# 19(A). Router On A Stick

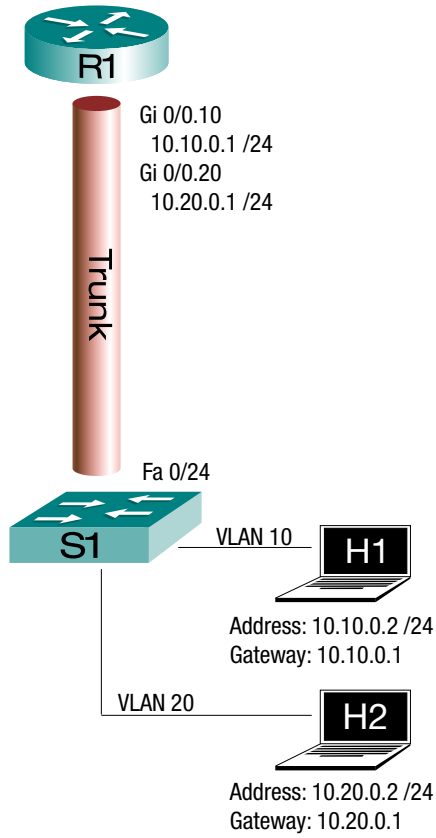


ROAS (Router On A Stick)—a conceptually simple approach to routing between L2 VLANs. The VLANs are delivered to the router via an Ethernet trunk, separated by 802.1Q. On arrival, they are shunted to subinterfaces based on their 802.1Q VLAN tags and the router routes between those subinterfaces based on destination IP address, just like normal.

802.1Q tags stretch the header by inserting a 32-bit (4-byte) tag into a normal Ethernet header. 802.1Q-compliant recipients know to expect that an 802.1Q frame may occasionally be oversized by up to those 4 bytes.

Native VLAN—one of the VLANs on the trunk can be designated as "native." Its frames will receive no tag and will be just a normal Ethernet frame. This copes with devices that don't understand VLANs, yet are on the trunk's network segment (perhaps a hub between the router and switch has a printer on one of its ports).

Bonus Information—Devices can tell the difference between an 802.1Q frame and a normal Ethernet frame because the 4-byte header happens to be inserted right before the EtherType header field, pushing it to the right. The first part of the 802.1Q tag is just a flag, sitting where the EtherType field would have been, screaming "I'm an 802.1Q frame."




EXAMPLE

One possible configuration to support the diagram at the top-right of this page follows. VLAN 10 is designated as native across the trunk (highlighted on lines 6 and 12).

| | ROUTER R1 | SWITCH S1 |
|---|---|---|
| 1 | `interface GigabitEthernet0/0` | `interface FastEthernet0/1` |
| 2 | `  description Trunk to S1` | `  switchport access vlan 10` |
| 3 | `  no ip address` | `  switchport mode access` |
| 4 | `!` | `!` |
| 5 | `interface GigabitEthernet0/0.10` | `interface FastEthernet0/2` |
| 6 | `  encapsulation dot1Q 10 native` | `  switchport access vlan 20` |
| 7 | *The 10 names the VLAN* | `  switchport mode access` |
| 8 | `  ip address 10.10.0.1 255.255.255.0` | `!` |
| 9 | `!` | `interface FastEthernet0/24` |
| 10 | `interface GigabitEthernet0/0.20` | `  description Trunk to R1` |
| 11 | `  encapsulation dot1Q 20` | `  switchport trunk encapsulation dot1q` |
| 12 | `  ip address 10.20.0.1 255.255.255.0` | `  switchport trunk native vlan 10` |
| 13 | | `  switchport mode trunk` |

Another, older way of designating the native VLAN on the router is to simply allow those untagged frames to arrive on the underlying interface (Gi0/0 in this case). You can put an IP address there if you want to route them at L3. If only L2 protocols like CDP are involved, you can skip that.

## VERIFICATION

On your router, the command "show ip route" will tell you what's happening at L3 with your subinterfaces.

```
1  R1# show ip route
2                       Codes legend and gateway of last resort omitted
3        10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
4  C        10.10.0.0/24 is directly connected, GigabitEthernet0/0.10
5  L        10.10.0.1/32 is directly connected, GigabitEthernet0/0.10
6  C        10.20.0.0/24 is directly connected, GigabitEthernet0/0.20
7  L        10.20.0.1/32 is directly connected, GigabitEthernet0/0.20
```

To see what's happening with the VLANs on your router, you can use the command "show vlans."

```
1  R1# show vlans
2
3  Virtual LAN ID:  1 (IEEE 802.1Q Encapsulation)
4
5     vLAN Trunk Interface:   GigabitEthernet0/0
6
7     Protocols Configured:   Address:              Received:        Transmitted:
8          Other                                         0                  263
9
10    15 packets, 5760 bytes input
11    263 packets, 18380 bytes output
12
13 Virtual LAN ID:  10 (IEEE 802.1Q Encapsulation)
14
15    vLAN Trunk Interface:   GigabitEthernet0/0.10
16
17  This is configured as native Vlan for the following interface(s) :
18 GigabitEthernet0/0
19
20    Protocols Configured:   Address:              Received:        Transmitted:
21            IP              10.10.0.1                9721                9487
22         Other                                         0                  12
23
24    9796 packets, 1149364 bytes input
25    9499 packets, 1083272 bytes output
26
27 Virtual LAN ID:  20 (IEEE 802.1Q Encapsulation)
28
29    vLAN Trunk Interface:   GigabitEthernet0/0.20
30
31    Protocols Configured:   Address:              Received:        Transmitted:
32            IP               10.20.0.1               9654                9482
33         Other                                         0                  13
34
35    9654 packets, 1139064 bytes input
36    9495 packets, 1120724 bytes output
```

If you have a big enough screen to cope, this command will tell you which VLAN is on which subinterface with what IP address and which VLAN is native on the trunk [lines 17-18]. It also happens to tell you that Cisco's default VLAN for things like CDP, VLAN 1, is automatically being handled by the underlying interface, Gi0/0 [Lines 3-11].

On the switch, "show interfaces status" will tell you everything except the native VLAN on the trunk.

```
1  S1# show interfaces status
2
3  Port      Name               Status       Vlan       Duplex  Speed Type
4  Fa0/1                        connected    10         a-full  a-100 10/100BaseTX
5  Fa0/2                        connected    20         a-full  a-100 10/100BaseTX
6  …
7  Fa0/24    TRUNK TO R1        connected    trunk      a-full  a-100 10/100BaseTX
```

To learn the native VLAN on the trunk, you'll need the "switchport" option on the "show interfaces" command:

```
1  S1# show interfaces fa0/24 switchport
2  Name: Fa0/24
3  Switchport: Enabled
4  Administrative Mode: trunk
5  Operational Mode: trunk
6  Administrative Trunking Encapsulation: dot1q
7  Operational Trunking Encapsulation: dot1q
8  Negotiation of Trunking: On
9  Access Mode VLAN: 1 (default)
10 Trunking Native Mode VLAN: 10 (VLAN0010)
11 Administrative Native VLAN tagging: enabled
12 Voice VLAN: none
13 Administrative private-vlan host-association: none
14 Administrative private-vlan mapping: none
15 Administrative private-vlan trunk native VLAN: none
16 Administrative private-vlan trunk Native VLAN tagging: enabled
17 Administrative private-vlan trunk encapsulation: dot1q
18 Administrative private-vlan trunk normal VLANs: none
19 Administrative private-vlan trunk associations: none
20 Administrative private-vlan trunk mappings: none
21 Operational private-vlan: none
22 Trunking VLANs Enabled: ALL
23 Pruning VLANs Enabled: 2-1001
24 Capture Mode Disabled
25 Capture VLANs Allowed: ALL
26
27 Protected: false
28 Unknown unicast blocked: disabled
29 Unknown multicast blocked: disabled
30 Appliance trust: none
```

In handling VLANs, there's a pattern of half-information pairs that work together to give an answer. You've seen this in the configuration:

```
S1(config-if)# switchport access vlan 20
```
*IF you're an access port, be in VLAN 20*
```
S1(config-if)# switchport mode access
```
*You ARE an access port*

This output beautifully demonstrates those pairs of half-facts that you have to put together yourself:

- Interface fa0/24 is "administratively" configured to be a trunk [Line 4] *and* it actually is one, "operationally" [Line 5]
- It's assigned to be in VLAN 1 when it's an access port [Line 9] but it isn't one [Line 5]
- Its native VLAN will be 10 when it's a trunk [Line 10], and it is one [Line 5]

## WHAT CAN GO WRONG

To troubleshoot, you essentially have to go through the config and check for something missing or wrong. This is true even if "show running-config" is unavailable and you're using the commands above to reconstruct the configuration in your mind.

- On the router, does each VLAN have a subinterface? Does that subinterface have an IP address within the subnet being used on that VLAN? For example, VLAN 20:

```
interface GigabitEthernet0/0.20
   encapsulation dot1Q 20
   ip address 10.20.0.1 255.255.255.0
```

- On the switch side of the trunk, does the VLAN exist? Is it allowed on the trunk, not pruned, and not blocked by STP?

```
S1# show interface fa0/24 trunk

Port        Mode             Encapsulation  Status        Native vlan
Fa0/24      on               802.1q         trunking      10

Port        Vlans allowed on trunk
Fa0/24      1-4094

Port        Vlans allowed and active in management domain
Fa0/24      1,10,20

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/24      1,10,20
```

- Is your native VLAN correctly configured, matching on both ends of the trunk and in the correct IP subnet? If you didn't use the "native" keyword on one of your subinterfaces, the native VLAN will be handled by the underlying interface.
- Are any of the (sub)interfaces you're relying on shut down?