Lab – Viewing Network Device MAC Addresses (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	Default Gateway
R1	G0/1	192.168.1.1	255.255.255.0	N/A
S1	VLAN 1	N/A	N/A	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1

Objectives

Part 1: Set Up the Topology and Initialize Devices

- Set up equipment to match the network topology.
- Initialize and restart (if necessary) the router and switch.

Part 2: Configure Devices and Verify Connectivity

- Assign static IP address to PC-A NIC.
- Configure basic information on R1.
- Assign a static IP address to R1.
- Verify network connectivity.

Part 3: Display, Describe, and Analyze Ethernet MAC Addresses

- Analyze MAC address for PC-A.
- Analyze MAC addresses for router R1.
- Display the MAC address table on switch S1.

Background / Scenario

Every device on an Ethernet LAN is identified by a Layer-2 MAC address. This address is burned into the NIC. This lab will explore and analyze the components that make up a MAC address, and how you can find this information on various networking devices, such as a router, switch, and PC.

You will cable the equipment as shown in the topology. You will then configure the router and PC to match the addressing table. You will verify your configurations by testing for network connectivity.

After the devices have been configured and network connectivity has been verified, you will use various commands to retrieve information from the devices to answer questions about your network equipment.

Note: The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, 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. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

Note: Make sure that the routers and 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.

Instructor Note: If using routers other than the 2900 or 1900 series, you may be using fast Ethernet interfaces instead of the Gigabit interfaces. You will need to adjust the **show** commands accordingly.

Required Resources

- 1 Router (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 1 Switch (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- 1 PC (Windows 7, Vista, or XP 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

Part 1: Set Up the Topology and Initialize Devices

In Part 1, you will set up the network topology, clear any configurations, if necessary, and configure basic settings, such as the interface IP addresses on the router and PC.

Step 1: Cable the network as shown in the topology.

a. Attach the devices shown in the topology and cable as necessary.

b. Power on all the devices in the topology.

Step 2: Initialize and reload the router and switch.

Part 2: Configure Devices and Verify Connectivity

In Part 2, you will set up the network topology and configure basic settings, such as the interface IP addresses and device access. For device names and address information, refer to the Topology and Addressing Table.

Step 1: Configure the IPv4 address for the PC.

a. Configure the IPv4 address, subnet mask, and default gateway address for PC-A.

b. Ping the default gateway address from a PC-A command prompt.

Were the pings successful? Why or why not?

_____

_____

No. The default gateway (router interface) has not been configured yet, and the router G0/1 interface is shut down.

Step 2: Configure the router.

The configuration of a Cisco router is similar to configuring a Cisco switch. In this step, you will configure the device name and the IP address and disable DNS lookup on the router.

a. Console into the router and enter global configuration mode.

```
Router> enable
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

b. Assign a hostname to the router based on the Addressing Table.

```
Router(config)# hostname R1
```

c. Disable DNS lookup.

```
R1(config)# no ip domain-lookup
```

d. Configure and enable the G0/1 interface on the router.

```
R1(config)# interface GigabitEthernet0/1
R1(config-if)# ip address 192.168.1.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# end
*Feb 23 09:06:01.927: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to
down
*Feb 23 09:06:05.279: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to
up
*Feb 23 09:06:06.279: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/1, changed state to up
```

Step 3: Verify network connectivity.

Ping the default gateway address of R1 from PC-A.

Were the pings successful?

_____

The pings should be successful.

Part 3: Display, Describe, and Analyze Ethernet MAC Addresses

Every device on an Ethernet LAN has a Media Access Control (MAC) address that is burned into the Network Interface Card (NIC). Ethernet MAC addresses are 48-bits long. They are displayed using six sets of hexadecimal digits usually separated by dashes, colons, or periods. The following example shows the same MAC address using the three different notation methods:

    00-05-9A-3C-78-00   **00:05:9A:3C:78:00**   **0005.9A3C.7800**

Note: MAC addresses are also called physical addresses, hardware addresses, or Ethernet hardware addresses.

In Part 3, you will issue commands to display the MAC addresses on a PC, router, and switch, and you will analyze the properties of each one.

Step 1: Analyze the MAC address for the PC-A NIC.

Before you analyze the MAC address on PC-A, look at an example from a different PC NIC. You can issue the **ipconfig /all** command to view the MAC address of your NICs. An example screen output is shown below. When using the **ipconfig /all** command, notice that MAC addresses are referred to as physical addresses. Reading the MAC address from left to right, the first six hex digits refer to the vendor (manufacturer) of this device. These first six hex digits (3 bytes) are also known as the organizationally unique identifier (OUI). This 3-byte code is assigned to the vendor by the IEEE organization. To find the manufacturer, you can use a tool such as www.macvendorlookup.com or go to the IEEE web site to find the registered OUI vendor codes. The IEEE web site address for OUI information is http://standards.ieee.org/develop/regauth/oui/public.html. The last six digits are the NIC serial number assigned by the manufacturer.

a. Using the output from the **ipconfig /all** command, answer the following questions.

```
Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Realtek PCIe GBE Family Controller
   Physical Address. . . . . . . . . : C8-0A-A9-FA-DE-0D
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 192.168.1.3(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.1.1
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

What is the OUI portion of the MAC address for this device?

_____

C8-0A-A9

What is the serial number portion of the MAC address for this device?

_____

FA-DE-0D

Using the example above, find the name of the vendor that manufactured this NIC.

_____

Quanta Computer Inc.

b. From the command prompt on PC-A, issue the **ipconfig /all** command and identify the OUI portion of the MAC address for the NIC of PC-A.

_____

Answers will vary based on manufacturer.

Identify the serial number portion of the MAC address for the NIC of PC-A.

_____

Answers will vary based on manufacturer serial number code.

Identify the name of the vendor that manufactured the NIC of PC-A.

_____

Answers will vary based on manufacturer OUI.

Step 2: Analyze the MAC address for the R1 G0/1 interface.

You can use a variety of commands to display MAC addresses on the router.

a. Console into R1 and use the **show interfaces g0/1** command to find the MAC address information. A sample is shown below. Use output generated by your router to answer the questions.

```
R1# show interfaces g0/1
GigabitEthernet0/1 is up, line protocol is up
  Hardware is CN Gigabit Ethernet, address is 30f7.0da3.1821 (bia 30f7.0da3.1821)
  Internet address is 192.168.1.1/24
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full Duplex, 100Mbps, media type is RJ45
  output flow-control is unsupported, input flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 3000 bits/sec, 4 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     15183 packets input, 971564 bytes, 0 no buffer
     Received 13559 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 301 multicast, 0 pause input
     1396 packets output, 126546 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     195 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

What is the MAC address for G0/1 on R1?

_____

Answers will vary based on router student is using. Using output from above, the answer would be 30f7.0da3.1821.

What is the MAC serial number for G0/1?

_____

Answers will vary based on router student is using. Using output from above, the answer would be a3-18-21.

What is the OUI for G0/1?

_____

Answers will vary based on router. Using output from above, the answer would be 30-f7-0d.

Based on this OUI, what is the name of the vendor?

_____

Cisco Systems

What does bia stand for?

_____

Burned in address.

Why does the output show the same MAC address twice?

_____

The MAC address can be changed via a software command. The actual address (bia) will still be there which is shown in the parenthesis.

b. Another way to display the MAC addresses on the router is to use the **show arp** command. Use the **show arp** command to display MAC address information. This command maps the Layer 2 address to its corresponding Layer 3 address. A sample is shown below. Use output generated by your router to answer the questions.

```
R1# show arp
Protocol  Address         Age (min)  Hardware Addr   Type    Interface
Internet  192.168.1.1           -    30f7.0da3.1821  ARPA    GigabitEthernet0/1
Internet  192.168.1.3           0    c80a.a9fa.de0d  ARPA    GigabitEthernet0/1
```

What Layer 2 addresses are displayed on R1?

_____

R1 G0/1 and PC-A MAC addresses. If student also records the MAC addresses, answers will vary.

What Layer 3 addresses are displayed on R1?

_____

R1 and PC-A IP addresses

Why do you think there is no information showing for the switch with the **show arp** command?

_____

The **show arp** maps Layer 2 to Layer 3 addresses. The switch does not have an IP address assigned to it.

Step 3: View the MAC addresses on the switch.

a. Console into the switch and use the **show interfaces** command for ports 5 and 6 to display MAC address information. A sample is shown below. Use output generated by your switch to answer the questions.

```
Switch> show interfaces f0/5
FastEthernet0/5 is up, line protocol is up (connected)
  Hardware is Fast Ethernet, address is 0cd9.96e8.7285 (bia 0cd9.96e8.7285)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, media type is 10/100BaseTX
  input flow-control is off, output flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:45, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
```

```
      Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
      Queueing strategy: fifo
      Output queue: 0/40 (size/max)
      5 minute input rate 0 bits/sec, 0 packets/sec
      5 minute output rate 0 bits/sec, 0 packets/sec
         3362 packets input, 302915 bytes, 0 no buffer
         Received 265 broadcasts (241 multicasts)
         0 runts, 0 giants, 0 throttles
         0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
         0 watchdog, 241 multicast, 0 pause input
         0 input packets with dribble condition detected
         38967 packets output, 2657748 bytes, 0 underruns
         0 output errors, 0 collisions, 1 interface resets
         0 babbles, 0 late collision, 0 deferred
         0 lost carrier, 0 no carrier, 0 PAUSE output
         0 output buffer failures, 0 output buffers swapped out
```

What is the MAC address for F0/5 on your switch?

_____

Answers will vary. In example above, the MAC address is 0cd9.96e8.7285.

Issue the same command and write down the MAC address for F0/6.

_____

Answers will vary.

Are the OUIs shown on the switch the same as those that were displayed on the router?

_____

Answers will vary. Generally the answer will be no. Cisco Systems has many OUIs registered with IEEE.

The switch keeps track of devices by their Layer 2 MAC addresses. In our topology, the switch has knowledge of both MAC address of R1 and the MAC address of PC-A.

b. Issue the **show mac address-table** command on the switch. A sample is shown below. Use output generated by your switch to answer the questions.

Instructor Note: The **show mac address-table** command can vary based on the model switch that you are on. For example, syntax on some switches is **show mac-address-table.**

```
Switch> 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    30f7.0da3.1821    DYNAMIC    Fa0/5
  1    c80a.a9fa.de0d    DYNAMIC    Fa0/6
Total Mac Addresses for this criterion: 22
```

Did the switch display the MAC address of PC-A? If you answered yes, what port was it on?

_____

Answers will vary for the MAC address. In example above the MAC address would be c80a.a9fa.de0d. Port should be F0/6.

Did the switch display the MAC address of R1? If you answered yes, what port was it on?

_____

Answers will vary for the MAC address. In example above the MAC address would be 30f7.0da3.1821. Port should be F0/5.

Reflection

1. Can you have broadcasts at the Layer 2 level? If so, what would the MAC address be?

_____

You can and often do have broadcasts at Layer 2. ARP will use broadcasts to find MAC address information. The broadcast address is FF.FF.FF.FF.FF.FF.

2. Why would you need to know the MAC address of a device?

_____

There could be a variety of reasons. In a large network, it may be easier to pinpoint location and identity of a device by MAC address rather than IP address. The MAC OUI will list the manufacturer, which may help narrow down the search. Security measures can be applied at Layer 2 so knowledge of allowable MAC addresses is needed.

Router Interface Summary Table

Router Interface Summary				
Router Model	**Ethernet Interface #1**	**Ethernet Interface #2**	**Serial Interface #1**	**Serial Interface #2**
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Device Config

Router R1

```
R1#sh run
Building configuration...

Current configuration : 1176 bytes
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
hostname R1
boot-start-marker
boot-end-marker
!
no aaa new-model
!
no ipv6 cef
!
no ip domain lookup
ip cef
multilink bundle-name authenticated
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
```

```
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 2000000
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
control-plane
!
line con 0
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```