CS 408 – Computer Networks Spring 2024 Homework 1

Kanat Özgen 00030973

Question 1:

a) Invocation of "**ping**" command on different hours

```
PS C:\Users\koezgen> ping stanford.edu

Pinging stanford.edu [171.67.215.200] with 32 bytes of data:
Reply from 171.67.215.200: bytes=32 time=197ms TTL=239
Reply from 171.67.215.200: bytes=32 time=198ms TTL=239
Reply from 171.67.215.200: bytes=32 time=198ms TTL=239
Reply from 171.67.215.200: bytes=32 time=197ms TTL=239

Ping statistics for 171.67.215.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 197ms, Maximum = 198ms, Average = 197ms
```

ping command invoked at 03:34

```
PS C:\Users\koezgen> ping stanford.edu

Pinging stanford.edu [171.67.215.200] with 32 bytes of data:
Reply from 171.67.215.200: bytes=32 time=198ms TTL=239
Reply from 171.67.215.200: bytes=32 time=198ms TTL=239
Reply from 171.67.215.200: bytes=32 time=198ms TTL=239
Reply from 171.67.215.200: bytes=32 time=197ms TTL=239

Ping statistics for 171.67.215.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 197ms, Maximum = 198ms, Average = 197ms
```

ping command invoked at 15:34

There is a very, very small difference between the two invocations. No matter what I tried, there is little to none difference between the two invocations.

b) Invocation of "tracert" (traceroute on UNIX) on different hours

```
PS C:\Users\koezgen> tracert stanford.edu

Tracing route to stanford.edu [171.67.215.200]
over a maximum of 30 hops:

  1    4 ms    3 ms    4 ms  hgw.local [192.168.1.1]
  2    8 ms    8 ms    8 ms  10.99.0.1 [10.99.0.1]
  3    *       *       5 ms  81.212.73.29.static.turktelekom.com.tr [81.212.73.29]
  4    6 ms    5 ms    6 ms  34-acibadem-xrs-t2-2---34-acibadem-t3-6.statik.turktelekom
.com.tr [195.175.171.163]
  5    6 ms    6 ms    5 ms  34-ebgp-acibadem-sr12e-k---34-acibadem-xrs-t2-2.statik.tur
ktelekom.com.tr [81.212.209.216]
  6   44 ms   43 ms   44 ms  301-fra-col-2---34-ebgp-acibadem-sr12e-k.statik.turktelekо
m.com.tr [212.156.101.230]
  7    *       *       *     Request timed out.
  8    *       *       *     Request timed out.
  9    *       *       *     Request timed out.
 10    *       *       *     Request timed out.
 11    *     183 ms  197 ms  port-channel9.core3.sjc2.he.net [184.104.199.21]
 12    *       *       *     Request timed out.
 13  182 ms  182 ms  182 ms  stanford-university.e0-62.core2.pao1.he.net [184.105.177.2
38]
 14  196 ms  195 ms  195 ms  campus-east-rtr-vl1118.SUNet [171.66.255.228]
 15    *       *       *     Request timed out.
 16  197 ms  198 ms  197 ms  web.stanford.edu [171.67.215.200]

Trace complete.
```

tracert command invoked at 03:34

```
PS C:\Users\koezgen> tracert stanford.edu

Tracing route to stanford.edu [171.67.215.200]
over a maximum of 30 hops:

  1    4 ms    3 ms    3 ms  hgw.local [192.168.1.1]
  2    6 ms   11 ms    7 ms  10.99.0.1 [10.99.0.1]
  3    6 ms    6 ms    6 ms  81.212.73.29.static.turktelekom.com.tr [81.212.73.29]
  4    6 ms    5 ms    5 ms  34-acibadem-xrs-t2-2---34-acibadem-t3-6.statik.turktelekom
.com.tr [195.175.171.163]
  5    *       6 ms    6 ms  34-ebgp-acibadem-sr12e-k---34-acibadem-xrs-t2-2.statik.tur
ktelekom.com.tr [81.212.209.216]
  6   44 ms   43 ms   45 ms  301-fra-col-2---34-ebgp-acibadem-sr12e-k.statik.turktelekо
m.com.tr [212.156.101.230]
  7    *       *       *     Request timed out.
  8    *       *       *     Request timed out.
  9    *       *       *     Request timed out.
 10    *       *       *     Request timed out.
 11    *       *       *     Request timed out.
 12    *       *       *     Request timed out.
 13  182 ms  193 ms  181 ms  stanford-university.e0-62.core2.pao1.he.net [184.105.177.2
38]
 14  195 ms  196 ms  195 ms  campus-east-rtr-vl1118.SUNet [171.66.255.228]
 15    *       *       *     Request timed out.
 16  197 ms  196 ms  198 ms  web.stanford.edu [171.67.215.200]

Trace complete.
```

tracert command invoked at 15:34

Tracert command invoked at 15:34 took 196 miliseconds, which is understandable since the local time at Stanford would be 06:34 and there is not a reason for an increased traffic for that time of the day there.

c) There is an equal number of hops in both of the hours. However, the paths changed in between the two hours. In the invocation that took place in 3 AM, we arrived to a router which is inside a datacenter in California. This could have happened for the following reason: 03:34 is 18:34 in California and that is a time where there could be a lot of network traffic there. In order to accommodate for the increased network traffic, the router inside the datacenter started to serve the internet. That is why we arrived there before arriving to Stanford.

NOTE: These commands were invoked in my own house, at Istanbul, Küçükyalı, with an internet bandwidth of 200Mbits/s.

Question 2:

a) Stanford University is 10.818km. away from my location. If this were the fiber optic distance between my location and Stanford, d_prop would be 54ms.

b) The approximate fiber optic cable distance from Istanbul to Stanford if packets follow the given path, would be equal to a + b + c + d where:
   a. Istanbul – Marmaris land distance, which is 468.83km.
   b. Marmaris – GoonHilly Downs, UK via SeaMeWe-3 Submarine Cable, which is 6181.76km.
   c. UK – Bellport, NY, USA Yellow Cable which is 7001km.
   d. NY to San Francisco Distance, which is 4134.69km.

   This amounts to 17.786,28km. in total. d_prop then equals to 88ms. RTT then would be equal to 176ms.

c) The average RTT value that was calculated in Q1-a was equal to 198ms. The RTT is theoretically equal to 176ms. This was due to the fact that there was congestions that was occurring that led to queuing of my packets. The difference between the theoretical value could be attributed to d_queue and d_proc.

Question 3:

The topology of the STARLINK satellite array at Mediterranean sea at 02:54:

There exists a overhead created by one satellite uplink operation and one satellite downlink operation, which are the same value since the bandwidth is symmetric. d_trans is equal to a delay of 160ms, which equals to a 320ms of total d_trans. This value is found by dividing 8 by 50.

The total distance propagated by the packets is 801.02km, which creates a d_prop equal to 4ms.

The total delay is then equal to 324ms.