

1.

1.

(a) After NAT translation:

<u>Source</u>	<u>Destination</u>
138.76.29.7:8001	136.142.34.104:80
138.76.29.7:8003	52.25.108.148:443

(b)

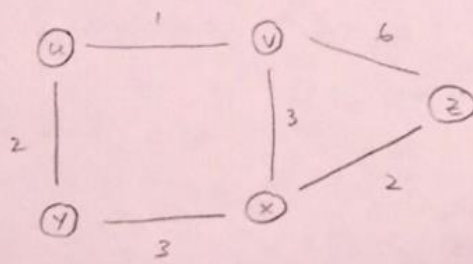
<u>Source</u>	<u>Destination</u>
136.142.34.104:80	192.168.0.3:2489
52.25.108.148:443	192.168.0.2:2202

2.

2.

<u>Destination Address Range</u>	<u>Interface</u>
224.0.0.0 / 10	0
224.64.0.0 / 16	1
224.0.0.0 / 7	2
others	3

3.



$t = 0$	u	v	x	y	z
u	0	1	∞	2	∞
v	1	0	3	∞	6
x	∞	3	0	3	2
y	2	∞	3	0	∞
z	∞	6	2	∞	0

$$d_v(y) = \min \{ c(v, y) + d_x(y), c \}$$

$t=1$	u	v	x	y	z
v	1	0	3	3	5
x	4	3	0	3	2
z	7	5	2	5	0

$t=2$	u	v	x	y	z
v	1	0	3	3	5
x	4	3	0	3	2
z	6	5	2	5	0

4.

4. (a) The arp -a command shows the mapping of IP addresses to MAC addresses in the same LAN
- (b) Destination column is broadcast
- (c) ARP response message is broadcast
- (d) These ARP messages figure out which device in my LAN the packets are being sent to, either the router or my computer.

5.

5. (a) TCP is better for reliability since it performs more robust error checking. UDP eschews some of these measures to focus on speed instead.

(b) Netflix - TCP, because it is apparently not an issue for the company to just buffer the content for a few seconds.

6.

(a)

```
>> c = tcpip("localhost", 3000, 'NetworkRole', 'client')
```

```
TCPIP Object : TCPIP-localhost
```

```
Communication Settings
```

```
RemotePort:      3000
RemoteHost:      localhost
Terminator:      'LF'
NetworkRole:     client
```

```
Communication State
```

```
Status:          closed
RecordStatus:    off
```

```
Read/Write State
```

```
TransferStatus:  idle
BytesAvailable:  0
ValuesReceived:  0
ValuesSent:      0
```

```
>> fopen(c)
```

```
>> fwrite(c, "ECE1150")
```

```
>> fclose(c)
```

```
>> |
```

```

>> s = tcpip("0.0.0.0", 3000, 'NetworkRole', 'server')

TCPIP Object : TCPIP-0.0.0.0

Communication Settings
  RemotePort:      3000
  RemoteHost:      0.0.0.0
  Terminator:      'LF'
  NetworkRole:     server

Communication State
  Status:          closed
  RecordStatus:    off

Read/Write State
  TransferStatus:  idle
  BytesAvailable:  0
  ValuesReceived:  0
  ValuesSent:      0

>> fopen(s)
>> fread(s)
Warning: The specified amount of data was not returned within the Timeout period.
'tcpip' unable to read all requested data. For more information on possible reasons, see TCPIP Read Warnings.

ans =

    69
    67
    69
    49
    49
    53
    48

>> fclose(c)
Undefined function or variable 'c'.

>> fclose(s)

```

(b)



```
> Frame 18: 44 bytes on wire (352 bits), 44 bytes captured (352 bits) on interface \Device\NPF_{Loopback}, id 0
  Null/Loopback
    Family: IP (2)
  > Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
  > Transmission Control Protocol, Src Port: 3000, Dst Port: 50344, Seq: 1, Ack: 8, Len: 0
    Source Port: 3000
    Destination Port: 50344
    [Stream index: 2]
    [TCP Segment Len: 0]
    Sequence Number: 1 (relative sequence number)
    Sequence Number (raw): 2548663710
    [Next Sequence Number: 1 (relative sequence number)]
    Acknowledgment Number: 8 (relative ack number)
    Acknowledgment number (raw): 4116986001
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 10233
    [Calculated window size: 10233]
    [Window size scaling factor: -1 (unknown)]
    Checksum: 0x6dfa [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  > [Timestamps]
```

Sequence number: 2548663710

Acknowledgement number: 4116986001

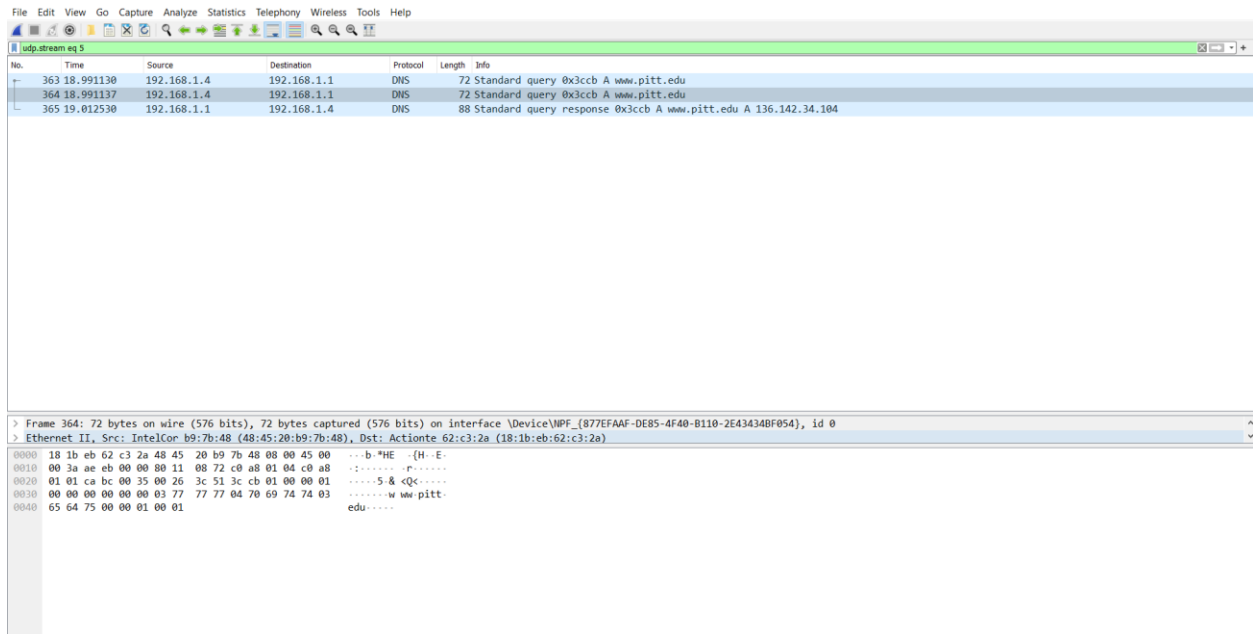
(e)

```
0000 02 00 00 00 45 00 00 2f d6 c3 40 00 80 06 00 00 ....E../ ..@....
0010 7f 00 00 01 7f 00 00 01 c4 a8 0b b8 f5 64 38 8a ..... d8
0020 97 e9 85 9e 50 18 27 f9 82 48 00 00 45 43 45 31 ....P.'.' .H. GGE
0030 31 35 36 156
```

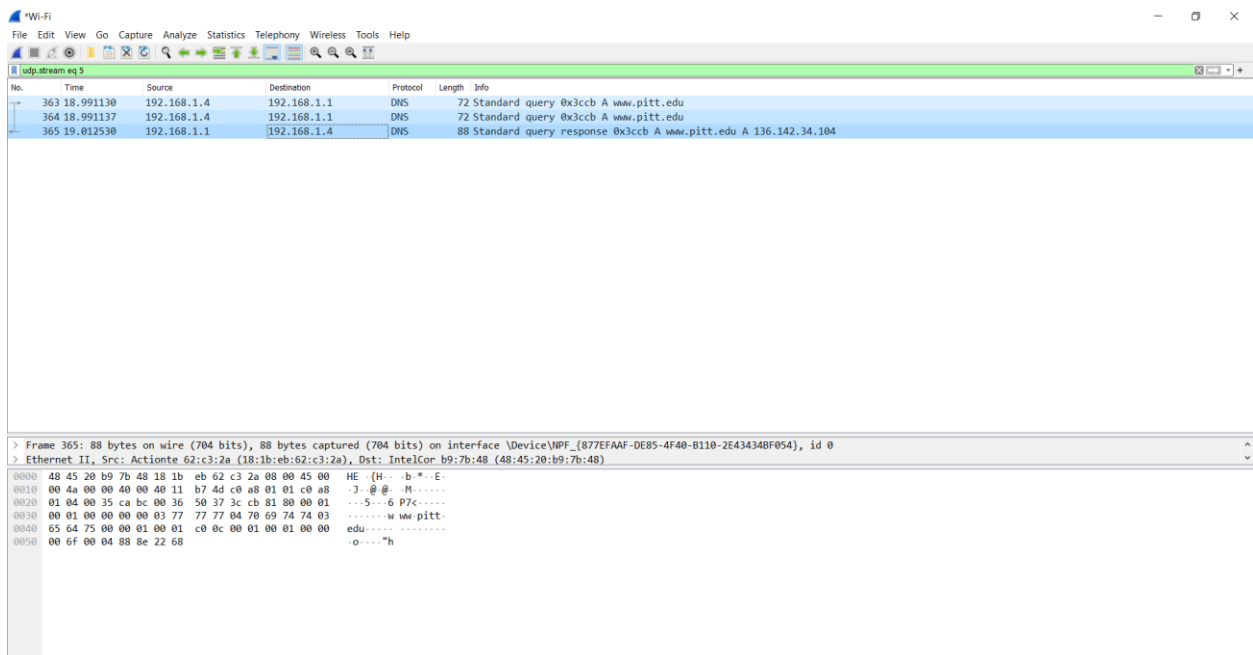
7.

(a)

Query packet:



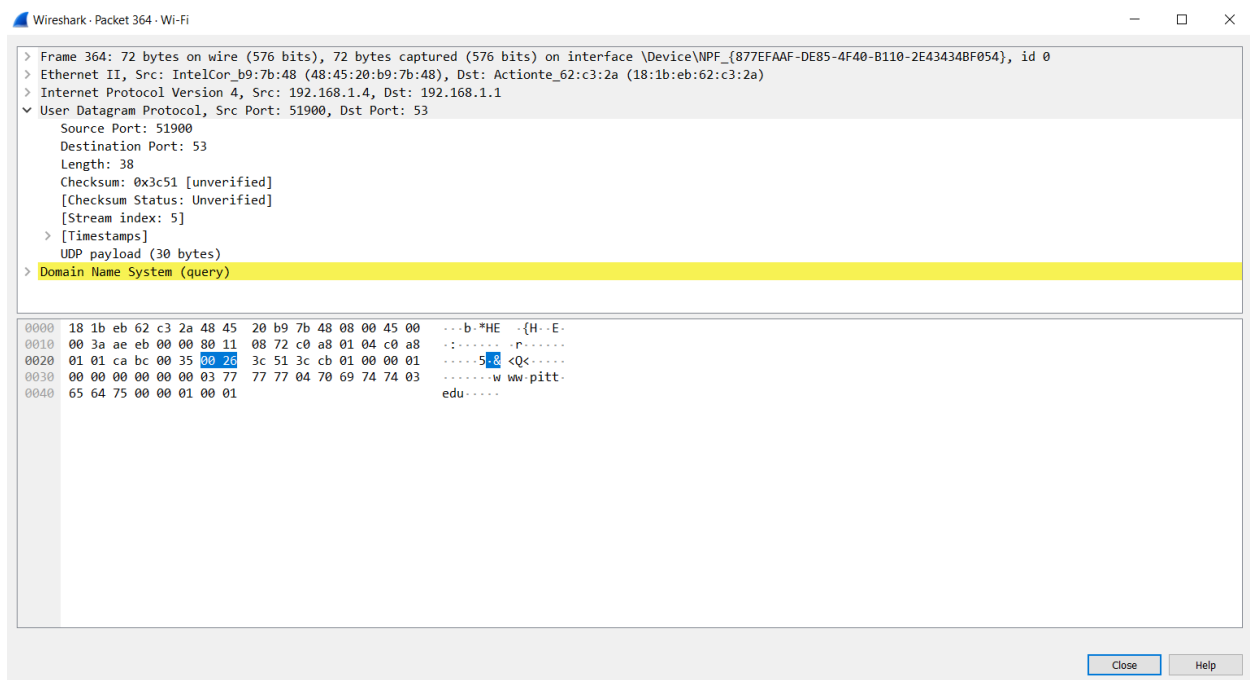
Response packet:



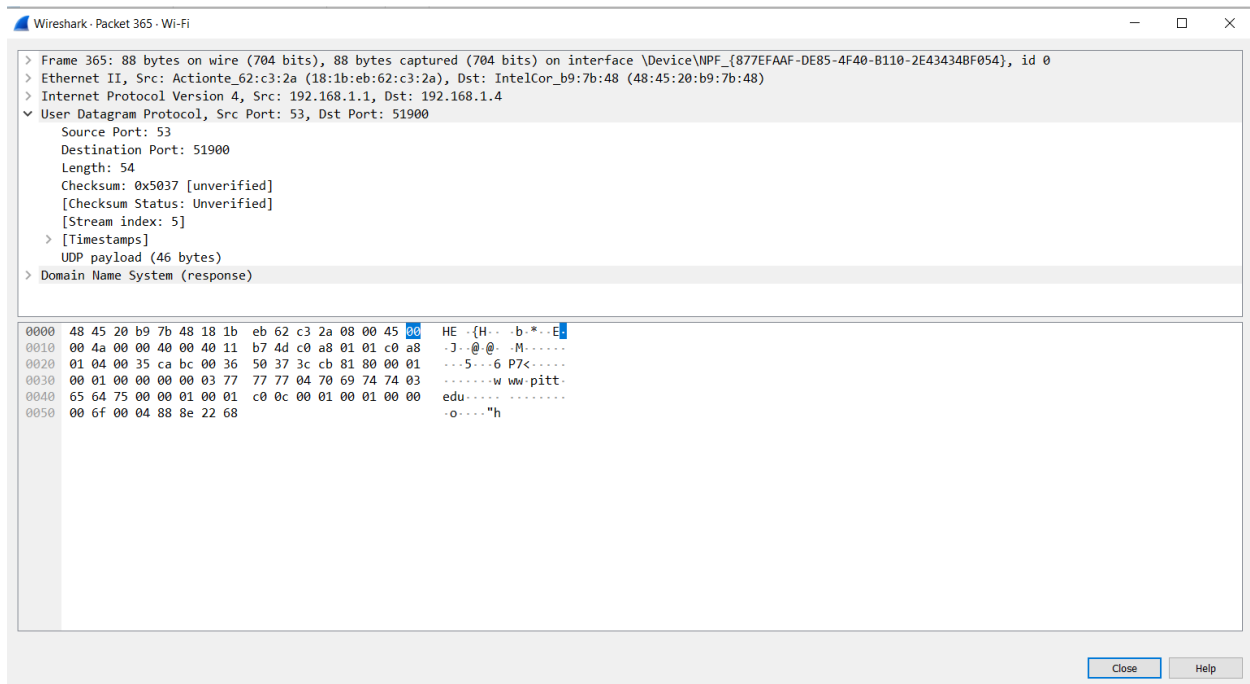
(b) They are sent over UDP.

(c) Query message (destination port = 53)





Response message (source port = 53)



(d) The IP address is 136.142.34.104

```
Answer RRs: 1
Authority RRs: 0
Additional RRs: 0
> Queries
v Answers
  v www.pitt.edu: type A, class IN, addr 136.142.34.104
    Name: www.pitt.edu
    Type: A (Host Address) (1)
    Class: IN (0x0001)
    Time to live: 111 (1 minute, 51 seconds)
    Data length: 4
    Address: 136.142.34.104
  [Request In: 363]
  [Time: 0.021400000 seconds]
```

```
0000 48 45 20 b9 7b 48 18 1b eb 62 c3 2a 08 00 45 00 HE .{H-- .b.*-.
0010 00 4a 00 00 40 00 40 11 b7 4d c0 a8 01 01 c0 a8 .J..@. .M.....
0020 01 04 00 35 ca bc 00 36 50 37 3c cb 81 80 00 01 ...5...6 P7<....
0030 00 01 00 00 00 00 03 77 77 77 04 70 69 74 74 03 .....w ww-pitt-
0040 65 64 75 00 00 01 00 01 c0 0c 00 01 00 01 00 00 edu.....
0050 00 6f 00 04 88 8e 22 68 .o...."h
```