Part1: Web Browsing (DNS, TCP)

1. Find the first DNS request packet sent by the client.(Request for **cse.nsysu.edu.tw**)

You can find a record like below on Wireshark. And you can answer the question.

```
5729 16.137999    140.117.171.179    140.117.11.1    DNS    76 Standard query 0x8b98 A lis.nsysu.edu.tw
```

(1) Examine the Ethernet

```
Ethernet II, Src: HewlettP_4f:6b:41 (40:a8:f0:4f:6b:41), Dst: JuniperN_73:14:01 (88:e0:f3:73:14:01)
  > Destination: JuniperN_73:14:01 (88:e0:f3:73:14:01)
  > Source: HewlettP_4f:6b:41 (40:a8:f0:4f:6b:41)
    Type: IPv4 (0x0800)
```

a. What is the Ethernet address of the source and destination?

Source: HewlettP_4f:6b:41 (40:a8:f0:4f:6b:41)

Destination: JuniperN_73:14:01 (88:e0:f3:73:14:01)

b. What is the content of the type field in the Ethernet frame?

Type: IPv4 (0x0800)

(2) Examine the Internet Protocol

```
Internet Protocol Version 4, Src: 140.117.171.179, Dst: 140.117.11.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 62
    Identification: 0x24c5 (9413)
  > Flags: 0x00
    Fragment offset: 0
    Time to live: 128
    Protocol: UDP (17)
    Header checksum: 0x0000 [validation disabled]
    [Header checksum status: Unverified]
    Source: 140.117.171.179
    Destination: 140.117.11.1
```

a. What is the IP address of the source and destination?

source: 140.117.171.179

destination: 140.117.11.1

b. What is the header length? What is the total packet length?

Header Length: 20 bytes

Total Length: 62 bytes

c. Identify the protocol type field. What is the number and type of the protocol in the payload?

Protocol: UDP (17)

(3) Examine the User Datagram Protocol

```
User Datagram Protocol, Src Port: 55438, Dst Port: 53
    Source Port: 55438
    Destination Port: 53
    Length: 42
    Checksum: 0xcfda [unverified]
    [Checksum Status: Unverified]
    [Stream index: 194]
```

a. Identify the client ephemeral port number and the server well-known port number .

client:55438

Server:53

b. What type of application layer protocol is in the payload?

UDP

(4) Examine the Domain Name System (query)

```
Domain Name System (query)
    [Response In: 5807]
    Transaction ID: 0x8b98
  > Flags: 0x0100 Standard query
    Questions: 1
    Answer RRs: 0
    Authority RRs: 0
    Additional RRs: 0
  > Queries
```

a. What field indicates whether the message is a query or a response?

Domain Name System (query)

b. What is the query transaction ID?

Transaction ID: 0x8b98

c. Identify the fields that carry the type and class of the query.

Flags: 0x0100 Standard query

Questions: 1

Answer RRs: 0

Authority RRs: 0

Additional RRs: 0

2. Find the DNS response packet which is response to the DNS request packet from the above question.

You can find a record like below on Wireshark. And you can answer the question.

5806	16.143660	140.117.11.1	140.117.171.179	DNS	196 Standard query response 0x61a4 A alumni.sec.nsysu.edu.tw A 140.117.13.24

(1) Examine the Ethernet.

```
Ethernet II, Src: JuniperN_73:14:01 (88:e0:f3:73:14:01), Dst: HewlettP_4f:6b:41 (40:a8:f0:4f:6b:41)
> Destination: HewlettP_4f:6b:41 (40:a8:f0:4f:6b:41)
> Source: JuniperN_73:14:01 (88:e0:f3:73:14:01)
  Type: IPv4 (0x0800)
```

a. What is the Ethernet address of the source and destination?

Source: JuniperN_73:14:01 (88:e0:f3:73:14:01)

Destination: HewlettP_4f:6b:41 (40:a8:f0:4f:6b:41)

b. What is the content of the type field in the Ethernet frame?

Type: IPv4 (0x0800)

(2) Examine the Internet Protocol & Domain Name System (response)

```
Internet Protocol Version 4, Src: 140.117.11.1, Dst: 140.117.171.179
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  Total Length: 182
  Identification: 0xedaa (60842)
> Flags: 0x02 (Don't Fragment)
  Fragment offset: 0
  Time to live: 251
  Protocol: UDP (17)
  Header checksum: 0xc1ec [validation disabled]
  [Header checksum status: Unverified]
  Source: 140.117.11.1
  Destination: 140.117.171.179
```

a. What is the IP address of the source and destination?

Source: 140.117.11.1

Destination: 140.117.171.179

b. What is the header length? What is the total packet length? Is it longer than the query?

Header Length: 20 bytes (5)

Total Length: 182 bytes

Yes，response 比 query 長

c. How many answers are provided in the response message? Compare the answers and their time-to-live values.

One，time to live:3

3. Find the first TCP packet sent by client. (The destination IP address is response from above question.) You can find three record like below on Wireshark. It's TCP three-way handshake.

(1) Examine the Transmission Control Protocol.

996	8.132505	140.117.171.179	104.115.172.121	TCP	66	50936→80 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
999	8.137538	104.115.172.121	140.117.171.179	TCP	66	80→50936 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=32
1000	8.137569	140.117.171.179	104.115.172.121	TCP	54	50936→80 [ACK] Seq=1 Ack=1 Win=65536 Len=0

a. What are the ephemeral port number used by the client and the well-known port number used by the server?

   client :50936

   server:80

b. What is the length of the TCP segment?

   Len:0

c. What is the initial sequence number for the segments from the client to the server?

```
Transmission Control Protocol, Src Port: 50936, Dst Port: 80, Seq: 0, Len: 0
    Source Port: 50936
    Destination Port: 80
    [Stream index: 38]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    Acknowledgment number: 0
    Header Length: 32 bytes
  > Flags: 0x002 (SYN)
    Window size value: 8192
    [Calculated window size: 8192]
    Checksum: 0x4d3c [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  > Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted
```

   Sequence number: 0 (relative sequence number)

d. What is the initial window size?

   Window size value: 8192

e. What is the maximum segment size?

```
  ⌄ Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted
    > Maximum segment size: 1460 bytes
    > No-Operation (NOP)
    > Window scale: 8 (multiply by 256)
    > No-Operation (NOP)
    > No-Operation (NOP)
    > TCP SACK Permitted Option: True
```

   Maximum segment size: 1460 bytes

f. Find the hex character that contains the SYN flag bit

   Flags: 0x002 (SYN)

Part 2 Probing the Internet (ICMP, PING, Traceroute)

命令提示字元

```
Microsoft Windows [版本 10.0.10240]
(c) 2015 Microsoft Corporation. All rights reserved.

C:\Users\chen jia ming>ping 8.8.8.8

Ping 8.8.8.8 (使用 32 位元組的資料):
回覆自 8.8.8.8: 位元組=32 時間=15ms TTL=48
回覆自 8.8.8.8: 位元組=32 時間=15ms TTL=48
回覆自 8.8.8.8: 位元組=32 時間=15ms TTL=48
回覆自 8.8.8.8: 位元組=32 時間=15ms TTL=48

8.8.8.8 的 Ping 統計資料:
    封包: 已傳送 = 4，已收到 = 4，已遺失 = 0 (0% 遺失)，
大約的來回時間 (毫秒):
    最小值 = 15ms，最大值 = 15ms，平均 = 15ms

C:\Users\chen jia ming>
```

1. Ping Captured.

(1) Find the first ICMP Echo Request packet.

454	4.380460	140.117.171.179	8.8.8.8	ICMP	74 Echo (ping) request id=0x0001, seq=1/256, ttl=128 (reply in 455)

a. First, examine the Internet Protocol. What is the Time-to-Live?

Time to live: 128

```
Internet Protocol Version 4, Src: 140.117.171.179, Dst: 8.8.8.8
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 60
    Identification: 0x2611 (9745)
  > Flags: 0x00
    Fragment offset: 0
    Time to live: 128
    Protocol: ICMP (1)
    Header checksum: 0x0000 [validation disabled]
    [Header checksum status: Unverified]
    Source: 140.117.171.179
    Destination: 8.8.8.8
```

b. Next examine the Internet Control Message Protocol. What is the ICMP message type?

Type: 8 (Echo (ping) request)

```
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0
    Checksum: 0x4d5a [correct]
    [Checksum Status: Good]
    Identifier (BE): 1 (0x0001)
    Identifier (LE): 256 (0x0100)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    [Response frame: 455]
```

c. What is the message identifier and sequence number?

Identifier (BE): 1 (0x0001)

Identifier (LE): 256 (0x0100)

Sequence number (BE): 1 (0x0001)

Sequence number (LE): 256 (0x0100)

(2) Find the first ICMP Echo Reply packet.

455	4.396176	8.8.8.8	140.117.171.179	ICMP	74	Echo (ping) reply id=0x0001, seq=1/256, ttl=48 (request in 454)

a. Examine the Internet Protocol. What are the source and destination addresses?

Source: 8.8.8.8

Destination: 140.117.171.179

```
Internet Protocol Version 4, Src: 8.8.8.8, Dst: 140.117.171.179
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 60
    Identification: 0x0000 (0)
  > Flags: 0x00
    Fragment offset: 0
    Time to live: 48
    Protocol: ICMP (1)
    Header checksum: 0x4289 [validation disabled]
    [Header checksum status: Unverified]
    Source: 8.8.8.8
    Destination: 140.117.171.179
```

b. Next, examine the Internet Control Message Protocol. What is the ICMP message type?

Type: 0 (Echo (ping) reply)

```
Internet Control Message Protocol
    Type: 0 (Echo (ping) reply)
    Code: 0
    Checksum: 0x555a [correct]
    [Checksum Status: Good]
    Identifier (BE): 1 (0x0001)
    Identifier (LE): 256 (0x0100)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    [Request frame: 454]
    [Response time: 15.716 ms]
```

2. Traceroute Captured.

```
C:\Users\chen jia ming>tracert 8.8.8.8

在上限 30 個躍點上
追蹤 google-public-dns-a.google.com [8.8.8.8] 的路由:

  1     2 ms     1 ms     1 ms  140.117.162.254
  2     1 ms     1 ms    <1 ms  10.10.129.254
  3    <1 ms    <1 ms    <1 ms  140.117.232.85
  4    <1 ms    <1 ms    <1 ms  140.117.232.33
  5     1 ms     1 ms     1 ms  140.117.232.25
  6     6 ms     6 ms     7 ms  202.169.174.161
  7     7 ms     7 ms     7 ms  72.14.196.229
  8    10 ms    10 ms    10 ms  72.14.233.20
  9    10 ms    10 ms    18 ms  209.85.242.163
 10    15 ms    15 ms    15 ms  209.85.243.21
 11     *        *        *     要求等候逾時。
 12    15 ms    16 ms    15 ms  google-public-dns-a.google.com [8.8.8.8]

追蹤完成。
```

(1) Find the first ICMP Echo Request packet.

11004	91.124827	140.117.171.179	8.8.8.8	ICMP	106 Echo (ping) request id=0x0001, seq=5/1280, ttl=1 (no response found!)

a. Examine the Internet Protocol. What are the source and destination addresses?

Src: 140.117.171.179, Dst: 8.8.8.8

```
Internet Protocol Version 4, Src: 140.117.171.179, Dst: 8.8.8.8
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  Total Length: 92
  Identification: 0x2615 (9749)
> Flags: 0x00
  Fragment offset: 0
> Time to live: 1
  Protocol: ICMP (1)
  Header checksum: 0x0000 [validation disabled]
  [Header checksum status: Unverified]
  Source: 140.117.171.179
  Destination: 8.8.8.8
```

b. What are the protocol type and the Time-to-Live in the IP packet?

Time to live: 1

Protocol: ICMP (1)

c. Next, examine the Internet Control Message Protocol. What is the ICMP message type? What are the message identifier and sequence number?

Identifier (BE): 1 (0x0001)

Identifier (LE): 256 (0x0100)

Sequence number (BE): 5 (0x0005)

Sequence number (LE): 1280 (0x0500)

```
Internet Control Message Protocol
  Type: 8 (Echo (ping) request)
  Code: 0
  Checksum: 0xf7f9 [correct]
  [Checksum Status: Good]
  Identifier (BE): 1 (0x0001)
  Identifier (LE): 256 (0x0100)
  Sequence number (BE): 5 (0x0005)
  Sequence number (LE): 1280 (0x0500)
> [No response seen]
> Data (64 bytes)
```

(2) Find an ICMP Time-to-live exceeded packet.

437	3.759229	140.117.162.254	140.117.171.179	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)

a. Examine the Internet Protocol. What are the source and destination addresses?

```
    Source: 140.117.162.254
    Destination: 140.117.171.179
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
Internet Control Message Protocol
    Type: 11 (Time-to-live exceeded)
    Code: 0 (Time to live exceeded in transit)
    Checksum: 0xf4ff [correct]
```

Source: 140.117.162.254

Destination: 140.117.171.179

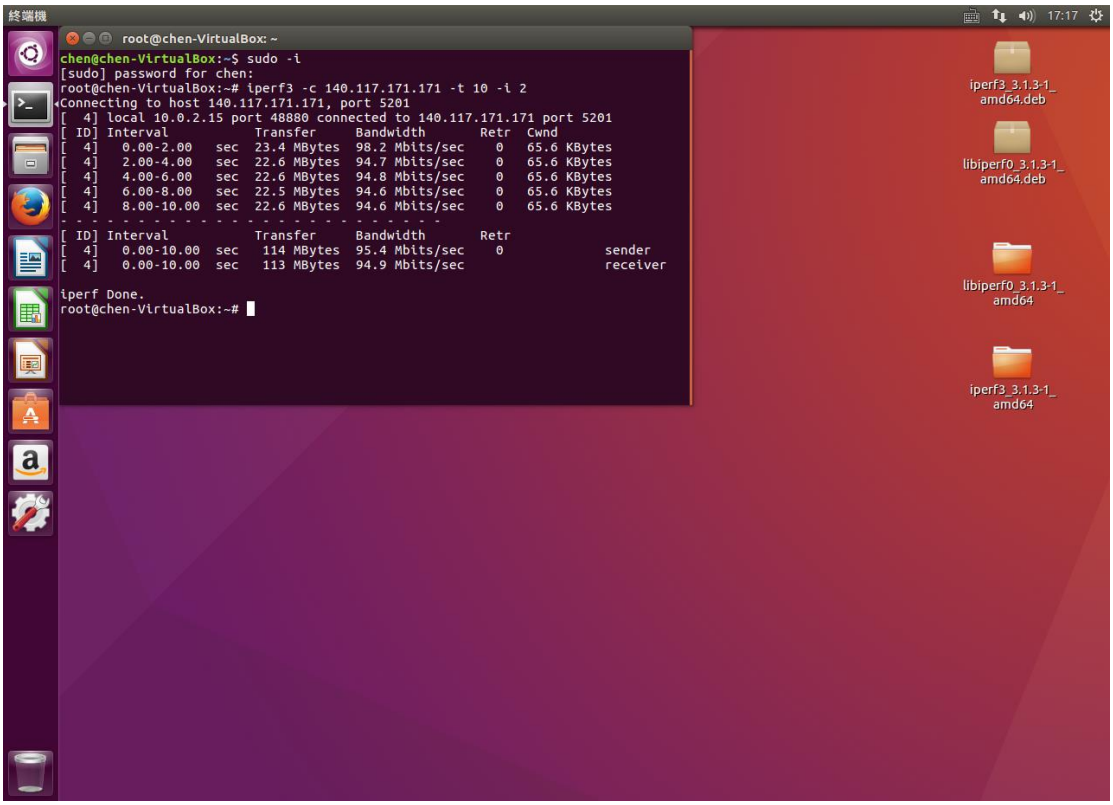
b. Next, examine the Internet Control Message Protocol. What is the ICMP message type?

Type: 11 (Time-to-live exceeded)

Part 3 Measuring Network Bandwidth

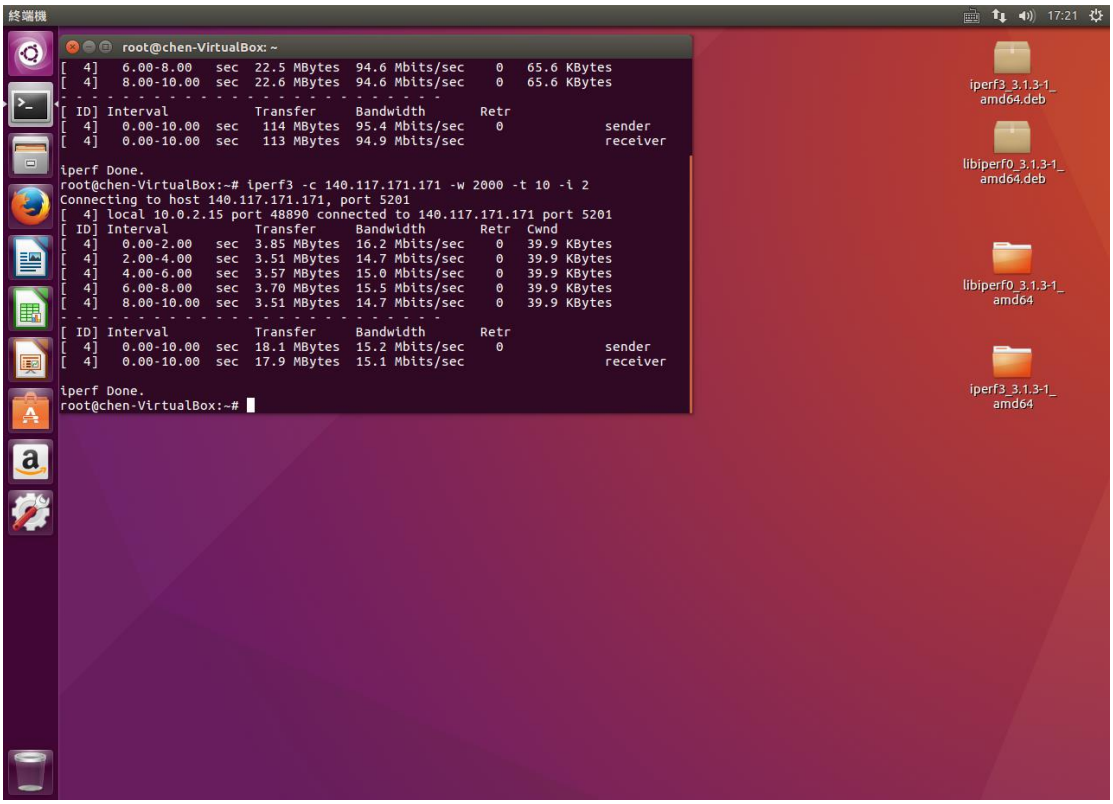
1. Measure the bandwidth for Transmission Control Protocol

Type “iperf3 -c 140.117.171.171 -t 10 -i 2”



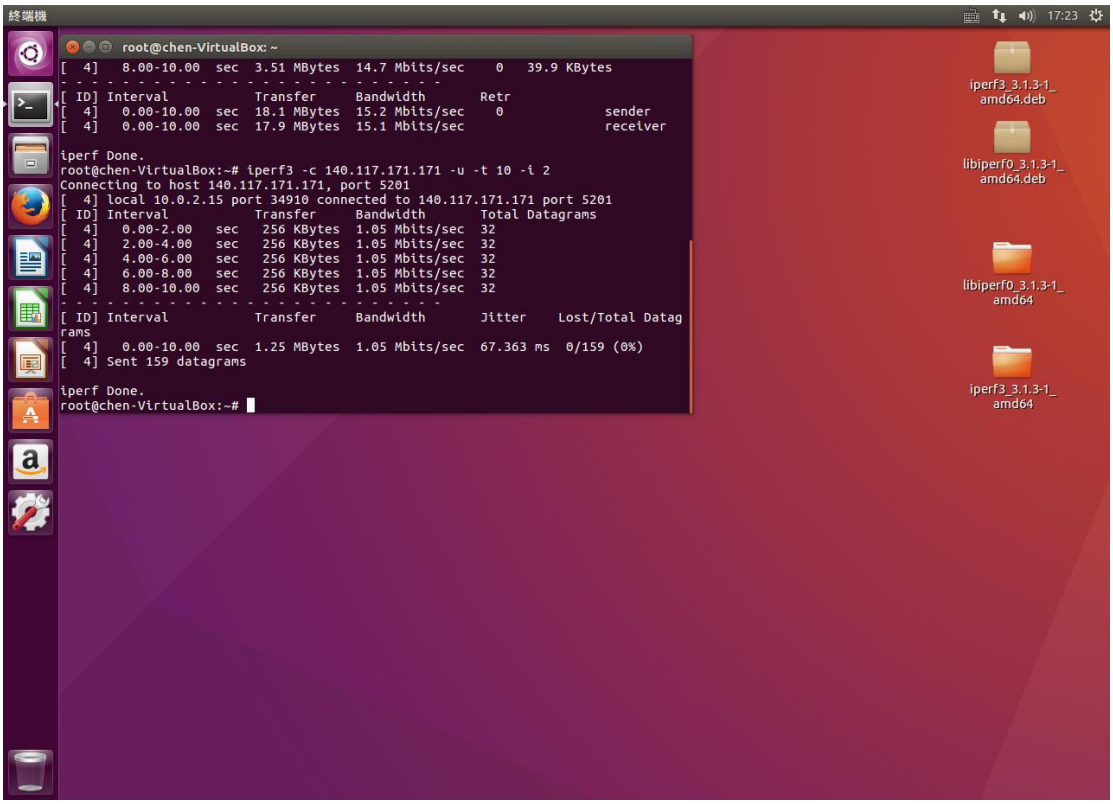
2. Adjust the window size for Transmission Control Protocol. See what's different.

Type "iperf3 -c 140.117.171.171 -w 2000 -t 10 -i 2"



3. Measure the bandwidth for User Datagram Protocol

Type "iperf3 -c 140.117.171.171 -u -t 10 -i 2"



4. Adjust the bandwidth for User Datagram Protocol.Measure the package lost rate or any else happened.

Type “iperf3 -c 140.117.171.171 -u -t 10 -i 2 -b 512G”