CS 168 Fall 2016 Section 6 – Addressing

Problem 1: Pop Quiz

a) Which protocol does a host use to learn its own IP address?

DHCP DNS ARP ICMP None of these

a) Which protocol does a host use to learn its own MAC address?

DHCP DNS ARP ICMP None of these

b) Which protocol does a host use to learn the MAC address of another host on the same network?

DHCP DNS ARP ICMP None of these

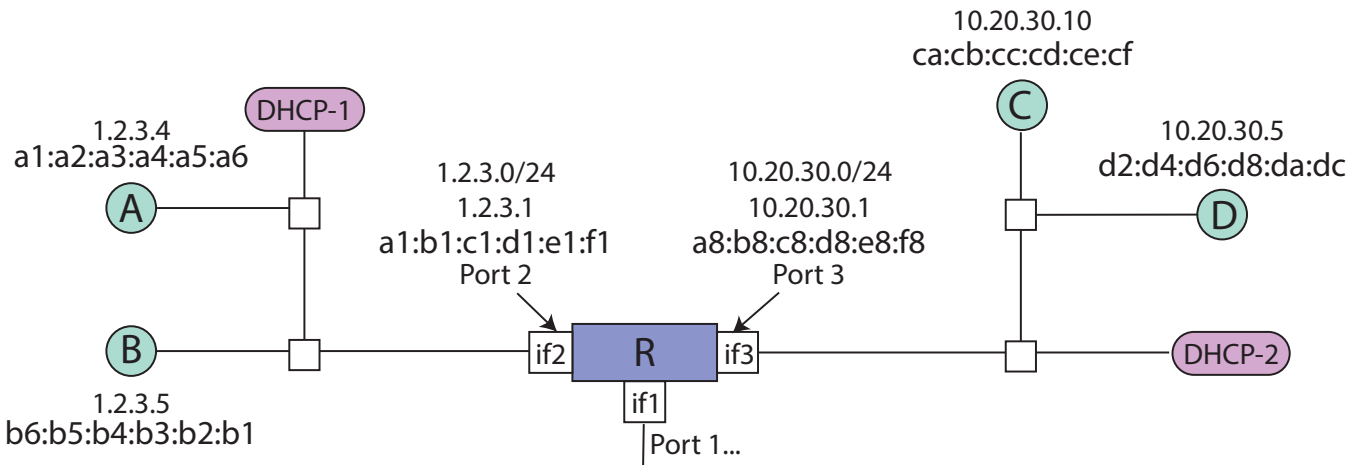
c) DHCP is a protocol in which layer? Physical / Datalink / Network / Transport / Application

b) ARP is a protocol in which layer? Physical / Datalink / Network / Transport / Application

Which of the following can a host learn with DHCP?

a. Its own MAC address
b. Its own IP address
c. The MAC address of another host
d. The IP address of another host
e. The IP address of its first hop router
f. The MAC address of its first hop router
g. Its own subnet mask

Problem 2: Host-to-Host



Consider the above topology. Here, two networks are connected through the router R. R has three interfaces, each associated with a port, MAC address, IP address, and subnet.

We are going to consider what happens when A sends a packet to C. Assume that A just attached to the network, but already knows the IP address of C (10.20.30.10). No hosts or routers have sent any previous ARP requests.

A. First A needs to learn its own IP address, subnet mask, and the IP of its first hop router by using DHCP. For each of the following DHCP messages, indicate the massage's timing in the packet exchange (1 is first, 4 is last), who sends the message, and whether the message is broadcast or unicast.

Message	**Order**	**Sender**	**Message type**
DHCP request	1 / 2 / 3 / 4	Client / Server	Broadcast / Unicast
DHCP ACK	1 / 2 / 3 / 4	Client / Server	Broadcast / Unicast
DHCP discovery	1 / 2 / 3 / 4	Client / Server	Broadcast / Unicast
DHCP offer	1 / 2 / 3 / 4	Client / Server	Broadcast / Unicast

B. Using this information, how does A determine if C is on the same subnet?
A uses its IP address, its subnet mask, and C's IP address. Using the bitwise AND operation, A checks if
<A's IP address> AND <A's subnet mask> == <C's IP address> AND <A's subnet mask>.
If this is true, then C is on the same subnet as A.

In this example, we have:
A's subnet: 11111111 11111111 11111111 00000000
A's IP: 00000001 00000010 00000011 00000100
C's IP: 00001010 00010100 00011110 00001010

The underscored portions are the network addresses, and since they are not equal, A and C are on different subnets.

C. Given that C is not on the same subnet as A, A must send the packet to its first hop router R. Which requests and responses are exchanged before this can happen?

Request	**Response**
ARP request for 1.2.3.4	ARP response: 1.2.3.4
ARP request for 1.2.3.1	ARP response: 1.2.3.1
ARP request for 10.20.30.10	ARP response: 10.20.30.10
ARP request for a1:a2:a3:a4:a5:a6	ARP response: a1:a2:a3:a4:a5:a6
ARP request for a1:b1:c1:d1:e1:f1	ARP response: a1:b1:c1:d1:e1:f1
ARP request for ca:cb:cc:cd:ce:cf	ARP response: ca:cb:cc:cd:ce:cf

D. Is the ARP request broadcast or unicast? What about the ARP response?
The ARP **request** is broadcast. After all, we're trying to learn the MAC address, so we would

have no idea, which address to use for unicast.

The ARP **response** is unicast. By looking at the source MAC address in the ARP request, the responder can tell which address to unicast the response to.

E. In the packet A now sends to R, what are the source and destination IP and MAC addresses?

Source IP: 1.2.3.4 (A's IP)

Source MAC: a1:a2:a3:a4:a5:a6 (A's MAC)

Destination IP: 10.20.30.10 (C's IP)

Destination MAC: a1:b1:c1:d1:e1:f1 (MAC of if2)

F. How does R know which interface to forward A's packet on?
R looks in its routing table for a prefix that matches 10.20.30.10. Assuming that the routing state has converged, R's forwarding table maps packets destined for 10.20.30.0/24 to port 3.

G. Now R has the packet. List all remaining packets that are exchanged until C receives the packet from A.
R sends an ARP request for 10.20.30.10
R receives an ARP response from C containing ca:cb:cc:cd:ce:cf
R sends the packet to C.

H. What are the source and destination IP and MAC addresses for the packet, R sends to C?

Source IP: 1.2.3.4 (A's IP)

Source MAC: a8:b8:c8:d8:e8:f8 (MAC of if3 on R)

Destination IP: 10.20.30.10 (C's IP)

Destination MAC: ca:cb:cc:cd:ce:cf (C's MAC)

Problem 3: Host-to-Host … Now on your own!

A. We've walked through the above example together. Now see if you can do it on your own. Below are a bunch of different events. Try to see if you can number them in the order they will happen, when D sends a packet to B. If an event never happens, don't give it a number. Assume that D just attached to the network, and that no hosts or routers have sent any previous ARP requests.

a. 3___ D sends a DHCP request
b. 1___ D sends a DHCP discovery message
c. _____ D sends a DHCP response
d. 2___ DHCP-2 sends a DHCP response
e. 4___ DHCP-2 sends a DHCP ACK
f. 5___ D checks if B is on the same subnet as D
g. _____ D sends an ARP request for 1.2.3.5
h. 6___ D sends an ARP request for 10.20.30.1
i. _____ D sends an ARP request for b6:b5:b4:b3:b2:b1
j. _____ D sends an ARP request for a8:b8:c8:d8:e8:f8
k. 7___ D receives an ARP response from R containing a8:b8:c8:d8:e8:f8
l. _____ D receives an ARP response from R containing a1:b1:c1:d1:e1:f1
m. _____ D receives an ARP response from B containing b6:b5:b4:b3:b2:b1
n. 8____ D sends an L2 packet to a8:b8:c8:d8:e8:f8
o. _____ D sends an L2 packet to b6:b5:b4:b3:b2:b1
p. 9___ R looks up a matching prefix for 1.2.3.5 in its forwarding table
q. ____ R looks up a matching prefix for 1.2.3.1 in its forwarding table
r. ____ R sends an ARP request for 1.2.3.1
s. 10_ R sends an ARP request for 1.2.3.5
t. ____ R sends an ARP request for b6:b5:b4:b3:b2:b1
u. ____ R receives an ARP response containing 1.2.3.5
v. 11_ R receives an ARP response containing b6:b5:b4:b3:b2:b1
w. ____ R receives an ARP response containing a1:b1:c1:d1:e1:f1
x. ____ R sends D's packet to 1.2.3.5
y. 12_ R sends D's packet to b6:b5:b4:b3:b2:b1

B. Now say D sends one more packet to B immediately (that is, before any IP allocations or ARP tables time out). Write down the letters of the events that happen during this exchange (in order).
f (D checks if B is on the same subnet as D)
n (D sends an L2 packet to a8:b8:c8:d8:e8:f8)
p (R looks up a matching prefix for 1.2.3.5 in its forwarding table)
y (R sends D's packet to b6:b5:b4:b3:b2:b1)