Eric Grunblatt
Aruna Balasubramanian
CSE 310
Due: April 19, 2023

Assignment 3 Writeup

Part A: ICMP Ping Tool

1. Testing client with localhost (127.0.0.1)


```
nment3>python sample_pinger.py localhost
Pinging 127.0.0.1 using Python:
36 bytes from 127.0.0.1; time=0.940561 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.997782 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
36 bytes from 127.0.0.1; time=0.000000 ms
--- localhost ping statistics ---
round-trip min/avg/max 0.000000/0.176213/0.997782 ms
```

   a.

2. Testing client by sending packets to stonybrook.edu


```
nment3>python sample_pinger.py stonybrook.edu
Pinging 172.30.32.25 using Python:
36 bytes from 172.30.32.25; time=8.111954 ms
36 bytes from 172.30.32.25; time=7.397413 ms
36 bytes from 172.30.32.25; time=6.660700 ms
36 bytes from 172.30.32.25; time=4.543543 ms
36 bytes from 172.30.32.25; time=6.996870 ms
36 bytes from 172.30.32.25; time=6.765127 ms
36 bytes from 172.30.32.25; time=7.081032 ms
36 bytes from 172.30.32.25; time=4.865646 ms
36 bytes from 172.30.32.25; time=7.870913 ms
36 bytes from 172.30.32.25; time=5.088091 ms
36 bytes from 172.30.32.25; time=7.324934 ms
--- stonybrook.edu ping statistics ---
round-trip min/avg/max 4.543543/6.609657/8.111954 ms
```

   a.

3. Testing client with 3 root servers outside the US
    a. I: 192.36.148.17 in Stockholm, Sweden

```
nment3>python sample_pinger.py 192.36.148.17
Pinging 192.36.148.17 using Python:
36 bytes from 192.36.148.17; time=112.854481 ms
36 bytes from 192.36.148.17; time=25.167227 ms
36 bytes from 192.36.148.17; time=23.160696 ms
36 bytes from 192.36.148.17; time=24.237871 ms
36 bytes from 192.36.148.17; time=23.463726 ms
36 bytes from 192.36.148.17; time=23.474216 ms
36 bytes from 192.36.148.17; time=22.044659 ms
36 bytes from 192.36.148.17; time=25.541067 ms
36 bytes from 192.36.148.17; time=25.190353 ms
36 bytes from 192.36.148.17; time=22.446394 ms
--- 192.36.148.17 ping statistics ---
round-trip min/avg/max 22.044659/32.758069/112.854481 ms
```

        i.
    b. K: 193.0.14.129 in Amsterdam, Netherlands

```
nment3>python sample_pinger.py 193.0.14.129
Pinging 193.0.14.129 using Python:
36 bytes from 193.0.14.129; time=91.920376 ms
36 bytes from 193.0.14.129; time=93.428612 ms
36 bytes from 193.0.14.129; time=93.600035 ms
36 bytes from 193.0.14.129; time=93.209505 ms
36 bytes from 193.0.14.129; time=93.869209 ms
36 bytes from 193.0.14.129; time=92.615843 ms
36 bytes from 193.0.14.129; time=93.356133 ms
36 bytes from 193.0.14.129; time=93.634605 ms
36 bytes from 193.0.14.129; time=92.204571 ms
36 bytes from 193.0.14.129; time=92.668056 ms
--- 193.0.14.129 ping statistics ---
round-trip min/avg/max 91.920376/93.050694/93.869209 ms
```

        i.
    c. M: 202.12.27.33 in Yokohama, Japan

```
nment3>python sample_pinger.py 202.12.27.33
Pinging 202.12.27.33 using Python:
36 bytes from 202.12.27.33; time=79.342604 ms
36 bytes from 202.12.27.33; time=79.753160 ms
36 bytes from 202.12.27.33; time=82.218647 ms
36 bytes from 202.12.27.33; time=80.753565 ms
36 bytes from 202.12.27.33; time=81.100464 ms
36 bytes from 202.12.27.33; time=79.320431 ms
36 bytes from 202.12.27.33; time=81.795454 ms
36 bytes from 202.12.27.33; time=79.559803 ms
36 bytes from 202.12.27.33; time=78.272820 ms
36 bytes from 202.12.27.33; time=78.231096 ms
--- 202.12.27.33 ping statistics ---
round-trip min/avg/max 78.231096/80.034804/82.218647 ms
```

        i.

4. Table for RTT statistics:

	Min RTT (ms)	Avg RTT (ms)	Max RTT (ms)
Localhost	0.0	0.176213	0.997782
Stonybrook.edu	4.543543	6.609657	8.111954
Sweden	22.044659	32.758069	112.854481
Netherlands	91.920376	93.050694	93.869209
Japan	78.231096	80.034804	82.218647

5. Explanation: The minimum, average, and maximum round trip times for each of the servers are far different from each other and have everything to do with where they are located. Since the localhost in part A is a server running on my laptop, there are no hops that it has to go through, which is why there was a minimum RTT of 0.0000 ms. It did not always get a time of 0, but it was consistently lower than all of the other servers with an average of 0.176 ms. With a server slightly farther away from my machine yet still located within the U.S., the stonybrook.edu server in part B had an average of 6.609 ms and minimum of 4.543 ms, which is definitely a larger increase. The reason for the big jump is because the packet has to travel through more routers going there and coming back whereas localhost didn't have to go through any. Now with the three servers located outside of the U.S. for part C, the program experienced much more latency as the servers are hundreds to thousands of miles away and have plenty more hops than the Stony Brook server. Sweden had a lower average RTT of 32.758 ms, despite the outlier of 122.854 ms, where the Netherlands and Japan had average RTT times of 93.050 and 80.034 ms respectively. Therefore, the reasoning for the higher RTT times for the servers outside the U.S. is due to having to travel through more routers to get the packet to its destination and receive a response.

Part B: ARP Packet Capture and Analysis

1. Show the result of an exchange of an ARP packet

```
PS C:\Users\emgru\Documents\Stony Brook\Spring 2023\CSE 310\grunblatt-eric-assignment3>
python analysis_pcap_arp.py assignment3_my_arp.pcap
------ ARP EXCHANGE START ------

ARP REQUEST:
Hardware type:  1
Protocol type:  0x800
Hardware size:  6
Protocol size:  4
Opcode: Request (1)
Sender MAC address:  08:f1:ea:5e:8d:00
Sender IP address:  172.25.80.3
Target MAC address:  00:00:00:00:00:00
Target IP address: 172.25.90.67

ARP RESPONSE:
Hardware type:  1
Protocol type:  0x800
Hardware size:  6
Protocol size:  4
Opcode: Response (2)
Sender MAC address:  84:fd:d1:82:35:11
Sender IP address:  172.25.90.67
Target MAC address:  08:f1:ea:5e:8d:00
Target IP address: 172.25.80.3

------ ARP EXCHANGE END ------
```

2. IP and MAC addresses of Router
   a. IP Address of Router: 172.25.80.1
   b. MAC Address of Router: aa:bb:cc:dd:ee:ff
   c. Doing this under the Stony Brook's Wi-Fi could have caused some conflict since running "arp -a" in the command line gave me the IP Address as 172.25.80.1 and a MAC Address as aa:bb:cc:dd:ee:ff. This is the correct information, but the ARP exchange in the screenshot did not have the same information. It should be the same for the request's sender MAC/IP addresses or the response's target MAC/IP addresses depending on where the laptop MAC/IP addresses are located.

   d.
```
C:\Users\emgru>arp -a

Interface: 172.25.90.67 --- 0xc
  Internet Address      Physical Address      Type
  172.25.80.1           aa-bb-cc-dd-ee-ff     dynamic
  172.25.80.3           08-f1-ea-5e-8d-00     dynamic
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```