# 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 form 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 a gateway router.

Write your solution to Problem 1 in this box

The computer will first need to obtain an IP address and will do that using the DHCP protocol. It will send a IP datagram to 255.255.255.255 and put it in an ethernet frame and broadcast in the ethernet. This will successfully give comp an IP address.

This will allow the computer to also know the first hop neighbors of it, what subnet it lives in, and also initial the local DNS server.

Next step is to build the ARP table to map IP addresses to MAC addresses to build the DNS. When you try to download a webpage, it will store the IP of the web page and then it will send a HTTP request to the web server.

This message will be in the form of a TCP packet -> wrapped in a IP packet -> wrapped in an ethernet frame. This frame is sent to the first hop router.

When the router recieves the frame, it will check its routing table and send the packet to the correct location.

Now that a connection is established, the webserver will send the web page to your computer with HTTP response messages. The messages that the webserver sends are in TCP packets -> then wrapped in IP packets. These IP packets will follow the routing table and make its way to your router, and the router will forward to your computer by encapsulating them into ethernet frames.

# Problem 2

Consider the hierarchical network in Slide 6-84 and suppose that the data center needs to support email and video distribution among other applications. Suppose four racks of servers are reserved for email and four racks are reserved for video. For each of the applications, all four racks must lie below a single tier-2 switch since the tier-2 to tier-1 links do not have sufficient bandwidth to support the intra-application traffic. For the email application, suppose that for 99.99 percent of the time only three racks are used, and that the video application has identical usage patterns.

(a) For what fraction of time does the email application need to use a fourth rack? How about for the video application?

(b) Assuming email usage and video usage are independent, for what fraction of time do (equivalently, what is the probability that) both applications need their fourth rack?

Write your solution to Problem 2 in this box

A. 1- .9999 = 0.0001

B. (0.0001)^2 = 1e-8

## Problem 3

Suppose there are two ISPs, providing WiFi access in a particular café, with each ISP operating its own AP and having its own IP address block.

(a) Further suppose that by accident, each ISP has configured its AP to operate over channel 11. Will the 802.11 protocol completely break down in this situation? Discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.

(b) Now suppose that one AP operates over Channel 1 and the other over Channel 11. How do your answers change?

Write your solution to Problem 3 in this box

A.
Both of the APs will have their own SSID as well as MAC addresses associated with them. So there will be no problem if they operate over the same channel. Someone connecting to the network can choose to connect to either one. However, both of these APs will be sharing the network bandwidth. And if different connections try to transmit at the same time, there will be a collision.

B. If the two AP are on different channels, there will not be a collision. Each AP will have its own bandwidth as well.

## Problem 4

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 4 in this box

Datagrams need to first go to the home agent first and then will get routed to the mobile. This means the delay will be more than directly routing to destination.

## Problem 5

Answer the following questions:

(a) What are three important differences between the 3G and 4G cellular architectures?

(b) What is the role of the eNodeB, MME, P-GW, and S-GW in 4G architecture?

Write your solution to Problem 5 in this box

A.

> all IP core: IP packets tunneled (through core IP network) from base station to gateway
> no separation between voice and data – all traffic carried over IP core to gateway
> 4G-LTE is also connected to the public internet and has evolved packet core where as 3g only is connected to radio network controller.

B.

role of eNodeB in 4G technology is to send the datagram's between User Equipment (EU) and the Packet Data Network Gateway (P-GW) through the all-IP enhanced packet core.

eNodeB  can be tunneled thru the P-GW gateway.