IoT Security and Privacy

Lab 4: Basic Network Security

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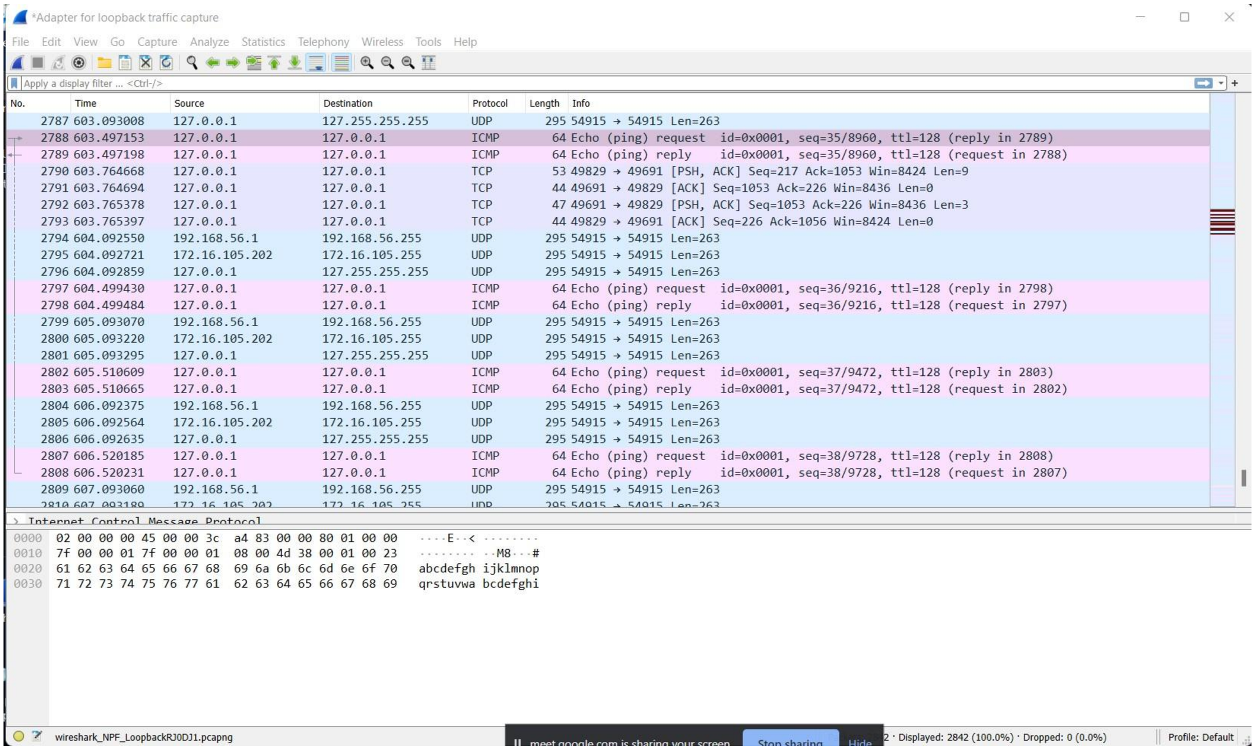
1. Ping localhost and select an example of a packet sent by the ping in wireshark

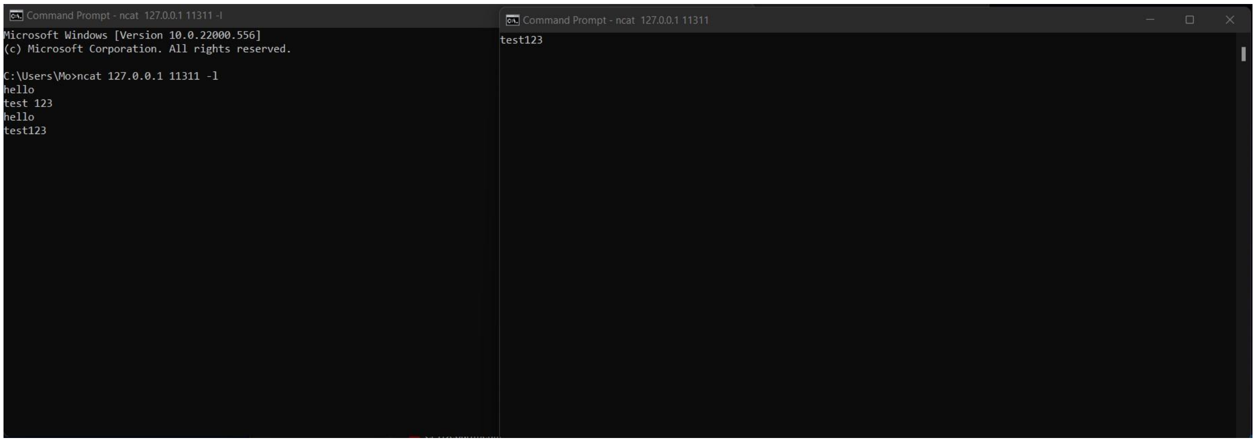

*Adapter for loopback traffic capture
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
2787	603.093008	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
2788	603.497153	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) request id=0x0001, seq=35/8960, ttl=128 (reply in 2789)
2789	603.497198	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) reply id=0x0001, seq=35/8960, ttl=128 (request in 2788)
2790	603.764668	127.0.0.1	127.0.0.1	TCP	53	49829 → 49691 [PSH, ACK] Seq=217 Ack=1053 Win=8424 Len=9
2791	603.764694	127.0.0.1	127.0.0.1	TCP	44	49691 → 49829 [ACK] Seq=1053 Ack=226 Win=8436 Len=0
2792	603.765378	127.0.0.1	127.0.0.1	TCP	47	49691 → 49829 [PSH, ACK] Seq=1053 Ack=226 Win=8436 Len=3
2793	603.765397	127.0.0.1	127.0.0.1	TCP	44	49829 → 49691 [ACK] Seq=226 Ack=1056 Win=8424 Len=0
2794	604.092550	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
2795	604.092721	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
2796	604.092859	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
2797	604.499430	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) request id=0x0001, seq=36/9216, ttl=128 (reply in 2798)
2798	604.499484	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) reply id=0x0001, seq=36/9216, ttl=128 (request in 2797)
2799	605.093070	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
2800	605.093220	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
2801	605.093295	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
2802	605.510609	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) request id=0x0001, seq=37/9472, ttl=128 (reply in 2803)
2803	605.510665	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) reply id=0x0001, seq=37/9472, ttl=128 (request in 2802)
2804	606.092375	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
2805	606.092564	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
2806	606.092635	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
2807	606.520185	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) request id=0x0001, seq=38/9728, ttl=128 (reply in 2808)
2808	606.520231	127.0.0.1	127.0.0.1	ICMP	64	Echo (ping) reply id=0x0001, seq=38/9728, ttl=128 (request in 2807)
2809	607.093060	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
2810	607.093189	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263

```
> Internet Control Message Protocol
0000  02 00 00 00 45 00 00 3c  a4 83 00 00 80 01 00 00   ····E··< ········
0010  7f 00 00 01 7f 00 00 01  08 00 4d 38 00 01 00 23   ········ ··M8···#
0020  61 62 63 64 65 66 67 68  69 6a 6b 6c 6d 6e 6f 70   abcdefgh ijklmnop
0030  71 72 73 74 75 76 77 61  62 63 64 65 66 67 68 69   qrstuvwa bcdefghi
```

wireshark_NPF_LoopbackRJ0DJ1.pcapng
meet.google.com is sharing your screen.
Stop sharing
Hide
2 · Displayed: 2842 (100.0%) · Dropped: 0 (0.0%)
Profile: Default

2. In another terminal connect to port 11311 and send your name as a message

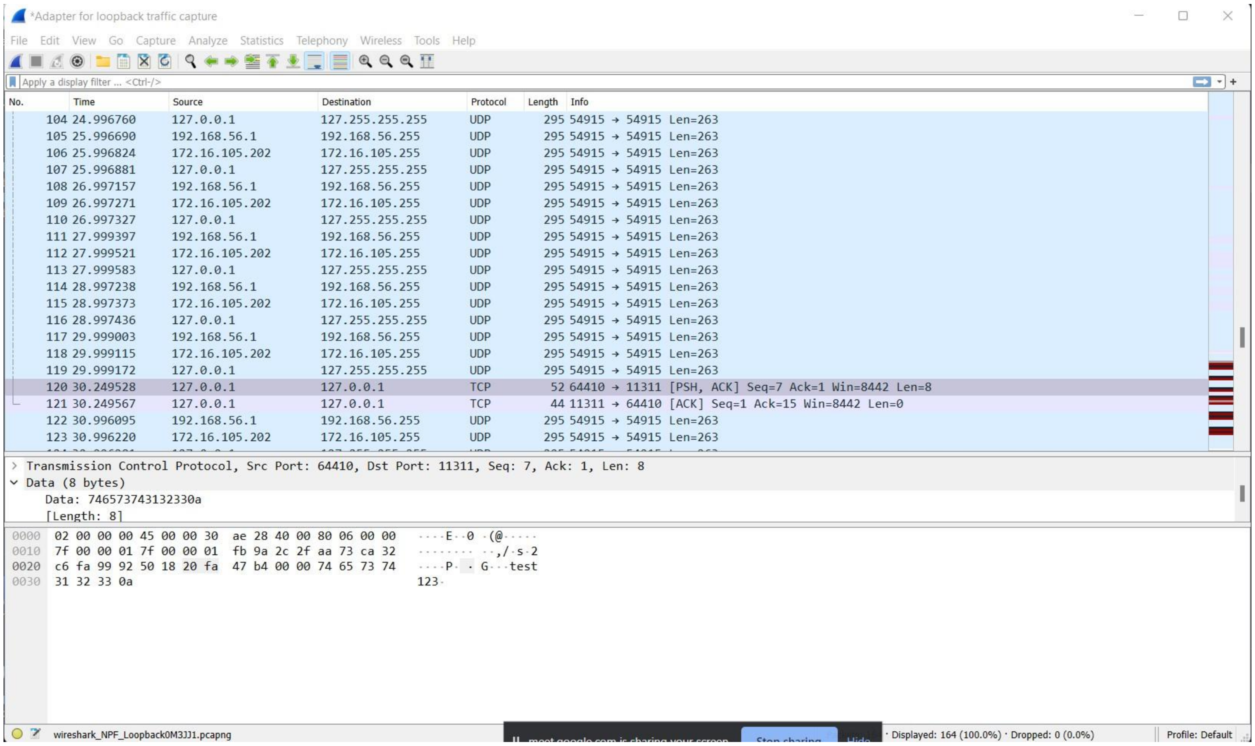

Command Prompt - ncat 127.0.0.1 11311 -l
Command Prompt - ncat 127.0.0.1 11311

```
Microsoft Windows [Version 10.0.22000.556]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Mo>ncat 127.0.0.1 11311 -l
hello
test 123
hello
test123
```

```
test123
```

3. Select the packet containing your name in wireshark and highlight your name in that packet


*Adapter for loopback traffic capture
File
Edit
View
Go
Capture
Analyze
Statistics
Telephony
Wireless
Tools
Help
Apply a display filter ... <Ctrl-/>
meet.google.com is sharing your screen.
Stop sharing
Hide

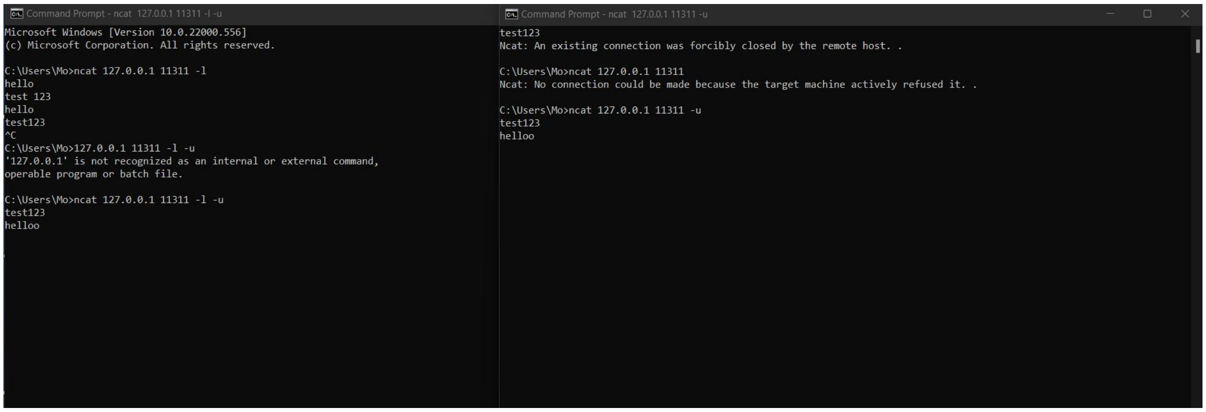
```
No.  Time          Source           Destination        Protocol  Length  Info
 104 24.996760     127.0.0.1        127.255.255.255    UDP         295 54915 → 54915 Len=263
 105 25.996690     192.168.56.1     192.168.56.255     UDP         295 54915 → 54915 Len=263
 106 25.996824     172.16.105.202   172.16.105.255     UDP         295 54915 → 54915 Len=263
 107 25.996881     127.0.0.1        127.255.255.255    UDP         295 54915 → 54915 Len=263
 108 26.997157     192.168.56.1     192.168.56.255     UDP         295 54915 → 54915 Len=263
 109 26.997271     172.16.105.202   172.16.105.255     UDP         295 54915 → 54915 Len=263
 110 26.997327     127.0.0.1        127.255.255.255    UDP         295 54915 → 54915 Len=263
 111 27.999397     192.168.56.1     192.168.56.255     UDP         295 54915 → 54915 Len=263
 112 27.999521     172.16.105.202   172.16.105.255     UDP         295 54915 → 54915 Len=263
 113 27.999583     127.0.0.1        127.255.255.255    UDP         295 54915 → 54915 Len=263
 114 28.997238     192.168.56.1     192.168.56.255     UDP         295 54915 → 54915 Len=263
 115 28.997373     172.16.105.202   172.16.105.255     UDP         295 54915 → 54915 Len=263
 116 28.997436     127.0.0.1        127.255.255.255    UDP         295 54915 → 54915 Len=263
 117 29.999003     192.168.56.1     192.168.56.255     UDP         295 54915 → 54915 Len=263
 118 29.999115     172.16.105.202   172.16.105.255     UDP         295 54915 → 54915 Len=263
 119 29.999172     127.0.0.1        127.255.255.255    UDP         295 54915 → 54915 Len=263
 120 30.249528     127.0.0.1        127.0.0.1          TCP          52 64410 → 11311 [PSH, ACK] Seq=7 Ack=1 Win=8442 Len=8
 121 30.249567     127.0.0.1        127.0.0.1          TCP          44 11311 → 64410 [ACK] Seq=1 Ack=15 Win=8442 Len=0
 122 30.996095     192.168.56.1     192.168.56.255     UDP         295 54915 → 54915 Len=263
 123 30.996220     172.16.105.202   172.16.105.255     UDP         295 54915 → 54915 Len=263

> Transmission Control Protocol, Src Port: 64410, Dst Port: 11311, Seq: 7, Ack: 1, Len: 8
v Data (8 bytes)
    Data: 746573743132330a
    [Length: 8]

0000  02 00 00 00 45 00 00 30  ae 28 40 00 80 06 00 00   ····E··0 ·(@·····
0010  7f 00 00 01 7f 00 00 01  fb 9a 2c 2f aa 73 ca 32   ········ ··,/·s·2
0020  c6 fa 99 92 50 18 20 fa  47 b4 00 00 74 65 73 74   ····P· · G···test
0030  31 32 33 0a                                        123·

wireshark_NPF_Loopback0M3JJ1.pcapng    · Displayed: 164 (100.0%) · Dropped: 0 (0.0%)    Profile: Default
```

4. Repeat these steps using UDP protocol instead of the default TCP


Command Prompt - ncat 127.0.0.1 11311 -l -u
Command Prompt - ncat 127.0.0.1 11311 -u

```
Microsoft Windows [Version 10.0.22000.556]
(c) Microsoft Corporation. All rights reserved.

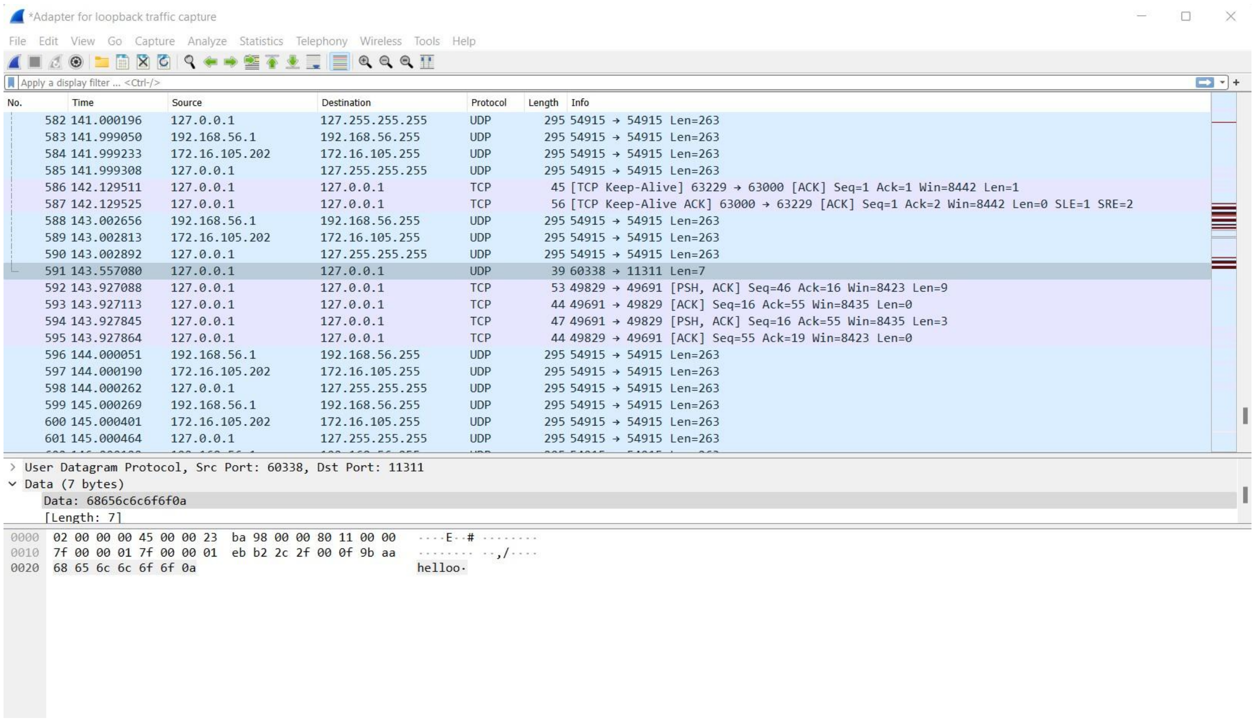
C:\Users\Mo>ncat 127.0.0.1 11311 -l
hello
test 123
hello
test123
^C
C:\Users\Mo>127.0.0.1 11311 -l -u
'127.0.0.1' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\Mo>ncat 127.0.0.1 11311 -l -u
test123
helloo
```

```
test123
Ncat: An existing connection was forcibly closed by the remote host. .

C:\Users\Mo>ncat 127.0.0.1 11311
Ncat: No connection could be made because the target machine actively refused it. .

C:\Users\Mo>ncat 127.0.0.1 11311 -u
test123
helloo
```

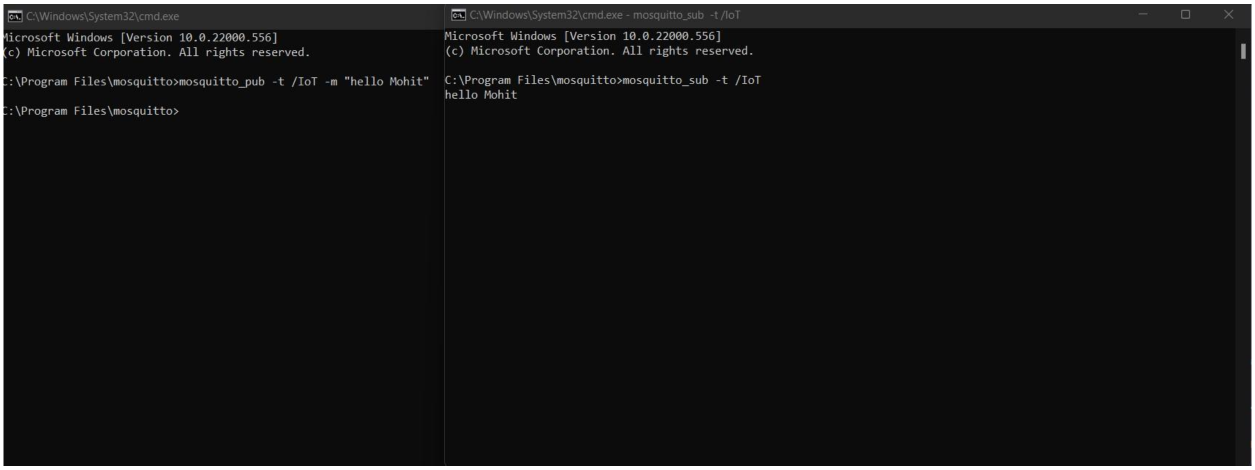

*Adapter for loopback traffic capture
File
Edit
View
Go
Capture
Analyze
Statistics
Telephony
Wireless
Tools
Help
Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
582	141.000196	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
583	141.999050	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
584	141.999233	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
585	141.999308	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
586	142.129511	127.0.0.1	127.0.0.1	TCP	45	[TCP Keep-Alive] 63229 → 63000 [ACK] Seq=1 Ack=1 Win=8442 Len=1
587	142.129525	127.0.0.1	127.0.0.1	TCP	56	[TCP Keep-Alive ACK] 63000 → 63229 [ACK] Seq=1 Ack=2 Win=8442 Len=0 SLE=1 SRE=2
588	143.002656	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
589	143.002813	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
590	143.002892	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
591	143.557080	127.0.0.1	127.0.0.1	UDP	39	60338 → 11311 Len=7
592	143.927088	127.0.0.1	127.0.0.1	TCP	53	49829 → 49691 [PSH, ACK] Seq=46 Ack=16 Win=8423 Len=9
593	143.927113	127.0.0.1	127.0.0.1	TCP	44	49691 → 49829 [ACK] Seq=16 Ack=55 Win=8435 Len=0
594	143.927845	127.0.0.1	127.0.0.1	TCP	47	49691 → 49829 [PSH, ACK] Seq=16 Ack=55 Win=8435 Len=3
595	143.927864	127.0.0.1	127.0.0.1	TCP	44	49829 → 49691 [ACK] Seq=55 Ack=19 Win=8423 Len=0
596	144.000051	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
597	144.000190	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
598	144.000262	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263
599	145.000269	192.168.56.1	192.168.56.255	UDP	295	54915 → 54915 Len=263
600	145.000401	172.16.105.202	172.16.105.255	UDP	295	54915 → 54915 Len=263
601	145.000464	127.0.0.1	127.255.255.255	UDP	295	54915 → 54915 Len=263

```
> User Datagram Protocol, Src Port: 60338, Dst Port: 11311
v Data (7 bytes)
    Data: 68656c6c6f6f0a
    [Length: 7]
```

```
0000  02 00 00 00 45 00 00 23  ba 98 00 00 80 11 00 00   ····E··# ········
0010  7f 00 00 01 7f 00 00 01  eb b2 2c 2f 00 0f 9b aa   ········ ··,/····
0020  68 65 6c 6c 6f 6f 0a                               helloo·
```

5. Mosquitto_pub your name to /IoT


C:\Windows\System32\cmd.exe
C:\Windows\System32\cmd.exe - mosquitto_sub -t /IoT

```
icrosoft Windows [Version 10.0.22000.556]
(c) Microsoft Corporation. All rights reserved.

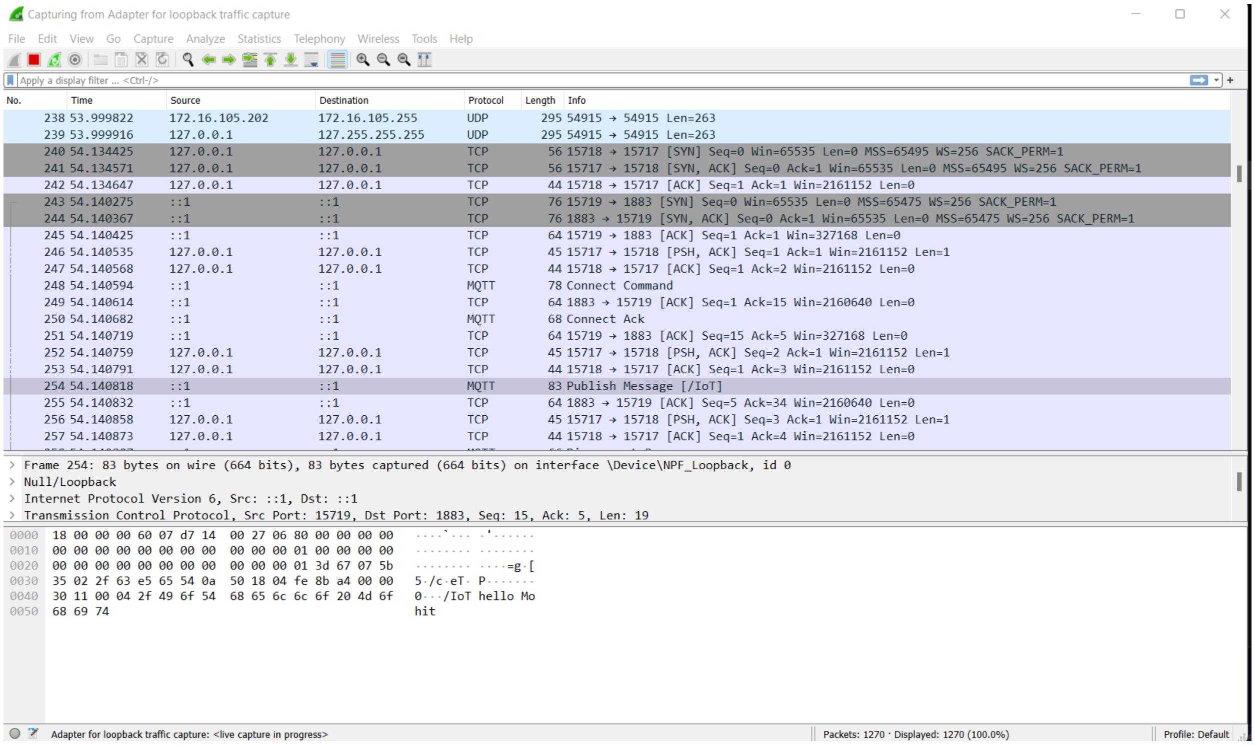
:\Program Files\mosquitto>mosquitto_pub -t /IoT -m "hello Mohit"

:\Program Files\mosquitto>
```

```
Microsoft Windows [Version 10.0.22000.556]
(c) Microsoft Corporation. All rights reserved.

C:\Program Files\mosquitto>mosquitto_sub -t /IoT
hello Mohit
```

6. Identify and select the packet containing your name in wireshark.


Capturing from Adapter for loopback traffic capture
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>

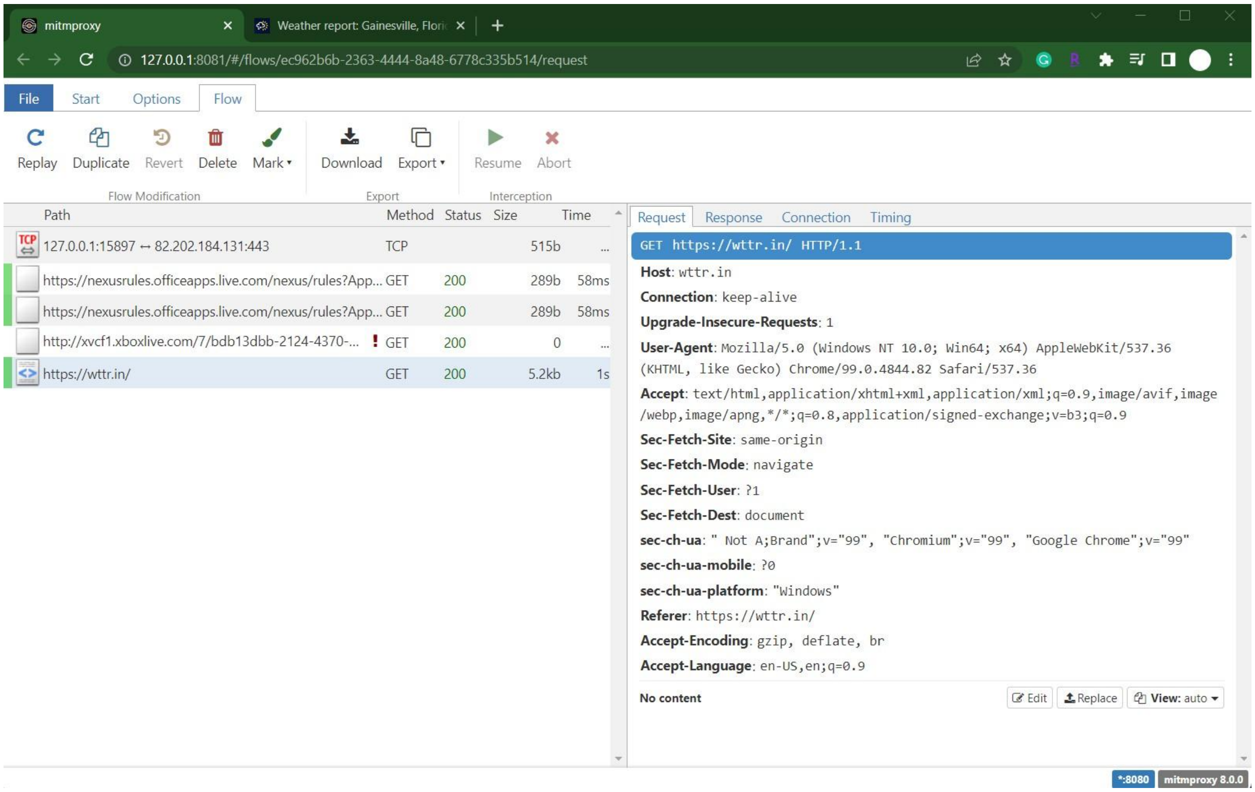
```
No.   Time        Source          Destination      Protocol  Length Info
  238 53.999822   172.16.105.202  172.16.105.255   UDP       295 54915 → 54915 Len=263
  239 53.999916   127.0.0.1       127.255.255.255  UDP       295 54915 → 54915 Len=263
  240 54.134425   127.0.0.1       127.0.0.1        TCP        56 15718 → 15717 [SYN] Seq=0 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM=1
  241 54.134571   127.0.0.1       127.0.0.1        TCP        56 15717 → 15718 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=65495 WS=256 SACK_PERM=1
  242 54.134647   127.0.0.1       127.0.0.1        TCP        44 15718 → 15717 [ACK] Seq=1 Ack=1 Win=2161152 Len=0
  243 54.140275   ::1             ::1              TCP        76 15719 → 1883 [SYN] Seq=0 Win=65535 Len=0 MSS=65475 WS=256 SACK_PERM=1
  244 54.140367   ::1             ::1              TCP        76 1883 → 15719 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=65475 WS=256 SACK_PERM=1
  245 54.140425   ::1             ::1              TCP        64 15719 → 1883 [ACK] Seq=1 Ack=1 Win=327168 Len=0
  246 54.140535   127.0.0.1       127.0.0.1        TCP        45 15717 → 15718 [PSH, ACK] Seq=1 Ack=1 Win=2161152 Len=1
  247 54.140568   127.0.0.1       127.0.0.1        TCP        44 15718 → 15717 [ACK] Seq=1 Ack=2 Win=2161152 Len=0
  248 54.140594   ::1             ::1              MQTT       78 Connect Command
  249 54.140614   ::1             ::1              TCP        64 1883 → 15719 [ACK] Seq=1 Ack=15 Win=2160640 Len=0
  250 54.140682   ::1             ::1              MQTT       68 Connect Ack
  251 54.140719   ::1             ::1              TCP        64 15719 → 1883 [ACK] Seq=15 Ack=5 Win=327168 Len=0
  252 54.140759   127.0.0.1       127.0.0.1        TCP        45 15717 → 15718 [PSH, ACK] Seq=2 Ack=1 Win=2161152 Len=1
  253 54.140791   127.0.0.1       127.0.0.1        TCP        44 15718 → 15717 [ACK] Seq=1 Ack=3 Win=2161152 Len=0
  254 54.140818   ::1             ::1              MQTT       83 Publish Message [/IoT]
  255 54.140832   ::1             ::1              TCP        64 1883 → 15719 [ACK] Seq=5 Ack=34 Win=2160640 Len=0
  256 54.140858   127.0.0.1       127.0.0.1        TCP        45 15717 → 15718 [PSH, ACK] Seq=3 Ack=1 Win=2161152 Len=1
  257 54.140873   127.0.0.1       127.0.0.1        TCP        44 15718 → 15717 [ACK] Seq=1 Ack=4 Win=2161152 Len=0
```

```
> Frame 254: 83 bytes on wire (664 bits), 83 bytes captured (664 bits) on interface \Device\NPF_Loopback, id 0
> Null/Loopback
> Internet Protocol Version 6, Src: ::1, Dst: ::1
> Transmission Control Protocol, Src Port: 15719, Dst Port: 1883, Seq: 15, Ack: 5, Len: 19
```

```
0000  18 00 00 00 60 07 d7 14  00 27 06 80 00 00 00 00   ····`··· ·'······
0010  00 00 00 00 00 00 00 00  00 00 00 01 00 00 00 00   ········ ········
0020  00 00 00 00 00 00 00 00  00 00 00 01 3d 67 07 5b   ········ ····=g·[
0030  35 02 2f 63 e5 65 54 0a  50 18 04 fe 8b a4 00 00   5·/c·eT· P·······
0040  30 11 00 04 2f 49 6f 54  68 65 6c 6c 6f 20 4d 6f   0···/IoT hello Mo
0050  68 69 74                                           hit
```

Adapter for loopback traffic capture: <live capture in progress>
Packets: 1270 · Displayed: 1270 (100.0%)
Profile: Default

7. Identify the Flow related to that request in mitmweb

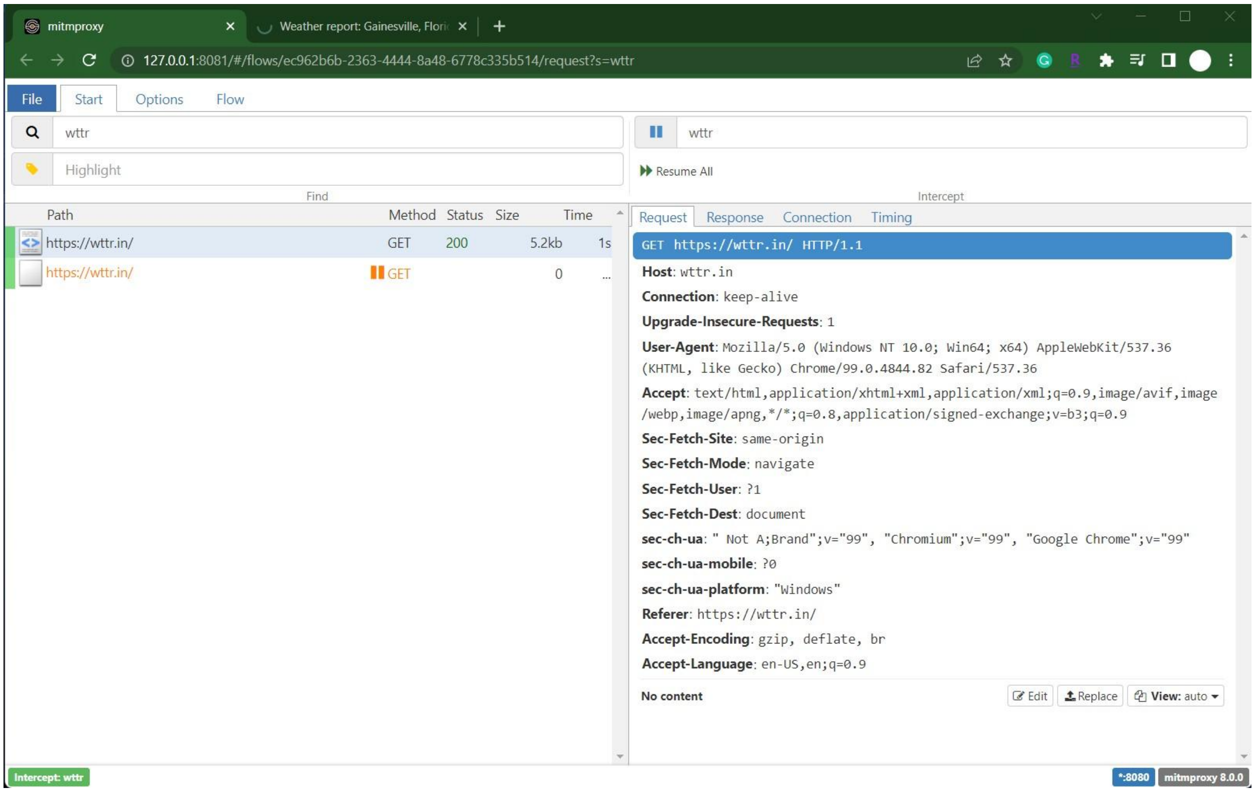


Path	Method	Status	Size	Time
127.0.0.1:15897 ↔ 82.202.184.131:443	TCP		515b	...
https://nexusrules.officeapps.live.com/nexus/rules?App...	GET	200	289b	58ms
https://nexusrules.officeapps.live.com/nexus/rules?App...	GET	200	289b	58ms
http://xvcf1.xboxlive.com/7/bdb13dbb-2124-4370-... !	GET	200	0	...
https://wttr.in/	GET	200	5.2kb	1s

```
GET https://wttr.in/ HTTP/1.1
Host: wttr.in
Connection: keep-alive
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/99.0.4844.82 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: navigate
Sec-Fetch-User: ?1
Sec-Fetch-Dest: document
sec-ch-ua: " Not A;Brand";v="99", "Chromium";v="99", "Google Chrome";v="99"
sec-ch-ua-mobile: ?0
sec-ch-ua-platform: "Windows"
Referer: https://wttr.in/
Accept-Encoding: gzip, deflate, br
Accept-Language: en-US,en;q=0.9
```

No content

8. Enter intercept mode in mitmweb and repeat the request to wttr.in

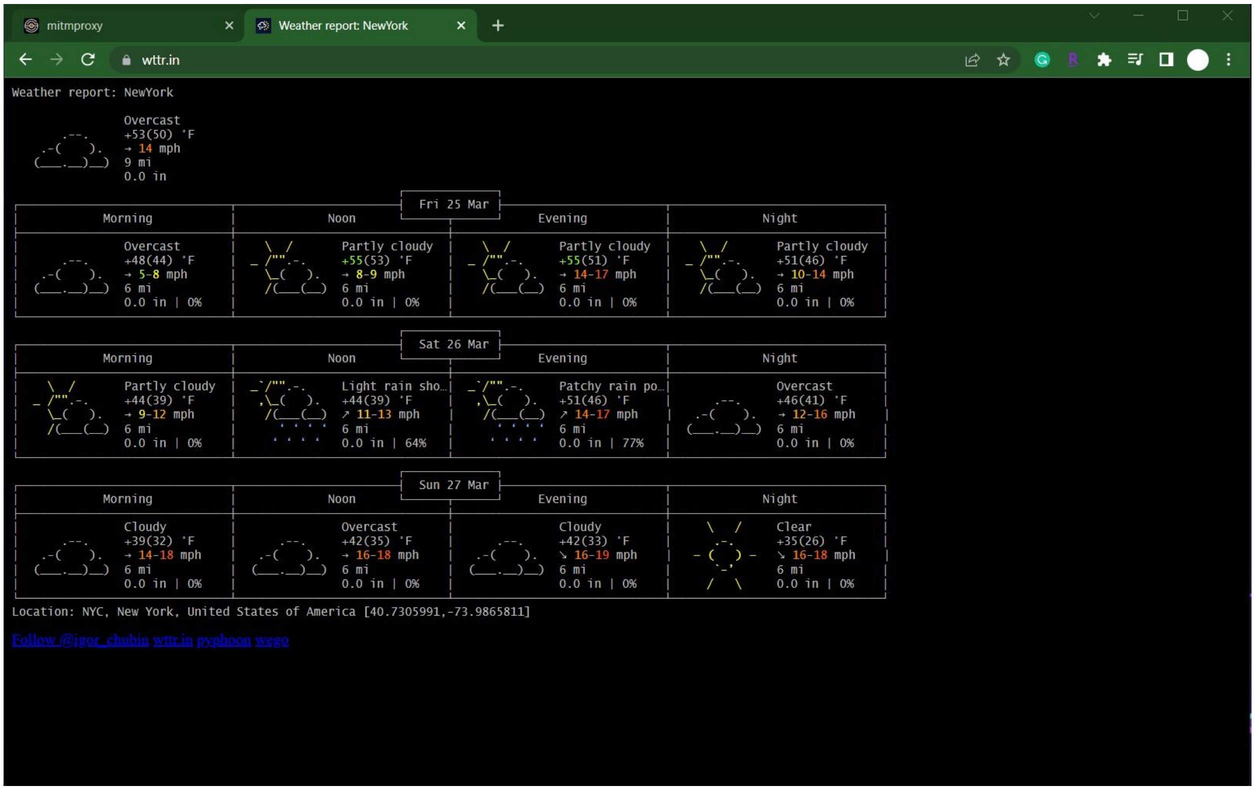


Path	Method	Status	Size	Time
https://wttr.in/	GET	200	5.2kb	1s
https://wttr.in/	GET		0	...

```
GET https://wttr.in/ HTTP/1.1
Host: wttr.in
Connection: keep-alive
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/99.0.4844.82 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image
/webp,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: navigate
Sec-Fetch-User: ?1
Sec-Fetch-Dest: document
sec-ch-ua: " Not A;Brand";v="99", "Chromium";v="99", "Google Chrome";v="99"
sec-ch-ua-mobile: ?0
sec-ch-ua-platform: "Windows"
Referer: https://wttr.in/
Accept-Encoding: gzip, deflate, br
Accept-Language: en-US,en;q=0.9
```

No content

9. Edit the request to the wttr.in server so that the server returns the information for New York instead of Gainesville



```
Weather report: NewYork

               Overcast
      .--.     +53(50) °F
   .-(    ).   → 14 mph
  (___.__)__)  9 mi
               0.0 in
                                                       ┌─────────────┐
┌──────────────────────────────┬───────────────────────┤  Fri 25 Mar ├───────────────────────┬──────────────────────────────┐
│            Morning           │             Noon      └──────┬──────┘     Evening           │             Night            │
├──────────────────────────────┼──────────────────────────────┼──────────────────────────────┼──────────────────────────────┤
│               Overcast       │    \  /       Partly cloudy  │    \  /       Partly cloudy  │    \  /       Partly cloudy  │
│      .--.     +48(44) °F     │  _ /"".-.     +55(53) °F     │  _ /"".-.     +55(51) °F     │  _ /"".-.     +51(46) °F     │
│   .-(    ).   → 5-8 mph      │    \_(   ).   → 8-9 mph      │    \_(   ).   → 14-17 mph    │    \_(   ).   → 10-14 mph    │
│  (___.__)__)  6 mi           │    /(___(__)  6 mi           │    /(___(__)  6 mi           │    /(___(__)  6 mi           │
│               0.0 in | 0%    │               0.0 in | 0%    │               0.0 in | 0%    │               0.0 in | 0%    │
└──────────────────────────────┴──────────────────────────────┴──────────────────────────────┴──────────────────────────────┘
                                                       ┌─────────────┐
┌──────────────────────────────┬───────────────────────┤  Sat 26 Mar ├───────────────────────┬──────────────────────────────┐
│            Morning           │             Noon      └──────┬──────┘     Evening           │             Night            │
├──────────────────────────────┼──────────────────────────────┼──────────────────────────────┼──────────────────────────────┤
│    \  /       Partly cloudy  │  _`/"".-.     Light rain sho…│  _`/"".-.     Patchy rain po…│               Overcast       │
│  _ /"".-.     +44(39) °F     │   ,\_(   ).   +44(39) °F     │   ,\_(   ).   +51(46) °F     │      .--.     +46(41) °F     │
│    \_(   ).   → 9-12 mph     │    /(___(__)  ↗ 11-13 mph    │    /(___(__)  ↗ 14-17 mph    │   .-(    ).   → 12-16 mph    │
│    /(___(__)  6 mi           │      ‘ ‘ ‘ ‘  6 mi           │      ‘ ‘ ‘ ‘  6 mi           │  (___.__)__)  6 mi           │
│               0.0 in | 0%    │     ‘ ‘ ‘ ‘   0.0 in | 64%   │     ‘ ‘ ‘ ‘   0.0 in | 77%   │               0.0 in | 0%    │
└──────────────────────────────┴──────────────────────────────┴──────────────────────────────┴──────────────────────────────┘
                                                       ┌─────────────┐
┌──────────────────────────────┬───────────────────────┤  Sun 27 Mar ├───────────────────────┬──────────────────────────────┐
│            Morning           │             Noon      └──────┬──────┘     Evening           │             Night            │
├──────────────────────────────┼──────────────────────────────┼──────────────────────────────┼──────────────────────────────┤
│               Cloudy         │               Overcast       │               Cloudy         │     \   /     Clear          │
│      .--.     +39(32) °F     │      .--.     +42(35) °F     │      .--.     +42(33) °F     │      .-.      +35(26) °F     │
│   .-(    ).   → 14-18 mph    │   .-(    ).   → 16-18 mph    │   .-(    ).   ↘ 16-19 mph    │   ― (   ) ―   ↘ 16-18 mph    │
│  (___.__)__)  6 mi           │  (___.__)__)  6 mi           │  (___.__)__)  6 mi           │      `-’      6 mi           │
│               0.0 in | 0%    │               0.0 in | 0%    │               0.0 in | 0%    │     /   \     0.0 in | 0%    │
└──────────────────────────────┴──────────────────────────────┴──────────────────────────────┴──────────────────────────────┘
Location: NYC, New York, United States of America [40.7305991,-73.9865811]

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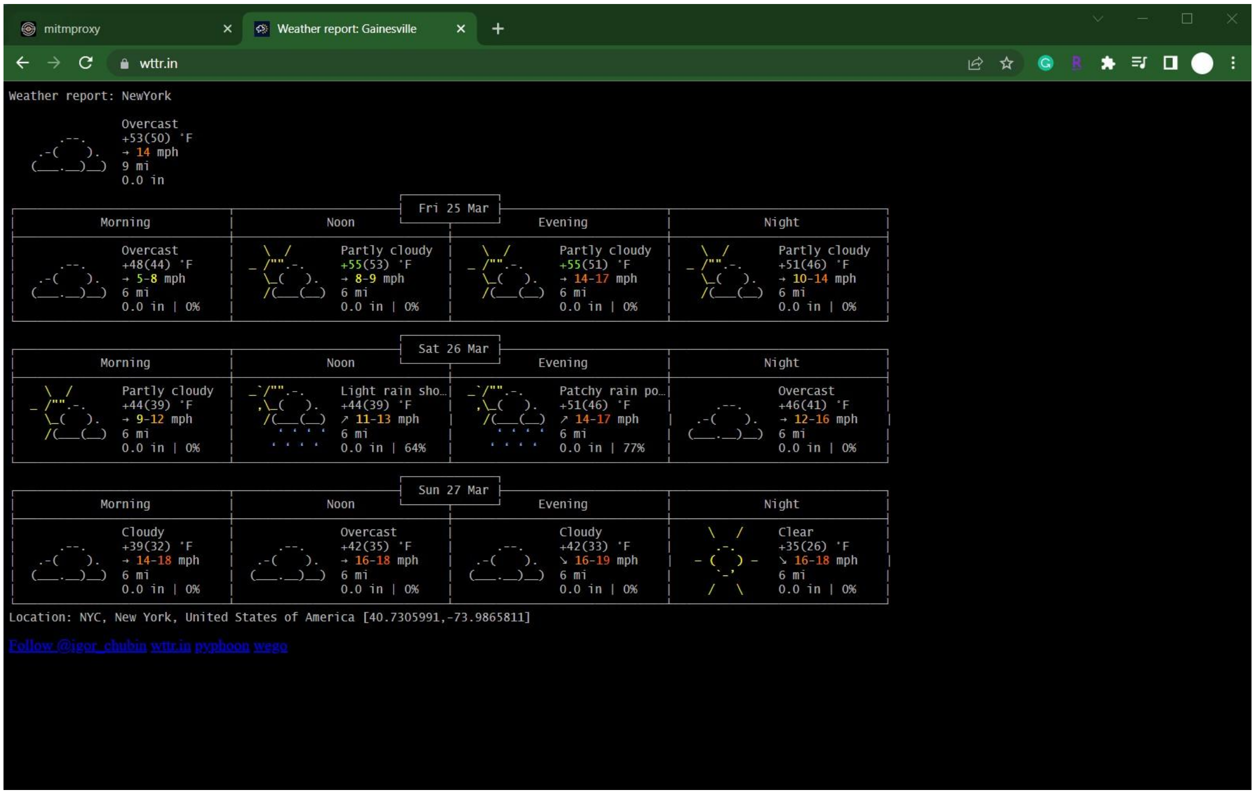
```

10. Edit the response from the server so that the page returned to the browser is titled ‘Gainesville’ instead of New York



```
Weather report: NewYork

               Overcast
      .--.     +53(50) °F
   .-(    ).   → 14 mph
  (___.__)__)  9 mi
               0.0 in
                                                       ┌─────────────┐
┌──────────────────────────────┬───────────────────────┤  Fri 25 Mar ├───────────────────────┬──────────────────────────────┐
│            Morning           │             Noon      └──────┬──────┘     Evening           │             Night            │
├──────────────────────────────┼──────────────────────────────┼──────────────────────────────┼──────────────────────────────┤
│               Overcast       │    \  /       Partly cloudy  │    \  /       Partly cloudy  │    \  /       Partly cloudy  │
│      .--.     +48(44) °F     │  _ /"".-.     +55(53) °F     │  _ /"".-.     +55(51) °F     │  _ /"".-.     +51(46) °F     │
│   .-(    ).   → 5-8 mph      │    \_(   ).   → 8-9 mph      │    \_(   ).   → 14-17 mph    │    \_(   ).   → 10-14 mph    │
│  (___.__)__)  6 mi           │    /(___(__)  6 mi           │    /(___(__)  6 mi           │    /(___(__)  6 mi           │
│               0.0 in | 0%    │               0.0 in | 0%    │               0.0 in | 0%    │               0.0 in | 0%    │
└──────────────────────────────┴──────────────────────────────┴──────────────────────────────┴──────────────────────────────┘
                                                       ┌─────────────┐
┌──────────────────────────────┬───────────────────────┤  Sat 26 Mar ├───────────────────────┬──────────────────────────────┐
│            Morning           │             Noon      └──────┬──────┘     Evening           │             Night            │
├──────────────────────────────┼──────────────────────────────┼──────────────────────────────┼──────────────────────────────┤
│    \  /       Partly cloudy  │  _`/"".-.     Light rain sho…│  _`/"".-.     Patchy rain po…│               Overcast       │
│  _ /"".-.     +44(39) °F     │   ,\_(   ).   +44(39) °F     │   ,\_(   ).   +51(46) °F     │      .--.     +46(41) °F     │
│    \_(   ).   → 9-12 mph     │    /(___(__)  ↗ 11-13 mph    │    /(___(__)  ↗ 14-17 mph    │   .-(    ).   → 12-16 mph    │
│    /(___(__)  6 mi           │      ‘ ‘ ‘ ‘  6 mi           │      ‘ ‘ ‘ ‘  6 mi           │  (___.__)__)  6 mi           │
│               0.0 in | 0%    │     ‘ ‘ ‘ ‘   0.0 in | 64%   │     ‘ ‘ ‘ ‘   0.0 in | 77%   │               0.0 in | 0%    │
└──────────────────────────────┴──────────────────────────────┴──────────────────────────────┴──────────────────────────────┘
                                                       ┌─────────────┐
┌──────────────────────────────┬───────────────────────┤  Sun 27 Mar ├───────────────────────┬──────────────────────────────┐
│            Morning           │             Noon      └──────┬──────┘     Evening           │             Night            │
├──────────────────────────────┼──────────────────────────────┼──────────────────────────────┼──────────────────────────────┤
│               Cloudy         │               Overcast       │               Cloudy         │     \   /     Clear          │
│      .--.     +39(32) °F     │      .--.     +42(35) °F     │      .--.     +42(33) °F     │      .-.      +35(26) °F     │
│   .-(    ).   → 14-18 mph    │   .-(    ).   → 16-18 mph    │   .-(    ).   ↘ 16-19 mph    │   ― (   ) ―   ↘ 16-18 mph    │
│  (___.__)__)  6 mi           │  (___.__)__)  6 mi           │  (___.__)__)  6 mi           │      `-’      6 mi           │
│               0.0 in | 0%    │               0.0 in | 0%    │               0.0 in | 0%    │     /   \     0.0 in | 0%    │
└──────────────────────────────┴──────────────────────────────┴──────────────────────────────┴──────────────────────────────┘
Location: NYC, New York, United States of America [40.7305991,-73.9865811]

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11. List three ways wireshark may present a Threat to an IoT system. For each, estimate the Vulnerability of that Threat to determine total risk to the system.

1. If two people having different levels of authority are connected to the same network, sensitive information to the person having less authority can be easily sniffed by monitoring packets. This can happen through sniffing of data from nodes through an IoT network.
2. If it is a large wireless network all the sensitive sensor data can be recorded and manipulated using Wireshark which is risky depending upon the confidentiality level of the data. Nodes can be manipulated to send false data The communication protocol and trace can be tracked
3. When Wireshark is run by root/administrator all the system critical information which is transferred through the network trace can be monitored and used maliciously. This causes a threat to the core of the system and disrupts the entire network.

12. How can these Risks be further mitigated?
1. Always protect critical information sent through nodes with encryption. Even if the attacker views the information decrypting it will still be a task and sensitive data will remain protected.
2. Authentication at different levels of the communication protocol stack can ensure reliable communication.
3. Always update to the latest version of Wireshark as there is frequent bug fixing in updates versions
4. Avoiding to run Wireshark as root/administrator
5. Analyze captured files in an uncritical environment
6. Each node can use SSL brokers and generate server certificates for verification. The system can continuously verify if the server certificate is valid to check correct/safe behavior of node in the system.