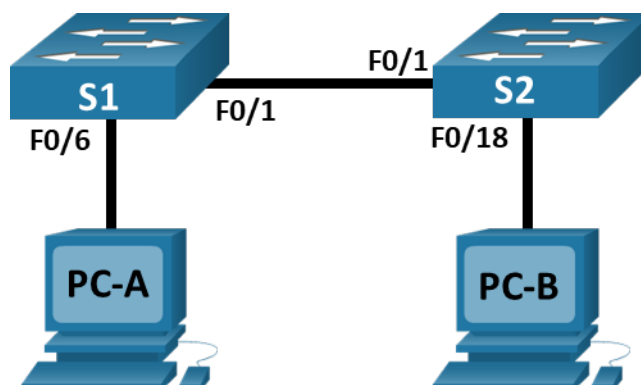


Lab - View the Switch MAC Address Table (Instructor Version)

Instructor Note: Red font color or gray highlights indicate text that appears in the instructor copy only.

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask
S1	VLAN 1	192.168.1.11	255.255.255.0
S2	VLAN 1	192.168.1.12	255.255.255.0
PC-A	NIC	192.168.1.1	255.255.255.0
PC-B	NIC	192.168.1.2	255.255.255.0

Objectives

Part 1: Build and Configure the Network

Part 2: Examine the Switch MAC Address Table

Background / Scenario

The purpose of a Layer 2 LAN switch is to deliver Ethernet frames to host devices on the local network. The switch records host MAC addresses that are visible on the network, and maps those MAC addresses to its own Ethernet switch ports. This process is called **building the MAC address table**. When a switch receives a frame from a PC, it examines the frame's source and destination MAC addresses. The source MAC address is recorded and mapped to the switch port from which it arrived. Then the destination MAC address is looked up in the MAC address table. If the destination MAC address is a known address, then the frame is forwarded out of the corresponding switch port associated with that MAC address. If the MAC address is unknown, then the frame is **broadcasted out of all switch ports**, except the one from which it came. It is important to observe and understand the function of a switch and how it delivers data on the network. The way a switch operates has implications for network administrators whose job it is to ensure secure and consistent network communication.

Switches are used to interconnect and deliver information to computers on local area networks. Switches deliver Ethernet frames to host devices identified by network interface card MAC addresses.

In Part 1, you will build a multi-switch topology with a trunk linking the two switches. In Part 2, you will ping various devices and observe how the two switches build their MAC address tables.

Note: The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.2(2) (lanbasek9 image). Other switches and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs.

Note: Make sure that the switches have been erased and have no startup configurations. If you are unsure contact your instructor.

Instructor Note: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

Required Resources

- 2 Switches (Cisco 2960 with Cisco IOS Release 15.2(2) lanbasek9 image or comparable)
- 2 PCs (Windows with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

Note: The Fast Ethernet interfaces on Cisco 2960 switches are autosensing and an Ethernet straight-through cable may be used between switches S1 and S2. If using another model Cisco switch, it may be necessary to use an Ethernet crossover cable.

Instructions

Part 1: Build and Configure the Network

Step 1: Cable the network according to the topology.

Step 2: Configure PC hosts.

Step 3: Initialize and reload switches as necessary.

Step 4: Configure basic settings for each switch.

- a. Configure device name as shown in the topology.
- b. Configure IP address as listed in Addressing Table.
- c. Assign **cisco** as the console and vty passwords.
- d. Assign **class** as the privileged EXEC password.

Part 2: Examine the Switch MAC Address Table

A switch learns MAC addresses and builds the MAC address table, as network devices initiate communication on the network.

Step 1: Record network device MAC addresses.

- a. Open a command prompt on PC-A and PC-B and type **ipconfig /all**.

What are the Ethernet adapter physical addresses?

PC-A MAC Address:

Answers will vary. The MAC address in this example is 00-50-56-B3-27-D6.

PC-B MAC Address:

Answers will vary. The MAC address in this example is 00-50-56-B3-FF-54.

- b. Console into switch S1 and S2 and type the **show interface F0/1** command on each switch.

On the second line of command output, what is the hardware addresses (or burned-in address [bia])?

S1 Fast Ethernet 0/1 MAC Address:

Answers will vary. From the example output below, the S1 F0/1 MAC address is 0cd9.96e2.3d01.

S2 Fast Ethernet 0/1 MAC Address:

Answers will vary. From the example output below, the S2 F0/1 MAC address is 0cd9.96d2.3f81.

```
S1# show interface f0/1
FastEthernet0/1 is up, line protocol is up (connected)
  Hardware is Fast Ethernet, address is 001a.e3cf.b883 (bia 001a.e3cf.b883)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
<output omitted>

S2# show interface f0/1
FastEthernet0/1 is up, line protocol is up (connected)
  Hardware is Fast Ethernet, address is 0025.83e6.9081 (bia 0025.83e6.9081)
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
<output omitted>
```

Step 2: Display the switch MAC address table.

Console into switch S2 and view the MAC address table, both before and after running network communication tests with ping.

- a. Establish a console connection to S2 and enter privileged EXEC mode.
- b. In privileged EXEC mode, type the **show mac address-table** command and press Enter.

```
S2# show mac address-table
```

Even though there has been no network communication initiated across the network (i.e., no use of ping), it is possible that the switch has learned MAC addresses from its connection to the PC and the other switch.

Are there any MAC addresses recorded in the MAC address table?

The switch may have one or more MAC addresses in its table, based on whether or not the students entered a ping command when configuring the network. The switch will most likely have learned MAC addresses through S1's F0/1 switch port. The switch will record multiple MAC addresses of hosts learned through the connection to the other switch on F0/1.

```
S2# show mac address-table
      Mac Address Table
```

```
-----
```

Lab - View the Switch MAC Address Table

Vlan	Mac Address	Type	Ports
----	-----	-----	-----
All	0100.0ccc.cccc	STATIC	CPU
All	0100.0ccc.cccd	STATIC	CPU
All	0180.c200.0000	STATIC	CPU
All	0180.c200.0001	STATIC	CPU
All	0180.c200.0002	STATIC	CPU
All	0180.c200.0003	STATIC	CPU
All	0180.c200.0004	STATIC	CPU
All	0180.c200.0005	STATIC	CPU
All	0180.c200.0006	STATIC	CPU
All	0180.c200.0007	STATIC	CPU
All	0180.c200.0008	STATIC	CPU
All	0180.c200.0009	STATIC	CPU
All	0180.c200.000a	STATIC	CPU
All	0180.c200.000b	STATIC	CPU
All	0180.c200.000c	STATIC	CPU
All	0180.c200.000d	STATIC	CPU
All	0180.c200.000e	STATIC	CPU
All	0180.c200.000f	STATIC	CPU
All	0180.c200.0010	STATIC	CPU
All	ffff.ffff.ffff	STATIC	CPU
1	001a.e3cf.b883	DYNAMIC	Fa0/1

Total Mac Addresses for this criterion: 21

What MAC addresses are recorded in the table? To which switch ports are they mapped and to which devices do they belong? Ignore MAC addresses that are mapped to the CPU.

There may be multiple MAC addresses recorded in the MAC address table, especially MAC addresses learned through S1's F0/1 switch port. In the example output above, the S1 F0/1 MAC address and PC-A MAC address are mapped to S2 F0/1.

If you had not previously recorded MAC addresses of network devices in Step 1, how could you tell which devices the MAC addresses belong to, using only the output from the **show mac address-table** command? Does it work in all scenarios?

The output of the show mac address-table command shows the port that the MAC address was learned on. In most cases this would identify which network device the MAC address belongs to, except in the case of multiple MAC addresses associated to the same port. This happens when switches are connected to other switches and record all of the MAC addresses for devices connected to the other switch.

Step 3: Clear the S2 MAC address table and display the MAC address table again.

- In privileged EXEC mode, type the **clear mac address-table dynamic** command and press **Enter**.
S2# **clear mac address-table dynamic**
- Quickly type the **show mac address-table** command again.

Does the MAC address table have any addresses in it for VLAN 1? Are there other MAC addresses listed?

No. The student will most likely discover that the MAC address for the other switch's F0/1 switch port has been quickly reinserted in the MAC address table.

```
S2# show mac address-table
```

```
Mac Address Table
```

```
-----  
  
Vlan    Mac Address      Type      Ports  
----    -  
All     0100.0ccc.cccc   STATIC    CPU  
All     0100.0ccc.cccd   STATIC    CPU  
All     0180.c200.0000   STATIC    CPU  
All     0180.c200.0001   STATIC    CPU  
All     0180.c200.0002   STATIC    CPU  
All     0180.c200.0003   STATIC    CPU  
All     0180.c200.0004   STATIC    CPU  
All     0180.c200.0005   STATIC    CPU  
All     0180.c200.0006   STATIC    CPU  
All     0180.c200.0007   STATIC    CPU  
All     0180.c200.0008   STATIC    CPU  
All     0180.c200.0009   STATIC    CPU  
All     0180.c200.000a   STATIC    CPU  
All     0180.c200.000b   STATIC    CPU  
All     0180.c200.000c   STATIC    CPU  
All     0180.c200.000d   STATIC    CPU  
All     0180.c200.000e   STATIC    CPU  
All     0180.c200.000f   STATIC    CPU  
All     0180.c200.0010   STATIC    CPU  
All     ffff.ffff.ffff   STATIC    CPU  
1       001a.e3cf.b883   DYNAMIC    Fa0/1  
Total Mac Addresses for this criterion: 21
```

Wait 10 seconds, type the **show mac address-table** command, and press Enter. Are there new addresses in the MAC address table?

Answers will vary. There may be more MAC addresses in the table.

Step 4: From PC-B, ping the devices on the network and observe the switch MAC address table.

- From PC-B, open a command prompt and type **arp -a**.

Not including multicast or broadcast addresses, how many device IP-to-MAC address pairs have been learned by ARP?

Answers will vary. The ARP cache may have no entries in it, or it may have the gateway IP address to MAC address mapping.

```
C:\Users\PC-B> arp -a
```

```
<output omitted>
```

```
Interface: 192.168.1.2 --- 0x6
```

Lab - View the Switch MAC Address Table

Internet Address	Physical Address	Type
192.168.1.255	ff-ff-ff-ff-ff-ff	static
224.0.0.22	01-00-5e-00-00-16	static
224.0.0.252	01-00-5e-00-00-fc	static
255.255.255.255	ff-ff-ff-ff-ff-ff	static

- b. From the PC-B command prompt, ping PC-A, S1, and S2.

Did all devices have successful replies? If not, check your cabling and IP configurations.

If the network was cabled and configured correctly the answer should be yes.

- c. From a console connection to S2, enter the **show mac address-table** command.

Has the switch added additional MAC addresses to the MAC address table? If so, which addresses and devices?

There may only be one additional MAC address mapping added to the table, most likely the MAC address of PC-A.

S2# **show mac address-table**

Mac Address Table

Vlan	Mac Address	Type	Ports
----	-----	-----	-----
All	0100.0ccc.cccc	STATIC	CPU
All	0100.0ccc.cccd	STATIC	CPU
All	0180.c200.0000	STATIC	CPU
All	0180.c200.0001	STATIC	CPU
All	0180.c200.0002	STATIC	CPU
All	0180.c200.0003	STATIC	CPU
All	0180.c200.0004	STATIC	CPU
All	0180.c200.0005	STATIC	CPU
All	0180.c200.0006	STATIC	CPU
All	0180.c200.0007	STATIC	CPU
All	0180.c200.0008	STATIC	CPU
All	0180.c200.0009	STATIC	CPU
All	0180.c200.000a	STATIC	CPU
All	0180.c200.000b	STATIC	CPU
All	0180.c200.000c	STATIC	CPU
All	0180.c200.000d	STATIC	CPU
All	0180.c200.000e	STATIC	CPU
All	0180.c200.000f	STATIC	CPU
All	0180.c200.0010	STATIC	CPU
All	ffff.ffff.ffff	STATIC	CPU
1	001a.e3cf.b883	DYNAMIC	Fa0/1
1	001a.e3cf.b8c0	DYNAMIC	Fa0/1
1	0050.56b3.27d6	DYNAMIC	Fa0/1
1	0050.56b3.ff54	DYNAMIC	Fa0/18

Lab - View the Switch MAC Address Table

Total Mac Addresses for this criterion: 24

From PC-B, open a command prompt and retype **arp -a**.

Does the PC-B ARP cache have additional entries for all network devices that were sent pings?

Answers may vary, but the ARP cache on PC-B should have more entries.

```
C:\Users\PC-B> arp -a
```

```
<output omitted>
```

```
Interface: 192.168.1.2 --- 0x6
```

Internet Address	Physical Address	Type
192.168.1.1	00-50-56-b3-27-d6	dynamic
192.168.1.11	00-1a-e3-cf-b8-c0	dynamic
192.168.1.12	00-25-83-e6-90-c0	dynamic
192.168.1.255	ff-ff-ff-ff-ff-ff	static
224.0.0.22	01-00-5e-00-00-16	static
224.0.0.252	01-00-5e-00-00-fc	static
239.255.255.250	01-00-5e-7f-ff-fa	static

Reflection Question

On Ethernet networks, data is delivered to devices by their MAC addresses. For this to happen, switches and PCs dynamically build ARP caches and MAC address tables. With only a few computers on the network this process seems fairly easy. What might be some of the challenges on larger networks?

ARP broadcasts could cause broadcast storms. Because ARP and switch MAC tables do not authenticate or validate the IP addresses to MAC addresses it would be easy to spoof a device on the network.

Device Configs

Switch S1

```
S1# show running-config
```

```
Building configuration...
```

```
version 15.0
```

```
no service pad
```

```
service timestamps debug datetime msec
```

```
service timestamps log datetime msec
```

```
no service password-encryption
```

```
!
```

```
hostname S1
```

```
!
```

```
boot-start-marker
```

```
boot-end-marker
```

```
!
```

```
enable secret 5 $1$1Rkm$DF1xhlhb6FCH14J.ux4Fb/
```

```
!
```

Lab - View the Switch MAC Address Table

```
no aaa new-model
system mtu routing 1500
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
!
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
```


Lab - View the Switch MAC Address Table

```
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 192.168.1.11 255.255.255.0
!
ip http server
ip http secure-server
!
line con 0
line vty 0 4
 password cisco
 login
line vty 5 15
 login
!
end
```

Switch S2

```
S2#show running-config
Building configuration...

version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname S2
!
boot-start-marker
boot-end-marker
!
enable secret 5 $1$1Rkm$DF1xhlhb6FCH14J.ux4Fb/
!
no aaa new-model
system mtu routing 1500
!
spanning-tree mode pvst
spanning-tree extend system-id
```

Lab - View the Switch MAC Address Table

```
!  
vlan internal allocation policy ascending  
!  
interface FastEthernet0/1  
!  
interface FastEthernet0/2  
!  
interface FastEthernet0/3  
!  
interface FastEthernet0/4  
!  
interface FastEthernet0/5  
!  
interface FastEthernet0/6  
!  
interface FastEthernet0/7  
!  
interface FastEthernet0/8  
!  
interface FastEthernet0/9  
!  
interface FastEthernet0/10  
!  
interface FastEthernet0/11  
!  
interface FastEthernet0/12  
!  
interface FastEthernet0/13  
!  
interface FastEthernet0/14  
!  
interface FastEthernet0/15  
!  
interface FastEthernet0/16  
!  
interface FastEthernet0/17  
!  
interface FastEthernet0/18  
!  
interface FastEthernet0/19  
!  
interface FastEthernet0/20  
!  
interface FastEthernet0/21  
!  
interface FastEthernet0/22  
!  
interface FastEthernet0/23  
!  
interface FastEthernet0/24
```

Lab - View the Switch MAC Address Table

```
!  
interface GigabitEthernet0/1  
!  
interface GigabitEthernet0/2  
!  
interface Vlan1  
  ip address 192.168.1.12 255.255.255.0  
!  
ip http server  
ip http secure-server  
!  
line con 0  
line vty 0 4  
  password cisco  
  login  
line vty 5 15  
  login  
!  
end
```