15-441 Computer Networks
Homework 5

Due: May 3, 2019

Name:
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A Multiplexing

You are given the job of designing a network in which 100 users communicate with a server. The users share must share the bottleneck link, which runs at 500kbps. You can choose between two different multiplexing techniques for sharing the bottleneck link bandwidth between the users:

- Time division multiplexing them into 100 different time slices of 500ms each.
- Frequency division multiplexing into 100 different frequencies, each running at 5kbps.

Assume link latency is negligible.

1. Suppose the primary purpose of your network is to support delay-sensitive, interactive applications like video games that send small updates of 500b every 10ms.
   (a) Which multiplexing strategy would you use?

   (b) Why?

2. Suppose instead the primary purpose of your network is for applications that tend to do bursty transfers of exactly 250kb (assume that this accounts for protocol overhead).
   (a) Which multiplexing strategy would you use?

   (b) Why?

B Shannon's Law

1. Please answer the following question using Shannon's theorem:
   (a) Consider an ideal, noiseless channel with 1000 Hz bandwidth. What does Shannon's law predict the capacity of this link will be? (Capacity in bits per second).

   (b) For a noisy channel of 1000 HZ bandwidth, a wire length of 10km, a received signal level of 500 and a noise level of 10 (on the same linear scale), what is the maximum channel capacity in unit of bits per second? Explain.

C Datacenters

1. Consider the following datacenter topology:

For every new server, we plug it directly into a central switch. This is called a 'star' topology.

   (a) Is it more reliable, less reliable, or about the same as a Clos tree topology? (Circle one)

   (b) Does it have lower latency, higher latency, or about the same latency as a Clos tree topology? (Circle one)

   (c) Does it require more costly, less costly, or about the same cost switches as a Clos tree topology? (You get it...)

   (d) Is it more complicated, less complicated, or about the same as a Clos tree topology? (You get it...)

2. Why can network virtualization help a network like Fanta, that wants to route all traffic between its nodes through an intermediary proxy?

D NAT

1. Consider Joe and Bob, two home neighbors.

   (a) Joe and Bob each buy a new home wireless router with an included NAT. After connecting each of their laptops to the router they each enter the command "hostname -i" which prints out their IP address. After doing this they find that they actually have the same IP address. How is this possible?

   (b) Give one reason that wide-spread deployment of IPv6 would let them get rid of their NAT device.

   (c) Give one reason that they might want to continue using their NAT even if they could use IPv6.