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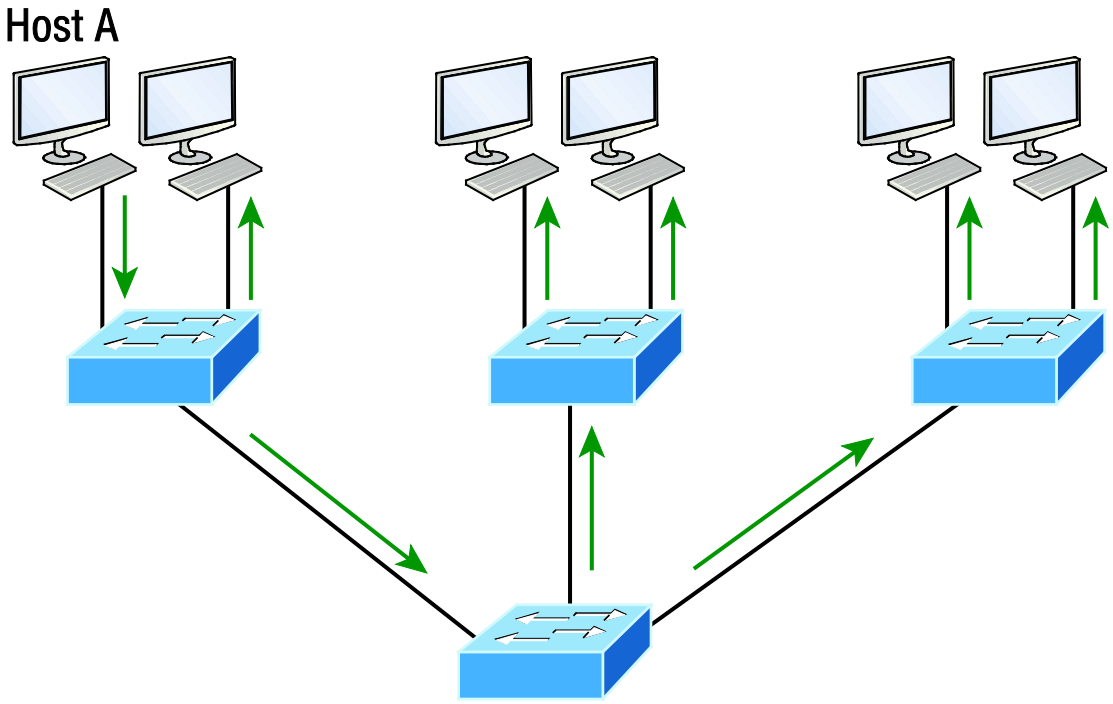
CCENT Study Guide

Chapter 11
VLANs and Inter-VLAN Routing

Chapter 11 Objectives

- The CCENT Topics Covered in this chapter include:
- **2.0 LAN Switching Technologies**
- 2.4 Configure, verify, and troubleshoot VLANs (normal range)
- spanning multiple switches.
- 2.4.a Access ports (data and voice)
- 2.4.b Default VLAN
- 2.5 Configure, verify, and troubleshoot interswitch
- connectivity.
- 2.5.a Trunk ports
- 2.5.b 802.1Q
- 2.5.c Native VLAN
- **3.0 Routing Technologies**
- 3.4 Configure, verify, and troubleshoot inter-VLAN routing.
- 3.4.a Router on a stick

Figure 11.1: Flat network structure



With this configuration, every broadcast packet transmitted is seen by every device on the network regardless of whether the device needs to receive that data or not.

Figure 11.2: The benefit of a switched network

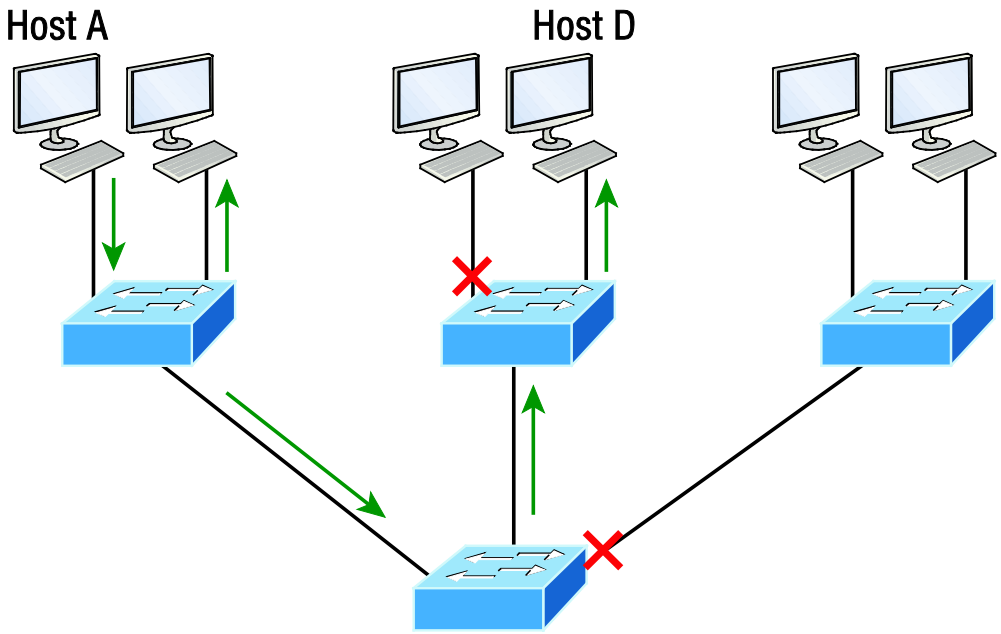


Figure 11.2 pictures a switched network and shows Host A sending a frame with Host D as its destination. Clearly, the important factor here is that the frame is only forwarded out the port where Host D is located.

Figure 11.3: One switch, one LAN: Before VLANs, there was no separation between hosts.

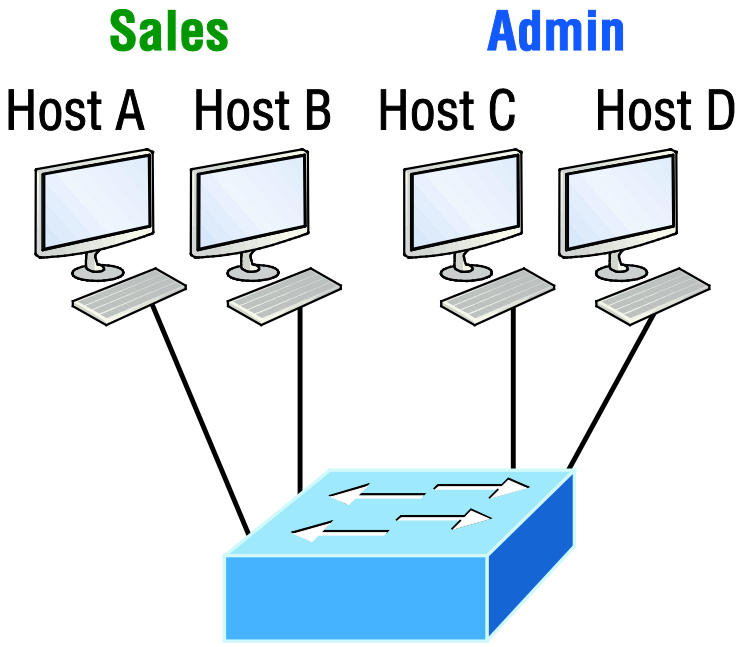


Figure 11.3 shows all hosts in this very small company connected to one switch, meaning all hosts will receive all frames, which is the default behavior of all switches.

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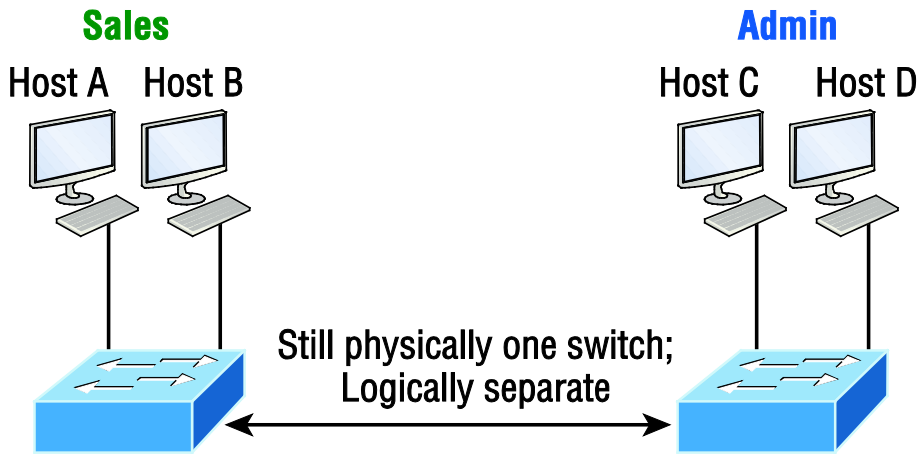
Figure 11.4: One switch, two virtual LANs (*logical* separation between hosts):

Still physically one switch, but this switch acts as many separate devices.



In Figure 11.4, I configured the switch to be two separate LANs, two subnets, two broadcast domains, two VLANs—they all mean the same thing—without buying another switch.

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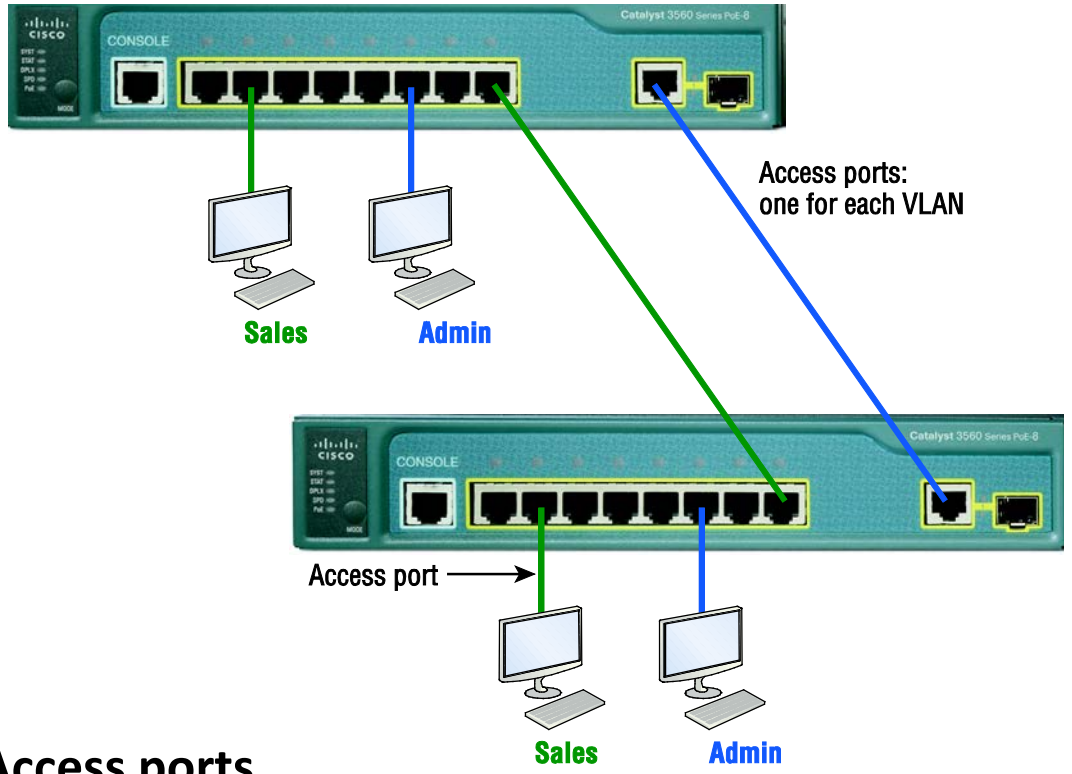
Figure 11.5: Access ports



Access ports

An *access port* belongs to and carries the traffic of only one VLAN. Traffic is both received and sent in native formats with no VLAN information (tagging) whatsoever. Anything arriving on an access port is simply assumed to belong to the VLAN assigned to the port. Because an access port doesn't look at the source address, tagged traffic—a frame with added VLAN information—can be correctly forwarded and received only on trunk ports.

Figure 11.6: VLANs can span across multiple switches by using trunk links, which carry traffic for multiple VLANs.

Trunk ports

A *trunk link* is a 100, 1000, or 10000 Mbps point-to-point link between two switches, between a switch and router, or even between a switch and server, and it carries the traffic of multiple VLANs—from 1 to 4,094 VLANs at a time. But the amount is really only up to 1,001 unless you're going with something called extended VLANs.

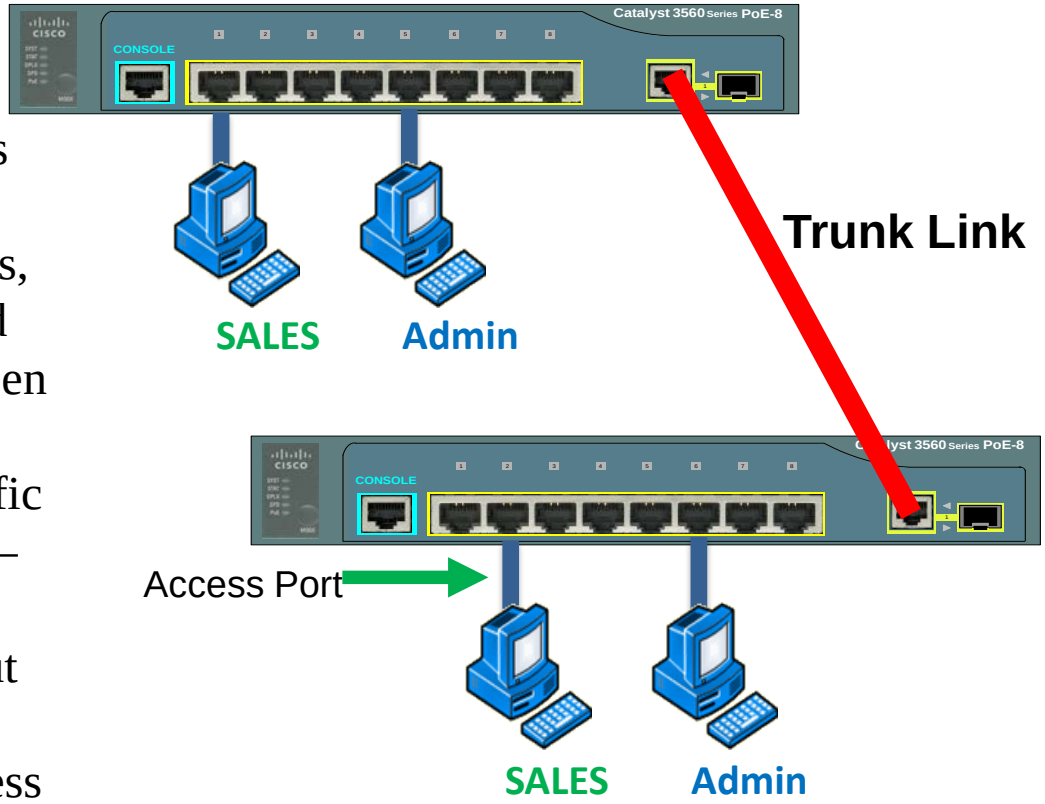


Figure 11.7: IEEE 802.1q encapsulation with and without the 802.1q tag

Preamble (7-bytes)	Start Frame Delimiter (1-byte)	Destination MAC Address (6-bytes)	Source MAC Address (6-bytes)	Type/Length (2-bytes)	Packet (0 – n bytes)	Pad (0 – p bytes)	Frame Check Sequence (4-bytes)

Preamble (7-bytes)	Start Frame Delimiter (1-byte)	Destination MAC Address (6-bytes)	Source MAC Address (6-bytes)	Type/Length = 802.1Q Tag Type (2-bytes)	Tag Control Information	Length/Type (2-Bytes)	Packet (0 – n bytes)	Pad (0 – p bytes)	Frame Check Sequence (4-bytes)

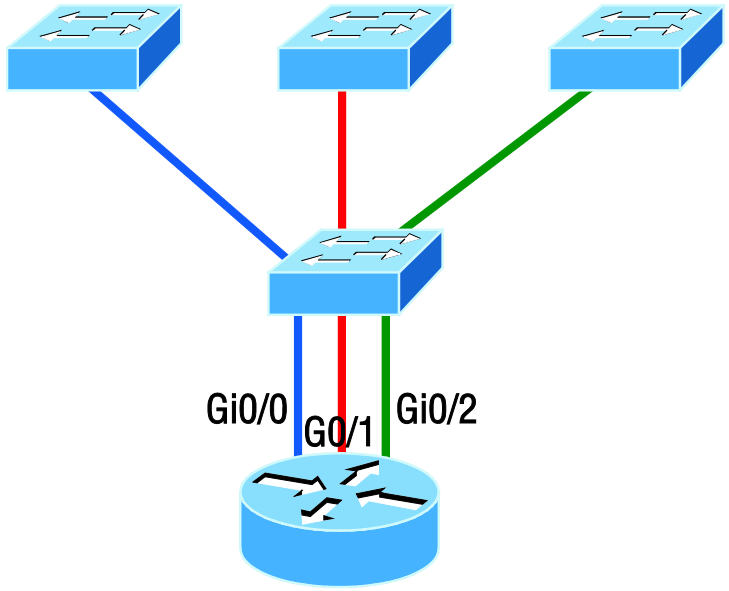
802.1q Field inserted

CRC must be recalculated

3 bits = User priority field
1 bit = Canonical Format Identifier (CFI)
12 bits – VLAN Identifier (VLAN ID)

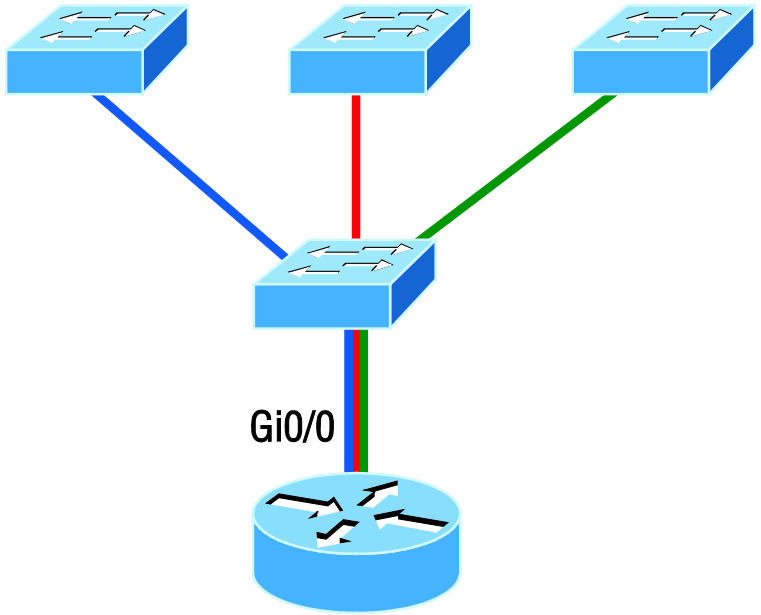
Created by the IEEE as a standard method of frame tagging, IEEE 802.1q actually inserts a field into the frame to identify the VLAN.

Figure 11.8: Router connecting three VLANs together for inter-VLAN communication, one router interface for each VLAN



What we see in Figure 11.8 is that each router interface is plugged into an access link. This means that each of the routers' interface IP addresses would then become the default gateway address for each host in each respective VLAN.

Figure 11.9: "Router on a stick": Single router interface connecting all three VLANs together for inter-VLAN communication



Instead of using a router interface for each VLAN, you can use one FastEthernet interface and run ISL or 802.1q trunking. Figure 11.9 shows how a FastEthernet interface on a router will look when configured with ISL or 802.1q trunking. This allows all VLANs to communicate through one interface. Cisco calls this a "router on a stick (ROAS)."

Figure 11.10: A router creates logical interfaces.

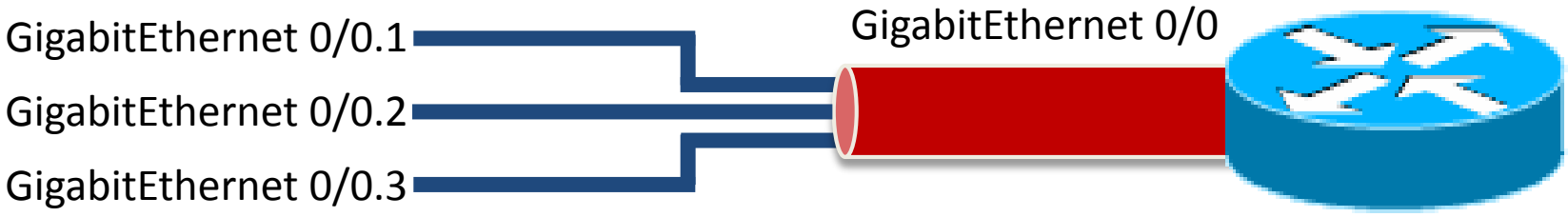
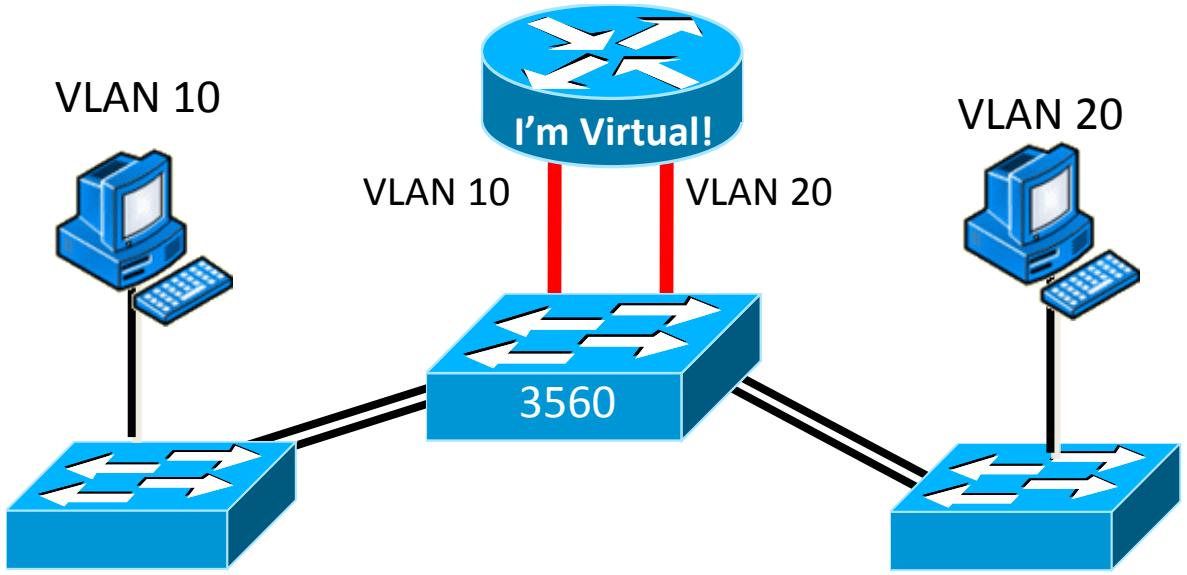


Figure 11.10 shows how we would create a router on a stick using a router's physical interface by creating logical interfaces—one for each VLAN.

Figure 11.11: With IVR, routing runs on the backplane of the switch, and it appears to the hosts that a router is present.



Instead of using an external router interface for each VLAN, or an external router on a stick, we can configure logical interfaces on the backplane of the layer 3 switch; this is called inter-VLAN routing (IVR).

Creating VLANs

```
S1(config)#vlan ?
  WORD        ISL VLAN IDs 1-4094
  access-map  Create vlan access-map or
enter vlan access-map command mode
  dot1q       dot1q parameters
  filter      Apply a VLAN Map
  group       Create a vlan group
  internal    internal VLAN
S1(config)#vlan 2
S1(config-vlan)#name Sales
S1(config-vlan)#vlan 3
S1(config-vlan)#name Marketing
S1(config-vlan)#vlan 4
S1(config-vlan)#name Accounting
S1(config-vlan)#^Z
S1#
```

Viewing Access Ports

Once the VLANs are created, verify your configuration with the `show vlan` command (`sh vlan` for short):

```
S1#sh vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------
-----------
1    default                           active    Fa0/1, Fa0/2,
Fa0/3, Fa0/4
                                                 Fa0/5, Fa0/6,
Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10,
Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14,
Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22,
Fa0/23, Gi0/1
                                                 Gi0/2
2    Sales                                  active
3    Marketing                              active
4    Accounting                             active
[output cut]
```

Configuring Trunk ports

The following switch output shows the trunk configuration on interfaces Fa0/15–18 as set to `trunk`:

```
S1(config)#int range f0/15-18
S1(config-if-range)#switchport trunk encapsulation dot1q
S1(config-if-range)#switchport mode trunk
```

If you have a switch that only runs the 802.1q encapsulation method, then you wouldn't use the encapsulation command as I did in the preceding output.

View Trunk Ports

```
S1# show interfaces trunk
Port        Mode             Encapsulation  Status        Native
vlan
Fa0/15      desirable        n-isl          trunking      1
Fa0/16      desirable        n-isl          trunking      1
Fa0/17      desirable        n-isl          trunking      1
Fa0/18      desirable        n-isl          trunking      1

Port        Vlans allowed on trunk
Fa0/15      1-4094
Fa0/16      1-4094
Fa0/17      1-4094
Fa0/18      1-4094

 [output cut]
```

Sho interface *interface* switchport

Another helpful command, which is also part of the Cisco exam objectives, is the `show interfaces interface switchport` command.

```
S1#sh interfaces FastEthernet0/15 switchport
Name: Fa0/15
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
[output cut]
```

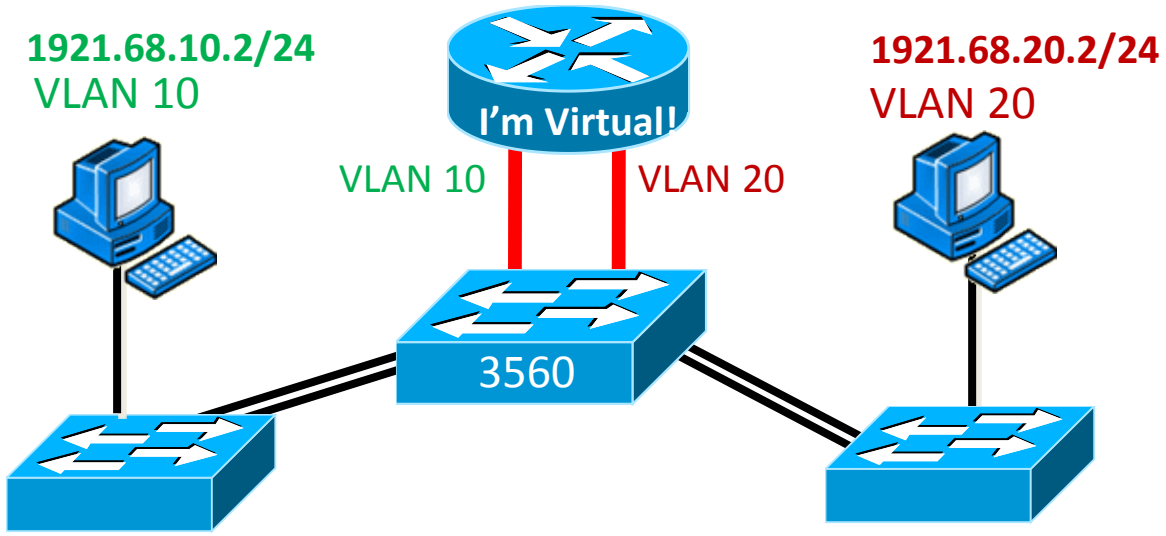
Assigning access ports

```
S3(config-if)#switchport mode ?
    access         Set trunking mode to ACCESS unconditionally
  dot1q-tunnel  set trunking mode to TUNNEL unconditionally
  dynamic       Set trunking mode to dynamically negotiate
access or trunk mode
  private-vlan  Set private-vlan mode
  trunk         Set trunking mode to TRUNK unconditionally

S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 3
```

By starting with the `switchport mode access` command, you're telling the switch that this is a nontrunking layer 2 port.

Figure 11.16: Inter-VLAN routing with a multilayer switch




```
config)#ip routing
S1(config)#int vlan 10
S1(config-if)#ip address 192.168.10.1 255.255.255.0
S1(config-if)#int vlan 20
S1(config-if)#ip address 192.168.20.1 255.255.255.0
```

Set your hosts to the IP address associated to their VLAN, and that's all it takes!

Written Labs and Review Questions

- Read through the Exam Essentials section together in class.
- Open your books and go through all the written labs and the review questions.
- Review the answers in class.