College of Computer and Information Science
Northeastern University
CS4700 & CS5700: Fundamentals of Computer Networks

Fall 2011

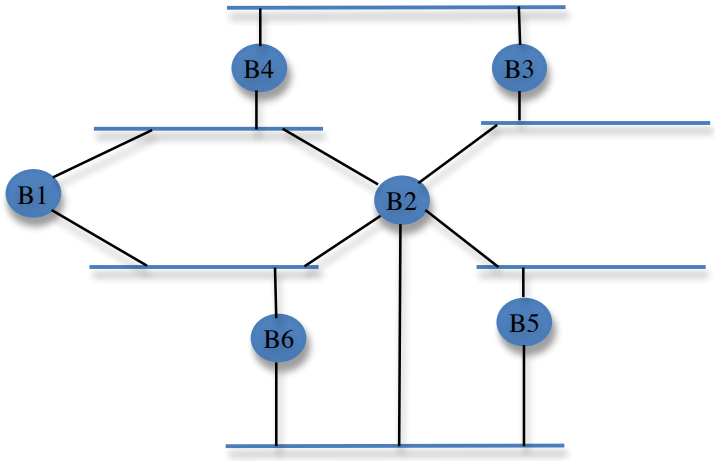
Problem Set 4 (due October 23, 2011).

Important Notes:

1. All questions should be answered individually (no team work).
2. Late submissions will result in a 10% penalty per day (e.g., 2.5 days late result in 25% penalty).
3. You can use the Internet to get some help, but you should use your own words, examples, and code when answering the questions. Reference Internet materiel when appropriate.

Problems 1-5 are for both CS4700 & CS5700 students.

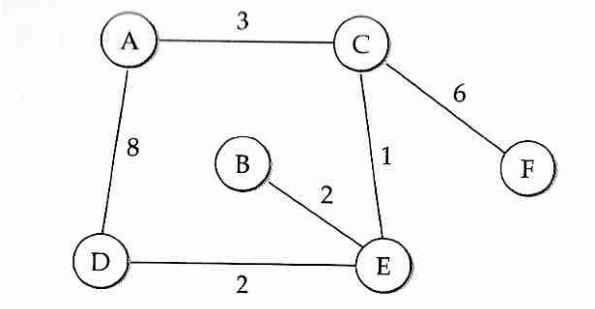
Problem 1 [10 points]: Bridging - Spanning Tree



a. Consider the above extended LAN. Indicate which ports are not selected by the spanning tree.
b. Assume that bridge B1 fails. Indicate which ports are not selected by the spanning tree after the recovery process.

Problem 2 [10 points]: Routing – Bellman-Ford Algorithm

Consider a distance vector routing protocol based on the Bellman-Ford Algorithm running on the following network topology.



a. What is the initial global view of the routing tables (i.e., node to node distances, See table 3.10 in textbook for example)?
b. What is the global view of the routing tables after the first step of message exchanges?
c. What is the global view of the routing tables after they reach a stable state.

Problem 3 [10 points]: Routing – Dijkstra's Algorithm
Consider the network topology of Problem 2, and a link state routing protocol using Dijkstra's algorithm. Show the steps of building the routing table at node A as done in class or textbook (for reference you can see Table 3.14).

Problem 4 [10 points]: Fragmentation
Suppose and IP packet is fragmented into 10 fragments, each with 1% (independent) probability of loss. What is the probability of net loss of the whole packet if the packet is transmitted twice, (consider the following two cases):

a. assuming all fragments received must have been part of the same transmission

b. assuming any given fragment may have been part of either transmission

Discuss how the *Ident* IP header field can help.

Problem 5 [10 points]: Switch Performance
(Textbook Chapter 3, Exercise 28, page 291)

Suppose a switch is built using a computer workstation and that it can forward packets at a rate of 500,000 packets per second, regardless (within limits) of size. Assume the workstation uses direct memory access (DMA) to move data in and out of its main memory, which has a bandwidth of 2 Gbps, and that the I/O bus has a bandwidth of 1Gbps. At what packet size would the bus bandwidth become the limiting factor?

Additional Required Problem for graduate students (CS5700).

Problem 6 [10 points]:
Persons arrive at a taxi stand with room for W taxis according to a Poisson process with rate λ. A person boards a taxi upon arrival if one is available and otherwise waits in a line. Taxis arrive at the stand according to a Poisson process with rate μ. An arriving taxi that finds the stand full departs immediately; otherwise, it picks up a customer it at least one is waiting, or else joins the queue of waiting taxis.

Use an $M/M/1$ queue formulation to obtain the steady-state distribution of the person's queue. What is the steady-state distribution of the taxi queue size when $W = 5$, and $\lambda = 1$ taxi per minute, and $\mu = 2$ taxi per minute.