ASSIGNMENT 1

CSCI 6704 - Advanced Topics in Networks

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Question 1 <Exploratory question> - ICANN

To access a website, we need to enter its address into our device. The entered address might be a name or a number, and it must be unique for the computer to know where to look for that address. Internet Corporation for Assigned Names and Numbers (ICANN) manages and administers these unique identifiers globally through a system known as Domain Name System (DNS). [1]

ICANN also performs other operations, some of which are listed below [1]:

- Internet Protocol (IP) address allocation
- Domain Name System (DNS)
- Protocol Parameter Registry
- Root Servers System
- Generic Top-Level Domain Name System Management
- Country Code Top Level Domain Name DNS
- Time Zone Database Management

The main objective of ICANN is to preserve operational stability and follow guidelines as mandated by the American government. ICANN is also responsible for ensuring the security of operations over the Internet. ICANN mandates and thereby ensures that the operational and service stability of the Internet is maintained to promote competition, broadly represent the global Internet community, and design policies relevant to ICANN's mission. ICANN, by the United States government, was asked to mandate its operations in a bottom-up, consensus-driven, democratic manner. ICANN was also asked to resolve the issue of the ownership of domain names for generic top-level domains (gTLDs). The resolution of this issue is today, most commonly known as Uniform Dispute Resolution Policy (UDRP) which offers a cheap, fast, and relevant solution of the domain name, thereby avoiding domain name conflicts [2].

ICANN operated on some defined regulations and standards known as the "Operating Standards" developed for the conduct of reviews. These standards shall be developed through community consultation which includes public comment opportunities. The Operating Standards must be aligned with the guidelines as defined adhering to accountability, transparency, security, stability, resiliency, competition, consumer trust, and consumer choice. Additionally, for each of the operations as performed by ICANN, it mandates the use of guidelines and working standards for all of them. [3]

ICANN has implemented an efficient and cost-effective Uniform Domain Dispute Resolution Policy which has resolved numerous disputes over domain name rights. Along with the support of several technical communities, ICANN regulated deployment guidelines for Internationalized Domain Names (IDN). This has allowed domain enrolment in hundreds of the world's languages. ICANN also, together with the National Telecommunications and International Administration of the U.S government successfully deployed the Domain Name System Security Extensions (DNSSEC) in July 2010. ICANN designed and implemented a program that allows any registered organization to operate its top-level domain. ICANN is now globally accepted as a body that handles governance policies of the Internet. [1]

References for Question 1

[1] ICANN, "Welcome to ICANN! - ICANN," Internet Corporation for Assigned Names and Numbers, [Online]. Available: https://www.icann.org/resources/pages/welcome-2012-02-25-en. [Accessed 24 September 2021].

[2] Wikipedia, "ICANN," Wikipedia, [Online]. Available: https://en.wikipedia.org/wiki/ICANN. [Accessed 24 September 2021].

[3] ICANN, "BYLAWS FOR INTERNET CORPORATION FOR ASSIGNED NAMES AND NUMBERS | A California Nonprofit Public-Benefit Corporation," Internet Corporation for Assigned Names and Numbers, [Online]. Available: https://www.icann.org/resources/pages/governance/bylaws-en/#article4.6. [Accessed 24 September 2021].

Question 2 <Virtual Circuit Packet Switching>

Figure 1 displays the screenshot of the solved virtual circuit package switching network.

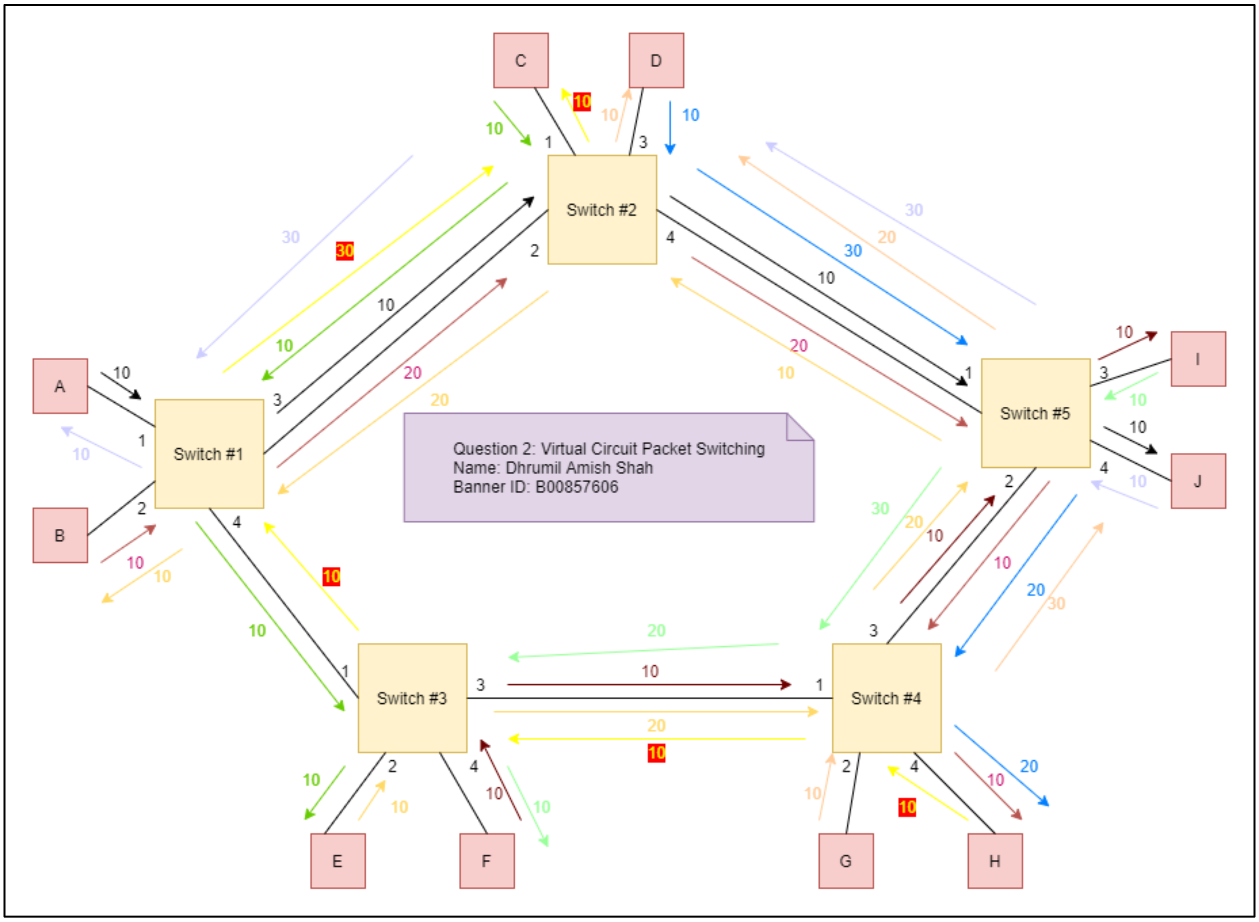

Figure 1: Screenshot of the Virtual Circuit Package Switching [4]

Virtual Circuit Paths

The list of all the virtual circuit paths is as below:

Source	Destination	Route
Host A	Host J	Switch #2
Host B	Host H	Switch #2 and #5
Host C	Host E	Switch #1
Host D	Host H	Switch #5
Host F	Host I	Switch #4
Host E	Host B	Switch #4, #5, and #2
Host G	Host D	Switch #5
Host H	Host C	Switch #3 and #1
Host I	Host F	Switch #4
Host J	Host A	Switch #2

Virtual circuit tables for switches #1 to #5

Switch #1

VCin	In Port	VCout	Out Port
10	1	10	3
10	2	20	3
10	3	10	4
20	3	10	2
10	4	30	3
30	3	10	1

Switch #2

VCin	In Port	VCout	Out Port
10	2	10	4
20	2	20	4
10	1	10	2
10	3	30	4
10	4	20	2
20	4	10	3
30	2	10	1
30	4	30	2

Switch #3

VCin	In Port	VCout	Out Port
10	1	10	2
10	4	10	3
10	2	20	3
10	3	10	1
20	3	10	4

Switch #4

VCin	In Port	VCout	Out Port
10	3	10	4
20	3	20	4
10	1	10	3
20	1	20	3
10	2	30	3
10	4	10	1
30	3	20	1

Switch #5

VCin	In Port	VCout	Out Port
10	1	10	4
20	1	10	2
30	1	20	2
10	2	10	3
20	2	10	1
30	2	20	1
10	3	30	2
10	4	30	1

References for Question 2

[4] Grotto Networking, "MPLS Origins," Grotto Networking, [Online]. Available: https://www.grotto-networking.com/BBMPLS.html. [Accessed 24 September 2021].

Question 3 <Bandwidth delay problems>

3 (A) Consider the following scenario:
N = number of hops between two end systems
L = length of the message in bits
B = bandwidth in bits per second, on all links
P = packet size in bits (for datagram and virtual circuit packet switching) The size is the same for all packets, and it includes the message portion plus any overhead
H = overhead for each packet in bits (for datagram packet switching only; ignore the overhead for virtual circuit packet switching)
S = call set up time in seconds (for circuit switching and virtual circuit packet switching)
R = call release time in seconds (for circuit switching and virtual circuit packet switching)
D = propagation delay per hop in seconds
Ignore queuing and processing delays.

If N = 8, L= 4096, B = 1024, P = 128, H = 32, S = 0.2, R = 0.1, D = 0.001, compute the end-to-end delay for the following three cases:

- Message is sent using circuit switching
- Message is sent using datagram packet switching
- Message is sent using virtual circuit packet switching

Answer

⇨ <u>Problem 1: Message is sent using circuit switching</u>

Given –

Call setup time = S = 0.2 seconds

Length of the message = L = 4096 bits

Number of hops between two end systems = N = 8

Propagation delay per hop = D = 0.001 seconds

Bandwidth = B = 1024 bits per second

Call release time = R = 0.1 seconds

To find –

End-to-end delay for the message sent using circuit switching

From the question –

= S + Ttrans + Tprop + R

= S + (L/B) + (D*N) + R (where, Ttrans = L/B & Tprop = D*N)

= 0.2 + (4096/1024) + (0.001*8) + 0.1

= 0.2 + 4 + 0.008 + 0.1

= 4.308 seconds

Final answer –

The end-to-end delay for the message sent using circuit switching is 4.308 seconds.

⇨ Problem 2: Message is sent using datagram packet switching

Given –

Number of hops between two end systems = N = 8

Length of the message = L = 4096 bits

Bandwidth = B = 1024 bits per second

Packet size= P = 128 bits

Overhead for each packet = H = 32 bits

Propagation delay per hop = D = 0.001 seconds

To find –

End-to-end delay for the message sent using datagram packet switching

From the question –

P = 128 bits

H = 32 bits

Therefore, bits of message sent per packet = P – H = 128 – 32 = 96 bits

Now, total number of packets = L/bits of message sent per packet = 4096/96 = 42.67 = 43 packets

Total number of hops = 8

For the first hop, D1 = Time required to transmit and deliver all packets in the first hop

Therefore, D1 = Number of packets * (Ttrans + Tprop)

= Number of packets * (P/B + D) (where, Ttrans = P/B & Tprop = D)

= 43 * (128/1024 + 0.001)

= 43 * (0.125 + 0.001)

= 43 * 0.126

= 5.418 seconds

Now, for the remaining hops, D2 = D3 = … = D8 = Time required to deliver the last packet across the remaining hops

Therefore, D2 = D3 = … = D8 = Ttrans + Tprop

= P/B + D (where, Ttrans = P/B & Tprop = D)

= (128/1024 + 0.001)

= 0.125 + 0.001

= 0.126

Therefore,

Total delay = T = D1 + D2 + D3 + D4 + D5 + D6 + D7 + D8

= 5.418 + 0.126 + 0.126 + 0.126 + 0.126+ 0.126 + 0.126 + 0.126

= 6.3 seconds

Final answer –

The end-to-end delay for the message sent using datagram packet switching is <u>6.3 seconds</u>.

⇨ <u>Problem 3: Message is sent using virtual circuit packet switching</u>

Given –

Call setup time = S = 0.2 seconds

Number of hops between two end systems = N = 8

Length of the message = L = 4096 bits

Bandwidth = B = 1024 bits per second

Packet size= P = 128 bits

Propagation delay per hop = D = 0.001 seconds

Call release time = R = 0.1 seconds

To find –

End-to-end delay for the message sent using virtual circuit packet switching

From the question –

P = 128 bits

Now, total number of packets = L/P = 4096/128 = 32 packets

Total number of hops = 8

For the first hop, D1 = Time required to transmit and deliver all packets in the first hop

Therefore, D1 = Number of packets * (Ttrans + Tprop)

= Number of packets * (P/B + D) (where, Ttrans = P/B & Tprop = D)

= 32 * (128/1024 + 0.001)

= 32 * (0.125 + 0.001)

= 32 * 0.126

= 4.032 seconds

Now, for the remaining hops, D2 = D3 = … = D8 = Time required to deliver the last packet across the remaining hops

Therefore, D2 = D3 = … = D8 = Ttrans + Tprop

= P/B + D (where Ttrans = P/B & Tprop = D)

= (128/1024 + 0.001)

= 0.125 + 0.001

= 0.126

Therefore,

Delay = T = D1 + D2 + D3 + D4 + D5 + D6 + D7 + D8

= 4.032 + 0.126 + 0.126 + 0.126 + 0.126+ 0.126 + 0.126 + 0.126

= 4.914 seconds

Thus, Total delay = S + T + R

= 0.2 + 4.914 + 0.1

= 5.214 seconds

Final answer –

The end-to-end delay for the message sent using virtual circuit packet switching is 5.214 seconds.

3(B) Consider two hosts, A and B, connected by a single link of bandwidth R bits per sec. Suppose that the two hosts are separated by m meters, and suppose the propagation speed along the link is s meters/sec. Host A is to send a packet of size L bits to Host B. Ignore the processing and queuing delays. Suppose s = 2.5 * 10^8 , L = 100 bits, and R = 28 kbps. Find the distance m so that the propagation delay equals transmission delay.

Answer

Given –

Vprop = s meters/sec = 2.5 * 10^8 meters/sec

Packet size = L = 100 bits

Bandwidth = R = 28kbps = 28 * 10^3 bps

To find –

Dprop = m meters = (?)

From the question –

Tprop = Ttrans

Dprop/Vprop = L/R (where, Tprop = Dprop/Vprop & Ttrans = L/R)

Dprop = (L * Vprop)/(R)

= (100 * 2.5 * 10^8)/(28 * 10^3)

= 8.92857143 * 10^5 meters

= 892.857143 * 10^3 meters

= 892.857143 kilometers

Final answer –

Distance m is 892.86 kilometers.

3(C) Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of R = 2 Mbps. Suppose the propagation speed over the link is 2.5*10^8 meters/sec. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one big message. How long does it take to send the file?

Suppose now the file is broken up into 20 packets each with each packet containing 40,000 bits. Suppose the receiver acknowledges each packet and the transmission time of an acknowledgement packet is 100 ms. Finally, assume that the sender cannot send a packet until the preceding one is acknowledged. How long does it take to send the file?

Answer

<u>Problem 1</u>
Given –

Dprop = 20,000 kilometers = 20,000 * 10^3 meters

Bandwidth = R = 2Mbps = 2 * 10^3 * 10^3 bps

Vprop = 2.5*10^8 meters/sec

File size = L = 800,000 bits

To find –

Time to send the one big file as a continuous message.

From the question –

Total time to send file = Ttrans + Tprop

= L/R + Dprop/Vprop (where, Ttrans = L/R & Tprop = Dprop/Vprop)

= (800,000)/(2*10^3*10^3) + (20,000*10^3)/(2.5*10^8)

= 0.4 + 0.08

= 0.48 seconds

Final answer –

Time to send the file as a continuous message is <u>0.48 seconds</u>.

Problem 2

Given –

Dprop = 20,000 kilometers = 20,000 * 10^3 meters

Bandwidth = R = 2Mbps = 2 * 10^3 * 10^3 bps

Vprop = 2.5*10^8 meters/sec

Data packet size = 40,000 bits

Total packets = 20

Ttrans of acknowledgement packet = 100ms = 0.1s

To find –

Time to send the file as packets

Assumption –

Since the Tprop of the acknowledgement packet is not provided, it can be assumed that the propagation time (Tprop) for the data packet and the acknowledgement packet is the same.

From the question –

Total time to send file = Total number of packets * (Ttrans of each data packet + Tprop of each data packet + Ttrans of each acknowledgement packet + Tprop of each acknowledgement packet)

= Total number of packets * (Data packet size/R + Dprop of each data packet/Vprop of each data packet + Ttrans of each acknowledgement packet + Dprop of each acknowledgement packet/Vprop of each acknowledgement packet)

= 20 * ((40,000)/(2*10^3*10^3) + (20,000*10^3)/(2.5*10^8) + 0.1 + (20,000*10^3)/(2.5*10^8))

= 20 * (0.02 + 0.08 + 0.1 + 0.08)

= 20 * (0.28)

= 5.6 seconds

Final answer –

The time to send the file as packets is 5.6 seconds.

Question 4 <TCP/IP Encapsulation Discovery using Wireshark>

Figure 2 displays the screenshot of the **request** made and **response** received from the website - http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html. The first line displays the request made and the second line displays the response received.

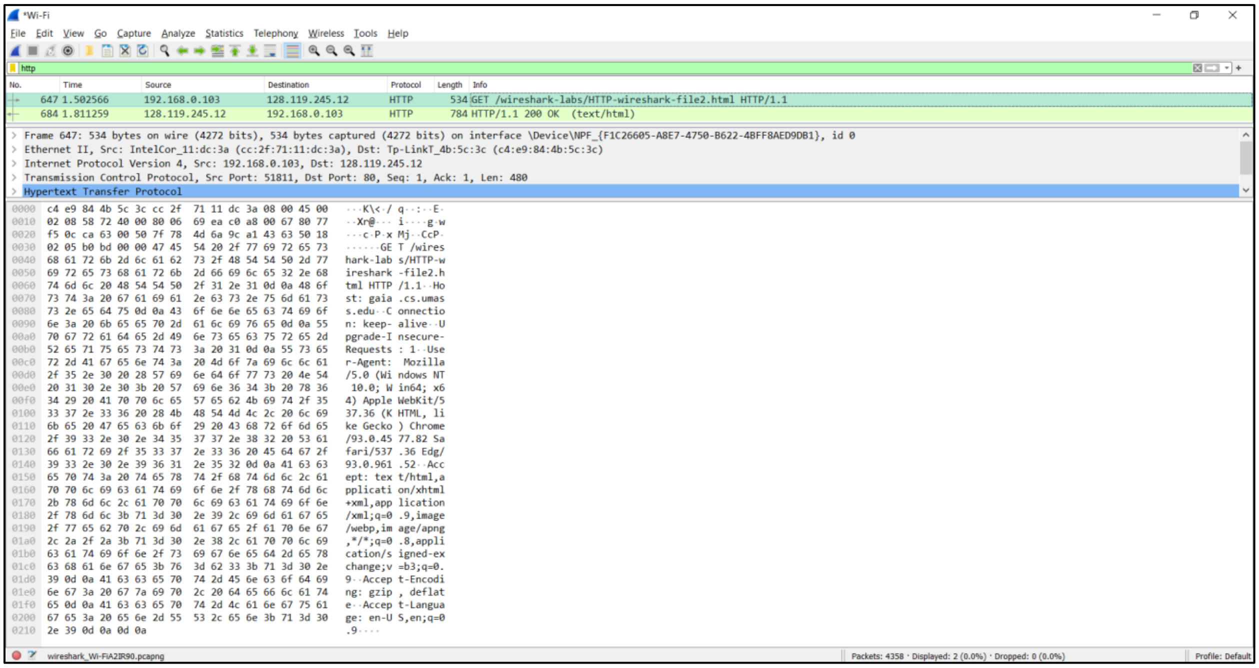

Figure 2: Screenshot of the request and response for the website http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html

Figure 3 displays the screenshot of the Application Layer component for the **request** message.

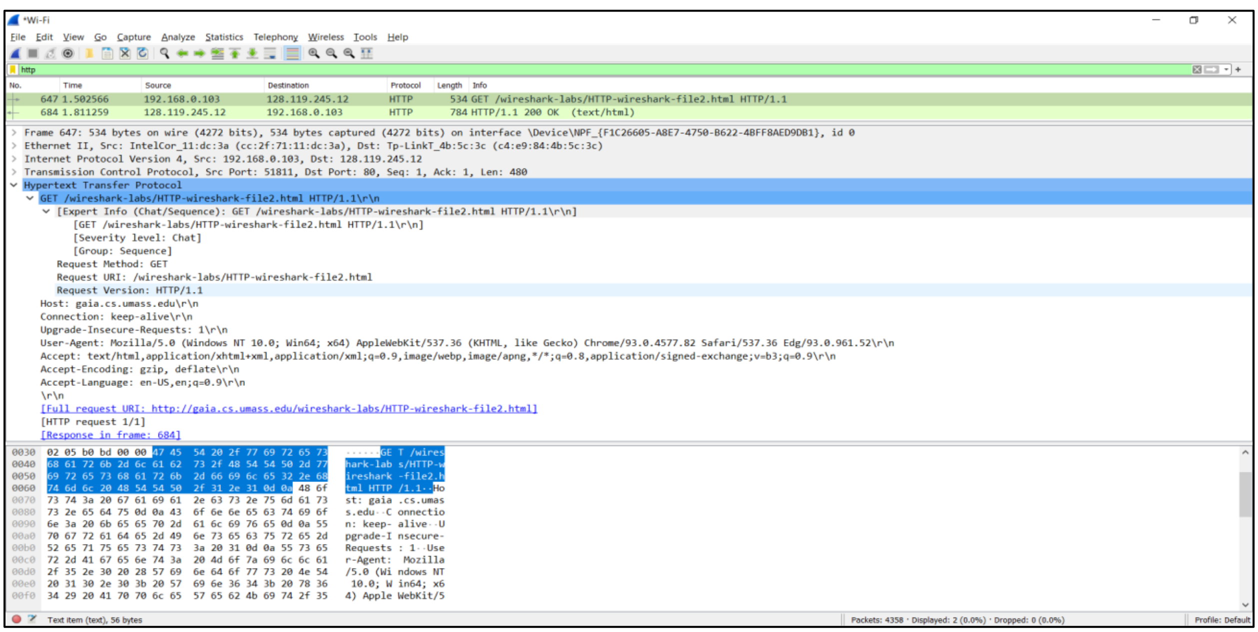

Figure 3: Screenshot of the Application Layer component

The various header components of the **request** message are explained below:

Figure 4 displays the screenshot of the TCP Header component for the **request** message captured using the Wireshark tool.

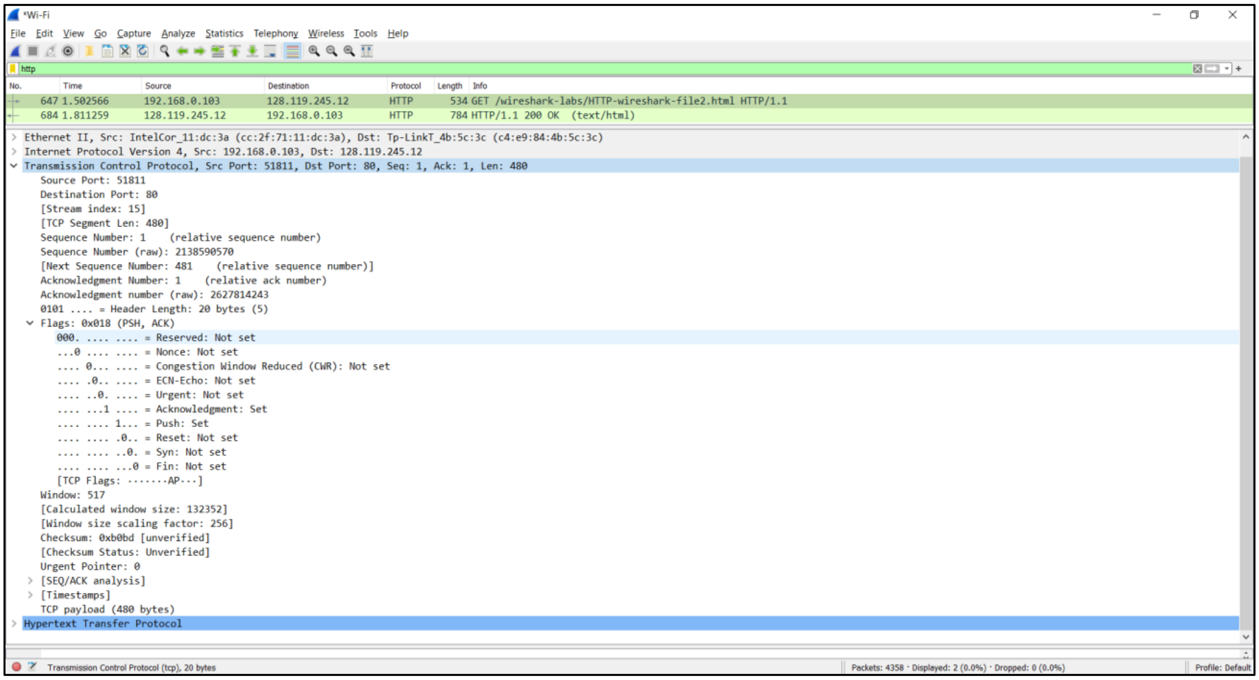

Figure 4: Screenshot of the TCP Header component for the request message captured using the Wireshark tool

Figure 5 displays the screenshot of the TCP Header component for the **request** message.

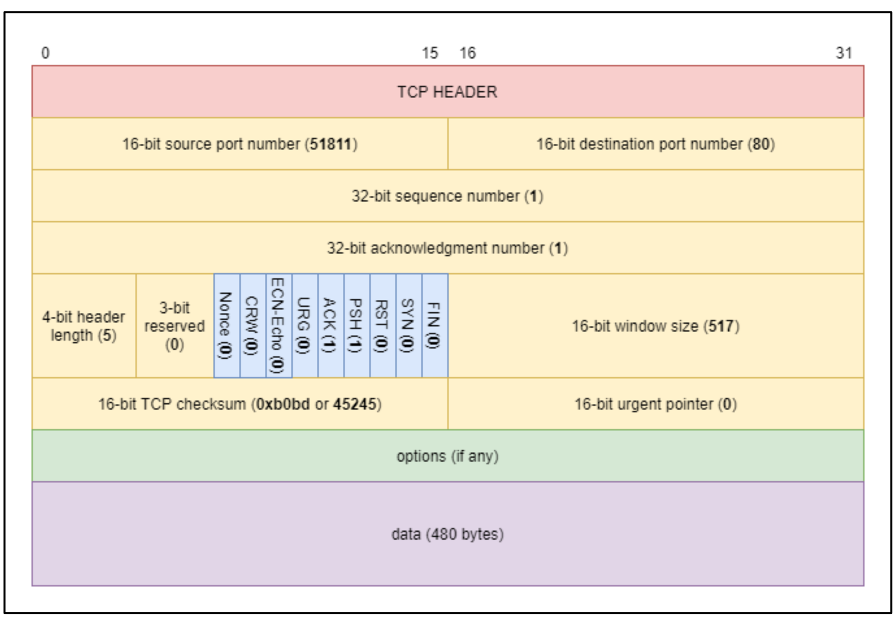

Figure 5: Screenshot of the TCP Header component for the request message built using https://app.diagrams.net/

Figure 6 displays the screenshot of the IP Header component for the **request** message captured using the Wireshark tool.

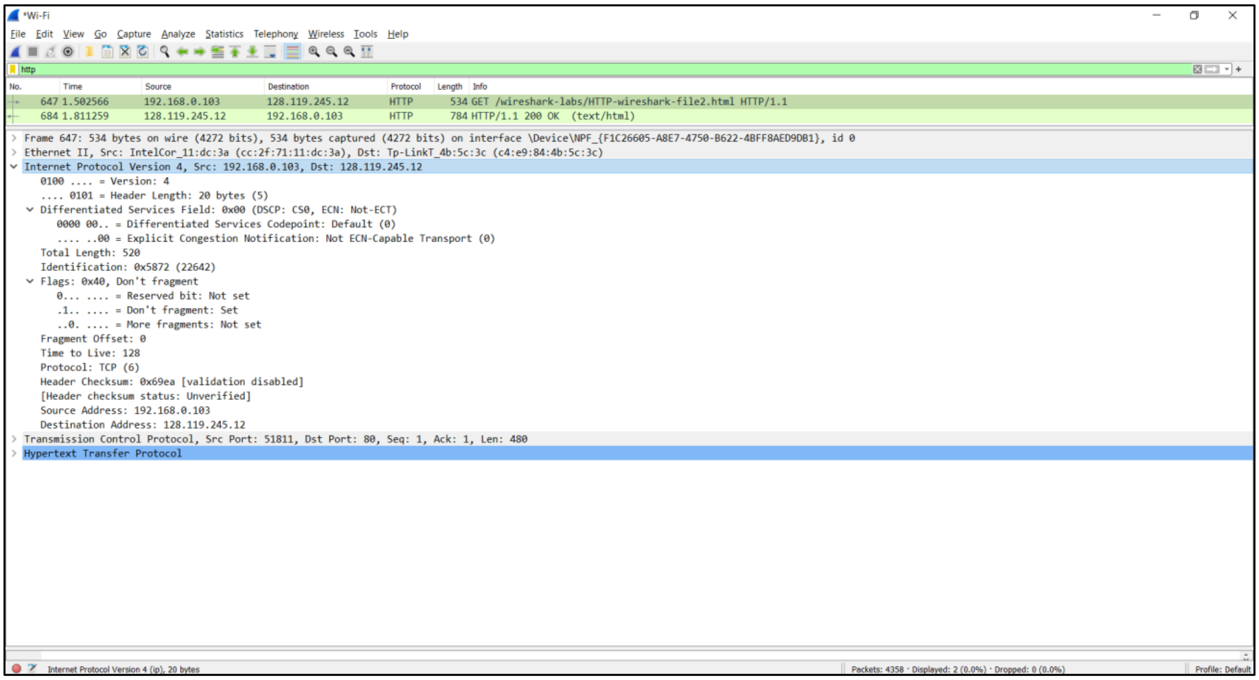

Figure 6: Screenshot of the IP Header component for the request message captured using the Wireshark tool

Figure 7 displays the screenshot of the IP Header component for the **request** message.

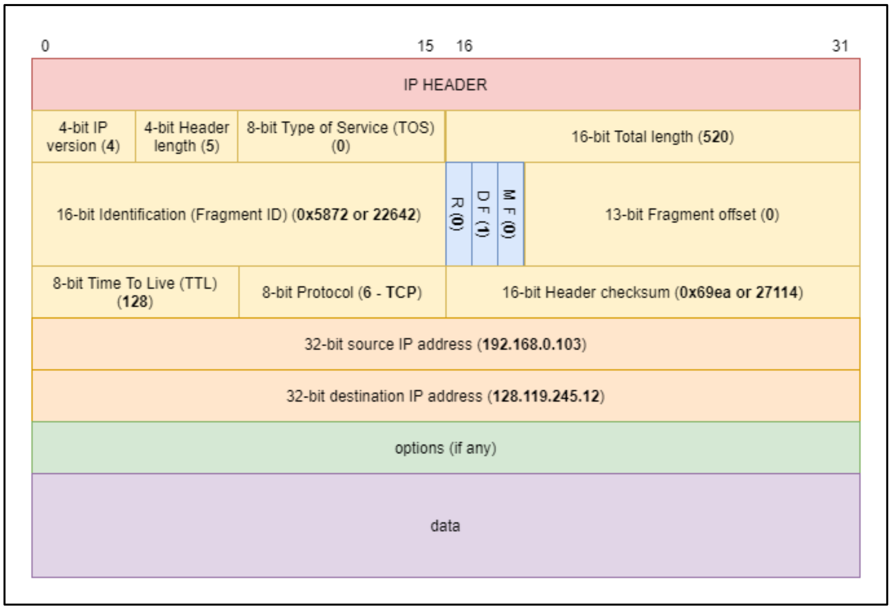

Figure 7: Screenshot of the IP Header component for the request message built using https://app.diagrams.net/

Figure 8 displays the screenshot of the Ethernet Header component for the **request** message captured using the Wireshark tool.

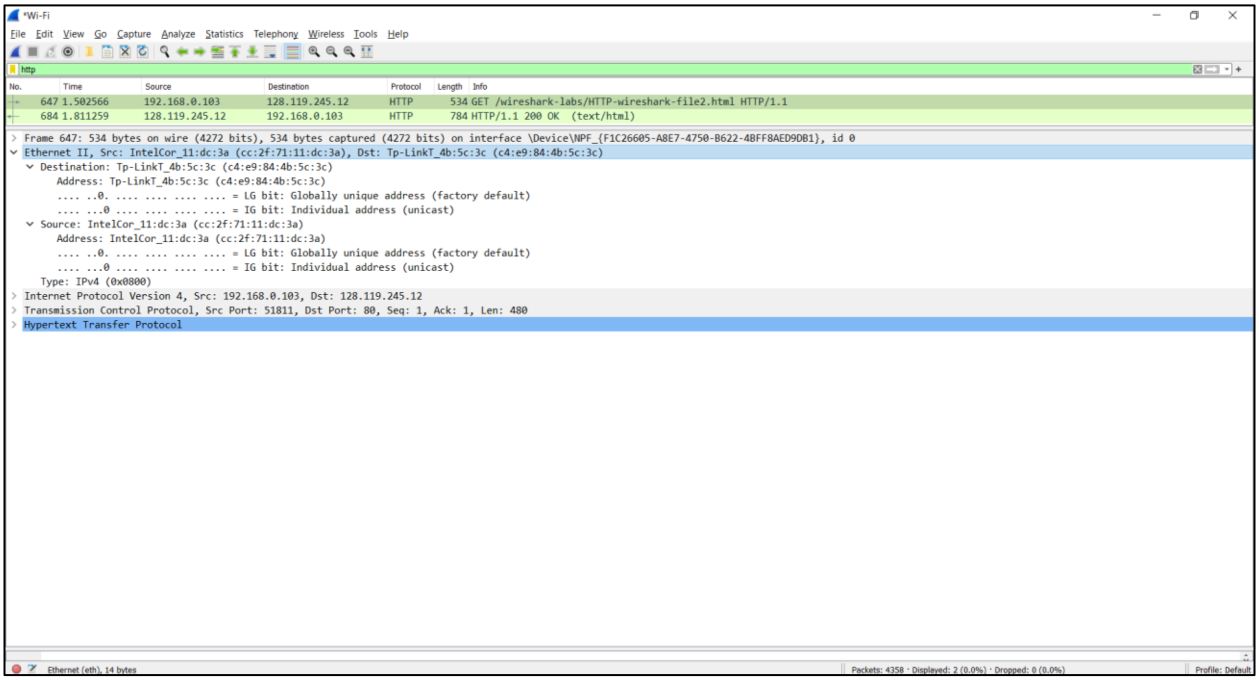

Figure 8: Screenshot of the Ethernet Header component for the request message captured using the Wireshark tool

Figure 9 displays the screenshot of the Ethernet Header component for the **request** message.

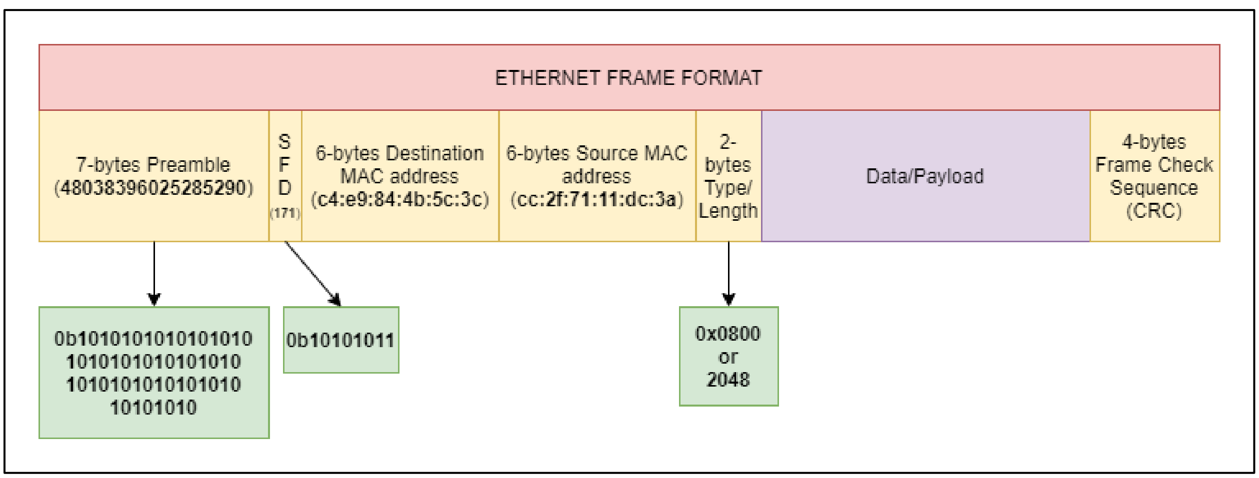

Figure 9: Screenshot of the Ethernet Header component for the request message built using https://app.diagrams.net/

Short paragraph answer:

Question.) Are you able to find the Data Link Trailer in the Ethernet frame capture in Wireshark? Why or why not?

Answer.) The value of the Data Link Trailer is computed by the sender computer's Network Interface Card (NIC). Since this is the sender computer's outgoing traffic, it is first routed through the Wireshark's capture engine and then sent to the NIC.

Reference: https://osqa-ask.wireshark.org/questions/1846/wireshark-capture-of-ethernet-frame-size-shows-as-43-bytes/