Comp 4320 Homework 2

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1.) For the application layer, the client would use DNS and HTTP. For the transport layer, the client would use UDP for DNS and TCP for HTTP. So, for this scenario we would need the **DNS, TCP, and UDP** protocols.

2.) The total time elapsed can be obtained with the following equation:

$$2RTT_x + RTT_1... + RTT_d + d_t$$

3.) a.) For non-persistent HTTP with no parallel TCP connections the connection will be closed after each object is sent. Meaning we will be using the same equation from above 7 extra times (excluding the time to get the IP):

$$16RTT_x + RTT_1... + RTT_d$$

b.) For non-persistent HTTP with the browser configured for 4 parallel connections we will be able to send 4 objects at a time before the connection is closed. This means that we will only need to use the above equation 2 times since 8 connections is enough for 7 objects:

$$6RTT_x + RTT_1... + RTT_d$$

c.) For persistent HTTP with pipelining we do not have to worry about the connection closing so we will only need to have 1 extra RTT:

$$3RTT_x + RTT_1... + RTT_d$$

4.) For this we will say that the propagation delay between the client and server will be denoted by d_{prop}. Since we have 8 objects, we can say that we will have 8 parallel connections which will allow the connections to split up the 320 bits per second into 40 bits per second each. Now using $d = (d_p) + (d_t)$ we can get the **non-persistent time**:
$(180/320 + d_{prop} + 180/320 + d_{prop} + 180/320 + d_{prop} + 200,000/320 + d_{prop})$
$\quad + (180/40 + d_{prop} + 180/40 + d_{prop} + 180/40 + d_{prop} + 200,000/40 + d_{prop})$
$= (626.6875 + 4d_{prop}) + (5013.5 + 4d_{prop}) = $ **5640.2 + 8d$_{prop}$ seconds**

Now in order to calculate the **persistent time** we can use the same equation: $(180/320 + d_{prop} + 180/320 + d_{prop} + 180/320 + d_{prop} + 200,000/320 + d_{prop})$
   $+ 8(180/320 + d_{prop} + 200,000/320 + d_{prop})$
$= (626.6875 + 4d_{prop}) + (5004.5 + 16d_{prop}) =$ **$5631.2 + 20d_{prop}$**

Given that d_{prop} comes out to less than 0.1msec, it is negligible in this situation. This leaves us with 5640sec for non-persistent and 5631sec for persistent. From what we have calculated **non-persistent HTTP makes sense**. As we can see, the persistent connection **does not have a significant difference** since the two values are similar.

5.) a.) Yes, John would be able to get Web pages faster. This is due to John's connection being able to split the work evenly over each parallel instance, while the others are using a single instance to get the Web page.

b.) Yes, John would still benefit if they all used parallel instances. If they were to all use parallel instances, John would still be able to utilize the shared link to split up the work evenly over each parallel instance.

6.) a.) We are told that α = time to send an object and λ = arrival rate of objects. So, in order to find our total average response time, we must first get these two values. First to get α we use the equation L/R which gives us:
560,000 bits / 15,000,000 bits/sec = 0.037 sec.
Now we are told that λ = 25 requests/sec, so we can use this to go ahead and calculate $\alpha\lambda$ of the given equation$[\alpha/(1-\alpha\lambda)]$: (25 requests/sec) * (0.037 sec) = 0.925.

We now know that α = 0.037sec/request and $\alpha\lambda$ = 0.925. We can now plug these into the given equation $[\alpha/(1-\alpha\lambda)]$: 0.037 / (1 − 0.925) = 0.5 seconds. Now adding this to the time for response we are given: 2.5 + 0.5 = **3.0 seconds for total average response**

b.) Using our equation from before we can find the total response time by adding the hit rate time to the miss rate time. We know that the hit rate = 0.25, which means that the miss rate will be 0.75. First for the average access delay we get:
0.037 / (1 − (0.75) * (0.925)) = 0.121 sec.
Now adding this to our given time: 2.5 + 0.121 = 2.621 sec.

Now we can use this to calculate total response time:
(0.25) * (0) + (0.75) * (2.621) = **1.97 seconds for total response time**