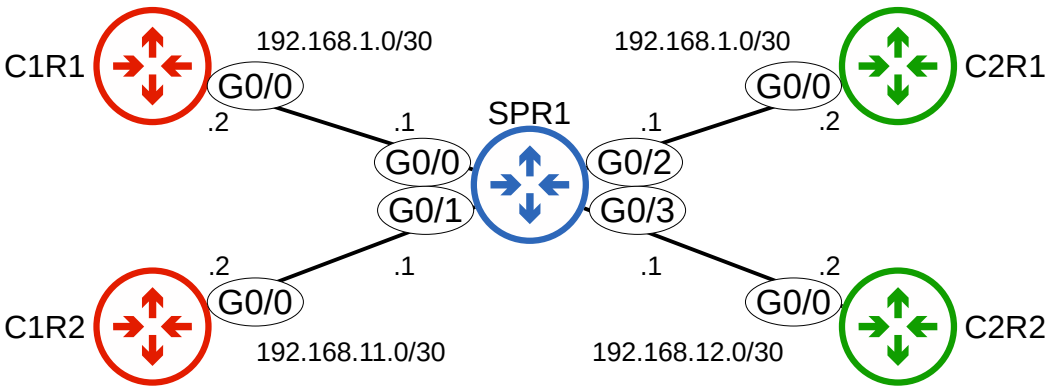
VRF Configuration

```
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.

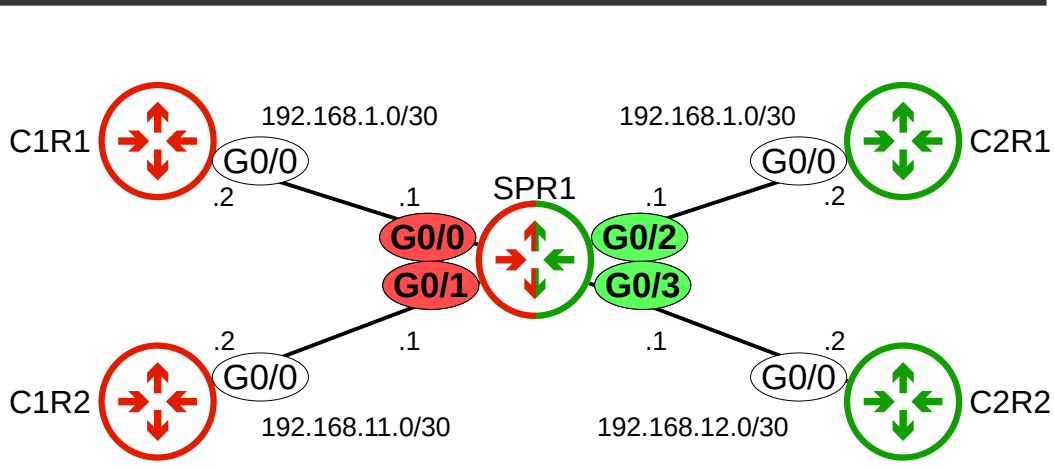


VRF Configuration

```
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`

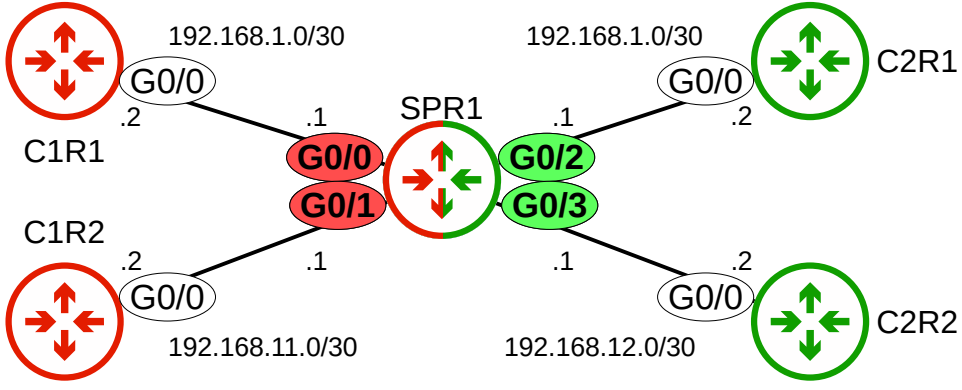
If an interface has an IP address configured, the IP address will be removed when you assign the interface to a VRF.



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

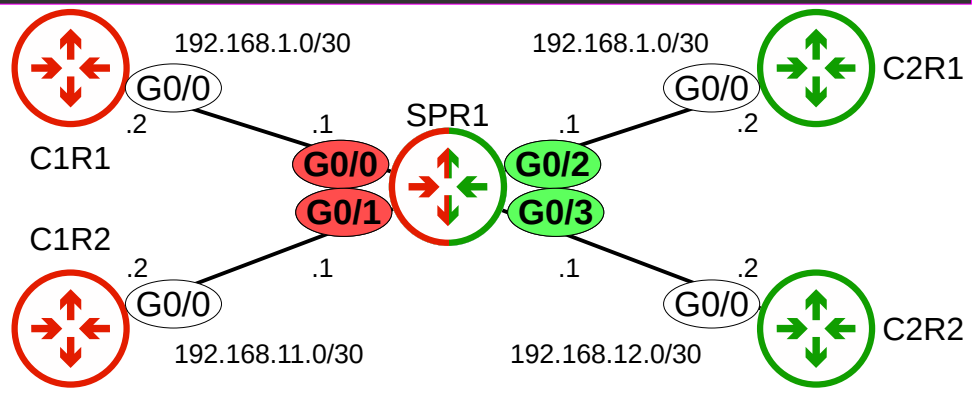
```
SPR1# ping 192.168.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

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)
```

C1R1

```
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
```

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

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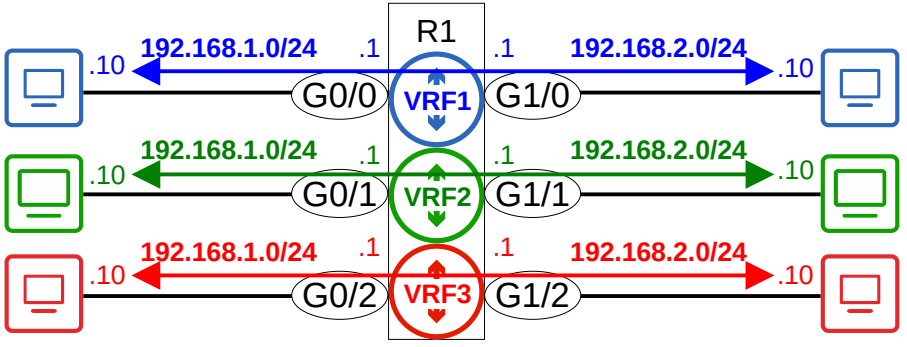
- VRF Configuration



Quiz 1

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.

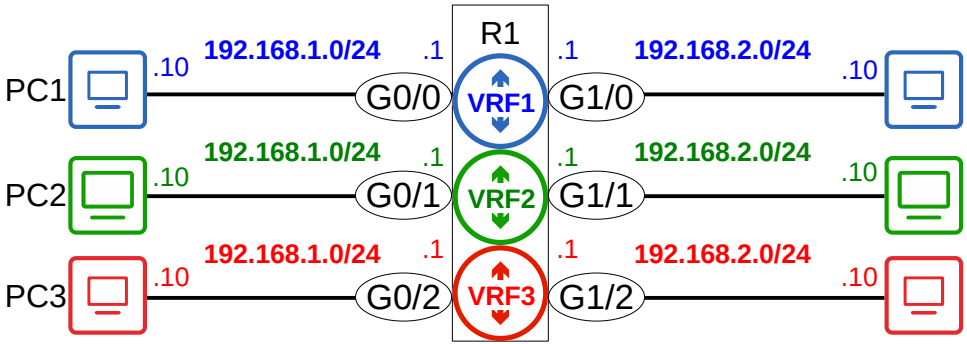
c) You must use **`show ip route vrf VRF1`** to view the IP address.

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.

Quiz 3

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.