CCNA 200-301

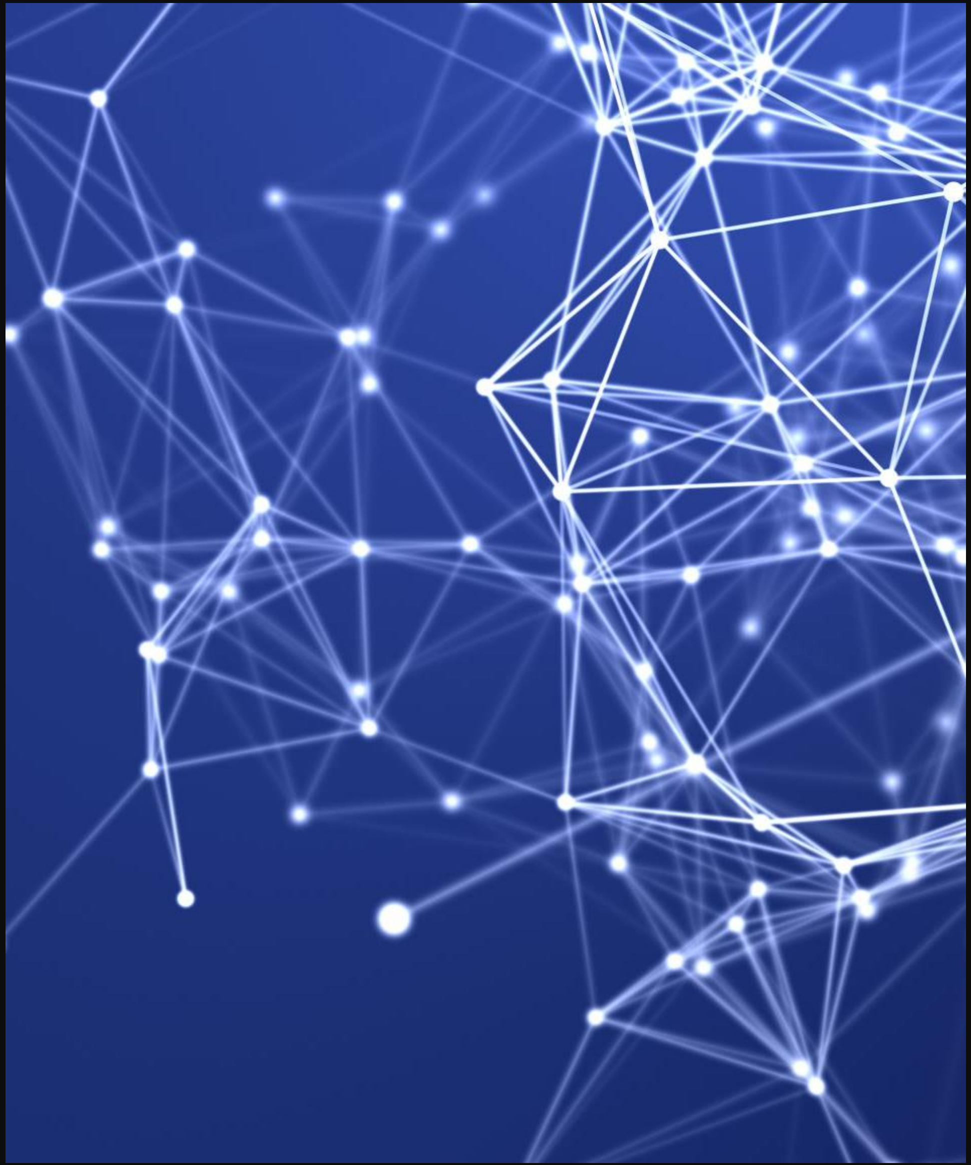
Lesson 17

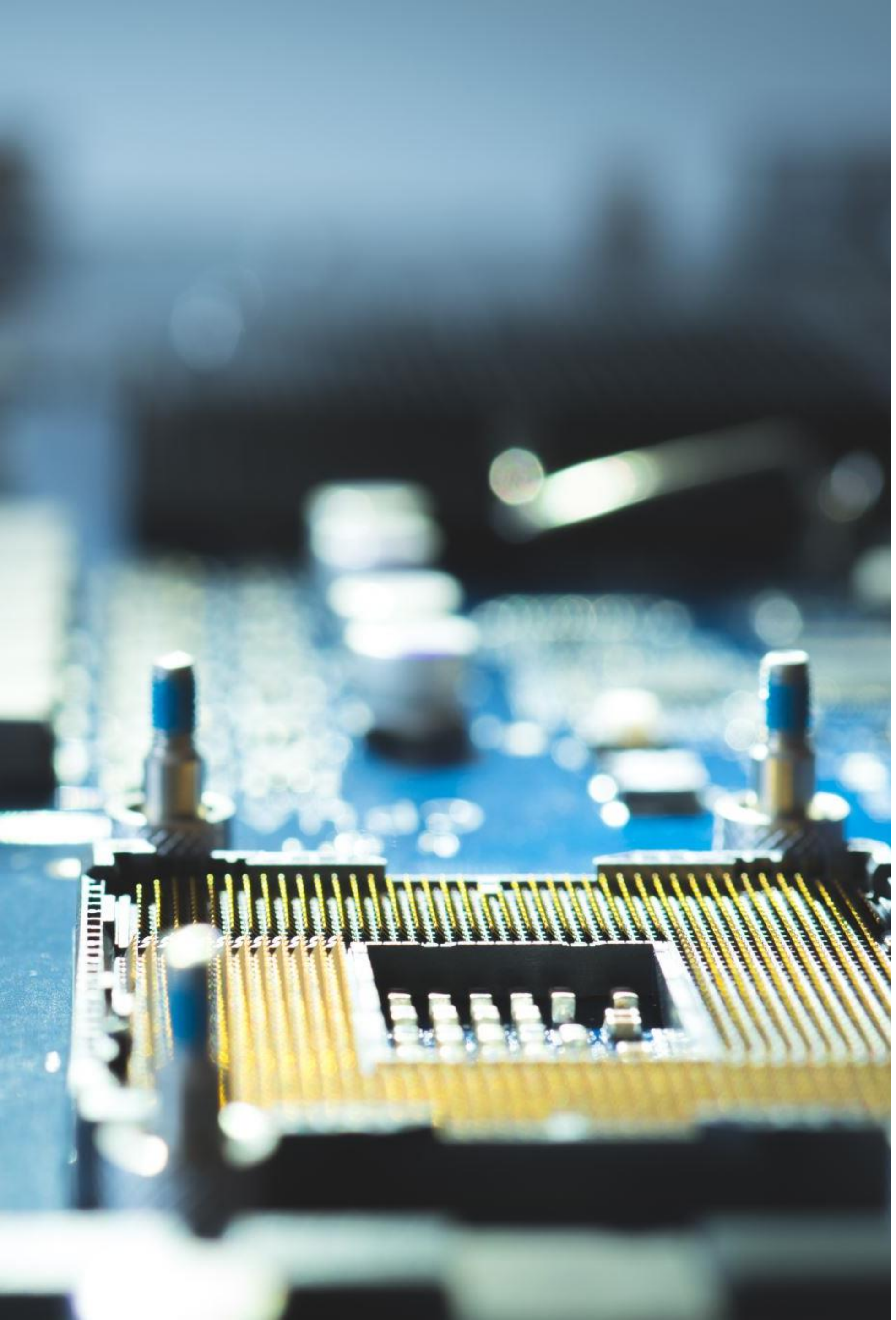
IP Routing in the LAN

- VLAN Routing with Router 802.1Q Trunks
- Configuring ROAS
- VLAN Routing with Layer 3 Switch SVIs
- VLAN Routing with Layer 3 Switch Routed Ports

Extended PING command

Extended TRACEROUTE command





VLAN Routing with Router 802.1Q Trunks

Almost all enterprise networks use VLANs. To route IP packets in and out of those VLANs, some devices (either routers or Layer 3 switches) need to have an IP address in each subnet and have a connected route to each of those subnets. Then the IP addresses on those routers or Layer 3 switches can serve as the default gateways in those subnets.

LAN routing options are divided into four categories:

- Use a router, with one router LAN interface and cable connected to the switch for each and every VLAN (typically not used)
- Use a router, with a VLAN trunk connecting to a LAN switch (known as router-on-a stick, or ROAS)
- Use a Layer 3 switch with switched virtual interfaces (SVI)
- Use a Layer 3 switch with routed interfaces (which may or may not be Layer 3 EtherChannels)

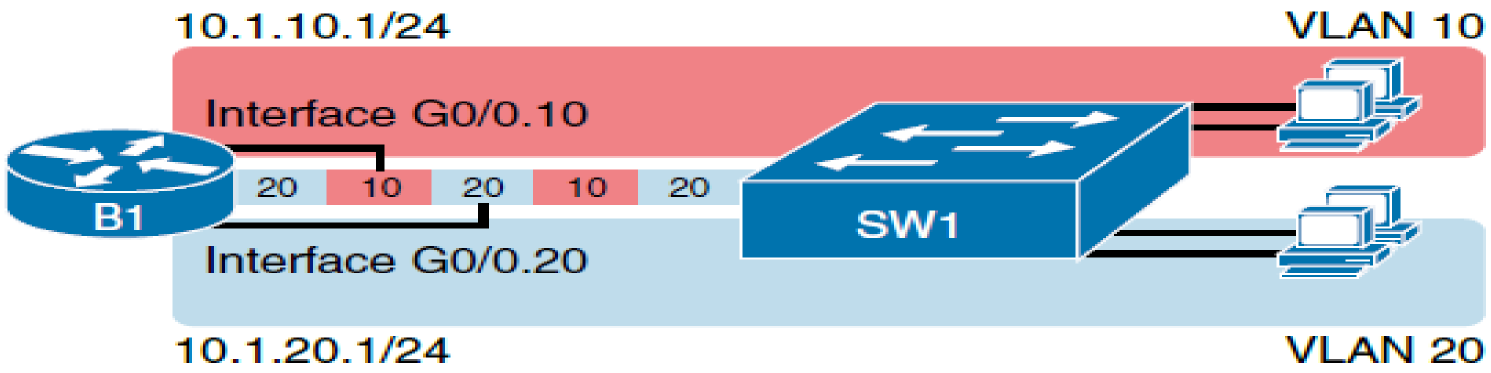
Configuring ROAS

(Router-On-A-Stick)

ROAS uses router VLAN trunking configuration to give the router a logical router interface connected to each VLAN. Because the router then has an interface connected to each VLAN, the router can also be configured with an IP address in the subnet that exists on each VLAN.

Routers use subinterfaces as the means to have an interface connected to a VLAN. The router needs to have an IP address/mask associated with each VLAN on the trunk. However, the router has only one physical interface for the link connected to the trunk. Cisco solves this problem by creating multiple virtual router interfaces, one associated with each VLAN on that trunk (at least for each VLAN that you want the trunk to support). Cisco calls these virtual interfaces *subinterfaces*. The configuration can then include an **ip address** command for each subinterface.

Figure shows the concept with Router B1, one of the branch routers. Because this router needs to route between only two VLANs, the figure also shows two subinterfaces, named G0/0.10 and G0/0.20, which create a new place in the configuration where the per-VLAN configuration settings can be made. The router treats frames tagged with VLAN 10 as if they came in or out of G0/0.10 and frames tagged with VLAN 20 as if they came in or out G0/0.20.



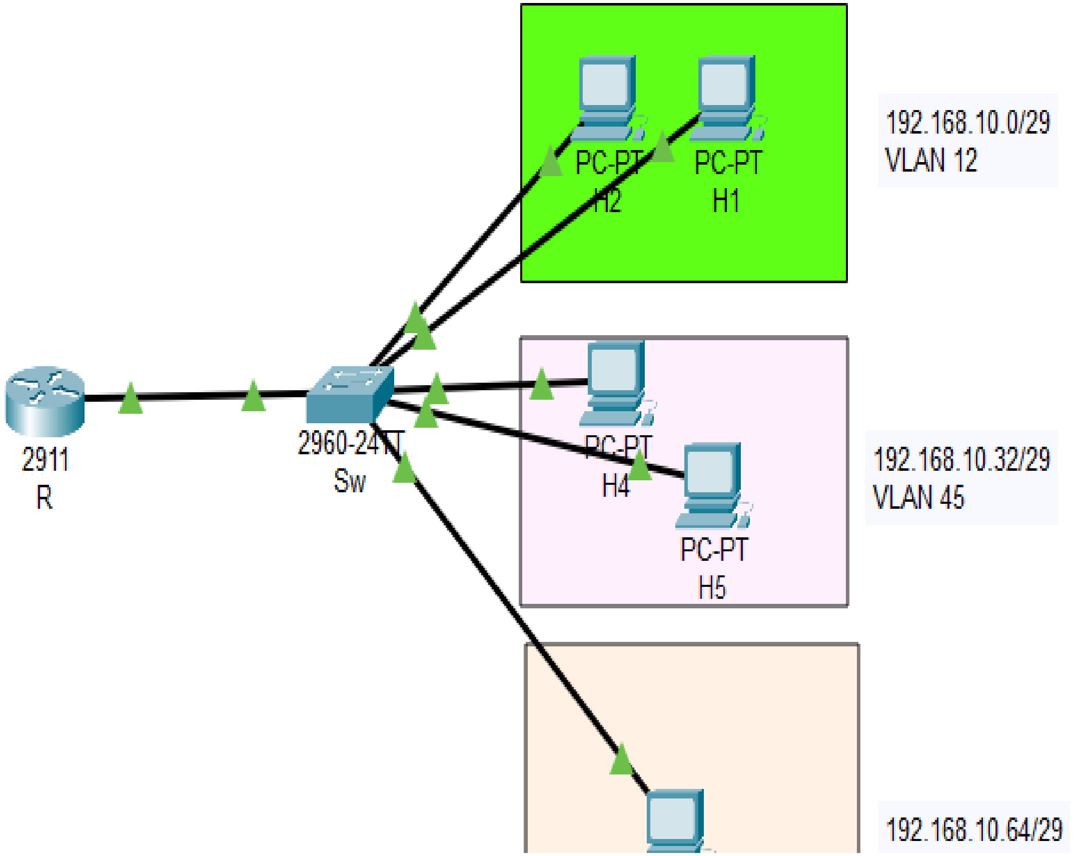
ROAS example

More generally, these steps detail how to configure 802.1Q trunking on a router:

Step 1. Use the **interface** *type number.subint* command in global configuration mode to create a unique subinterface for each VLAN that needs to be routed.

Step 2. Use the **encapsulation dot1q** *vlan_id* command in subinterface configuration mode to enable 802.1Q and associate one specific VLAN with the subinterface.

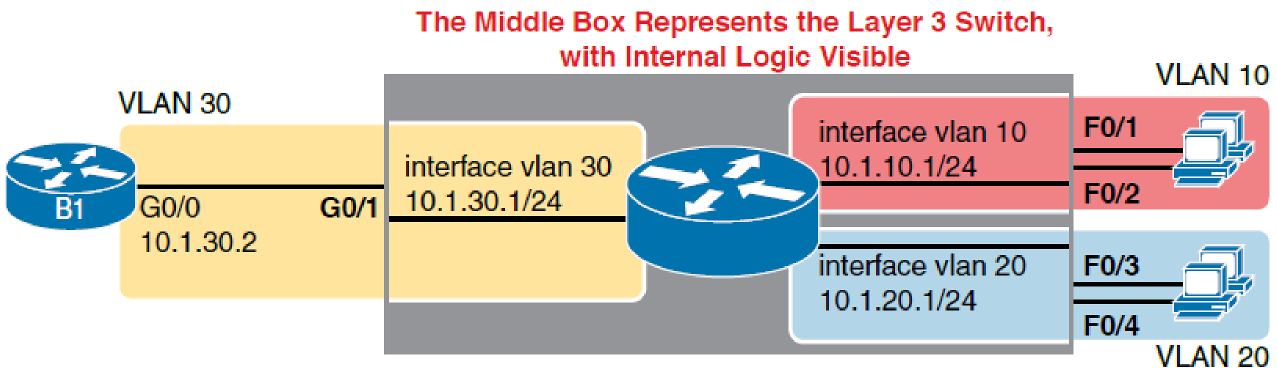
Step 3. Use the **ip address** *address mask* command in subinterface configuration mode to configure IP settings (address and mask).



VLAN Routing with Layer 3 Switch SVIs

Using a router with ROAS to route packets makes sense in some cases, particularly at small remote sites. In sites with a larger LAN, network designers choose to use Layer 3 switches for most inter-VLAN routing.

A Layer 3 switch (also called a multilayer switch) is one device, but it executes logic at two layers: Layer 2 LAN switching and Layer 3 IP routing. The Layer 2 switch function forwards frames inside each VLAN, but it will not forward frames between VLANs. The Layer 3 forwarding (routing) logic forwards IP packets between VLANs. Layer 3 switches typically support two configuration options to enable IPv4 routing inside the switch, specifically to enable IPv4 on switch interfaces. An option that uses switched virtual interfaces (SVI)



Configuring Routing Using Switch SVIs example

Step 1. Enable IP routing on the switch, as needed:

A. Use the **sdm prefer lanbase-routing** command (or similar) in global configuration mode to change the switch forwarding ASIC settings to make space for IPv4 routes at the next reload of the switch.

B. Use the **reload** EXEC command in enable mode to reload (reboot) the switch to pick up the new **sdm prefer** command setting.

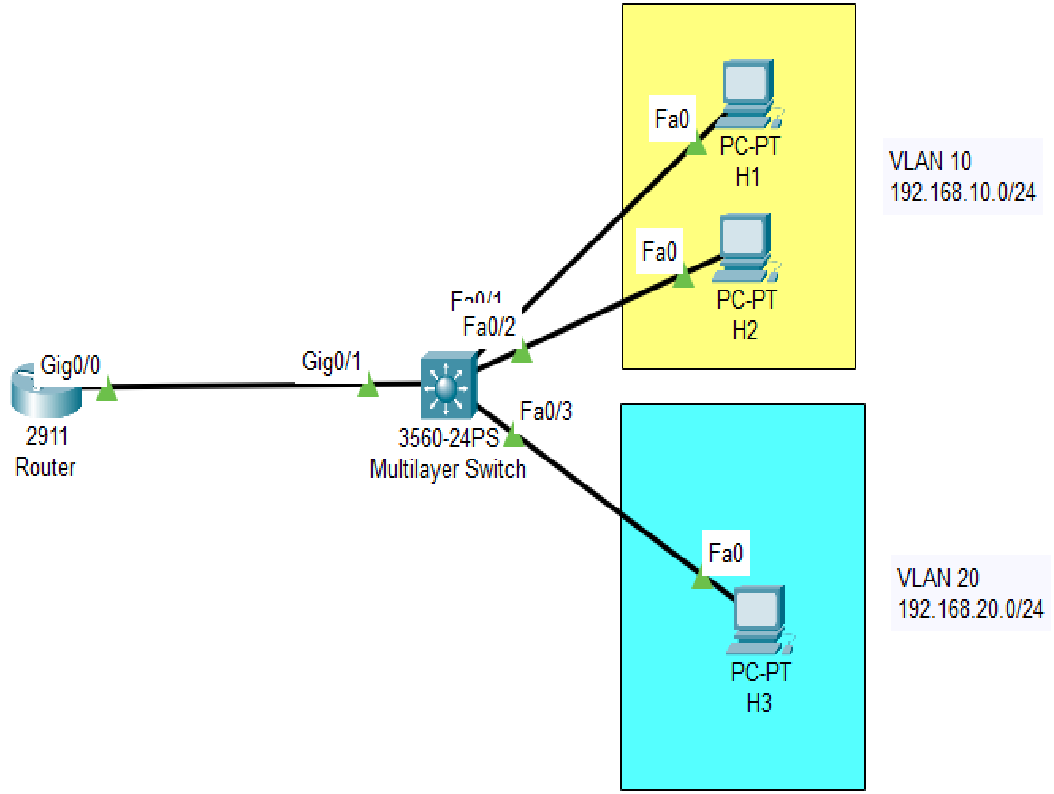
C. Once reloaded, use the **ip routing** command in global configuration mode to enable the IPv4 routing function in IOS software and to enable key commandslike **show ip route**.

Step 2. Configure each SVI interface, one per VLAN for which routing should be done by this Layer 3 switch:

A. Use the **interface vlan** *vlan_id* command in global configuration mode to create a VLAN interface and to give the switch's routing logic a Layer 3 interface connected into the VLAN of the same number.

B. Use the **ip address** *address mask* command in VLAN interface configuration mode to configure an IP address and mask on the VLAN interface, enabling IPv4 routing on that VLAN interface.

C. (As needed) Use the **no shutdown** command in interface configuration mode to enable the VLAN interface (if it is currently in a shutdown state).



VLAN Routing with Layer 3 Switch Routed Ports

When Layer 3 switches use SVIs, the physical interfaces on the switches act like they always have: as Layer 2 interfaces. That is, the physical interfaces receive Ethernet frames. The switch learns the source MAC address of the frame, and the switch forwards the frame based on the destination MAC address. To perform routing, any Ethernet frames destined for any of the SVI interface MAC addresses trigger the processing of the Layer 2 switching logic, resulting in normal routing actions like stripping data-link headers, making a routing decision, and so on.

Alternately, the Layer 3 switch configuration can make a physical port act like a router interface instead of a switch interface. To do so, the switch configuration makes that port a routed port. On a *routed* port, the switch does not perform Layer 2 switching logic on that frame. Instead, frames arriving in a routed port trigger the Layer 3 routing logic, including

1. Stripping off the incoming frame’s Ethernet data-link header/trailer

2. Making a Layer 3 forwarding decision by comparing the destination IP address to the IP routing table

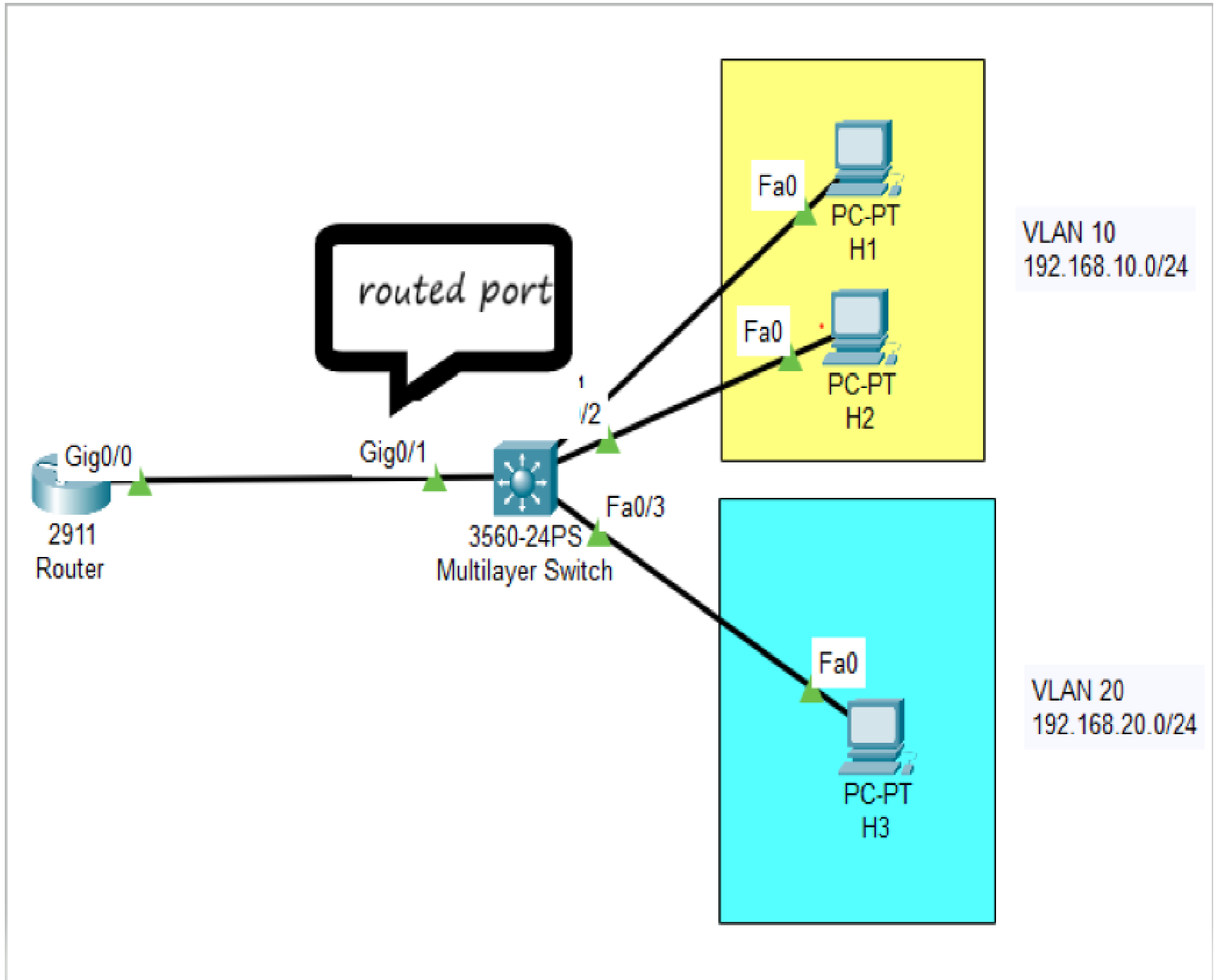
3. Adding a new Ethernet data-link header/trailer to the packet

4. Forwarding the packet, encapsulated in a new frame

VLAN Routing with Layer 3 Switch Routed Ports example

Enabling a switch interface to be a routed interface instead of a switched interface is simple: just use the **no switchport** subcommand on the physical interface. Cisco switches capable of being a Layer 3 switch use a default of the **switchport** command to each switch physical interface. Think about the word *switchport* for a moment. With that term, Cisco tells the switch to treat the port like it is a port on a switch—that is, a Layer 2 port on a switch. To make the port stop acting like a switch port and instead act like a router port, use the **no switchport** command on the interface.

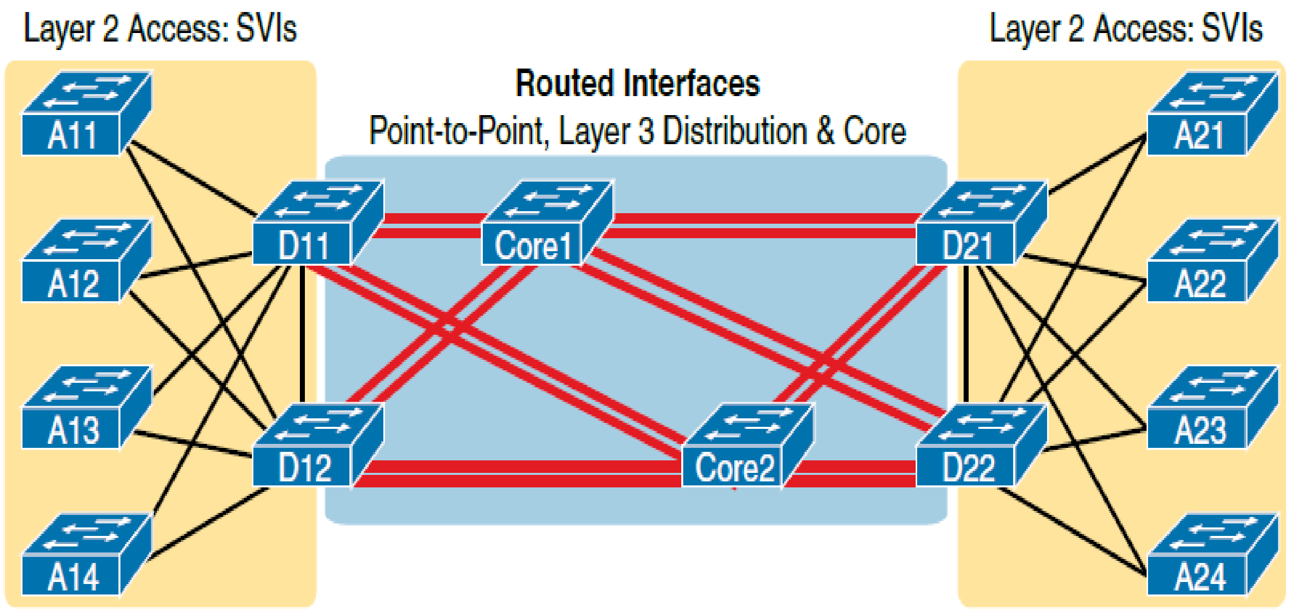
Once the port is acting as a routed port, think of it like a router interface. That is, configure the IP address on the physical port



Implementing Layer 3 EtherChannels

In most designs, the network engineers use at least two links between each pair of distribution and core switches. While each individual port in the distribution and core could be treated as a separate routed port, it is better to combine each pair of parallel links into a Layer 3 EtherChannel.

Using a Layer 3 EtherChannel makes more sense with multiple parallel links between two switches. By doing so, each pair of links acts as one Layer 3 link. So, each pair of switches has one routing protocol neighbor relationship with the neighbor, and not two. Each switch learns one route per destination per pair of links, and not two. IOS then balances the traffic, often with better balancing than the balancing that occurs with the use of multiple IP routes to the same subnet. Overall, the Layer 3 EtherChannel approach works much better than leaving each link as a separate routed port and using Layer 3 balancing.



Layer 3 EtherChannels example

Step 1. Configure the physical interfaces as follows, in interface configuration mode:

A. Add the **channel-group** *number* **mode on** command to add it to the channel. Use the same number for all physical interfaces on the same switch, but the number used (the channel-group number) can differ on the two neighboring switches.

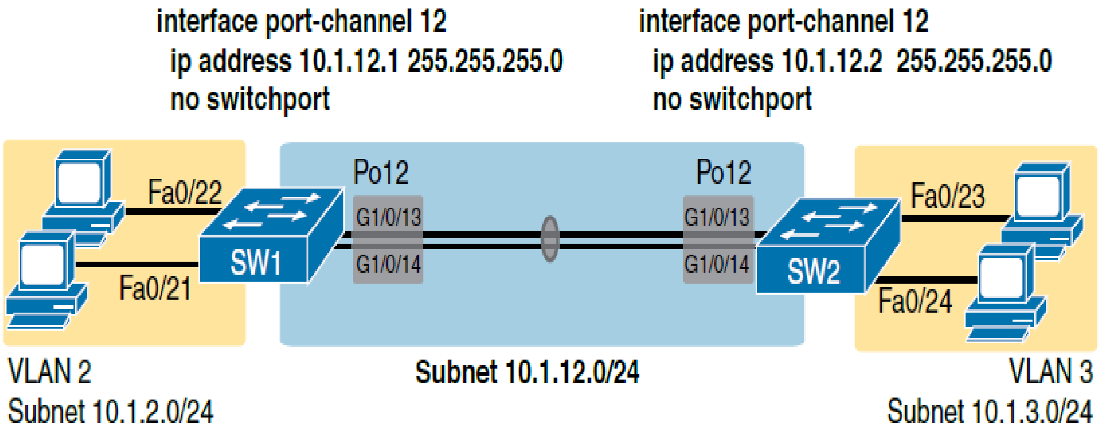
B. Add the **no switchport** command to make each physical port a routed port.

Step 2. Configure the PortChannel interface:

A. Use the **interface port-channel** *number* command to move to port-channel configuration mode for the same channel number configured on the physical interfaces.

B. Add the **no switchport** command to make sure that the port-channel interface acts as a routed port. (IOS may have already added this command.)

C. Use the **ip address** *address mask* command to configure the address and mask.



Extended Ping command

The extended **ping** command does allow the user to type all the parameters on a potentially long command, but it also allows users to simply issue the **ping** command, press **Enter**, with IOS then asking the user to answer questions to complete the command, as shown in Example.

```
R1# ping
Protocol [ip]:
Target IP address: 172.16.2.101
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 172.16.1.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.2.101, timeout is 2 seconds:
Packet sent with a source address of 172.16.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

Extended TRACEROUTE command

The extended **traceroute** command, as shown in Example, follows the same basic command structure as the extended **ping** command. The user can type all the parameters on one command line, but it is much easier to just type **traceroute**, press **Enter**, and let IOS prompt for all the parameters, including the source IP address of the packets (172.16.1.1 in this example).

```
R1# traceroute
Protocol [ip]:
Target IP address: 172.16.2.101
Source address: 172.16.1.1
Numeric display [n]:
Timeout in seconds [3]:
Probe count [3]:
Minimum Time to Live [1]:
Maximum Time to Live [30]:
Port Number [33434]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Type escape sequence to abort.
Tracing the route to 172.16.2.101
VRF info: (vrf in name/id, vrf out name/id)
   1 172.16.4.2 0 msec 0 msec 0 msec
   2 172.16.2.101 0 msec 0 msec *
```

That is all for Lesson 17

The key is :

Learn

Repeat

Practice

You will be able to reach your goals.

GOOD LUCK !!!!!...