

Electrical, Computer, and Systems Engineering  
ECSE-6600: Internet Protocols  
Spring 2001

**Problem Set 2**

**[On-Campus and Non-Delayed Students: Due Monday, March 19<sup>th</sup> 2000**

**[Delayed students: Due Thursday, March 22<sup>nd</sup> 2000]**

<b>Your Name</b>	
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**Notes:**

1. Be brief.
2. A significant part of the homework credit is given to reading. Reading assignments will be quizzed in both informal and formal quizzes
3. Please write your answers on separate sheets and staple it along with the questions to facilitate easy grading.

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1	1A	2	3	4	Total
20	20	30	15	15	100

TA Signature : \_\_\_\_\_

1. (20 pts) *Reading assignment:*

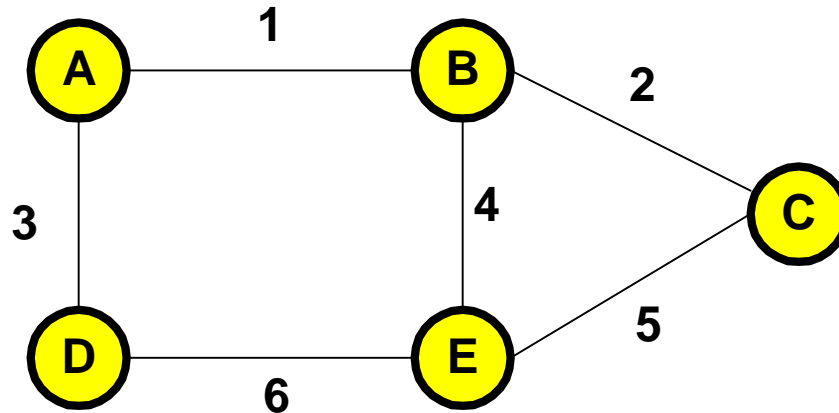
- Summarize the essence of papers/RFCs you read:
  - a) Kent/Mogul fragmentation paper,
  - b) Jacobson TCP congestion control paper,
  - c) Karn/Partridge paper on RTT estimation and RTO backoff,
  - d) Chiu/Jain paper on increase/decrease schemes, and
  - e) RFC 1034 on DNS

1A. Questions on reading assignments:

- A) (2 pts) Give examples to argue why fragmentation and reassembly are both inefficient under packet or fragment loss.
- B) (3 pts) Why is the DF-bit setting and ICMP-based approach for path MTU detection preferred over the other alternatives described in the paper ?
- C) (2 pts) What is meaning of the packet-conservation principle in general, and especially when the congestion window is growing ? (Jacobson paper)
- D) (3 pts) Explain how the use of timestamps in packet headers can be used to avoid the retransmission ambiguity problem in TCP (posed by Karn/Partridge. Timestamp option in TCP was introduced in RFC 1323).
- E) (2 pts) Explain how and why the fairness line and efficiency line are represented in the vector representation of Chiu/Jain's paper.
- F) (3 pts) Explain the precise reasons why non-linear schemes other than additive increase/multiplicative decrease were eliminated in Chiu/Jain's paper.
- G) (2 pts) Explain the difference between recursive and iterative DNS queries. What are the limitations on recursive queries? Why do root servers (for the "." domain) not support recursive queries?
- H) (3 pts) Explain when CNAME and SOA types may be useful. How are they resolved in DNS ? Give an example.
- Optional Creativity question: (10 BONUS points) Jacobson proposes a self-clocking approach for transmission. Forget for a moment the strong reliability semantics of TCP and assume not all packets in a window are lost and reverse paths are reliable. Now consider the following alternative: source uses a congestion window but decreases it in response to negative acknowledgements (NAKs). There are no ACKs to self-clock the system. NAKs also bring implicit timing estimates which are used to calculate round trip times (same algorithm  $RTO = SRTT + 4 D$ ). The source

increases its window by 1 MSS every RTO if no NAKs are received during that period. Discuss how differently this non-self clocked system might behave compared to a self-clocked. Deep answers will get more credit. State any reasonable assumptions you make. How does the behavior change (if at all) if rate-based control (i.e. a rate-throttle) is used instead of a window-based control (I.e. a window).

- f) (30 pts) Consider the following simple network. Based upon the notations covered in class, write out the steps of how the Bellman-Ford Algorithm and Dijkstra's Algorithm will progress at node A and what is the final forwarding table at node A.



- g) (15 pts) Identify web sites in different parts of the US, Asia and Europe. Choose both academic and business sites covering a wide range of RTTs, and geographical diversity (max 10 sites should be enough). Run multiple ping and traceroute to these sites, (and optionally repeat the experiment at different times of the day and different days). Explain what useful information you can reliably gather from these experiments. Also explain why some parts of the information cannot be reliably gathered.
- The average RTT and standard deviation in RTT based upon multiple ping/traceroutes to the same site.
  - The loss rate experienced in accessing the site.
  - The average end-to-end bandwidth one can expect when accessing the site
  - The average number of hops in accessing the site and the types of backbone and regional networks traversed along the path.

- h) (15 pts) Use the command 'tcpdump -n -vv -s 512 &' to look into the DNS packets on a linux machine with tcpdump enabled (contact TAs if you have trouble setting up tcpdump or do not have access to a linux machine). Now try the following commands:
- a) nslookup 192.48.96.9
  - b) nslookup shiv.ecse.rpi.edu
  - c) host way.cis.ohio-state.edu

Capture and annotate the output in each case. Refer to pg 196-199 in your text for guidance in interpreting these values. You will see many kinds of DNS queries and responses including pointer, A, CNAME, MX, DNS error etc. Explain why multiple DNS queries are generated for each case. Hint: look at /etc/resolv.conf