CSCI 4171 Assignment 1

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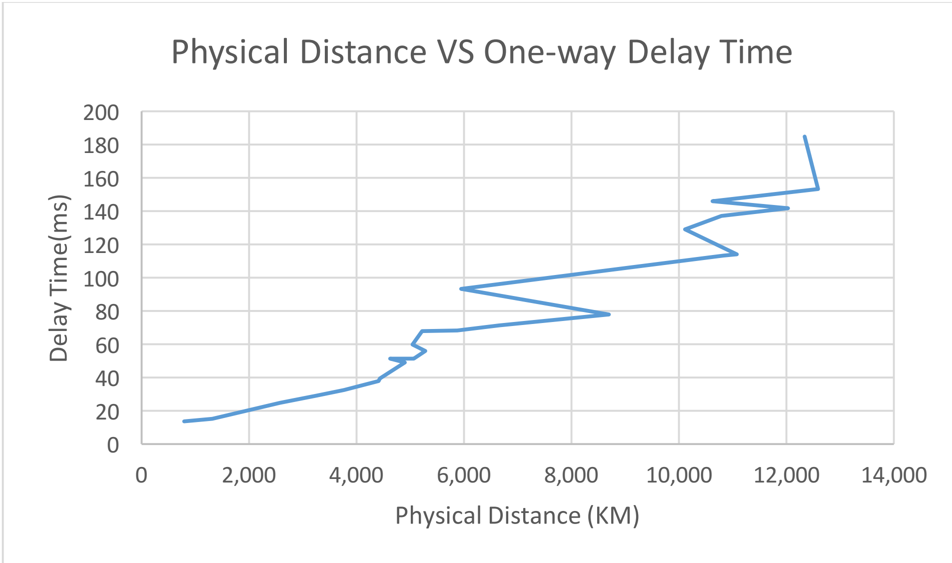
1. <Experimental study of traceroute>

Website	Delay Time (ms)	Number of Hops	Physical Distance (KM)
www.mcgill.ca	13.8121667	12	792
www.harvard.edu	15.2898333	10	1,308
www.umanitoba.ca	24.8353333	12	2,580
www.usask.ca	29.1796667	13	3,238
www.ucalgary.ca	32.6168333	14	3,766
www.ubc.ca	38.0141667	13	4,410
www.washington.edu	39.462	10	4,432
www.ugent.be	49.0725	15	4,902
www.cam.ac.uk	51.5028333	14	4,628
www.rwth-aachen.de	51.6255	14	5,069
www.ku.dk	56.1983333	12	5,282
www.uio.no	59.8548333	14	5,036
www.ub.edu	67.8991667	11	5,216
www.ut.ee	68.5078333	15	5,876
www.msu.ru	71.4441667	18	6,658
www.hawaii.edu	77.958	12	8,692
www.ase.ro	93.514	14	5,943
www.snu.ac.kr	113.293667	11	10,823
www.pusan.ac.kr	114.2745	12	11070.68
www.uaeu.ac.ae	129.271167	10	10,116
www.u-tokyo.ac.jp	137.299333	16	10,794
www.uct.ac.za	142.0095	16	12033.1
www.pku.edu.cn	145.9455	19	10,625
www.baidu.com	153.351833	15	12585.07
www.xmu.edu.cn	185.13	24	12342.06

Followings are two graphs of the above table:

One-way delay time VS physical distance



Observations:

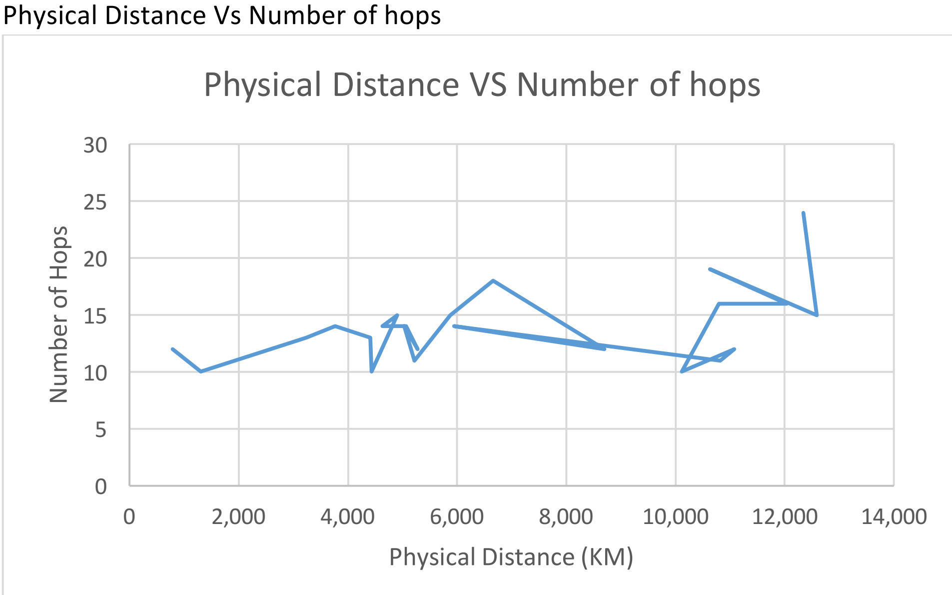
1. From the above graph, we can see that with the increasing in physical distance, delay time also increases. We can conclude that:

    Physical distance influences delay time

    Larger physical distance => longer delay time

    Shorter physical distance => shorter delay time

Physical Distance Vs Number of hops



Observation:

1. From the graph, we can see that with the increasing in physical distance, there is no significant increase in number of hops. We can conclude that:
   Physical distance does not have strong influence in number of hops.

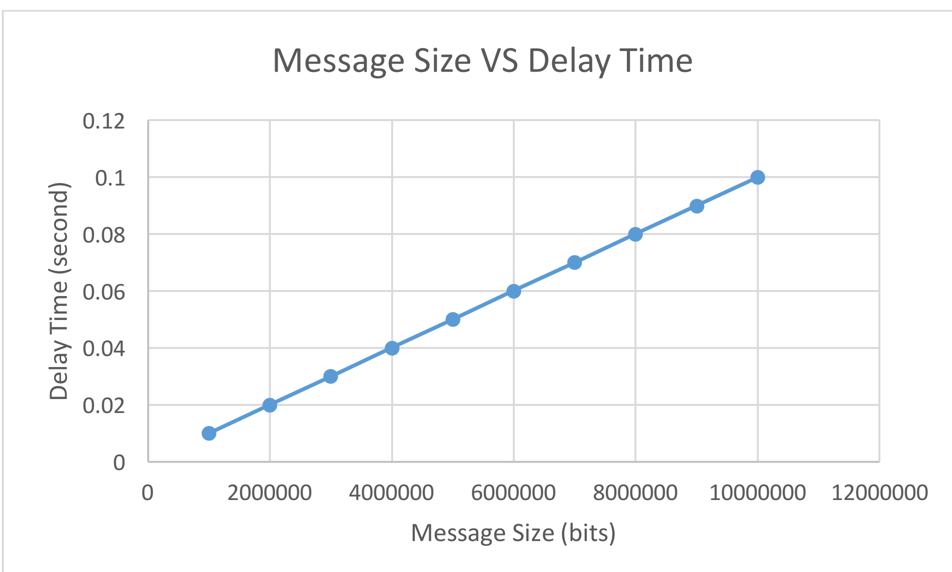
Conclusion:
Physical distance is an important factor that affects delay time.
Physical distance is not an important factor that affects number of hops. Moreover, number of hops is not an important factor that affects delay time.

2. <Programming-simple simulation>
   C++ program is in the same folder.

Message size VS Delay Time

Bandwidth = 100 Mbps Packet Size = 10 bits

Message Size (bits)	Delay Time (seconds)
1000000	0.0100003
2000000	0.0200003
3000000	0.0300003
4000000	0.0400003
5000000	0.0500003
6000000	0.0600003
7000000	0.0700003
8000000	0.0800003
9000000	0.0900003
10000000	0.1000003



Observation:

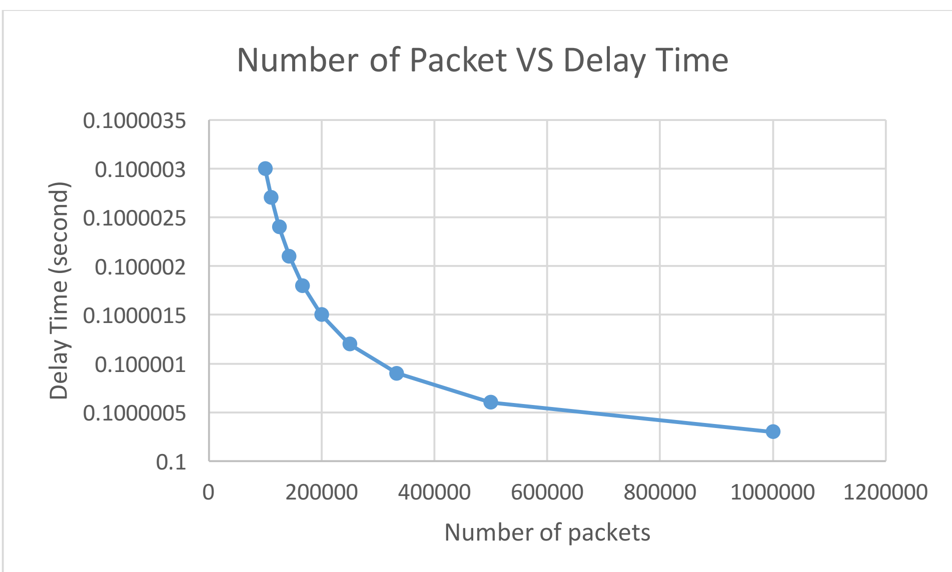
1. From the above graph, with the increase in message size, delay time also increases. We can conclude that:

Larger message size => longer delay time
Smaller message size => shorter delay time

Number of packet VS Delay Time

Size of message: 10000000 bits, Bandwidth = 100 Mbps

Size of packet (bit)	Number of packet	Delay Time (seconds)
10	1000000	0.1000003
20	500000	0.1000006
30	333334	0.1000009
40	250000	0.1000012
50	200000	0.1000015
60	166667	0.1000018
70	142858	0.1000021
80	125000	0.1000024
90	111112	0.1000027
100	100000	0.100003



Observations:

1. With the increase in number of packet (decrease in packet size), delay time decreases. We can conclude that:

More packets (smaller packet size) => smaller delay time
Less packets (larger packet size) =>larger delay time

3.

$$Propagation\ delay: d_{propagation} = \frac{m}{s} = \frac{m}{2.5 * 10^8 meter/second}$$

$$Transmission\ Delay: d_{transmission} = \frac{L}{R} = \frac{100\ bit}{28\ kbps} = \frac{100bit}{28000\ bit\ per\ second}$$

$$In\ order\ to\ let\ d_{propagation} = d_{transmission}$$

$$\frac{m}{s} = \frac{L}{R}$$

$$m = \frac{s * L}{R} = \frac{2.5 * 10^8 * 100}{28000} = 892857.142857m \approx 892.857\ km$$

4.

a. It is a virtual-circuit packet-switched network. We only need to transmit a packet of F bits. Source adds h bits of header to each packet, thus the total size of each packet: F+h bits

   Time for establishing virtual-circuit packet-switched network: t_s

   The time for transmitting a packet over a path Q links:

$$t_p = \frac{F + h}{R} * Q$$

   Total time for sending a packet from source to destination over a path of Q links (VC packet-switched network)

$$\text{Total time} = t_p + t_s = \frac{F + h}{R} * Q + t_s$$

b. It is a datagram packet-switched network. It is because the connectionless service, this network does not have establishing time.
   By adding 2h bits of header to each packet, the total size of a packet is: 2h+F bits
   A packet is transmitted over a path with Q links with R bps, thus the total time is:

$$\text{Total time} = \frac{2h + F}{R} * Q$$

5.

a.

Propagation Delay: $d_{prop} = \frac{\text{Distance between A and B}}{\text{propagation speed}} = \frac{20000*10^3}{2.5*10^8} = 0.08\ second$

Transmission Delay: $d_{trans} = \frac{\text{size of file}}{R} = \frac{800000}{2000000} = 0.4\ second$

Total time = Propagation Delay + Transmission Delay = $d_{prop} + d_{trans} = 0.08 + 0.4 = 0.48\ \text{second}$

b.

Time for sending an acknowledgement packet:

$$\mathrm{t_{ack}} = \text{propagation delay} + \text{transmission delay} = \mathrm{d_{prop}} + \mathrm{d_{trans}} = 0.08 + 100 * 0.0001 = 0.18 second$$

There are total 20 packets and each packet containing 40000 bits. Thus the time for sending one packet is:

$$\mathrm{t_{packet}} = d_{prop} + d_{trans} = 0.08 + \frac{40000}{2000000} = 0.1 \text{ second}$$

Send the entire file equals sending all 20 packets, thus the time for sending a file:

$$\text{Total time} = 20 * \left(\mathrm{t_{packet}} + \mathrm{t_{ack}}\right) = 20 * (0.1 + 0.18) = 5.6 \text{ second}$$

6.

FTP: S (Client) ->D (Server) The port number for FTP: 21, Source port address for S 50000

SSH: D (Client) ->S (Server) The port number for SSH: 22, Source port address for D 51000

a. Frame on Token Ring1 – FTP message from S to D.

s,r11,S,D,50000,21

b.Frame on FDDI – FTP message from S to D.

r14,r21,S,D,50000,21

c. Frame on Token Ring 2 – FTP message from S to D.

r22,r34,S,D,50000,21

d. Frame on Ethernet – FTP message from S to D.

r31,d,S,D,50000,21

e. Frame on Token Ring 1 – FTP message from D to S.

r11,s,D,S,21,50000

f. Frame on FDDI – FTP message from D to S.

r21,r14,D,S,21,50000

g. Frame on Token Ring 2 – FTP message from D to S.

r34,r22,D,S,21,50000

h. Frame on FDDI – SSH message from S to D.

r14,r21,S,D,22,51000

i. Frame on Token Ring 2 – SSH message from S to D.

r22,r34,S,D,22,51000

j. Frame on Ethernet – SSH message from S to D.

r31,d,S,D,22,51000

k. Frame on Token Ring 1 – SSH message from D to S.

r11,s,D,S,51000,22

l. Frame on FDDI – SSH message from D to S

r21,r14,D,S,51000,22