Lab 1

CSC 412

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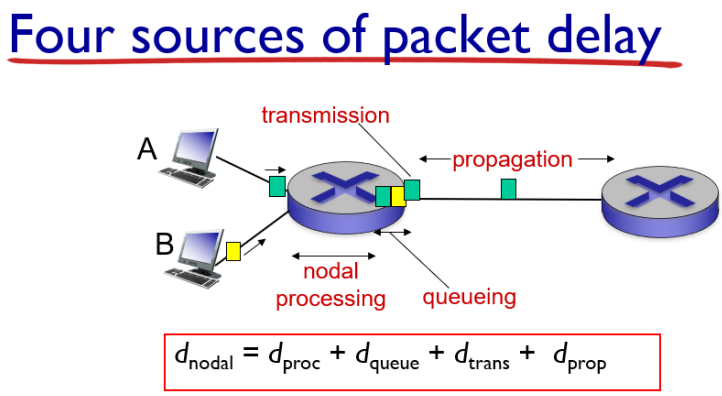
1. **What is the university you are trying to research?**

In this lab, I will be using Trace Route (tracert) to reach the Columbia University server. I will be running the command tracert columbia.edu to measure the delays along the path to the Columbia server.

2. **Explain why the reported times are different in any trace back.**

    a. Why the three numbers are different in any row?



Based on the above equation, we can assume d queue is directly proportional to d nodal. As we send each packet into the queue, the queue becomes congested and may have an increase in delay. This increase in delay causes the entire node delay to increase, and thus the time it takes to go through the entire path increases.

    b. Why do two rows have different reported times?

Based on Figure 1, we can assume d prop is directly proportional to d nodal. Along the path to the *i*th router, the path itself increases in length. This means the distance each packet travels to get to the *i*th router increases, therefore the delay in propagation (d prop) increases. And as d nodal is directly proportional to d prop, d nodal therefore returns a higher number. In the case where the d nodal actually decreases per row, this is because the packets found a better path to travel to reach the specified router, therefore smaller d prop and in turn smaller d nodal.

3. Find the average and standard deviation of the round-trip delays at each of the three hours.

Test1 (Night):

- Mean: 12 ms
- Standard Deviation: 5.72 ms

Test2 (Day):

- Mean: 24.33 ms
- Standard Deviation: 23.10 ms

Test3 (Afternoon):

- Mean: 5 ms
- Standard Deviation: 0 ms

4. Find the number of routers in the path at each of the three hours. Did the paths change during different hours?

There are fifteen routers along the path to columbia.edu, but only 3 give responses back. The paths did not change, however when I tried doing traceroute at home (I had used traceroute on the city college wifi for these tests) I had experienced around 20-25 routers along the path.

5. Try to identify the number of ISP networks that the Traceroute packets pass through from source to destination. In your experiments, do the largest delays occur at the peering interfaces between adjacent ISPs? (Hint: Routers with similar names and/or similar IP addresses could be considered as part of the same ISP)

We can tell there is at least 2 networks in this route: the ccny network which I, as the user, am sending the packets from (192.168…) and also the Columbia network (128.59.105…). Because we only received responses from 3 out of the possible 15 routers, we are unsure what the actual number of ISPs are, but I can give a range. There are at minimum 2 ISP networks, and at most 14 ISP networks. For our experiment, we can only tell the delays of two networks, and so the conclusion I can derive from these experiments is that the delays do not happen at the peering interfaces, but instead at the user's router (with the exception being the early morning experiment where the peering interface had the longer delays).