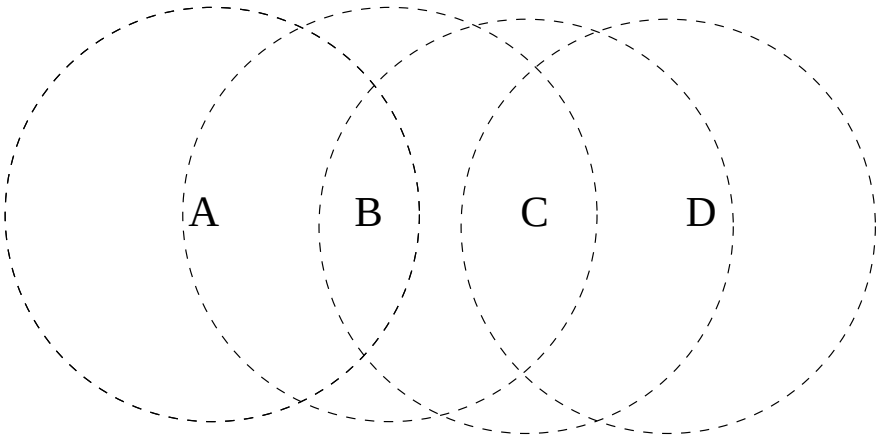
# 15-441: Computer Networks
# Homework 4

Assigned: Apr 23, 2008
Due: May 1, 2008
Lead TA: Xi Liu

1. Consider the following topology of wireless laptops A, B, C and D. The dotted lines indicate the range of wireless transmissions from each node. For example, B is within range of A, A & C are within range of B, B & D are within range of C and only C is within range of D. Assume that each node uses an RTS/CTS based MAC protocol.




   (a) Use the figure to give an example of how RTS/CTS can help solve hidden terminal problem.

   (b) RTS/CTS is usually disabled by default on commerical wireless routers, give one reason for this choice.

2. There are three forms of P2P lookup algorithms: centralized (napster), flooding-based (gnutella) and routing-based (DHTs). Which of the following statements is true about these algorithms?

   (a) Flooding-based and centralized systems can support much richer queries (regular expressions, wildcards) than routing-based systems.

   (b) Routing-based systems are more scalable than flooding-based systems since they produce less traffic per search.

   (c) Routing-based systems ensure that a client finds the copy of a file that is closest to it in the network.

   (d) Ring-based DHTs are not as flexible as other DHTs since they only allow routing in one dimension.

3. Imagine a Chord system using 4-bit ids. Let there be 4 nodes participating with IDs 0, 3, 9, 11 and 12.

   (a) Use the table below to fill in the finger table for node 0. Please assume clockwise data assignment.

| ID pointed to | Node storing ID |
|---|---|
| | |
| | |
| | |
| | |
| | |

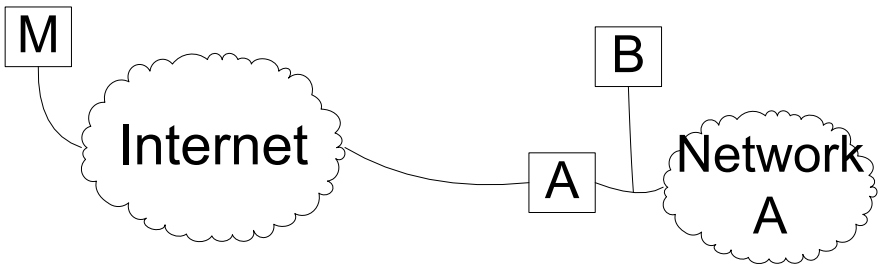
(b) Using the above Chord ring, what path would a request starting at node 0 take to find data item 12?

4. Suppose you retrieve index.html from cnn.com and find that it has 3 embedded images that have been akamaized. Assume that your browser does not use persistent connections and that your DNS cache is empty. Assume that the only TTLs used for DNS are 1 day and 1 minute. In retrieving the 3 images (not the html file), how many connections will your browser make to:
   (a) the original content provider
   (b) the DNS root/gTLD server
   (c) the Akamai high-level DNS server
   (d) the Akamai low-level
   (e) the closest Akamai server

5. Consider 10 flows with arrival rates of 1,2,...,10 Mbps that traverse a link of 50Mbps. Calculate the max-min fair share on this link. What is the fair share if the link capacity is 60 Mbps?

6. Consider 10 wireless users associated with an access point, and they are sending data to the access point using transmit rates of 1,2,...,10 Mbps, respectively.
   (a) Suppose all users are transmitting continuously with maximum frame size, e.g. 1500 bytes. Calculate the effective data rate for each wireless user, you can ignore the protocol overhead. (Hint: airwave is shared by all users and access point allocates equal link-layer throughput to every associated user.)
   (b) From the previous problem we can see that the effective data rate is greatly limited by the slow users. Propose a simple idea to solve this problem (describe your idea, do not write a complete solution).

7. Consider the following topology.




   (a) You want to deploy both a firewall and an NIDS, where do you want to place each of them (choose from A and B)? Briefly explain your choice.
   (b) Suppose there is a malicious attacker M in the Internet, how to set the rule on the firewall to prevent traffic from M (use the following table)?

| Rule | Dir | Src Addr | Src Port | Dst Addr | Dst Port |
|---|---|---|---|---|---|
| Ingress | | | | | |

(c) Suppose M knows the rule specified in (b), how can he evade such blocking, e.g. still be able to send packets to A?

(d) Traditional rules only inspect the IP headers. What is the limitation of this approach? Proxy-based firewall is deployed where packet content is also inspected, what are the pros and cons of this approach?