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.

1. Topology



1. 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 |

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.

1. 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.

1. 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

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.

* 1. Cable the network as shown in the topology.
     1. Attach the devices shown in the topology and cable as necessary.
     2. Power on all the devices in the topology.
  2. Initialize and reload the router and switch.

1. 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.

* 1. Configure the IPv4 address for the PC.
     1. Configure the IPv4 address, subnet mask, and default gateway address for PC-A.
     2. Ping the default gateway address from a PC-A command prompt.

Were the pings successful? Why or why not?

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

* 1. 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.

* + 1. 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)#

* + 1. Assign a hostname to the router based on the Addressing Table.

Router(config)# **hostname R1**

* + 1. Disable DNS lookup.

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

* + 1. 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

* 1. Verify network connectivity.

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

Were the pings successful?

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The pings should be successful.

1. 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**

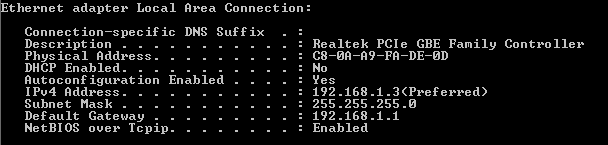
**Note**: MAC addresses are also called physical addresses, hardware addresses, or Ethernet hardware addresses.

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.

* 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](http://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.

* + 1. Using the output from the **ipconfig /all** command, answer the following questions.



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

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C8-0A-A9

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

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FA-DE-0D

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

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Quanta Computer Inc.

* + 1. 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.

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Answers will vary based on manufacturer.

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

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Answers will vary based on manufacturer serial number code.

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

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Answers will vary based on manufacturer OUI.

* 1. Analyze the MAC address for the R1 G0/1 interface.

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

* + 1. 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?

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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?

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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?

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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?

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Cisco Systems

What does bia stand for?

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Burned in address.

Why does the output show the same MAC address twice?

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

* + 1. 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?

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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?

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R1 and PC-A IP addresses

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

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

* 1. View the MAC addresses on the switch.
     1. 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?

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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.

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Answers will vary.

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

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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.

* + 1. 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?

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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?

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

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

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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.

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

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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.

1. 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. | | | | |

1. Device Config
2. 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