INTERNET PROTOCOL LAB ASSIGNMNET -11

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Establish a Client-Client Secure communication protocol, as shown in Figure 1.

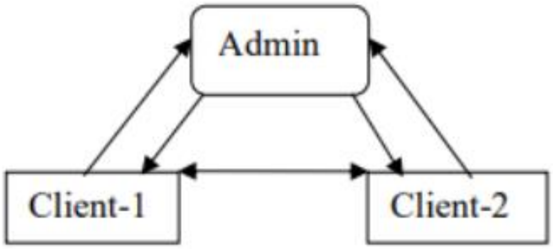
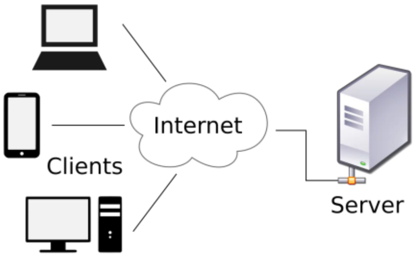


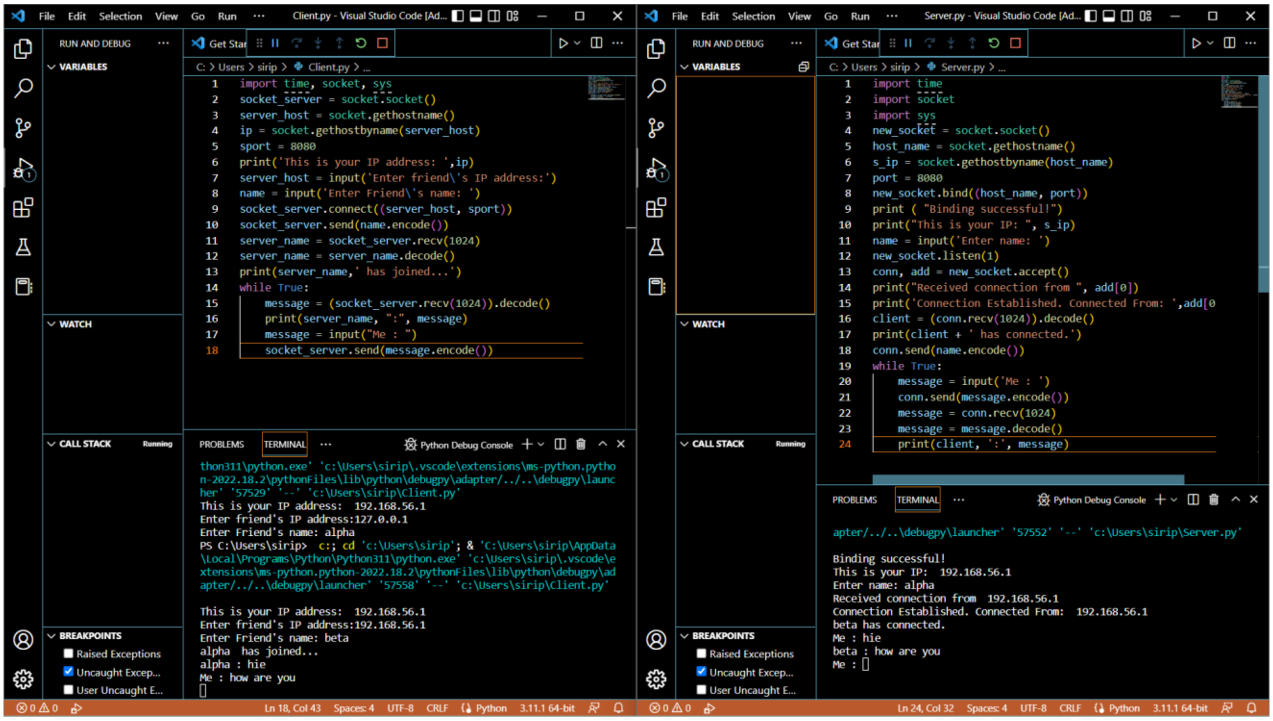
Figure 1: Secure Communication

The Client machines (Client-1 or client 2) and Admin machines are installed in different VMs. All the machines are interconnected through a network switch with different IP addresses. The admin runs a program that generates 2048-bit RSA public and private keys for a client that wants to communicate. Admin generates 2048-bit RSA public and private keys for Client-1 and Client-2. The private keys are distributed to client machines, and public keys are stored in a structure in the admin machine. When Client-1 wants to send a message to Client-2, it encrypts the messages with the public key of Client-2. Client-2 decrypts the message with its private key. A similar communication pattern from Client-2 to Client-1 needs to be maintained. Manually capture the traffic between the hosts to ensure the proper working of the encryption. Construct an asynchronous communication between the clients Client-1 or Client-2. Demonstrate the capability of Authentication, Confidentiality and Integrity in data transfer between two entities. Run a Wireshark/ TCPdump at the SPAN/Promiscuous port of the network switch and identify the communication between the communicating entities (Admin, Client-1, or Client-2)

A client server architecture:



A client and server communicating, without implementation of RSA:


File Edit Selection View Go Run ···
Client.py - Visual Studio Code [Ad...
RUN AND DEBUG
VARIABLES
WATCH
CALL STACK Running
BREAKPOINTS
Raised Exceptions
Uncaught Excep...
User Uncaught E...
C: > Users > sirip > Client.py > ...
PROBLEMS TERMINAL
Python Debug Console
Ln 18, Col 43 Spaces: 4 UTF-8 CRLF Python 3.11.1 64-bit
Server.py - Visual Studio Code [Ad...
C: > Users > sirip > Server.py > ...
Ln 24, Col 32 Spaces: 4 UTF-8 CRLF Python 3.11.1 64-bit

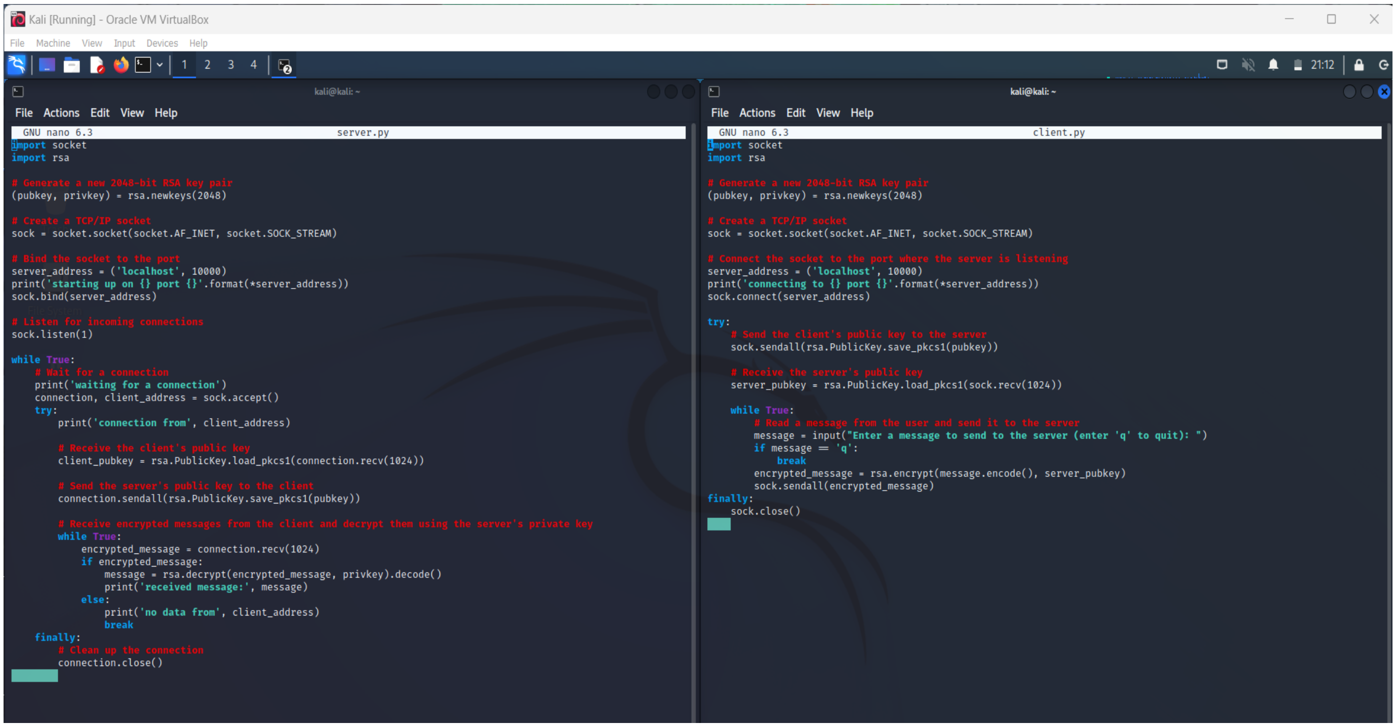
```python
import time, socket, sys
socket_server = socket.socket()
server_host = socket.gethostname()
ip = socket.gethostbyname(server_host)
sport = 8080
print('This is your IP address: ',ip)
server_host = input('Enter friend\'s IP address:')
name = input('Enter Friend\'s name: ')
socket_server.connect((server_host, sport))
socket_server.send(name.encode())
server_name = socket_server.recv(1024)
server_name = server_name.decode()
print(server_name,' has joined...')
while True:
    message = (socket_server.recv(1024)).decode()
    print(server_name, ":", message)
    message = input("Me : ")
    socket_server.send(message.encode())
```

```
thon311\python.exe' 'c:\Users\sirip\.vscode\extensions\ms-python.pytho
n-2022.18.2\pythonFiles\lib\python\debugpy\adapter/../..\debugpy\launc
her' '57529' '--' 'c:\Users\sirip\Client.py'
This is your IP address:  192.168.56.1
Enter friend's IP address:127.0.0.1
Enter Friend's name: alpha
PS C:\Users\sirip>  c:; cd 'c:\Users\sirip'; & 'C:\Users\sirip\AppData
\Local\Programs\Python\Python311\python.exe' 'c:\Users\sirip\.vscode\e
xtensions\ms-python.python-2022.18.2\pythonFiles\lib\python\debugpy\ad
apter/../..\debugpy\launcher' '57558' '--' 'c:\Users\sirip\Client.py'

This is your IP address:  192.168.56.1
Enter friend's IP address:192.168.56.1
Enter Friend's name: beta
alpha  has joined...
alpha : hie
Me : how are you
```

```python
import time
import socket
import sys
new_socket = socket.socket()
host_name = socket.gethostname()
s_ip = socket.gethostbyname(host_name)
port = 8080
new_socket.bind((host_name, port))
print ( "Binding successful!")
print("This is your IP: ", s_ip)
name = input('Enter name: ')
new_socket.listen(1)
conn, add = new_socket.accept()
print("Received connection from ", add[0])
print('Connection Established. Connected From: ',add[0
client = (conn.recv(1024)).decode()
print(client + ' has connected.')
conn.send(name.encode())
while True:
    message = input('Me : ')
    conn.send(message.encode())
    message = conn.recv(1024)
    message = message.decode()
    print(client, ':', message)
```

```
apter/../..\debugpy\launcher' '57552' '--' 'c:\Users\sirip\Server.py'

Binding successful!
This is your IP:  192.168.56.1
Enter name: alpha
Received connection from  192.168.56.1
Connection Established. Connected From:  192.168.56.1
beta has connected.
Me : hie
beta : how are you
Me : 
```

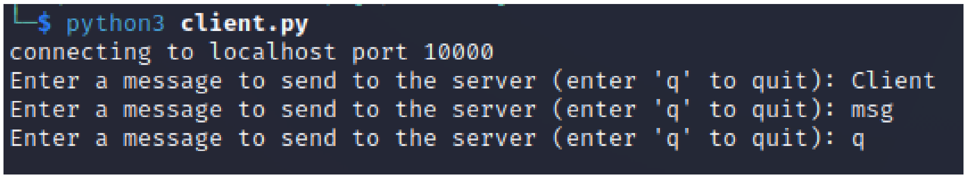
Code updating after implementing RSA


Kali [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
1 2 3 4
21:12
kali@kali: ~
File Actions Edit View Help
GNU nano 6.3
server.py
kali@kali: ~
File Actions Edit View Help
GNU nano 6.3
client.py

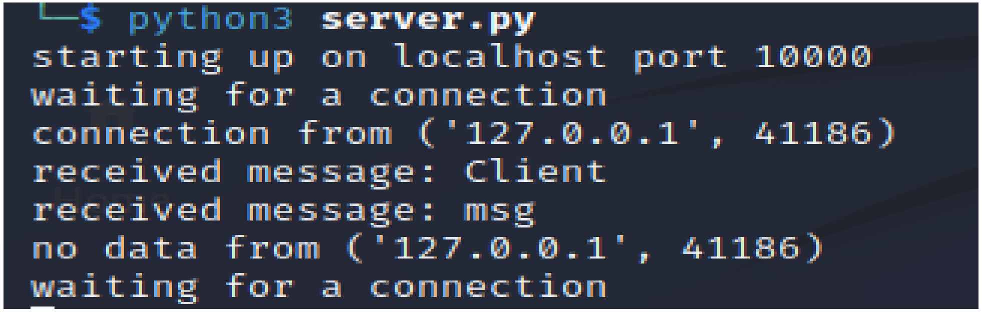
```
import socket
import rsa

# Generate a new 2048-bit RSA key pair
(pubkey, privkey) = rsa.newkeys(2048)

# Create a TCP/IP socket
sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)

# Bind the socket to the port
server_address = ('localhost', 10000)
print('starting up on {} port {}'.format(*server_address))
sock.bind(server_address)

# Listen for incoming connections
sock.listen(1)

while True:
    # Wait for a connection
    print('waiting for a connection')
    connection, client_address = sock.accept()
    try:
        print('connection from', client_address)

        # Receive the client's public key
        client_pubkey = rsa.PublicKey.load_pkcs1(connection.recv(1024))

        # Send the server's public key to the client
        connection.sendall(rsa.PublicKey.save_pkcs1(pubkey))

        # Receive encrypted messages from the client and decrypt them using the server's private key
        while True:
            encrypted_message = connection.recv(1024)
            if encrypted_message:
                message = rsa.decrypt(encrypted_message, privkey).decode()
                print('received message:', message)
            else:
                print('no data from', client_address)
                break
    finally:
        # Clean up the connection
        connection.close()
```

```
import socket
import rsa

# Generate a new 2048-bit RSA key pair
(pubkey, privkey) = rsa.newkeys(2048)

# Create a TCP/IP socket
sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)

# Connect the socket to the port where the server is listening
server_address = ('localhost', 10000)
print('connecting to {} port {}'.format(*server_address))
sock.connect(server_address)

try:
    # Send the client's public key to the server
    sock.sendall(rsa.PublicKey.save_pkcs1(pubkey))

    # Receive the server's public key
    server_pubkey = rsa.PublicKey.load_pkcs1(sock.recv(1024))

    while True:
        # Read a message from the user and send it to the server
        message = input("Enter a message to send to the server (enter 'q' to quit): ")
        if message == 'q':
            break
        encrypted_message = rsa.encrypt(message.encode(), server_pubkey)
        sock.sendall(encrypted_message)
finally:
    sock.close()
```

And the client server communication output we get is this:



```
└─$ python3 client.py
connecting to localhost port 10000
Enter a message to send to the server (enter 'q' to quit): Client
Enter a message to send to the server (enter 'q' to quit): msg
Enter a message to send to the server (enter 'q' to quit): q
```



```
└─$ python3 server.py
starting up on localhost port 10000
waiting for a connection
connection from ('127.0.0.1', 41186)
received message: Client
received message: msg
no data from ('127.0.0.1', 41186)
waiting for a connection
```

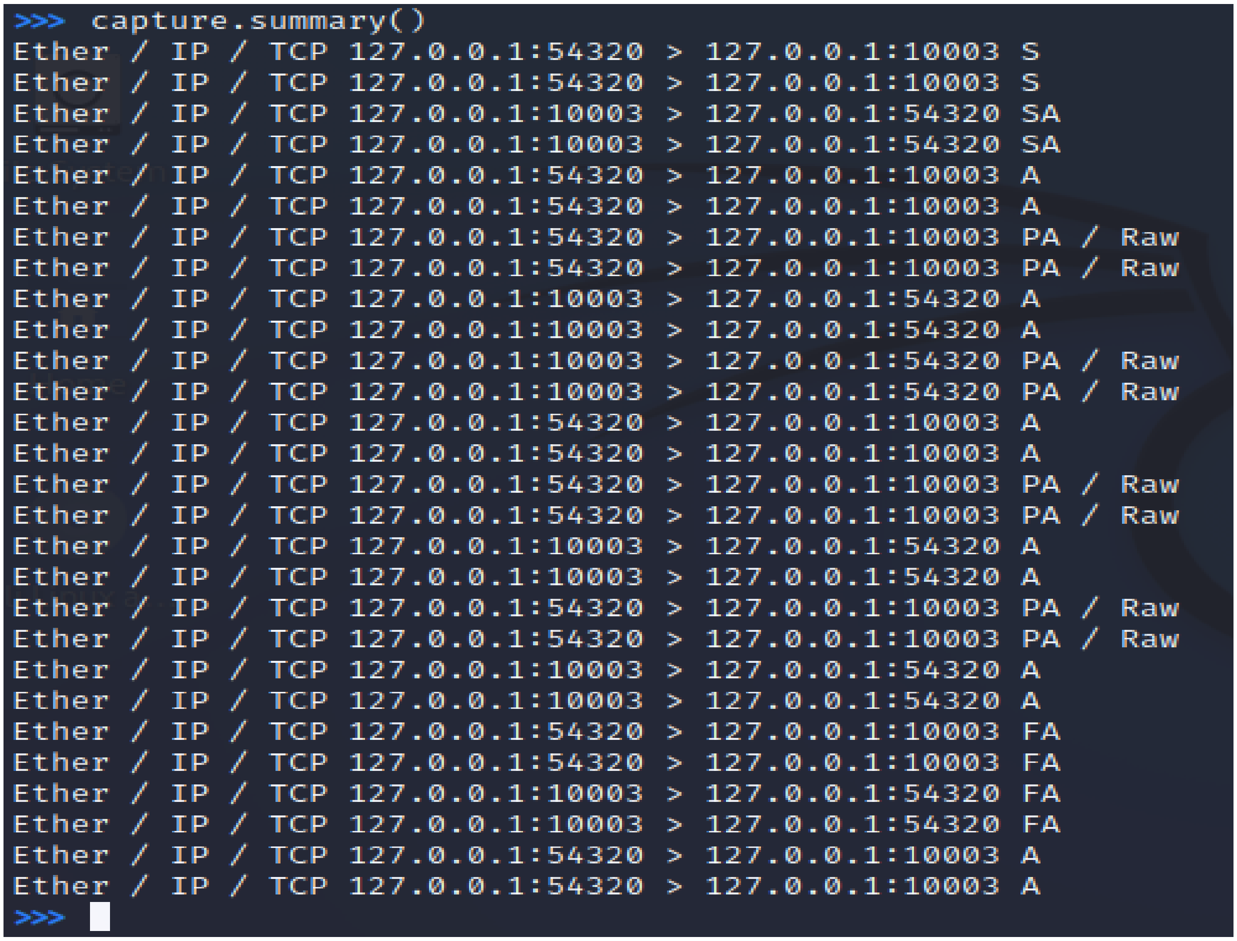
Now to capture files we can either use scapy or also through Wireshark.

So here now we are using scapy in kali linux.

The steps to use scapy are:

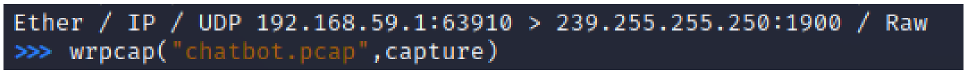
Using **capture=sniff(iface='lo')** command to sniff the packets.

The captured packets will be:



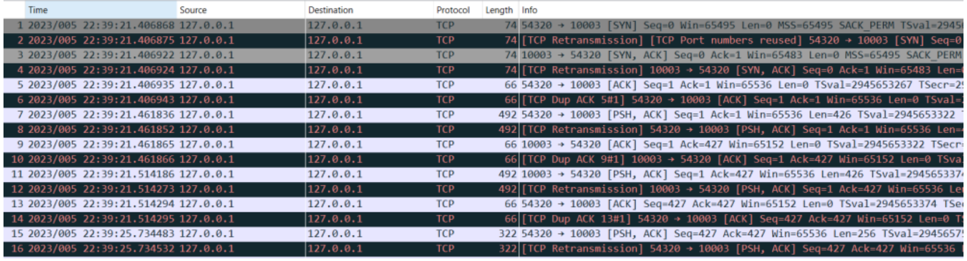
```
>>> capture.summary()
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 S
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 S
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 SA
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 SA
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 PA / Raw
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 PA / Raw
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 A
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 A
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 PA / Raw
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 PA / Raw
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 PA / Raw
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 PA / Raw
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 A
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 PA / Raw
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 PA / Raw
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 A
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 FA
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 FA
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 FA
Ether / IP / TCP 127.0.0.1:10003 > 127.0.0.1:54320 FA
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 A
Ether / IP / TCP 127.0.0.1:54320 > 127.0.0.1:10003 A
>>>
```

Saving the captured traffic as pcap file.

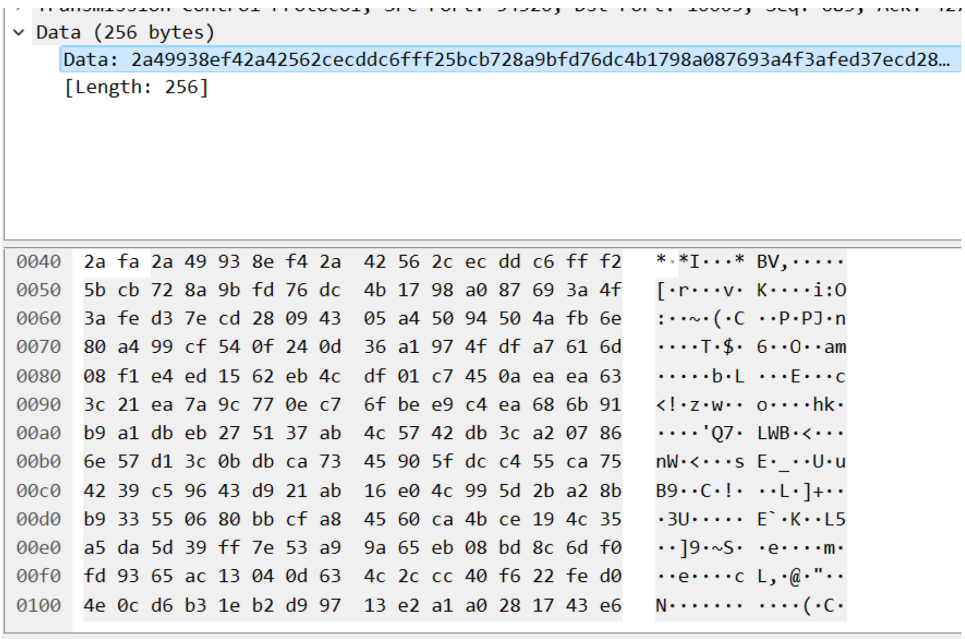


```
Ether / IP / UDP 192.168.59.1:63910 > 239.255.255.250:1900 / Raw
>>> wrpcap("chatbot.pcap",capture)
```

Now we are Analyzing the packets captured using wireshark.



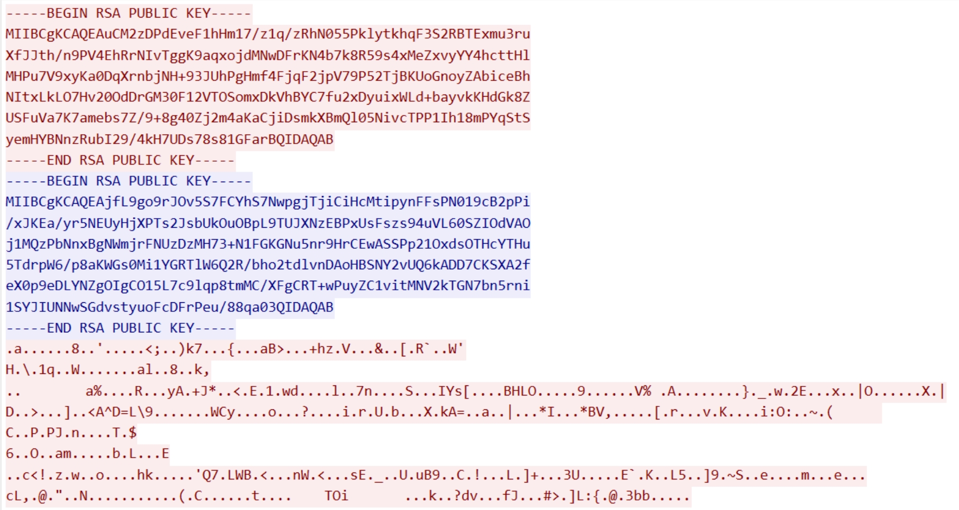
```
    Time                       Source     Destination  Protocol  Length  Info
 1 2023/005 22:39:21.406868 127.0.0.1   127.0.0.1    TCP        74  54320 → 10003 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM TSval=2945
 2 2023/005 22:39:21.406875 127.0.0.1   127.0.0.1    TCP        74  [TCP Retransmission] [TCP Port numbers reused] 54320 → 10003 [SYN] Seq=0
 3 2023/005 22:39:21.406922 127.0.0.1   127.0.0.1    TCP        74  10003 → 54320 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=0 MSS=65495 SACK_PERM
 4 2023/005 22:39:21.406924 127.0.0.1   127.0.0.1    TCP        74  [TCP Retransmission] 10003 → 54320 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=
 5 2023/005 22:39:21.406935 127.0.0.1   127.0.0.1    TCP        66  54320 → 10003 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=2945653267 TSecr=2
 6 2023/005 22:39:21.406943 127.0.0.1   127.0.0.1    TCP        66  [TCP Dup ACK 5#1] 54320 → 10003 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=
 7 2023/005 22:39:21.461836 127.0.0.1   127.0.0.1    TCP       492  54320 → 10003 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=426 TSval=2945653322
 8 2023/005 22:39:21.461852 127.0.0.1   127.0.0.1    TCP       492  [TCP Retransmission] 54320 → 10003 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=
 9 2023/005 22:39:21.461865 127.0.0.1   127.0.0.1    TCP        66  10003 → 54320 [ACK] Seq=1 Ack=427 Win=65152 Len=0 TSval=2945653322 TSecr
10 2023/005 22:39:21.461866 127.0.0.1   127.0.0.1    TCP        66  [TCP Dup ACK 9#1] 10003 → 54320 [ACK] Seq=1 Ack=427 Win=65152 Len=0 TSva
11 2023/005 22:39:21.514186 127.0.0.1   127.0.0.1    TCP       492  10003 → 54320 [PSH, ACK] Seq=1 Ack=427 Win=65536 Len=426 TSval=294565337
12 2023/005 22:39:21.514273 127.0.0.1   127.0.0.1    TCP       492  [TCP Retransmission] 10003 → 54320 [PSH, ACK] Seq=1 Ack=427 Win=65536 Le
13 2023/005 22:39:21.514294 127.0.0.1   127.0.0.1    TCP        66  54320 → 10003 [ACK] Seq=427 Ack=427 Win=65152 Len=0 TSval=2945653374 TSe
14 2023/005 22:39:21.514295 127.0.0.1   127.0.0.1    TCP        66  [TCP Dup ACK 13#1] 54320 → 10003 [ACK] Seq=427 Ack=427 Win=65152 Len=0 T
15 2023/005 22:39:25.734483 127.0.0.1   127.0.0.1    TCP       322  54320 → 10003 [PSH, ACK] Seq=427 Ack=427 Win=65536 Len=256 TSval=2945657
16 2023/005 22:39:25.734532 127.0.0.1   127.0.0.1    TCP       322  [TCP Retransmission] 54320 → 10003 [PSH, ACK] Seq=427 Ack=427 Win=65536
```



```
> Transmission Control Protocol, Src Port: 54320, Dst Port: 10003, Seq: 683, Ack: 427
v Data (256 bytes)
     Data: 2a49938ef42a42562cecddc6fff25bcb728a9bfd76dc4b1798a087693a4f3afed37ecd28…
     [Length: 256]
```

```
0040  2a fa 2a 49 93 8e f4 2a  42 56 2c ec dd c6 ff f2   *·*I···* BV,·····
0050  5b cb 72 8a 9b fd 76 dc  4b 17 98 a0 87 69 3a 4f   [·r···v· K····i:O
0060  3a fe d3 7e cd 28 09 43  05 a4 50 94 50 4a fb 6e   :··~·(·C ··P·PJ·n
0070  80 a4 99 cf 54 0f 24 0d  36 a1 97 4f df a7 61 6d   ····T·$· 6··O··am
0080  08 f1 e4 ed 15 62 eb 4c  df 01 c7 45 0a ea ea 63   ·····b·L ···E···c
0090  3c 21 ea 7a 9c 77 0e c7  6f be e9 c4 ea 68 6b 91   <!·z·w·· o····hk·
00a0  b9 a1 db eb 27 51 37 ab  4c 57 42 db 3c a2 07 86   ····'Q7· LWB·<···
00b0  6e 57 d1 3c 0b db ca 73  45 90 5f dc c4 55 ca 75   nW·<···s E·_··U·u
00c0  42 39 c5 96 43 d9 21 ab  16 e0 4c 99 5d 2b a2 8b   B9··C·!· ··L·]+··
00d0  b9 33 55 06 80 bb cf a8  45 60 ca 4b ce 19 4c 35   ·3U····· E`·K··L5
00e0  a5 da 5d 39 ff 7e 53 a9  9a 65 eb 08 bd 8c 6d f0   ··]9·~S· ·e····m·
00f0  fd 93 65 ac 13 04 0d 63  4c 2c cc 40 f6 22 fe d0   ··e····c L,·@·"··
0100  4e 0c d6 b3 1e b2 d9 97  13 e2 a1 a0 28 17 43 e6   N······· ····(·C·
```

Now when we check RSA Encryption we get the captured packet of RSA key



```
-----BEGIN RSA PUBLIC KEY-----
MIIBCgKCAQEAuCM2zDPdEveF1hHm17/z1q/zRhN055PklytkhqF3S2RBTExmu3ru
XfJJth/n9PV4EhRrNIvTggK9aqxojdMNwDFrKN4b7k8R59s4xMeZxvyYY4hcttHl
MHPu7V9xyKa0DqXrnbjNH+93JUhPgHmf4FjqF2jpV79P52TjBKUoGnoyZAbiceBh
NItxLkLO7Hv20OdDrGM30F12VTOSomxDkVhBYC7fu2xDyuixWLd+bayvkKHdGk8Z
USFuVa7K7amebs7Z/9+8g40Zj2m4aKaCjiDsmkXBmQl05NivcTPP1Ih18mPYqStS
yemHYBNnzRubI29/4kH7UDs78s81GFarBQIDAQAB
-----END RSA PUBLIC KEY-----
-----BEGIN RSA PUBLIC KEY-----
MIIBCgKCAQEAjfL9go9rJOv5S7FCYhS7NwpgjTjiCiHcMtipynFFsPN019cB2pPi
/xJKEa/yr5NEUyHjXPTs2JsbUkOuOBpL9TUJXNzEBPxUsFszs94uVL60SZIOdVAO
j1MQzPbNnxBgNWmjrFNUzDzMH73+N1FGKGNu5nr9HrCEwASSPp21OxdsOTHcYTHu
5TdrpW6/p8aKWGs0Mi1YGRTlW6Q2R/bho2tdlvnDAoHBSNY2vUQ6kADD7CKSXA2f
eX0p9eDLYNZgOIgCO15L7c9lqp8tmMC/XFgCRT+wPuyZC1vitMNV2kTGN7bn5rni
1SYJIUNNwSGdvstyuoFcDFrPeu/88qa03QIDAQAB
-----END RSA PUBLIC KEY-----
.a......8..'.....<;..)k7...{...aB>...+hz.V...&..[.R`..W'
H.\.1q..W.......al..8..k,
..        a%....R...yA.+J*..<.E.1.wd....l..7n....S...IYs[....BHLO.....9......V% .A........}._.w.2E...x..|O......X.|
D..>...]..<A^D=L\9.......WCy....o...?....i.r.U.b...X.kA=..a..|...*I...*BV,.....[.r...v.K....i:O:..~.(
C..P.PJ.n....T.$
6..O..am.....b.L...E
..c<!.z.w..o....hk.....'Q7.LWB.<...nW.<...sE._..U.uB9..C.!...L.]+...3U.....E`.K..L5..]9.~S..e....m...e...
cL,.@."..N...........(.C......t....    TOi       ...k..?dv...fJ...#>.]L:{.@.3bb.....
```