

CWID : 50380788

Name : Mukesh Ravichandran

## HOMEWORK – 1

### Networking-I

#### Problem1

Given Link Transmission rate  $R = 2\text{Mbps} = 2 \times 10^6 \text{ bps}$

Propagation speed  $s = 2.5 \times 10^8 \text{ m/sec}$

Length between hosts  $= 2000\text{km} = 2 \times 10^6 \text{ m}$

a. Propagation delay  $d_{\text{prop}} = d/s = (2 \times 10^6)/(2.5 \times 10^8) = 2/250 = 0.008 \text{ sec}$

b. Bandwidth-delay product  $= R \times d_{\text{prop}} = 2 \times 10^6 \times 0.008 = 16000 \text{ bits}$

c. Bandwidth-delay product  $= R \times d_{\text{prop}} = 102 \times 10^6 \times 0.008 = 800000 \text{ bits}$

#### Problem2

01001100 01101001

01101110 01101011

10111010 11010100

00100000 01001100

11011101 00100000

01100001 01111001

1 00111100 10011001

Since there are 17bits, the MSB needs to be wraparound

00111100 10011001

1

00111100 10011010

01100101 01110010

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10100010 00001100

The checksum is obtained by taking 1's complement of above. The result is 01011101

11110011

### Problem3

RTT is time for a small packet to travel from client to server and back

#### Non persistent

Client initiates TCP connection for every object including the html file, meaning it requires 2 RTTs for one object. Client needs to access the HTML file which references 4 objects on same server.

Hence 1 TCP connection and 1 HTTP connection for HTML page => 2 RTT

1TCP and 1 HTTP for each if the 4 objects =>  $2 \times 4 \Rightarrow 8$  RTT

Total RTTs needed are 10.

#### Persistent

TCP connection is established only once and then one RTT for each object when there is no pipelining.

Hence 1 TCP connection and 1 HTTP connection for HTML page => 2 RTT

1 HTTP for each if the 4 objects =>  $1 \times 4 \Rightarrow 4$  RTT

Total RTTs needed are 6.

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## Problem 4

4.a

The image shows a Wireshark packet capture window. The top bar indicates the capture was taken on February 19, 2025, at 12:53 PM, with the CWID 50380788. The display filter is set to 'http'. The packet list shows several packets, with packet 9338 selected. The packet details pane shows the structure of the selected packet, including the Ethernet II header, Internet Protocol Version 4 header, and Hypertext Transfer Protocol header. The packet bytes pane shows the raw data of the packet.

| No.  | Time       | Source          | Destination     | Protocol | Length | Info  |
|------|------------|-----------------|-----------------|----------|--------|---|
| 9336 | 635.641811 | 17.253.21.201   | 192.168.0.101   | TCP      | 74     | 80 → 61584 [SYN, ACK] Seq=0 Ack=1 Win=33212 Len=0 MSS=1456 SACK_PERM TSval=788... |
| 9337 | 635.641908 | 192.168.0.101   | 17.253.21.201   | TCP      | 66     | 61584 → 80 [ACK] Seq=1 Ack=1 Win=2944 Len=0 TSval=2285136667 TSecr=788979529      |
| 9338 | 635.642078 | 192.168.0.101   | 17.253.21.201   | HTTP     | 374    | GET /hotspot-detect.html HTTP/1.1   |
| 9339 | 635.644206 | 142.250.138.188 | 192.168.0.101   | TCP      | 78     | [TCP Dup ACK 9317#1] 5228 → 61565 [ACK] Seq=7020 Ack=2094 Win=267264 Len=0 TSv... |
| 9340 | 635.645348 | 142.250.138.188 | 192.168.0.101   | TLSv1    | 92     | Application Data  |
| 9341 | 635.645395 | 192.168.0.101   | 142.250.138.188 | TCP      | 66     | 61565 → 5228 [ACK] Seq=2094 Ack=7046 Win=131008 Len=0 TSval=1676092998 TSecr=9... |
| 9342 | 635.647180 | 142.250.114.188 | 192.168.0.101   | TLSv1    | 92     | Application Data  |
| 9343 | 635.647230 | 192.168.0.101   | 142.250.114.188 | TCP      | 66     | 61564 → 5228 [ACK] Seq=2095 Ack=7046 Win=131008 Len=0 TSval=2429750922 TSecr=1... |
| 9344 | 635.648290 | 192.168.0.101   | 17.248.185.36   | QUIC     | 770    | Protected Payload (KP0), DCID=026a11d401609b2120747180579e1fd53f45d5f             |
| 9345 | 635.648567 | 17.253.21.201   | 192.168.0.101   | TCP      | 74     | 80 → 61585 [SYN, ACK] Seq=0 Ack=1 Win=33212 Len=0 MSS=1456 SACK_PERM TSval=334... |
| 9346 | 635.648622 | 192.168.0.101   | 17.253.21.201   | TCP      | 66     | 61585 → 80 [ACK] Seq=1 Ack=1 Win=2944 Len=0 TSval=3784044732 TSecr=3345858712     |
| 9347 | 635.648966 | 192.168.0.101   | 17.253.21.201   | HTTP     | 374    | GET /hotspot-detect.html HTTP/1.1   |

Frame 9338: 374 bytes on wire (2992 bits), 374 bytes captured (2992 bits) on interface 0 (en0)

Section number: 1

Interface id: 0 (en0)

Encapsulation type: Ethernet (1)

Arrival Time: Feb 19, 2025 12:33:50.345677000 CST

UTC Arrival Time: Feb 19, 2025 18:33:50.345677000 UTC

Epoch Arrival Time: 1739990030.345677000

[Time shift for this packet: 0.000000000 seconds]

[Time delta from previous captured frame: 0.000170000 seconds]

[Time delta from previous displayed frame: 0.000170000 seconds]

[Time since reference or first frame: 635.642078000 seconds]

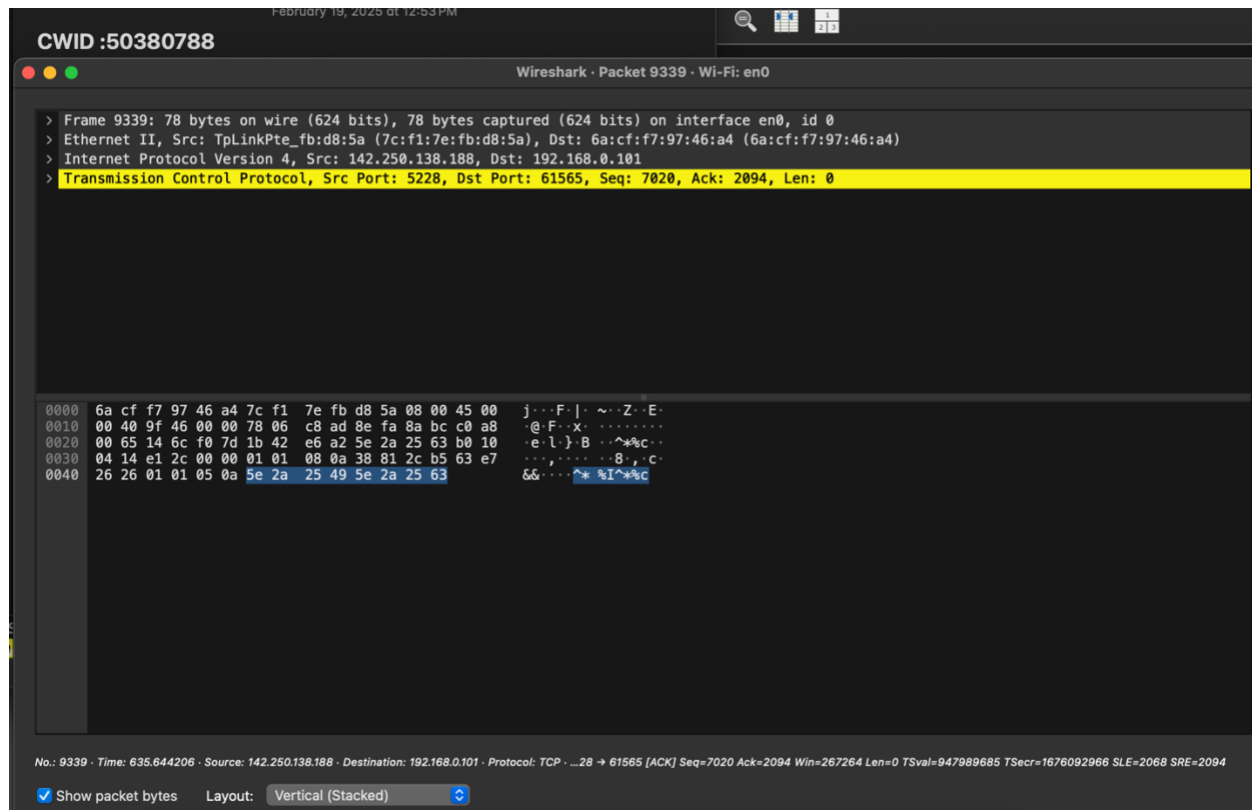
Frame Number: 9338

Frame Length: 374 bytes (2992 bits)

4.b

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Frame 9339: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface en0, id 0

Ethernet II, Src: TpLinkPte\_fb:d8:5a (7c:f1:7e:fb:d8:5a), Dst: 6a:cf:f7:97:46:a4 (6a:cf:f7:97:46:a4)

Internet Protocol Version 4, Src: 142.250.138.188, Dst: 192.168.0.101

Transmission Control Protocol, Src Port: 5228, Dst Port: 61565, Seq: 7020, Ack: 2094, Len: 0

**Source Port: 5228**

**Destination Port: 61565**

[Stream index: 77]

[Conversation completeness: Complete, WITH\_DATA (63)]

[TCP Segment Len: 0]

**Sequence Number: 7020** (relative sequence number)

**Sequence Number (raw): 457369250**

[Next Sequence Number: 7020 (relative sequence number)]

**Acknowledgment Number: 2094** (relative ack number)

**Acknowledgment number (raw): 1579820387**

1011 .... = **Header Length: 44 bytes (11)**

Flags: 0x010 (ACK)