1.1 step 2

```
IPv4 Route Table
===========================================================================
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0      192.168.1.1     192.168.1.26     35
```

```
C:\Users\them4>route -n get default

Manipulates network routing tables.

ROUTE [-f] [-p] [-4|-6] command [destination]
                  [MASK netmask]  [gateway] [METRIC metric]  [IF interface]
```

1.1 step 3

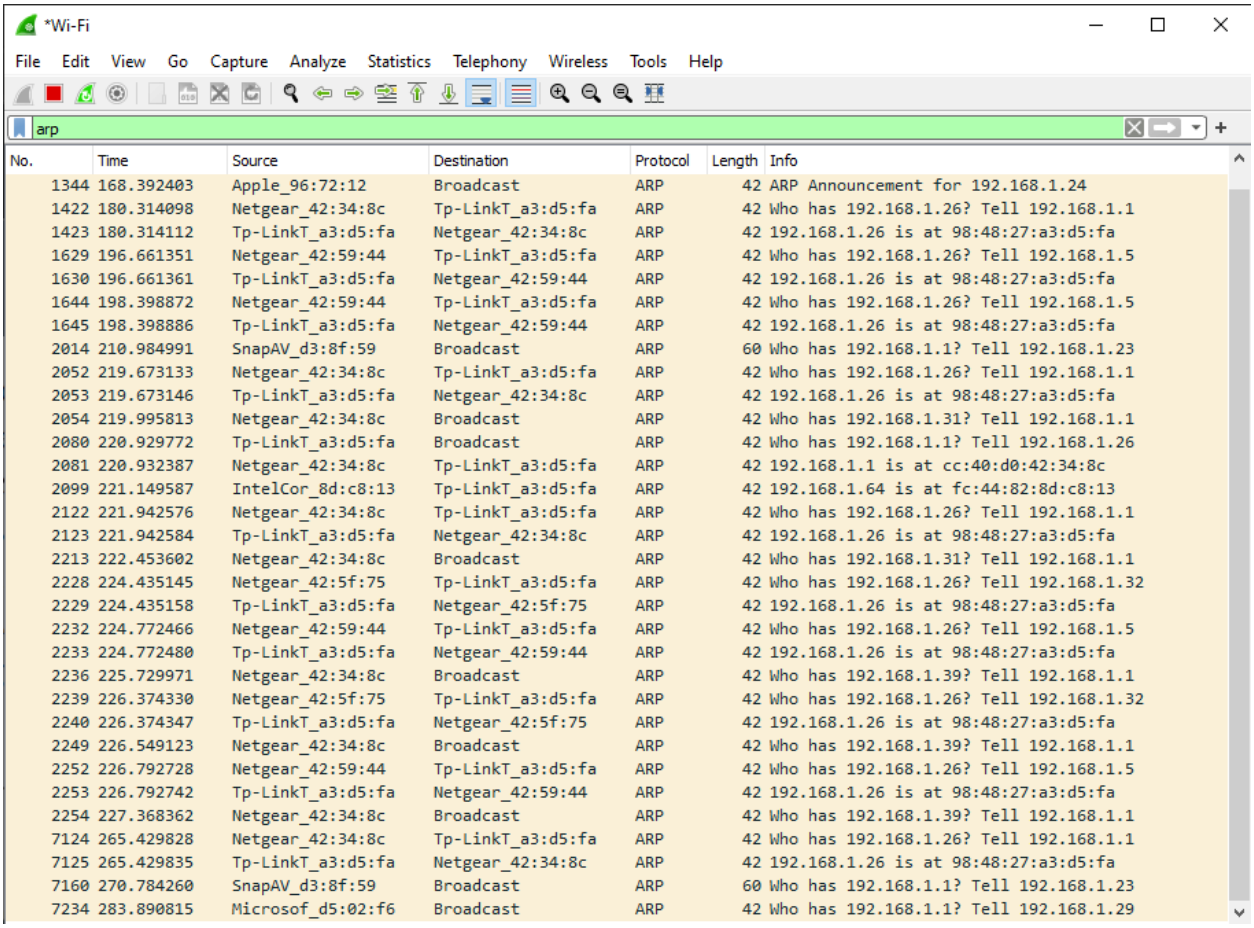
arp

No.	Time	Source	Destination	Protocol	Length	Info
27	3.973639	Netgear_42:5f:75	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.32
28	3.973649	Tp-LinkT_a3:d5:fa	Netgear_42:5f:75	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
34	5.821526	Netgear_42:5f:75	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.32
35	5.821540	Tp-LinkT_a3:d5:fa	Netgear_42:5f:75	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
151	30.768252	SnapAV_d3:8f:59	Broadcast	ARP	60	Who has 192.168.1.1? Tell 192.168.1.23
285	43.039548	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.1
286	43.039562	Tp-LinkT_a3:d5:fa	Netgear_42:34:8c	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
294	43.875705	Microsof_d5:02:f6	Broadcast	ARP	42	Who has 192.168.1.1? Tell 192.168.1.29
502	74.184085	Apple_96:72:12	Broadcast	ARP	42	ARP Announcement for 192.168.1.24
580	88.800345	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.1
581	88.800359	Tp-LinkT_a3:d5:fa	Netgear_42:34:8c	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
597	91.386615	SnapAV_d3:8f:59	Broadcast	ARP	60	Who has 192.168.1.1? Tell 192.168.1.23

1.1 step 4

```
C:\Windows\system32>arp -a

Interface: 192.168.1.26 --- 0xc
  Internet Address      Physical Address      Type
  192.168.1.1           cc-40-d0-42-34-8c     dynamic
  192.168.1.3           ac-2b-6e-19-9c-63     dynamic
  192.168.1.5           cc-40-d0-42-59-44     dynamic
  192.168.1.29          30-59-b7-d5-02-f6     dynamic
  192.168.1.32          cc-40-d0-42-5f-75     dynamic
  192.168.1.255         ff-ff-ff-ff-ff-ff     static
  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
  224.0.0.253           01-00-5e-00-00-fd     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

C:\Windows\system32>arp -d 192.168.1.1

C:\Windows\system32>arp -a

Interface: 192.168.1.26 --- 0xc
  Internet Address      Physical Address      Type
  192.168.1.1           cc-40-d0-42-34-8c     dynamic
  192.168.1.3           ac-2b-6e-19-9c-63     dynamic
  192.168.1.5           cc-40-d0-42-59-44     dynamic
  192.168.1.29          30-59-b7-d5-02-f6     dynamic
  192.168.1.32          cc-40-d0-42-5f-75     dynamic
  192.168.1.255         ff-ff-ff-ff-ff-ff     static
  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
  224.0.0.253           01-00-5e-00-00-fd     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Step 1 part 6



No.	Time	Source	Destination	Protocol	Length	Info
1344	168.392403	Apple_96:72:12	Broadcast	ARP	42	ARP Announcement for 192.168.1.24
1422	180.314098	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.1
1423	180.314112	Tp-LinkT_a3:d5:fa	Netgear_42:34:8c	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
1629	196.661351	Netgear_42:59:44	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.5
1630	196.661361	Tp-LinkT_a3:d5:fa	Netgear_42:59:44	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
1644	198.398872	Netgear_42:59:44	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.5
1645	198.398886	Tp-LinkT_a3:d5:fa	Netgear_42:59:44	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2014	210.984991	SnapAV_d3:8f:59	Broadcast	ARP	60	Who has 192.168.1.1? Tell 192.168.1.23
2052	219.673133	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.1
2053	219.673146	Tp-LinkT_a3:d5:fa	Netgear_42:34:8c	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2054	219.995813	Netgear_42:34:8c	Broadcast	ARP	42	Who has 192.168.1.31? Tell 192.168.1.1
2080	220.929772	Tp-LinkT_a3:d5:fa	Broadcast	ARP	42	Who has 192.168.1.1? Tell 192.168.1.26
2081	220.932387	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	192.168.1.1 is at cc:40:d0:42:34:8c
2099	221.149587	IntelCor_8d:c8:13	Tp-LinkT_a3:d5:fa	ARP	42	192.168.1.64 is at fc:44:82:8d:c8:13
2122	221.942576	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.1
2123	221.942584	Tp-LinkT_a3:d5:fa	Netgear_42:34:8c	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2213	222.453602	Netgear_42:34:8c	Broadcast	ARP	42	Who has 192.168.1.31? Tell 192.168.1.1
2228	224.435145	Netgear_42:5f:75	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.32
2229	224.435158	Tp-LinkT_a3:d5:fa	Netgear_42:5f:75	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2232	224.772466	Netgear_42:59:44	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.5
2233	224.772480	Tp-LinkT_a3:d5:fa	Netgear_42:59:44	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2236	225.729971	Netgear_42:34:8c	Broadcast	ARP	42	Who has 192.168.1.39? Tell 192.168.1.1
2239	226.374330	Netgear_42:5f:75	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.32
2240	226.374347	Tp-LinkT_a3:d5:fa	Netgear_42:5f:75	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2249	226.549123	Netgear_42:34:8c	Broadcast	ARP	42	Who has 192.168.1.39? Tell 192.168.1.1
2252	226.792728	Netgear_42:59:44	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.5
2253	226.792742	Tp-LinkT_a3:d5:fa	Netgear_42:59:44	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
2254	227.368362	Netgear_42:34:8c	Broadcast	ARP	42	Who has 192.168.1.39? Tell 192.168.1.1
7124	265.429828	Netgear_42:34:8c	Tp-LinkT_a3:d5:fa	ARP	42	Who has 192.168.1.26? Tell 192.168.1.1
7125	265.429835	Tp-LinkT_a3:d5:fa	Netgear_42:34:8c	ARP	42	192.168.1.26 is at 98:48:27:a3:d5:fa
7160	270.784260	SnapAV_d3:8f:59	Broadcast	ARP	60	Who has 192.168.1.1? Tell 192.168.1.23
7234	283.890815	Microsof_d5:02:f6	Broadcast	ARP	42	Who has 192.168.1.1? Tell 192.168.1.29

Step 2 part 2

```
Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: SnapAV_d3:8f:59 (d4:6a:91:d3:8f:59)
    Sender IP address: 192.168.1.23
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.1
```

```
Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: Tp-LinkT_a3:d5:fa (98:48:27:a3:d5:fa)
    Sender IP address: 192.168.1.26
    Target MAC address: Netgear_42:34:8c (cc:40:d0:42:34:8c)
    Target IP address: 192.168.1.1
```

Step 3

OP code for an ethernet request is 1. Code for reply is 2.

The request header is 60 bytes. The reply header is 42 bytes.

00:00:00_00:00:00 is the target MAC address when unknown.

ARP type is 0x0806 from the ethernet request

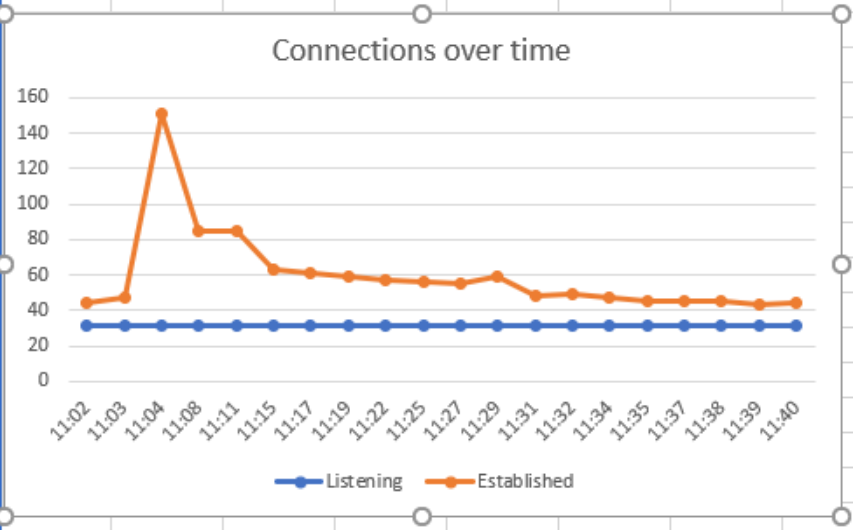
1.2

My netstat command took about 1-3 minutes to execute so I didn't do it once every 30 seconds, I just ran it 20 times.

```
@echo off
for %%i in (1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20) do (
        time /t
        netstat -a | findstr /c:"LISTENING" /c:"ESTABLISHED"
)
pause
```

This is the batch script I ran for it

	Listening	Established
11:02	32	44
11:03	32	47
11:04	32	151
11:08	32	85
11:11	32	85
11:15	32	63
11:17	32	61
11:19	32	59
11:22	32	57
11:25	32	56
11:27	32	55
11:29	32	59
11:31	32	48
11:32	32	49
11:34	32	47
11:35	32	45
11:37	32	45
11:38	32	45
11:39	32	43
11:40	32	44



And here is the data

1.3

Cannot download netcat sadly

1.4

```
C:\Users\them4>tracert www.asu.edu

Tracing route to pantheon-systems.map.fastly.net [199.232.154.133]
over a maximum of 30 hops:

  1     8 ms     2 ms     2 ms  192.168.1.1
  2    13 ms    12 ms    11 ms  10.28.232.1
  3    24 ms    19 ms    15 ms  100.127.74.64
  4    13 ms    15 ms    14 ms  68.1.0.187
  5    14 ms    16 ms    15 ms  167.82.128.150
  6    18 ms    14 ms    19 ms  199.232.154.133

Trace complete.
```

```
[ec2-user@ip-172-31-22-13 ~]$ traceroute www.asu.edu
traceroute to www.asu.edu (146.75.34.133), 30 hops max, 60 byte packets
 1  ec2-52-15-0-97.us-east-2.compute.amazonaws.com (52.15.0.97)  14.549 ms  14.530 ms ec2-52-15-0-117.us-east-2.compute.amazonaws.com (52.15.0.117)  4.395 ms
 2  100.65.28.48 (100.65.28.48)  1.886 ms 100.65.26.32 (100.65.26.32)  5.037 ms 100.65.30.0 (100.65.30.0)  6.942 ms
 3  100.66.12.112 (100.66.12.112)  3.138 ms 100.66.12.32 (100.66.12.32)  5.416 ms 100.66.12.90 (100.66.12.90)  8.046 ms
 4  100.66.15.134 (100.66.15.134)  16.981 ms 100.66.14.78 (100.66.14.78)  13.763 ms 100.66.14.226 (100.66.14.226)  16.953 ms
 5  241.0.12.137 (241.0.12.137)  0.447 ms 241.0.12.142 (241.0.12.142)  0.436 ms 241.0.12.136 (241.0.12.136)  0.521 ms
 6  243.254.12.5 (243.254.12.5)  0.510 ms 243.254.8.9 (243.254.8.9)  0.312 ms 243.254.12.5 (243.254.12.5)  0.292 ms
 7  108.166.248.54 (108.166.248.54)  0.313 ms 108.166.248.53 (108.166.248.53)  0.364 ms 108.166.248.63 (108.166.248.63)  0.292 ms
 8  242.0.91.89 (242.0.91.89)  4.273 ms 242.0.90.209 (242.0.90.209)  1.239 ms 242.0.91.77 (242.0.91.77)  0.368 ms
 9  15.230.134.98 (15.230.134.98)  1.267 ms 15.230.39.75 (15.230.39.75)  5.279 ms 52.95.3.137 (52.95.3.137)  2.472 ms
10  15.230.39.68 (15.230.39.68)  0.706 ms 15.230.140.177 (15.230.140.177)  2.531 ms 52.95.1.112 (52.95.1.112)  0.879 ms
11  52.95.2.5 (52.95.2.5)  4.053 ms 52.93.239.4 (52.93.239.4)  0.444 ms 52.93.239.92 (52.93.239.92)  0.558 ms
12  100.92.53.190 (100.92.53.190)  11.874 ms 100.92.53.10 (100.92.53.10)  10.969 ms 100.92.53.0 (100.92.53.0)  11.758 ms
13  100.92.48.128 (100.92.48.128)  14.252 ms 100.92.48.98 (100.92.48.98)  10.943 ms 100.92.48.102 (100.92.48.102)  10.789 ms
14  100.92.43.111 (100.92.43.111)  11.621 ms 100.92.48.43 (100.92.48.43)  16.130 ms 100.92.43.85 (100.92.43.85)  11.553 ms
15  100.92.44.42 (100.92.44.42)  11.732 ms 100.92.44.84 (100.92.44.84)  13.859 ms 100.92.44.60 (100.92.44.60)  15.093 ms
16  100.92.49.7 (100.92.49.7)  24.644 ms 100.92.44.9 (100.92.44.9)  11.005 ms 100.92.49.25 (100.92.49.25)  12.044 ms
17  54.239.43.160 (54.239.43.160)  11.361 ms 52.93.133.88 (52.93.133.88)  10.787 ms 52.93.133.163 (52.93.133.163)  11.955 ms
18  100.91.163.82 (100.91.163.82)  11.283 ms 100.91.167.122 (100.91.167.122)  11.974 ms 100.91.168.72 (100.91.168.72)  11.499 ms
19  100.91.163.139 (100.91.163.139)  11.068 ms 100.91.168.117 (100.91.168.117)  10.874 ms 100.91.163.139 (100.91.163.139)  11.060 ms
20  100.91.160.90 (100.91.160.90)  11.444 ms 100.91.165.14 (100.91.165.14)  12.095 ms 100.91.160.134 (100.91.160.134)  10.843 ms
21  100.91.164.35 (100.91.164.35)  12.082 ms 100.91.164.9 (100.91.164.9)  15.169 ms 100.91.160.101 (100.91.160.101)  11.908 ms
22  100.91.177.73 (100.91.177.73)  10.937 ms 100.91.176.255 (100.91.176.255)  10.756 ms 100.91.177.75 (100.91.177.75)  10.904 ms
23  100.100.8.69 (100.100.8.69)  11.645 ms 100.100.6.93 (100.100.6.93)  18.090 ms 100.100.8.43 (100.100.8.43)  11.159 ms
24  100.100.89.134 (100.100.89.134)  11.117 ms 100.100.80.70 (100.100.80.70)  11.247 ms 100.100.78.6 (100.100.78.6)  27.115 ms
25  100.100.94.5 (100.100.94.5)  47.255 ms 100.100.85.5 (100.100.85.5)  11.059 ms 100.100.76.133 (100.100.76.133)  11.960 ms
26  100.100.4.60 (100.100.4.60)  11.693 ms 100.100.4.52 (100.100.4.52)  15.768 ms 100.100.4.50 (100.100.4.50)  10.769 ms
```

My home computer was both faster and had fewer hops than the ec2 instance. 6 total hops compared to 26.

1.5.1

Screencast link: https://youtu.be/zhZihXjVI84

```
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockServer

> Task :SocketServer
Server ready for 3 connections
Server waiting for a connection
Received the String secret
Received the Integer 55
Server waiting for a connection
Received the String secret
Received the Integer 555
Server waiting for a connection
Received the String secreter
Received the Integer 53

BUILD SUCCESSFUL in 5m 10s
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>
```

```
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockClient -Phost=localhost -Pmessage=secr
et -Pnumber=55
Starting a Gradle Daemon, 1 busy and 1 stopped Daemons could not be reused, use --status for details

> Task :SocketClient
Got it!

BUILD SUCCESSFUL in 3s
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockClient -Phost=localhost -Pmessage=secr
et -Pnumber=555

> Task :SocketClient
Got it!

BUILD SUCCESSFUL in 891ms
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockClient -Phost=localhost -Pmessage=secr
eter -Pnumber=53

> Task :SocketClient
Got it!

BUILD SUCCESSFUL in 881ms
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>
```

1.5.2

```
[ec2-user@ip-172-31-22-13 JavaSimpleSock2]$ gradle SockServer
Starting a Gradle Daemon (subsequent builds will be faster)

> Task :SocketServer
Server ready for 3 connections
Server waiting for a connection
Received the String secreter
Received the Integer 53
Server waiting for a connection
Received the String secret
Received the Integer 2
Server waiting for a connection
Received the String secretNumber
Received the Integer 25

BUILD SUCCESSFUL in 2m 27s
2 actionable tasks: 1 executed, 1 up-to-date
[ec2-user@ip-172-31-22-13 JavaSimpleSock2]$
```

```
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockClient -Phost=18.218.120.48 -Pmessage=
secreter -Pnumber=53

> Task :SocketClient
Got it!

BUILD SUCCESSFUL in 1s
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockClient -Phost=18.218.120.48 -Pmessage=
secret -Pnumber=2

> Task :SocketClient
Got it!

BUILD SUCCESSFUL in 1s
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>gradle SockClient -Phost=18.218.120.48 -Pmessage=
secretNumber -Pnumber=25

> Task :SocketClient
Got it!

BUILD SUCCESSFUL in 1s
2 actionable tasks: 1 executed, 1 up-to-date
C:\Users\them4\Documents\GitHub\ser321examples\Sockets\JavaSimpleSock2>
```

On wireshark I had to change where I was capturing. For the localhost I used adapter for loopback traffic capture but for the ec2 server used the wifi capture.

In my gradle command line I just had to switch -Phost from localhost to the ip of the ec2 instance.

1.5.3

I'd assume the server locally and client on AWS would not work very well since AWS would have to go through the router first and couldn't directly jump to my local machine if it had the public ip address.

1.5.4

The router attempts to protect the devices it services and doesn't allow something outside to initiate the connection. The local machine has to send something out first then it can be responded to with the ip address but not beforehand.