

## Problem 1

In this problem, you will put together much of what you have learned about Internet protocols. Suppose you walk into a room, connect to Ethernet, and want to download a Web page. What are the protocol steps that take place, starting from powering on your PC to getting the Web page? Assume there is nothing in our DNS or browser caches when you power on your PC. Explicitly indicate in your steps how you obtain the IP and MAC addresses of the first-hop router.

Write your solution to Problem 1 in this box

## Problem 2

Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability  $p$ . The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

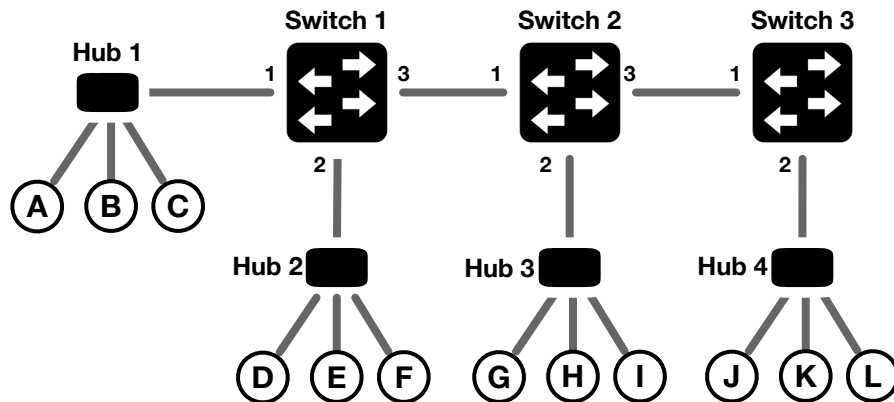
- (a) What is the probability that node A succeeds for the first time in slot 4?
- (b) What is the probability that any node (either A, B,C or D) succeeds in slot 3?

Write your solution to Problem 2 in this box

### Problem 3

Consider the following network connected by three switches. The circles in the figure indicate the hosts (From host A to host L). At time=0s, the forwarding tables of all three switches are empty. Assume that all the hosts already know MAC addresses of other hosts, therefore no ARP is required. Also, assume that the TTL values of the forwarding table entries are big enough so that it will not expire in this problem. Suppose, the following seven events happen sequentially:

- Time=1s: Host A sends an IP datagram to Host G
- Time=2s: Host G sends an IP datagram to Host A
- Time=3s: Host D sends an IP datagram to Host L
- Time=4s: Host D sends an IP datagram to Host I
- Time=5s: Host F sends an IP datagram to Host A
- Time=6s: Host K sends an IP datagram to Host G
- Time=7s: Host J sends an IP datagram to Host F



- (a) How many times has each switch broadcasted the received frames? (Considering all seven events above.)

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- (b) List the forwarding table of each switch after the seven events.

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- (c) At time=10s, Host A sends Broadcast IP datagram in the network. How many hosts will receive this broadcast IP datagram excluding the sender?

Write your solution to Problem 3 in this box

## Problem 4

Consider the difference between 802.3 (Ethernet) and 802.11 (WiFi) link layers.

- (a) Does the ACK in WiFi ensure reliable delivery in the link layer? Why?
- (b) Compared with WiFi, Ethernet doesn't use ACK in the link layer. What are the possible reasons that people choose not to use ACK in Ethernet? Will it cause problem with application that requires reliable delivery of data?
- (c) Why is collision detection not feasible in WiFi (so that it uses CSMA/CA instead of CSMA/CD)?

Write your solution to Problem 4 in this box

## Problem 5

In Mobile IP, what effect will mobility have on end-to-end delays of datagrams between the source and destination?

Write your solution to Problem 5 in this box