Homework 4 – Network Layer

Assigned: Thursday, November 5, 2009
Due: Tuesday, November 17, 2009 *at the beginning of class*
100 points

Note: All homework assignments should be done on your own, and your answers should be in your own words. The textbook and lecture notes may be used, but you should not copy verbatim from either of them. *Use of previous years' assignments/solutions or the textbook's solutions manual is **not** permitted.*

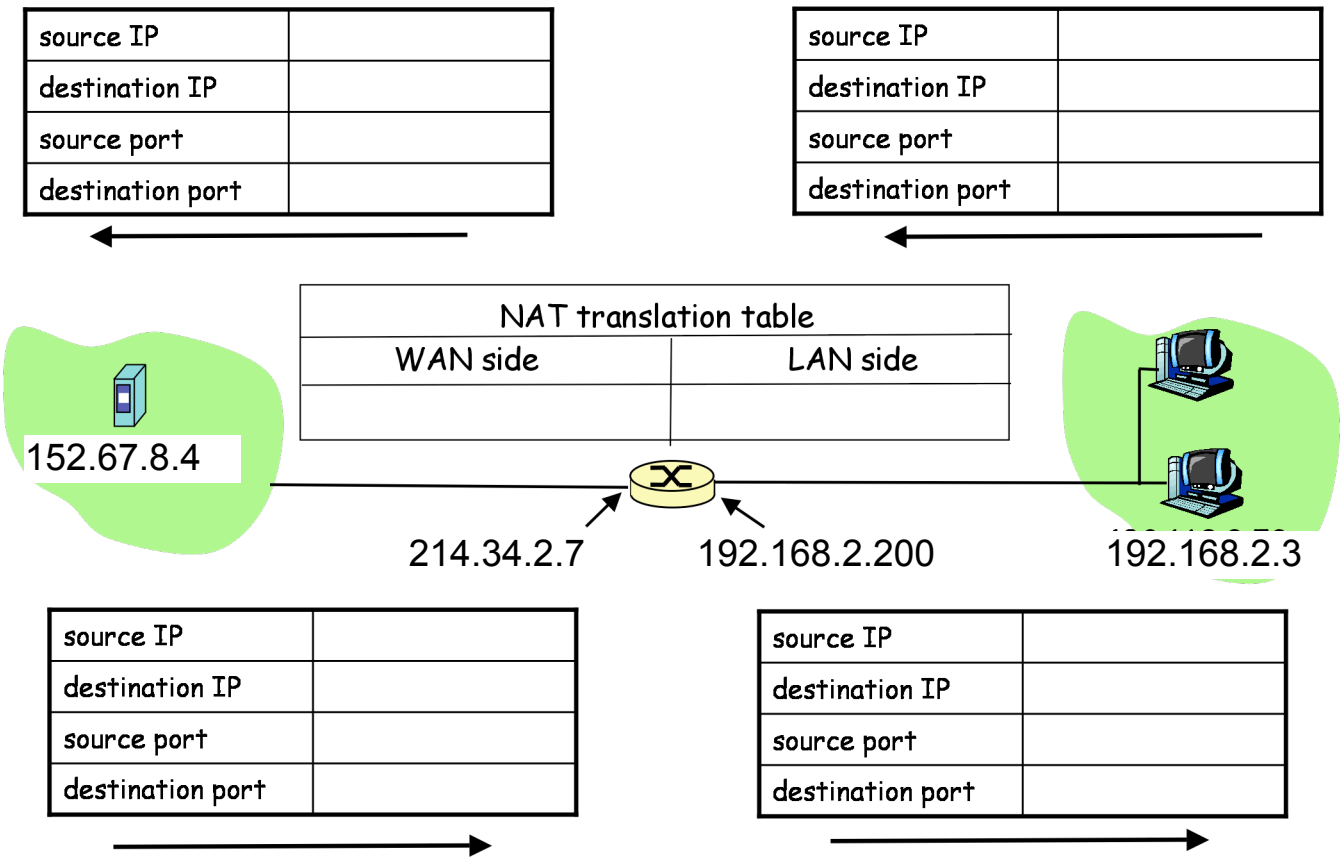
Review Questions [40 points - 2 pts each]

1. What is the difference between routing and forwarding?
2. What is the difference between a forwarding table used in a virtual circuit network and a forwarding table used in a datagram network?
3. What are the four main parts of a router?
4. What could cause buffering at an output port of a router?
5. How many IP addresses does a router have?
6. What is a subnet?
7. What is the advantage of CIDR addressing over class-based addressing?
8. List the private IP address ranges. What is special about how routers treat packets with private IP addresses?
9. Suppose there are three routers between a source host and destination host. Ignoring fragmentation, an IP datagram sent from the source host to the destination host will travel over how many interfaces?
10. What is the purpose of DHCP?
11. What causes IP fragmentation?
12. Where is a fragmented IP datagram reassembled?
13. Suppose an application generates chunks of 40 bytes of data every 20 milliseconds (ms), and each chunk gets encapsulated in a TCP segment and then an IP datagram.
    a. **[1 pt]** What percentage of each datagram will be overhead, and what percentage will be application data?
    b. **[1 pt]** What would be the percentage overhead and percentage application data if the application only encapsulated data every 500 ms?
14. Suppose Host A sends Host B a TCP segment encapsulated in an IP datagram. When Host B receives the datagram, how does the network layer in Host B know it should pass the segment (that is, the payload of the datagram) to TCP rather than UDP or to something else?

15. What is the purpose of NAT?
16. Can routing loops occur with link-state routing? with distance-vector routing?
17. What can be used to avoid the "count-to-infinity" problem in distance-vector routing?
18. What is the difference between a routing algorithm and a routing protocol?
19. Is it necessary that every AS use the same intra-AS routing algorithm? Why or why not?
20. What is BGP and what is it used for?

Problems

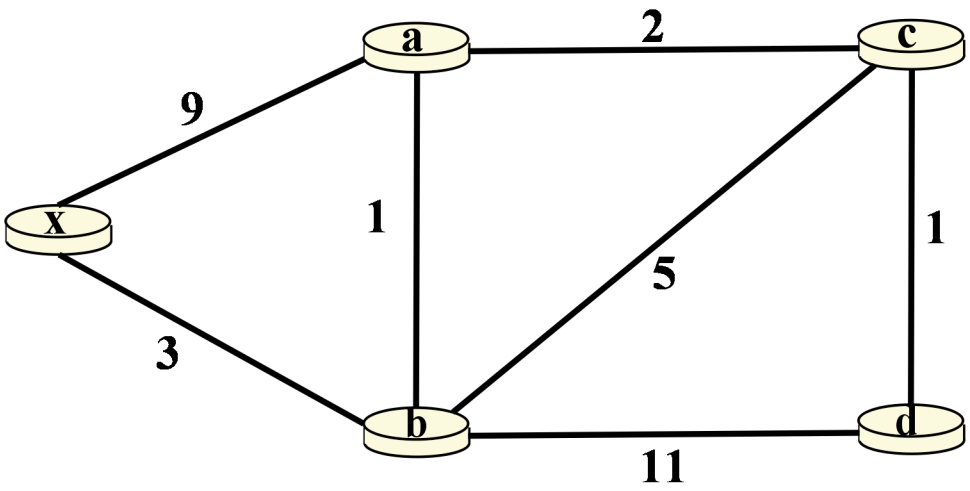
1. **[18 points]** You are downloading web pages from home. Your machine's IP address is 192.168.2.3, and the address your ISP assigned to you (and given to your home router running NAT) is 214.34.2.7. You are downloading a web page from the server 152.67.8.4. In the diagram below, fill in the NAT table entry for the connection and the source and destination IP addresses and port numbers for the IP datagrams traveling in directions indicated by the arrows. Use valid port numbers and assume the web server is listening on the standard default HTTP port.



2. **[6 points]** Consider a network where the MTU closest to the sender is 4000 bytes and the MTU closest to the receiver is 1500 bytes. If a 3600-byte IP datagram (including IP header) with an ID of 222 is sent from the sender to the receiver, show the fragments that would be created, including the relevant IP header fields: length, ID, offset, and fragment flag.

3. **[4 points]** You are the network administrator at Monarch Widgets, Inc. You've just been told that a new block of network addresses with the CIDR address of 168.2.47.128/25 has been assigned to the company.
   a. How many new valid IP host addresses can you assign?
   b. What is the range of those addresses?

4. **[20 points]** Given the following network with the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from **x** to all network nodes. Show how the algorithm works by filling in the following table, showing what happens at each step.



Step	N	D(a), p(a)	D(b), p(b)	D(c), p(c)	D(d), p(d)
0	x				
1					
2					
3					

5. **[12 points]** Complete the following distance-vector tables from the class discussion.