

CA169 Networks Assignment Two

Answer Sheets

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PROJECT NUMBER:	2
MODULE CODE:	CA169
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Declaration

In submitting this project, I declare that the project material, which I now submit, is my own work. Any assistance received by way of borrowing from the work of others has been cited and acknowledged within the work. I make this declaration in the knowledge that a breach of the rules pertaining to project submission may carry serious consequences.

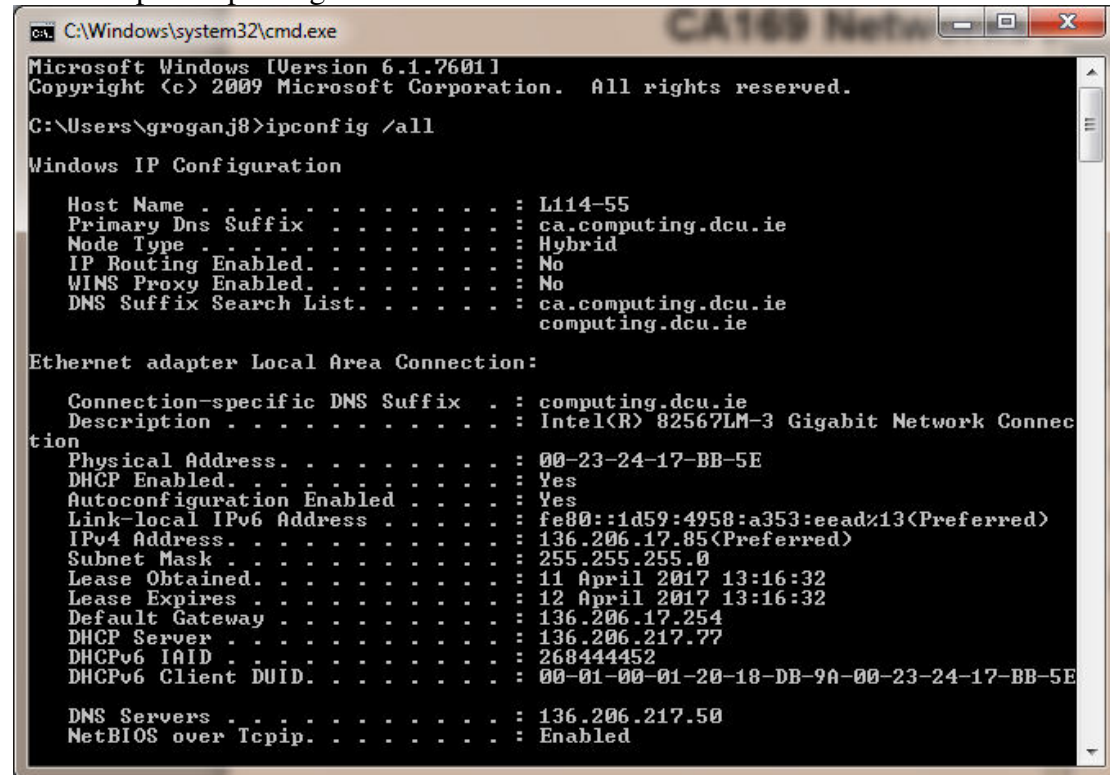
Part 1: DHCP traffic

Your IP & MAC address for this experiment (use ipconfig)

IP = 136.206.17.85

MAC = 00-23-24-17-BB-5E

Screen capture: ipconfig information cmd window



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\groganj8>ipconfig /all

Windows IP Configuration

    Host Name . . . . . : L114-55
    Primary Dns Suffix . . . . . : ca.computing.dcu.ie
    Node Type . . . . . : Hybrid
    IP Routing Enabled. . . . . : No
    WINS Proxy Enabled. . . . . : No
    DNS Suffix Search List. . . . . : ca.computing.dcu.ie
                                        computing.dcu.ie

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix . : computing.dcu.ie
    Description . . . . . : Intel(R) 82567LM-3 Gigabit Network Connection
    Physical Address. . . . . : 00-23-24-17-BB-5E
    DHCP Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::1d59:4958:a353:eead%13(Preferred)
    IPv4 Address. . . . . : 136.206.17.85(Preferred)
    Subnet Mask . . . . . : 255.255.255.0
    Lease Obtained. . . . . : 11 April 2017 13:16:32
    Lease Expires . . . . . : 12 April 2017 13:16:32
    Default Gateway . . . . . : 136.206.17.254
    DHCP Server . . . . . : 136.206.217.77
    DHCPv6 IAID . . . . . : 268444452
    DHCPv6 Client DUID. . . . . : 00-01-00-01-20-18-DB-9A-00-23-24-17-BB-5E

    DNS Servers . . . . . : 136.206.217.50
    NetBIOS over Tcpip. . . . . : Enabled
```

Screen capture of Wireshark with DHCP and all ARP packets shown.

Local Area Connection (ether host 00:23:24:17:8b:5e and (udp port 68 or arp)) [Wireshark 1.12.7 (v1.12.7-0-g7c8978 from master-112)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	136.206.17.85	136.206.217.77	DHCP	342	DHCP Release - Transaction ID 0x8a2d5729
2	3.82219700	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0xd28cd6ac
3	3.82601800	136.206.17.254	136.206.17.85	DHCP	411	DHCP Offer - Transaction ID 0xd28cd6ac
4	3.82635500	0.0.0.0	255.255.255.255	DHCP	372	DHCP Request - Transaction ID 0xd28cd6ac
5	3.82750500	136.206.17.254	136.206.17.85	DHCP	411	DHCP Offer - Transaction ID 0xd28cd6ac
6	3.82981200	136.206.17.254	136.206.17.85	DHCP	411	DHCP ACK - Transaction ID 0xd28cd6ac
7	3.87488500	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
8	3.87589500	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
9	3.89183700	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
10	3.89219200	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
11	4.33574300	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.85? Tell 0.0.0.0
12	5.33574100	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.85? Tell 0.0.0.0
13	6.33579500	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.85? Tell 0.0.0.0
14	6.34861900	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
15	6.34898000	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
16	6.83588400	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 169.254.238.173? Tell 0.0.0.0
17	6.99265700	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
18	6.99310200	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
19	7.02803400	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
20	7.02835000	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
21	7.33597100	G-ProcCom_17:bb:5e	Broadcast	ARP	42	Gratuitous ARP for 136.206.17.85 (Request)
22	7.34511900	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
23	7.34546300	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
24	7.35495600	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
25	7.35525800	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
26	7.38012700	G-ProcCom_17:bb:5e	Broadcast	ARP	42	who has 136.206.17.254? Tell 136.206.17.85
27	7.38049900	Cisco_84:fa:bf	G-ProcCom_17:bb:5e	ARP	60	136.206.17.254 is at d0:d0:fd:84:fa:bf
28	7.38502500	136.206.17.85	255.255.255.255	DHCP	342	DHCP Inform - Transaction ID 0xcc485ca5
29	7.38649200	136.206.17.254	136.206.17.85	DHCP	342	DHCP ACK - Transaction ID 0xcc485ca5
30	7.38735100	136.206.17.254	136.206.17.85	DHCP	342	DHCP ACK - Transaction ID 0xcc485ca5
31	9.44444300	136.206.17.85	136.206.217.77	DHCP	342	DHCP Release - Transaction ID 0xed2196a

Frame 28: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface 0

Ethernet II, Src: G-ProcCom_17:bb:5e (00:23:24:17:bb:5e), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

Internet Protocol Version 4, Src: 136.206.17.85 (136.206.17.85), Dst: 255.255.255.255 (255.255.255.255)

User Datagram Protocol, Src Port: 68 (68), Dst Port: 67 (67)

Bootstrap Protocol (Inform)

Message type: Boot Request (1)
Hardware type: Ethernet (0x01)
Hardware address length: 6
Hops: 0
Transaction ID: 0xcc485ca5
Seconds elapsed: 0
Bootp flags: 0x0000 (Unicast)
Client IP address: 136.206.17.85 (136.206.17.85)

```

0000  ff ff ff ff ff 00 23 24 17 bb 5e 08 00 45 00  .....#$.^..E.
0010  01 48 0a c7 00 00 80 11 94 bb 88 ce 11 55 ff ff  .H....U...
0020  ff ff 00 44 00 43 01 34 9b 68 01 01 06 00 cc 48  ...D.C.4.h...H
0030  5c a5 00 00 00 00 88 ce 11 55 00 00 00 00 00 00  \.....U.....
0040  00 00 00 00 00 00 00 23 24 17 bb 5e 00 00 00 00  .....#$.^.....
      ..n..n..n..n..n..n..n..n..n..n..n..n..n..n..n..n

```

File: "C:\Users\grogan\8\AppData\Local\Te... | Packets: 31 - Displayed: 31 (100.0%) - Dropped: 0 (0.0%) | Profile: Default

Packet numbers relevant to the DHCP interaction:

- DHCP DISCOVER – Packet 2
- DHCP OFFER – Packets 3, 5
- DHCP Request – Packet 4
- DHCP Acknowledgement – Packets 6, 29, 30
- DHCP Release – Packets 1, 31
- All ARP packets used – Packets 7 to 27

Function of each packet

- DHCP DISCOVER

Packet 2:

This is a broadcast packet sent out across the network from the host machine looking for a DHCP server in order to obtain an IP address. It contains information including its MAC address and hostname.

- DHCP OFFER

Packets 3, 5:

This is a message sent in reply to a DHCP Discover packet. It is from the DHCP server offering an IP address lease to the machine that sent the DHCP Discover packet.

c. DHCP Request

Packet 4:

This packet is broadcasted by the client in reply to the DHCP Offer packet. It is a packet accepting the offer of the IP address from the DHCP server.

d. DHCP Acknowledgement

Packets 6, 29, 30:

These are the packets sent by the DHCP server which acknowledges the request of the client machine. It also contains the length of the lease renewal.

e. DHCP Release

Packets 1, 31:

This is a packet sent from the client to the DHCP server which releases its IP address so that the DHCP server can lease it out to other clients.

f. ARP

Packets 7 to 27:

In this capture there are ARP Requests and Replies. The ARP Requests are sent from the client over the network as a broadcast message (MAC: FF:FF:FF:FF:FF:FF). It contains the IP address of the machine it wishes to talk to. If the machine that the client is looking for is on the network and its IP address is the same as the one contained in the ARP Request, it sends back an ARP Reply containing its MAC address. Now both machines can communicate.

There is also a Gratuitous ARP packet in packet 21 which is sent from the client, out across the network, telling other hosts on the network about its new IP/MAC mapping.

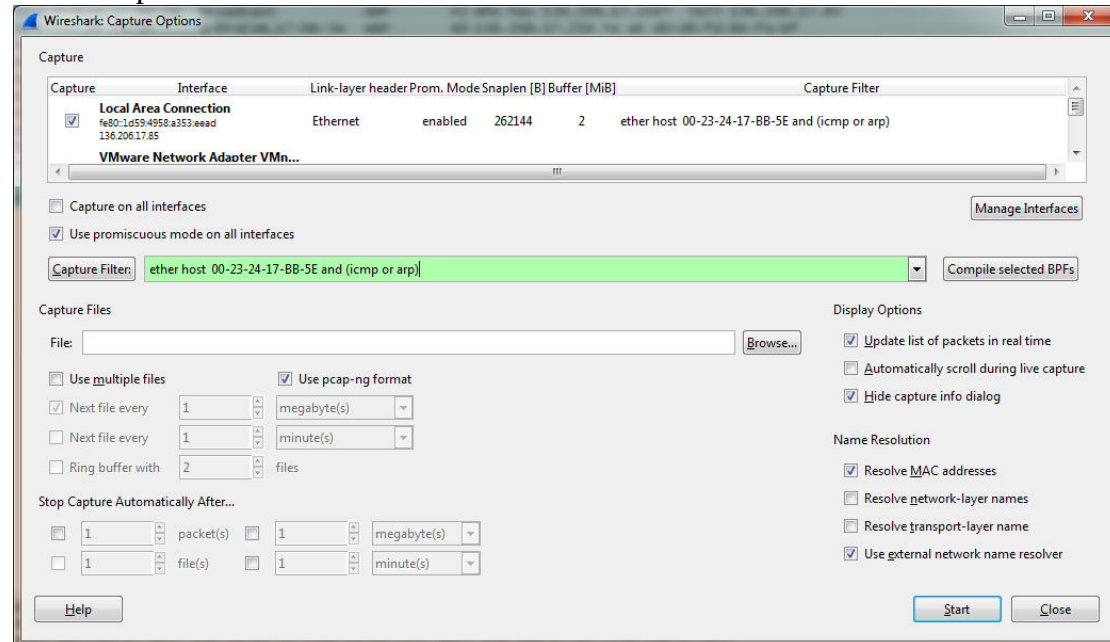
Part 2: ping traffic

Your IP & MAC address for this experiment (use ipconfig)

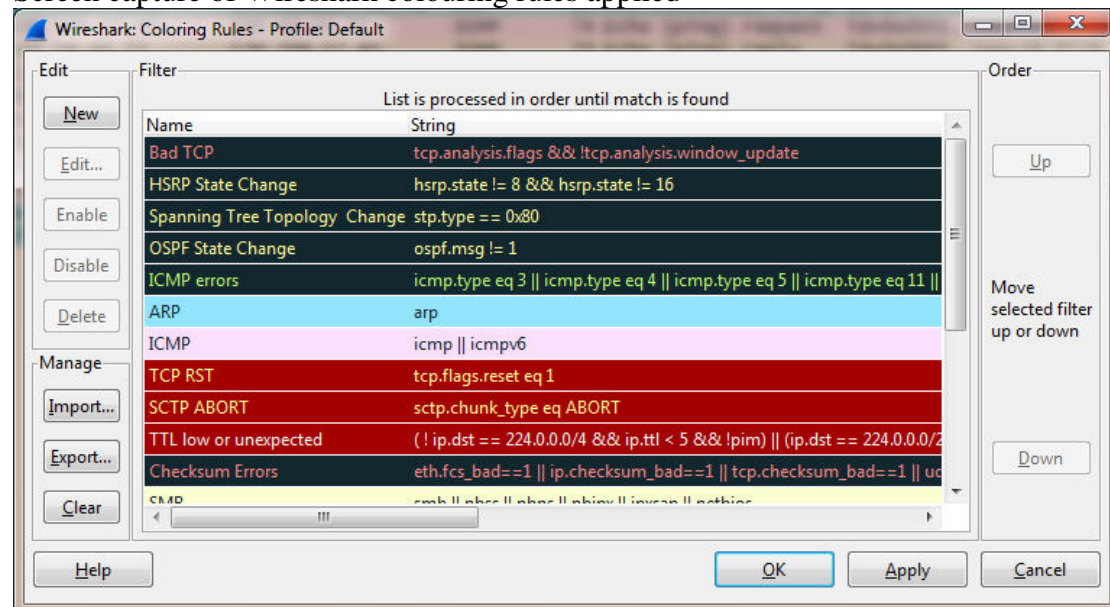
136.206.17.85

00-23-24-17-BB-5E

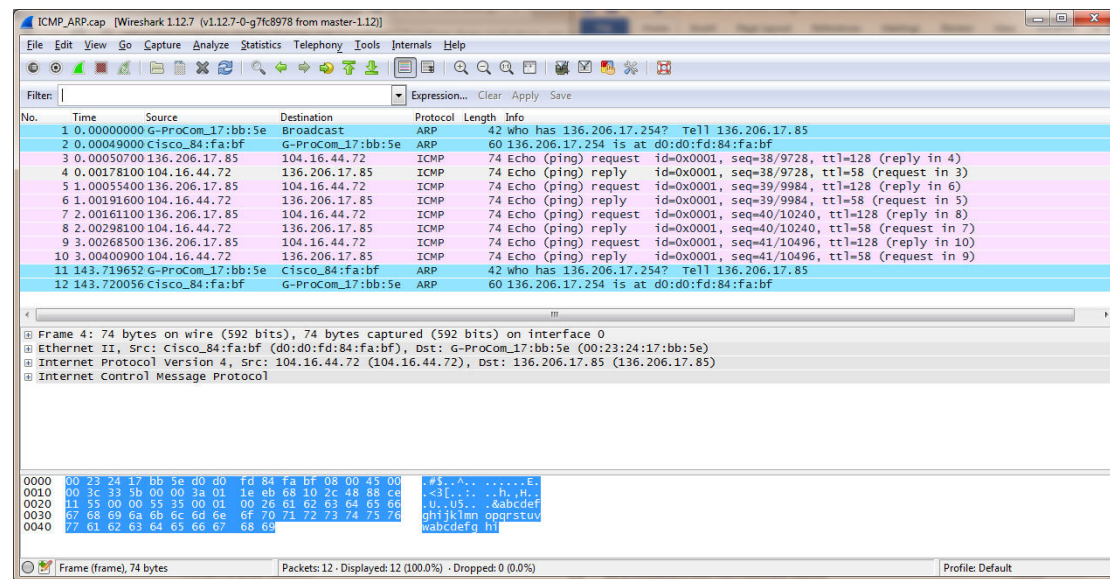
Screen capture of Wireshark filter utilised.



Screen capture of Wireshark colouring rules applied



Screen capture of Wireshark packet trace showing all relevant ping generated traffic, including ARP and ICMP traffic.



Packet numbers relevant to the experiment:

Packets 1 to 10 are relevant for this experiment

Explanation for each packet

For this experiment I pinged www.rte.ie after clearing the ARP cache.

- Function, why packet is generated and data contained in within it.

Packet 1: This is an ARP Request of length 42 bytes which is broadcasted across the network by the host machine asking which machine on the network has IP address 136.206.17.254, in this case, the router. The host machine needs the MAC address of 136.206.17.254 in order to communicate with it. It contains the host machines IP address, MAC address and the IP address of the target machine it wishes to communicate with.

Packet 2: This is the ARP Reply sent by 136.206.17.254 (Router), after receiving the ARP Request. When a machines IP address matches the IP address contained in the ARP Request, it sends back an ARP Reply containing its MAC address. Now the host machine and target machine can communicate. This process was necessary in order for the host machine to send the ICMP packets to www.rte.ie which follow.

Packet 3: This is the first ICMP Echo Request. It was sent when I pinged www.rte.ie . It is 74 bytes long. Its data payload is 32 bytes. ICMP is a basic way of checking if one machine can communicate with another. Inside the packet there is the Ethernet header which contains the destination address which is where the packet needs to go next, in this case, the router. Encapsulated by the Ethernet header is the IP header. This contains the IP

address of www.rte.ie (the final destination) and inside of that, the ICMP header which contains information including the ICMP packet type indicating it is an Echo request and the data payload. It also has a TTL (time to live) which is used to detect a packet which is caught in some form of routing loop. Each time the packet reaches a router its TTL is decremented. When it reaches zero it is discarded. Indicating it could not reach the target.

Packet 4: This is the ICMP Echo Reply. It was sent from 104.16.44.72 (RTE). It was sent in reply to **Packet 3**. Within the ICMP header is the type indicating it is an Echo Reply, identifier and sequence fields which can determine which stop replies and requests getting mixed up and its data payload. When the host machine receives an ICMP reply it now knows it can communicate with the target(RTE).

In **Packets 5, 7 and 9** the ICMP Echo Request process is repeated.

The **Packets 6, 8 and 10** are the ICMP Echo Replies from the above Requests.

The Echo Request and Reply process is repeated so we can get some statistics on the connection. We can find out the Round Trip times (time it takes from sending a request to receiving a reply) and amount of packet loss.

Part 3:

Your IP & MAC address for this experiment (use ipconfig)

IP = 136.206.17.80

MAC = 34-17-EB-B8-9C-18

For this experiment I connected to www.python.org

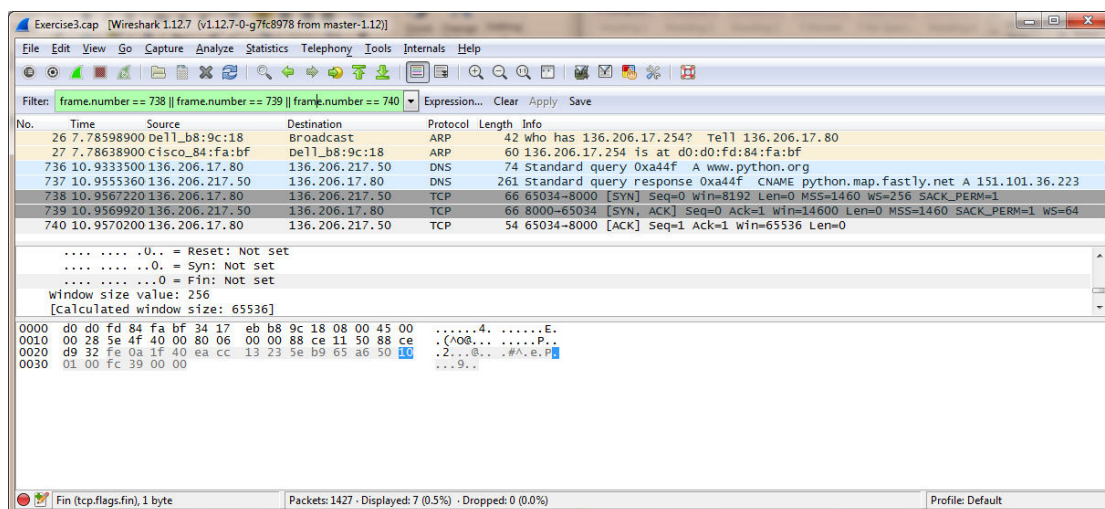
Filter to show only traffic concerning the test machine

Filter tcp.stream eq 8 or dns contains "python"

Explain how you found the start of the interaction between your PC and the website.

I found the interaction by starting the capture on Wireshark, loading the webpage then stopping the capture. I then entered the following display filter: "(dns contains "python" or tcp) and eth.addr eq 34-17-EB-B8-9C-18" this brought me to the packets where I could see the DNS queries for the website I connected to. Underneath these was the 3 way handshake and then the stream of data from the site. Then I chose the follow TCP stream option from the 3 way handshake and also included the DNS queries for the site, thus giving all traffic concerning the test machine.

Wireshark window showing the start of the interaction (should show ARP, DNS and TCP 3-way handshake)



Write down the numbers of the packets with the 3-way handshake.

Explain what is happening with these 3 packets.

Packet 738 [SYN]: The SYN packet is sent by the host machine to the server. The purpose of this message is to ask the server if it is open for new connections. This packet contains a sequence number, j, which in this case is 0.

Packet 739 [SYN/ACK]: When the server receives the SYN packet (Packet 738) it responds with a SYN/ACK packet indicating the host machine that sent

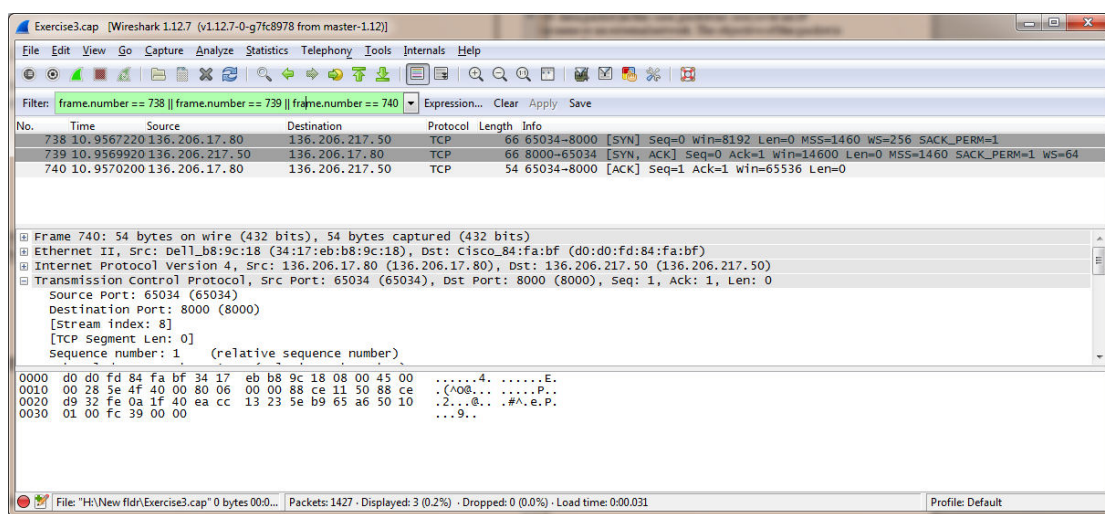
the SYN can connect to it. This packet contains a sequence number k , in this case and an ack number which is $J + 1$ which corresponds with SYN packet.

Packet 740 [ACK]: When the host machine receives the SYN/ACK packet (Packet 739) it responds with an ACK packet. Now a connection has been established. The ack number on this packet is $K + 1$ which corresponds with the previous SYN/ACK packet.

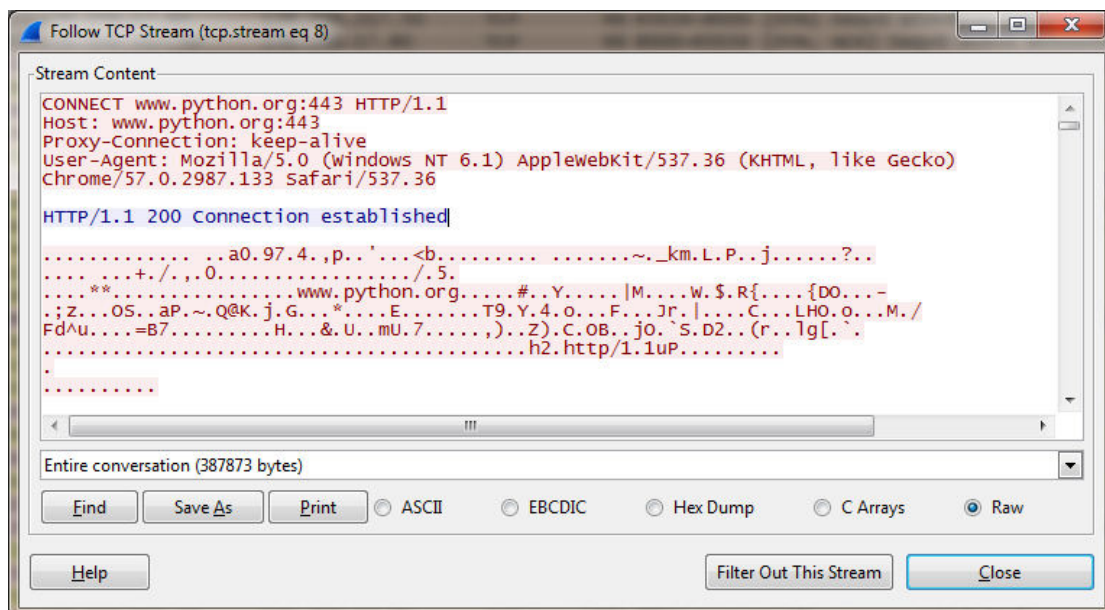
Write down a filter to show only these three-way-handshake packets

Filter	frame.number == 738 frame.number == 739 frame.number == 740
--------	---

Wireshark window for the 3-way-handshake



Show the **Follow TCP Stream** window here.



Your notes on...

a. The GET requests made

No.	Time	Source	Destination	Protocol	Length	Info
738	10.9567220	136.206.17.80	136.206.217.50	TCP	66	65034→8000 [SYN] Seq=0 win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
739	10.9569920	136.206.217.50	136.206.17.80	TCP	66	8000→65034 [SYN, ACK] Seq=0 Ack=1 win=14600 Len=0 MSS=1460 SACK_PERM=1 WS=64
740	10.9570200	136.206.17.80	136.206.217.50	TCP	54	65034→8000 [ACK] Seq=1 Ack=1 win=65536 Len=0
742	10.9573380	136.206.17.80	136.206.217.50	HTTP	265	CONNECT www.python.org:443 HTTP/1.1
745	10.9575490	136.206.217.50	136.206.17.80	TCP	60	8000→65034 [ACK] Seq=1 Ack=212 win=15680 Len=0
758	10.9998160	136.206.217.50	136.206.17.80	HTTP	93	HTTP/1.1 200 Connection established

I found a “CONNECT” request but no “GET”. I looked into this and found out that this causes the proxy server to establish a HTTP tunnel between the two endpoints (my machine and the webserver) which allows my machine and the webserver to talk directly without the proxy being able to decrypt the bytes. It is called end-to-end encryption and utilised in https://. However it still requests the webpage from the webserver.

b. The responses from the server

No.	Time	Source	Destination	Protocol	Length	Info
738	10.9567220	136.206.17.80	136.206.217.50	TCP	66	65034→8000 [SYN] Seq=0 win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
739	10.9569920	136.206.217.50	136.206.17.80	TCP	66	8000→65034 [SYN, ACK] Seq=0 Ack=1 win=14600 Len=0 MSS=1460 SACK_PERM=1 WS=64
740	10.9570200	136.206.17.80	136.206.217.50	TCP	54	65034→8000 [ACK] Seq=1 Ack=1 win=65536 Len=0
742	10.9573380	136.206.17.80	136.206.217.50	HTTP	265	CONNECT www.python.org:443 HTTP/1.1
745	10.9575490	136.206.217.50	136.206.17.80	TCP	60	8000→65034 [ACK] Seq=1 Ack=212 win=15680 Len=0
758	10.9998160	136.206.217.50	136.206.17.80	HTTP	93	HTTP/1.1 200 Connection established
760	11.0000460	136.206.17.80	136.206.217.50	TLSv1.2	571	client Hello
762	11.0003430	136.206.217.50	136.206.17.80	TCP	60	8000→65034 [ACK] Seq=40 Ack=729 win=18624 Len=0
768	11.0193440	136.206.217.50	136.206.17.80	TLSv1.2	204	Server Hello, change Cipher Spec, Encrypted Handshake Message
770	11.0197000	136.206.217.80	136.206.217.50	TLSv1.2	105	change Cipher Spec, Hello Request
775	11.0266740	136.206.17.80	136.206.217.50	TLSv1.2	107	Application data
776	11.0267020	136.206.17.80	136.206.217.50	TLSv1.2	110	Application data
777	11.0267180	136.206.17.80	136.206.217.50	TLSv1.2	96	Application data
778	11.0269990	136.206.217.50	136.206.17.80	TCP	60	8000→65034 [ACK] Seq=190 Ack=931 win=18624 Len=0
779	11.0274390	136.206.17.80	136.206.217.50	TLSv1.2	306	Application data
784	11.0461220	136.206.217.50	136.206.17.80	TLSv1.2	113	Application data
785	11.0464650	136.206.17.80	136.206.217.50	TLSv1.2	92	Application data
786	11.0471650	136.206.217.50	136.206.17.80	TCP	1502	[TCP segment of a reassembled PDU]
787	11.0474000	136.206.217.50	136.206.17.80	TLSv1.2	1514	Application data
788	11.0474010	136.206.217.50	136.206.17.80	TCP	1514	[TCP segment of a reassembled PDU]
789	11.0474010	136.206.217.50	136.206.17.80	TLSv1.2	1514	Application data
790	11.0474020	136.206.217.50	136.206.17.80	TCP	1514	[TCP segment of a reassembled PDU]
791	11.0474130	136.206.217.50	136.206.217.50	TCP	54	65034→8000 [ACK] Seq=1221 Ack=7537 win=65536 Len=0
792	11.0474720	136.206.217.50	136.206.17.80	TLSv1.2	1514	Application data
793	11.0474730	136.206.217.50	136.206.17.80	TCP	1514	[TCP segment of a reassembled PDU]
794	11.0474730	136.206.217.50	136.206.17.80	TLSv1.2	1514	Application data
795	11.0474740	136.206.217.50	136.206.17.80	TCP	986	[TCP segment of a reassembled PDU]
796	11.0474880	136.206.17.80	136.206.217.50	TCP	54	65034→8000 [ACK] Seq=1221 Ack=12849 win=65536 Len=0
797	11.0540000	136.206.17.80	136.206.217.50	TLSv1.2	155	Application data
798	11.0541250	136.206.17.80	136.206.217.50	TLSv1.2	147	Application data
799	11.0542650	136.206.17.80	136.206.217.50	TLSv1.2	130	Application data

Frame 760: 571 bytes on wire (4568 bits), 571 bytes captured (4568 bits) on interface 0
Ethernet II, Src: Dell_b8:9c:18 (34:17:eb:b8:9c:18), Dst: Cisco_84:fa:bf (d0:d0:fd:84:fa:bf)
Internet Protocol Version 4, Src: 136.206.17.80 (136.206.17.80), Dst: 136.206.217.50 (136.206.217.50)
Transmission Control Protocol, Src Port: 65034 (65034), Dst Port: 8000 (8000), Seq: 212, Ack: 40, Len: 517
Hypertext Transfer Protocol
Secure Sockets Layer

0030 01 00 fe 3e 00 00 16 03 01 02 00 01 00 01 fc 03 ...>... ..
0040 03 a6 81 20 06 84 61 30 0c 39 37 eb 34 ae 2c 70 ...a0.97.4..p
0050 a3 f9 27 f8 c2 a2 3c 62 d3 c3 b4 82 ed d1 94 93 ...<B.....
0060 13 20 98 d0 1f 1e 03 12 bf 7e e3 5f 6b 6d 1b 4ckmL
0070 2e 50 c6 8b 6a 91 ed 1a 81 15 d6 3f e9 13 0d 05 .P..j...7....
0080 c9 82 00 20 aa aa c0 2b c0 2f c0 2c c0 30 cc a9 ...+.../.0..
0090 cc a8 cc 14 cc 13 c0 13 c0 14 00 9c 00 9d 00 2f
00a0 00 35 00 0a 01 00 01 93 2a 2a 00 00 ff 01 00 01 .5.....*.py
00b0 00 00 00 00 13 00 11 00 00 0e 77 77 2e 70 79www.py
00c0 74 68 6f 6e 2e 6f 72 67 00 17 00 00 23 00 b0 thon.org.....#..

Packet 758: The initially response of the server is with a HTTP /1.1 200 Connection established.

Packets 768 and 770: These are the TSL handshakes when the client and server contact each other and choose the encryption keys they are going to use throughout the session.

Packets 775 onwards: These are data from the server and acknowledges.

- c. The HTTP response codes used in the interaction and what they mean (look them up yourself on the Web)

“HTTP /1.1 200 Connection Established” – The HTTP response code in this is 200 indicating “Ok” and that a connection has been established.

There were no other HTTP response codes found.