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CS 176A: Homework 5a

Part 1

1. **What kinds of problems can arise when two hosts on the same LAN share the same hardware address? Using a specific example, describe what happens and why that behavior is a problem.**
   When two hosts on the same network share a hardware address, ARP kicks in to determine which IP address to deliver content to. The problem is that because the MAC address is shared, so other devices cannot decipher anything. Content for Computer A could be delivered to Computer B or vice versa, and additionally, network switches will struggle to deliver packets because they depend on the MAC address. Switches can't forward if more than one device has the same address, which will oftentimes lead to packet loss.

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2. **In your own words, describe the difference between a switch and a router**
   Both switches and routers direct traffic between devices within networks. Routers direct traffic between networks, whereas switches route traffic on the same subnet. As such, switches operate at the link layer while routers operate on the network layer.

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3. **Consider the following network. IP and Ethernet addresses are marked for all interfaces. Assume a client on host A sends a TCP connection request message to a web server on host B. Show all the headers in the packet on link 1 and on link 2, assuming the addressing indicated on the figure. Include IP source and destination addresses, Ethernet source and destination addresses, and TCP source and destination port numbers. Use port numbers that make sense for the given application. Be sure to organize the headers in the proper layered order and label them.**
    a. Link 1 Headers
        i. IP Source: 128.111.41.23
        ii. IP Destination: 128.111.52.112
        iii. Ethernet Source: 43:00:08:A6:B1:13
        iv. Ethernet Destination: 34:7E:09:A0:12:01
        v. TCP Source Port: 8000
        vi. TCP Destination Port: 9000
    b. Link 2 Headers
        i. IP Source: 128.111.52.112
        ii. IP Destination: 128.111.41.23
        iii. Ethernet Source: 0A:09:56:44:BE:CD
        iv. Ethernet Destination:45:32:C9:BD:F9:03
        v. TCP Source Port: 8000
        vi. TCP Destination Port: 9000

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4. Consider 3 LANs interconnected by two routers as in the figure below.
    a. **Assign IP addresses to all of the interfaces. For subnet 1 (nodes A and B) use addresses of the form 128.111.41.xxx; for subnet 2 (nodes C and D) use addresses of the form 128.111.42.xxx; and for subnet 3 (nodes E and F) use addresses of the form 128.111.43.xxx.**
        i. Subnet 1
            1. Node A: 128.111.41.0
            2. Node B: 128.111.41.1
        ii. Subnet 2
            1. Node C: 128.111.42.0
            2. Node D: 128.111.42.1
        iii. Subnet 3
            1. Node E: 128.111.43.0
            2. Node F: 128.111.43.1
    b. **Assign MAC addresses to all the adapters.**
        i. Subnet 1
            1. Node A: 00:0A:95:9D:68:16
            2. Node B: 00:0A:95:9D:68:17
        ii. Subnet 2
            1. Node C: 00:0A:95:9D:68:18
            2. Node D: 00:0A:95:9D:68:19
        iii. Subnet 3
            1. Node E: 00:0A:95:9D:68:1A
            2. Node F: 00:0A:95:9D:68:1B
        iv. Router Interfaces (Router, Interface Side)
            1. (Left, Left): 00:0A:95:9D:68:1C
            2. (Left, Right): 00:0A:95:9D:68:1D
            3. (Right, Left): 00:0A:95:9D:68:1E
            4. (Right, Right): 00:0A:95:9D:68:1F
    c. **Consider sending an IP datagram from host A to host E. Suppose all of the ARP tables are up to date. Enumerate all the steps, as done in the book for the single-router example in section 6.4.1**
        i. The host uses Host E's IP as the address of its frame, and the MAC address selected is the left interface of the leftmost router.
            1. IP: 128.111.43.0
            2. MAC Address: 00:0A:95:9D:68:1C

ii. The left router passes this onwards and routes a datagram to Host E's IP (same as step i.) and the MAC address is of the left interface of the rightmost router.
    1. IP: 128.111.43.0
    2. MAC Address: 00:0A:95:9D:68:1E

iii. Finally, the right router passes this on and forwards the frame through the right interface (using its MAC Address) and to Host E's IP and MAC address
    1. IP: 128.111.43.0
    2. MAC Address 1: 00:0A:95:9D:68:1F
    3. MAC Address 2: 00:0A:95:9D:68:1A

d. Repeat (c) assuming that the ARP table in the sending host is empty (and the other tables are up to date).

i. Host A broadcasts with Host E's IP but the MAC address is initialized to FF:FF:FF:FF:FF:FF
    1. IP: 128.111.43.0
    2. MAC Address: FF:FF:FF:FF:FF:FF

ii. The left router provides its left MAC address so that it can pass the message onto Host E
    1. IP: 128.111.43.0
    2. MAC Address: 00:0A:95:9D:68:1C

iii. Host A sends the frame, using Host E's IP address and the MAC address of the left interface of the leftmost router
    1. IP: 128.111.43.0
    2. MAC Address: 00:0A:95:9D:68:1C

iv. The left router passes this onwards and routes a datagram to Host E's IP (same as step i.) and the MAC address is of the left interface of the rightmost router.
    1. IP: 128.111.43.0
    2. MAC Address: 00:0A:95:9D:68:1E

v. Finally, the right router passes this on and forwards the frame through the right interface (using its MAC Address) and to Host E's IP and MAC address
    1. IP: 128.111.43.0
    2. MAC Address 1: 00:0A:95:9D:68:1F
    3. MAC Address 2: 00:0A:95:9D:68:1A

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5. **Consider the network shown below. The IP and MAC addresses are shown for hosts A, B, C and D, as well as for the router's interfaces. Consider an IP datagram being sent from node A to node C.**
    a. **What is the source and destination MAC address on the frame at point (4)?**
        i. Source: 72-9E-4A-31-9C-42
        ii. Destination: 4C-9D-AA-74-D6-1F
    b. **What is the source and destination IP address of the datagram at point (4)?**
        i. Source: 128.119.97.18
        ii. Destination: 128.119.240.52

Now consider an IP datagram being sent from node D to node B.

    c. **c) What is the source and destination MAC address on the frame at point (5)?**
        i. Source: D5-A0-EE-9A-73-D5
        ii. Destination: 72-9E-4A-31-9C-42
    d. **d) What is the source and destination IP address of the datagram at point (5)?**
        i. Source: 128.119.240.116
        ii. Destination: 128.119.50.107

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6. **Consider the network below with six nodes, star-connected into an Ethernet switch. Suppose that A sends a frame to A', A' replies to A, then B sends a message to B' and B' replies to B. Enter the values (node identifier and interface) that are present in the switch's forwarding table after B'-to-B frame is sent and received. Assume that the table is initially empty and that entries are added to the table sequentially.**
    a. **What is the first entry added to the table?**

Address	Interface
A	1

    b. **What is the second entry added to the table?**

Address	Interface
A	1
A'	4

    c. **What is the third entry added to the table?**

Address	Interface
A	1
A'	4
B	2

    d. **What is the fourth entry added to the table?**

Address	Interface
A	1
A'	4
B	2
B'	5