CSC / ECE 573 Internet Protocols, Fall 2005

Homework #2

Due Date

- Tuesday, September 13, at 11:45 PM

Instructions

- Homeworks should be submitted individually. We will use the standard submit utility for our class to submit all work, which means your work must be prepared electronically.
- Put your name, the assignment number, and date at the top of the first page. Put solutions in order (don't make the TA hunt for your solution).
- Do not plagiarize; that means, do not copy content from any source without permission from the instructor, and if permitted, acknowledge the source.

Problems

1. Suppose ARP was implemented in the following way:
   Every host upon booting, and once each five minutes thereafter, broadcasts on its locally attached network its logical to hardware address binding. This information is cached by other machines, for use whenever needed. There is no ARP Request message.
   How does this scheme compare with the way ARP really works? Are there any advantages?

2. Convert the following:

   1. 10100011 00110011 01010100 00011001 to dotted decimal format

   2. 19.28.123.75 to binary format

3. For each of the following, indicate whether the address shown is a Class A, B, C, D, or E type address (assuming classful addressing is being used).

   1. 188.32.32.12

   2. 125.0.0.1

   3. 200.250.250.250

   4. 20.25.86.250

   5. 225.15.254.36

4. Using the web sites http://www.iana.org/assignments/ipv4-address-space and http://www.arin.net/whois/index.html, answer the following questions.

   1. What network address is assigned for use by the Xerox Corporation?

   2. To whom is the address 200.165.233.191 assigned?

   3. To whom is the address 216.77.177.137 assigned?

   4. To whom is the address 64.21.49.25 assigned?

5. Two networks, 192.168.1.0 and 10.0.0.0, are connected by a router with interfaces 192.168.1.1 and 10.0.0.1.

There are 3 hosts on the first network, with interface addresses 192.168.1.5, 192.168.1.6, and 192.168.1.7, and 3 hosts on the second network, with interface addresses 10.0.0.20, 10.0.0.21, and 10.0.0.22. The network is shown below.

For each of the following, what host(s) will receive the packets with the given source and destination address, sent by the host specified?

1. Source IP = 192.168.1.5, Destination IP = 127.0.0.1, sent by 192.168.1.5
2. Source IP = 192.168.1.6, Destination IP = 192.168.1.255, sent by 192.168.1.6
3. Source IP = 10.0.0.20, Destination IP = 255.255.255.255, sent by 10.0.0.20
4. Source IP = 0.0.0.0, Destination IP = 192.168.1.5, sent by 192.168.1.6
5. Source IP = 192.168.1.5, Destination IP = 10.255.255.255, sent by 192.168.1.5
6. Source IP = 192.168.1.7, Destination IP = 10.0.0.21, sent by 10.0.0.22

6. Destination-based forwarding will not split traffic from one source to one destination across multiple paths.
    1. What are one or two disadvantages of splitting traffic across multiple paths?
    2. In terms of the forwarding table and lookup process, what would have to change to support traffic splitting?
    3. Is there any way you could think of to split traffic from a single source to a single destination across multiple paths, using IP's current capabilities?
7. Shown below is a group of hosts and routers.

The routing table entries for each router or host are given below: (Notes: For an entry such as "192.168.80.0 = 192.168.80.16", that means the host is directly attached to network 192.168.80.0 and should use its interface (192.168.80.16) to reach that network. For an entry such as "192.168.80.0 = 192.168.100.111", that means to reach all hosts on network 192.168.80.0, the router interface 192.168.100.111 is the "next hop", or gateway. For an entry such as "192.168.90.25 = 192.168.80.23", that means to reach the host with address 192.168.90.25, the router interface 192.168.80.23 is the next hop or gateway. For an entry such as "default = 192.168.90.23", that means any destination not otherwise specified should use router interface 192.168.90.23 as the next hop or gateway. Loopback interfaces and routes are not shown.)

- A: 192.168.80.0 = directly connected, 192.168.90.25 = 192.168.80.5, default = 192.168.80.23
- B: 192.168.100.0 = directly connected, 192.168.80.0 = 192.168.100.111, default = 192.168.100.5
- C: 192.168.90.0 = directly connected, default = 192.168.90.23
- R1: 192.168.100.0 = directly connected (use 192.168.100.5), 192.168.80.0 = directly connected (use 192.168.80.5), 192.168.90.0 = 192.168.80.23, default = 192.168.80.8
- R2: 192.168.80.0 = directly connected (use 192.168.80.23), 192.168.90.0 = directly connected (use 192.168.90.23), 192.168.100.0 = 192.168.80.5, default = 192.168.80.8
- R3: 192.168.90.0 = directly connected (use 192.168.90.111), 192.168.100.0 = directly connected (use 192.168.100.111), default = 192.168.90.23
- R4: 194.100.3.0 = directly connected (use 194.100.3.8), default = 194.100.3.15 (not shown, part of another router connected to network 194.100.3.0), 192.168.80.0 = directly connected (use 192.168.80.8), 192.168.90.0 = 192.168.80.23
  (previously, this was (incorrectly) R4: 194.100.3.0 = 194.100.3.8, default = 194.100.0.15, 192.168.80.0 = 192.168.80.8, 192.168.90.0 = 192.168.80.8)

1. What path (list the interfaces) will a packet from host A to host B take in this network?
2. What path will a packet from host C to a host at address 194.100.3.45 take?
3. Find one case, if there is one, where a routing loop will occur, and indicate how this happens.

4. Find one case where a packet from host X to host Y will take a different path (sequence of interfaces) than the reverse path from host Y to host X. Name X and Y and indicate what path each packet will take.

5. For the above configuration, can you spot any other potential "routing errrors"?

8. Which of the following pairs of hosts are "directly connected", assuming classful addresses are being used?

    1. 135.5.5.15, 135.5.3.12

    2. 25.5.5.15, 25.1.3.12

    3. 192.168.5.15, 192.168.3.12

9. What can/should a user do if a packet she sends results in a "Port Not Bound to a Service" ICMP Destination Unreachable message being returned?

10. A host A wishes to send an IP datagram of size 1500 (including header) on a path that crosses three networks with MTUs respectively of 1500, 1300, and 1100. If it uses MTU discovery and wishes to avoid fragmentation, describe what will happen (what packets and/or messages are sent) as it attempts to send this datagram (assume it doesn't quit until the data is delivered). You do not have to show the actual packet contents.

11. "ping" is a program to determine whether a host is up, by sending an ICMP echo request to one of its IP addresses. The ping implementation can be found at see http://www.ping127001.com/pingpage/ping.html According to this implementation, multiple instances of ping may be running at the same time, and each will get a copy of *all* ICMP datagrams that arrive. How does a single instance of ping determine which ICMP messages it specifically should print out?

12. According to the ICMP implementation (icmp.c from http://lxr.linux.no/source/net/ipv4/), when an error message is sent, how much of the "offending" IP datagram is returned in the ICMP payload field?

13. Use tracert to determine where delay occurs on a particular route. Use "tracert www.uni-konstanz.de" from any machine ("traceroute www.uni-konstanz.de" on linux), and show the output.

    1. Where does most of the delay occur, according to the output?

    2. If you do this multiple times at different times of day, do you observe much variation in the total delay to www.uni-konstanz.de?

14. What are the conditions under which an ICMP error message should *not* be sent, even though some error occurred for an incoming IP datagram?

15. An IP packet containing an ICMP "Redirect" message has the following fields:

    - IP header: source address = 192.168.5.3, destination address = 192.168.5.12
    - ICMP Redirect: router address to use = 192.168.5.28
    - "Original" IP packet header (contained in ICMP message): source address = 192.168.5.12, destination address = 192.168.15.36

    1. What is the source IP address of the host that sent the original IP packet?

    2. What is the IP address of the router that (incorrectly) received this IP packet?

    3. What is the IP address of the router to which this packet should have been forwarded by the originating host?

16. Using ethereal and the "dumpb.txt" file from the previous assignment:

    1. How often did the 152.14.62.3 ask for the hardware address of 152.14.62.68, and at what times? How about 152.14.62.71?

    2. How many and what type of IP packets have flags.df == 1?

    3. How many IP datagrams have options (hint: header length > 20)? What types of options do you observe, in what types of datagrams?

4. Export the file of IP datagrams and create a histogram of IP datagram lengths, using any tool you wish (e.g., excel). What values are common?

5. From the same file of IP datagrams, create a histogram of TTL values. Which values are common?

6. (I'll have to get a more interesting dump to find ICMP packets :-)

Created on August 22, 2005
Last Modified September 21, 2005
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