

Cloud and Network Security-C1-2026

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Week 1: Assignment 1

Class Exercise: Examine TCP/IP and OSI Models in Action

1 ABSTRACT

This report documents an investigative simulation exercise conducted using Cisco Packet Tracer to analyze how the TCP/IP protocol suite operates in relation to the OSI reference model. The experiment focused on HTTP web traffic, DNS resolution, ARP communication, and TCP session establishment and termination. Simulation mode was used to observe Protocol Data Units (PDUs), encapsulation, and decapsulation processes across OSI layers. The results demonstrate how data is structured, transmitted, and interpreted across network layers, providing a clear understanding of real-world network communication processes.

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2 INTRODUCTION

The modern computer networks are relying on layered communication models to ensure interoperability, scalability and reliability.

There are two major models that form the basis of networking:

The seven-layered OSI Model.

The TCP/IP Four-layer model.

Although these models have got theoretical foundations, a thorough understanding of the models is essential in troubleshooting, security analysis and system architecture. Cisco Packet Tracer provides simulation platform which makes it possible to visualize these concepts that are abstract.

In this experiment, the researcher will discuss the details of how a client and a server communicate using HTTP, the domain name resolution process through DNS, and how TCP is used to maintain reliable communication over data transfer.

3 OBJECTIVES

The objectives of this experiment were:

1. To observe HTTP traffic using Packet Tracer Simulation Mode.
2. To analyze encapsulation and decapsulation across OSI layers.
3. To identify protocol roles within the TCP/IP suite.
4. To understand DNS, TCP session management, and ARP operations.
5. To correlate TCP/IP protocol functions with OSI layers.

4 METHODOLOGY

The Packet Tracer topology contained:

- Web Client

- Web Server
- DNS Server

Simulation mode was used to capture protocol events. HTTP was initially filtered to observe web traffic. DNS, TCP, and ARP events were later enabled.

5 PART 1: HTTP Web Traffic Analysis

5.1 Step 1: Switching to Simulation Mode

Simulation mode allowed pausing of time and viewing PDUs as envelopes. This enabled step-by-step inspection of protocol layers.

- a. Click the **Simulation** mode icon to switch from **Realtime** mode to **Simulation** mode.
- b. Select **HTTP** from the **Event List Filters**.

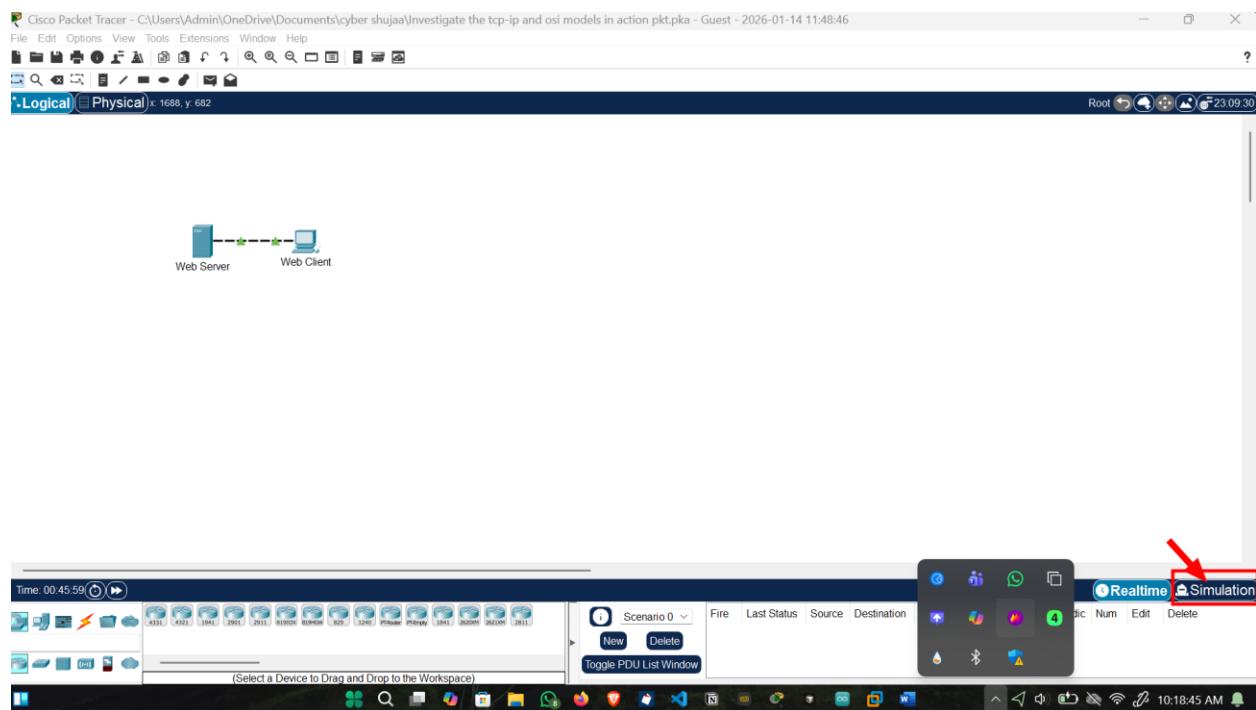


Figure 5.1 PT Switching Mode

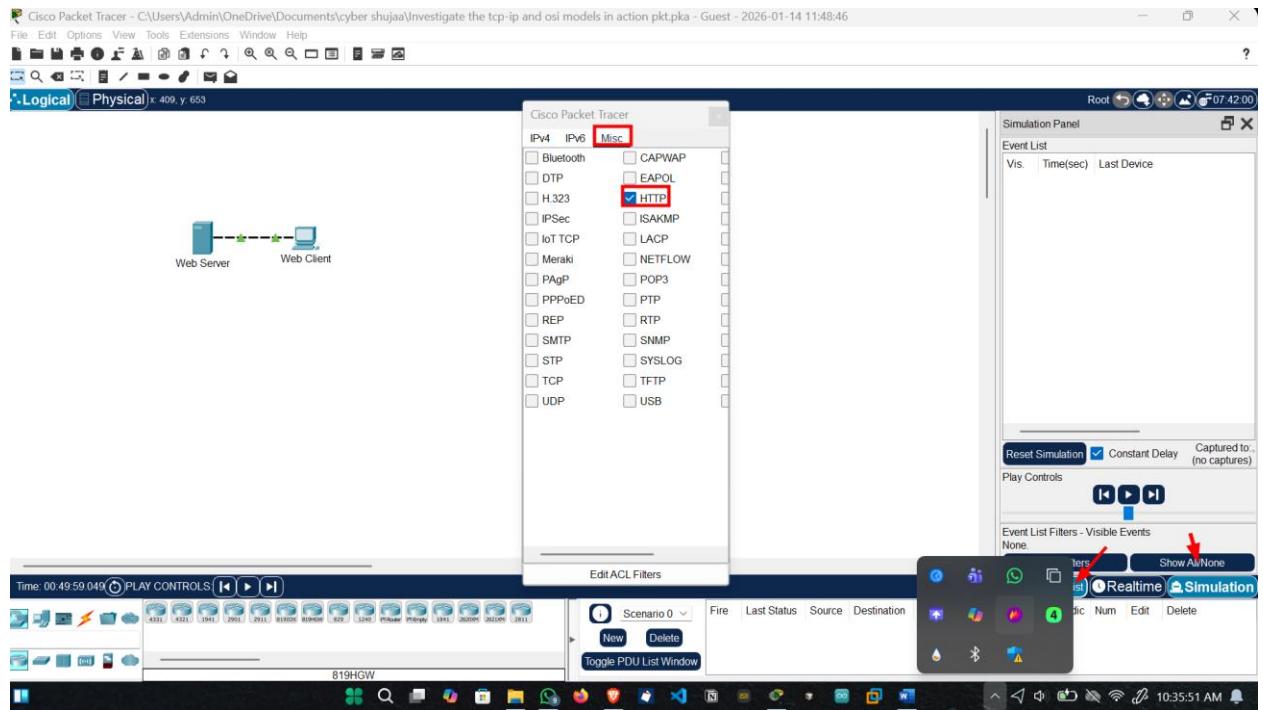


Figure 5.2 HTTP select

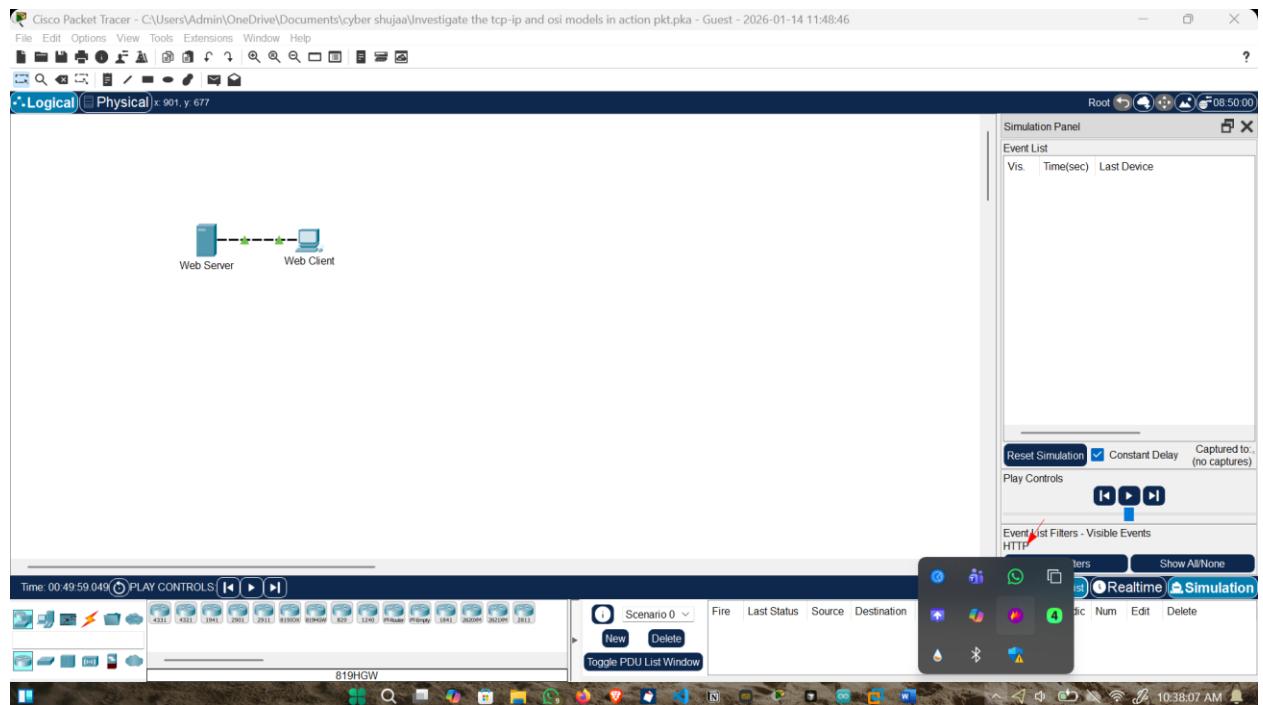


Figure 5.3 HTTP

5.2 Step 2: Generating HTTP Traffic

1. Click Web Client in the far-left pane.
2. Click the Desktop tab and click the Web Browser icon to open it.
3. In the URL field, enter www.osi.local and click Go.
4. Click **Capture/Forward** four times. There should be four events in the Event List.

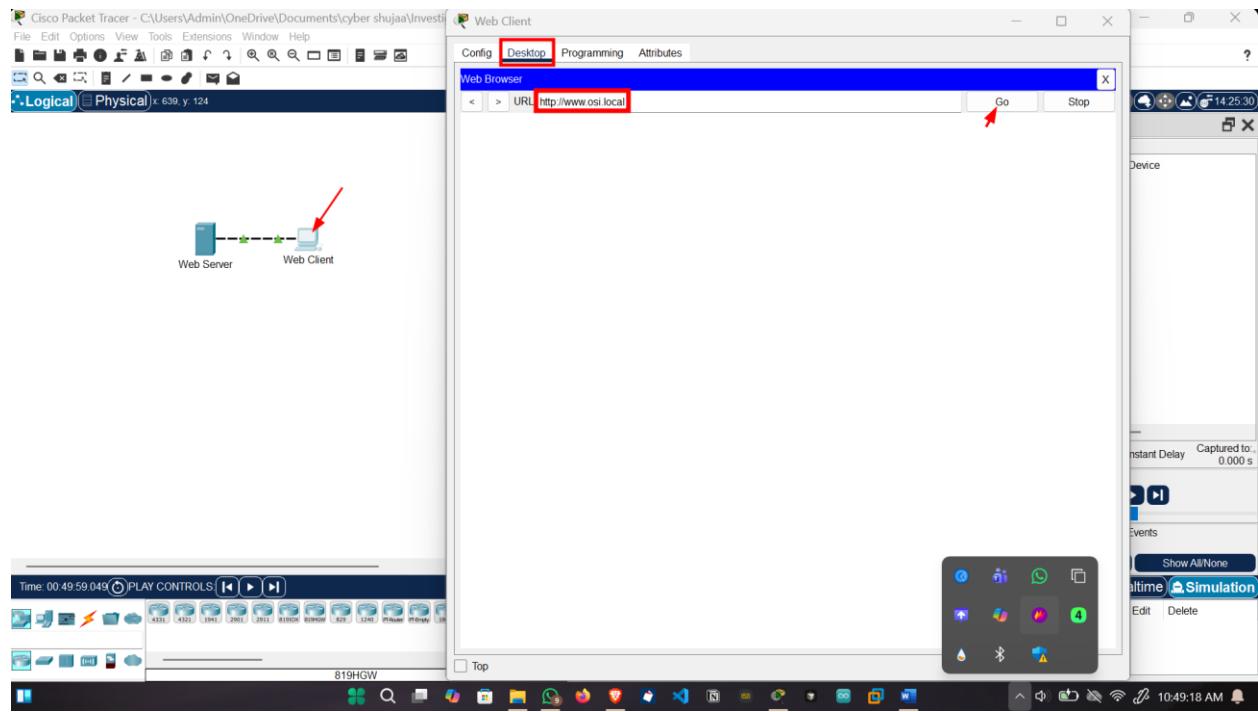


Figure 5.4 Generating HTTP Traffic 1

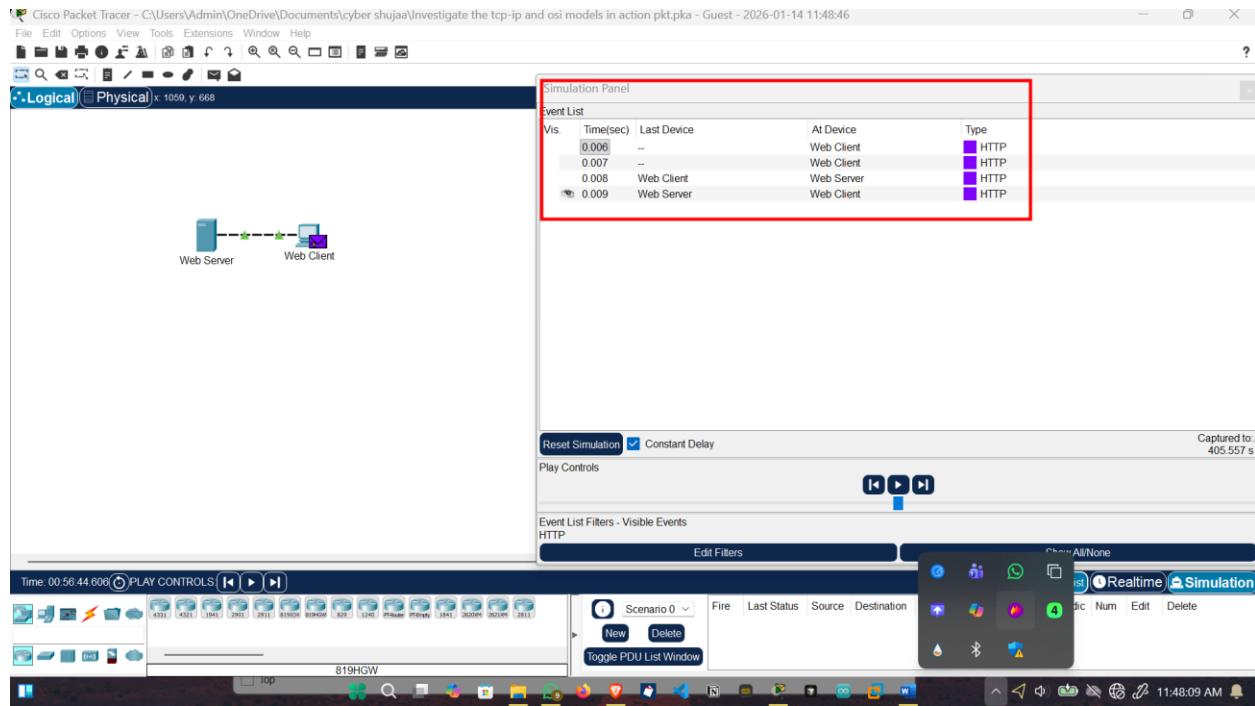


Figure 5.5 Generating HTTP Traffic 2

5.3 Step 3: Explore the contents of HTTP packets

1. Click the first colored square box under the **Event List**.
2. Ensure that the **OSI Model** tab is selected.
3. Click the **Outbound PDU Details** tab.
4. Click the next colored square box under the **Event List**
5. Advance to the next **HTTP Type** box within the **Event List** and click the colored square box.
6. Click the **Inbound and Outbound PDU Details** tab. Review the PDU details.
7. Click the last-colored square box under the **Info** column.

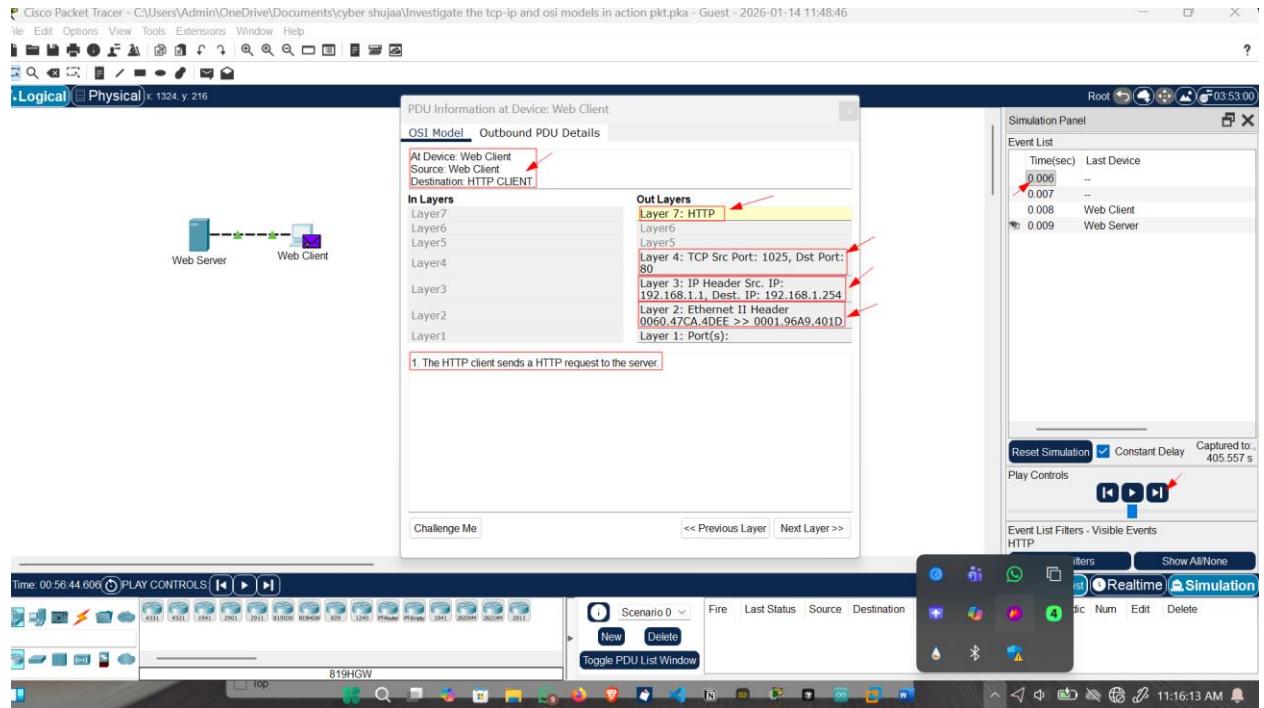


Figure 5.6 Explore the contents of HTTP packets1

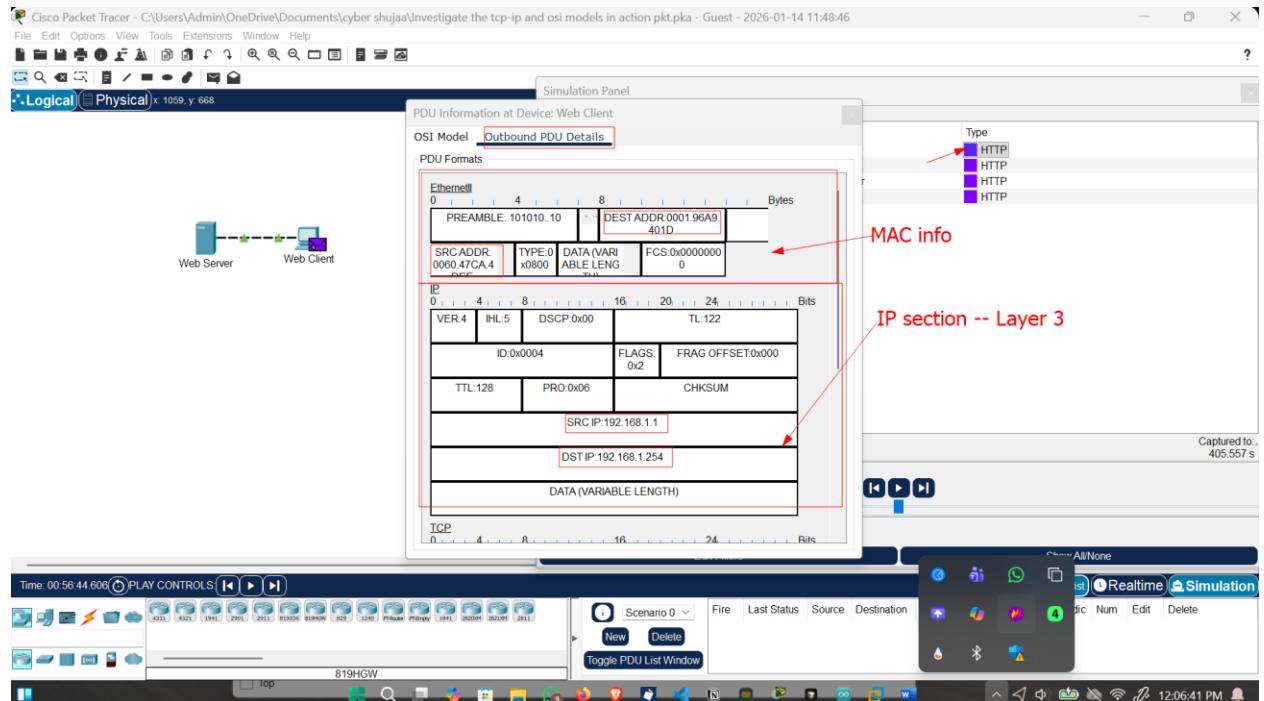


Figure 5.7 Explore the contents of HTTP packets 2

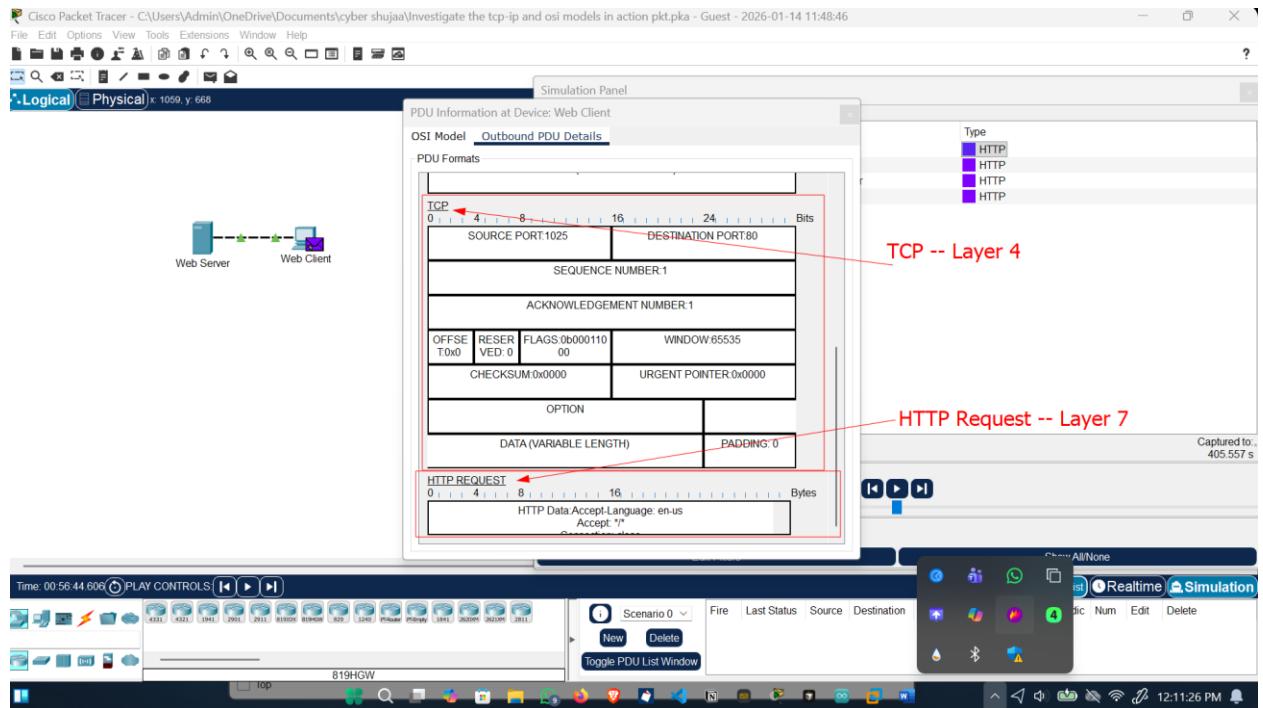


Figure 5.8 Explore the contents of HTTP packets 3

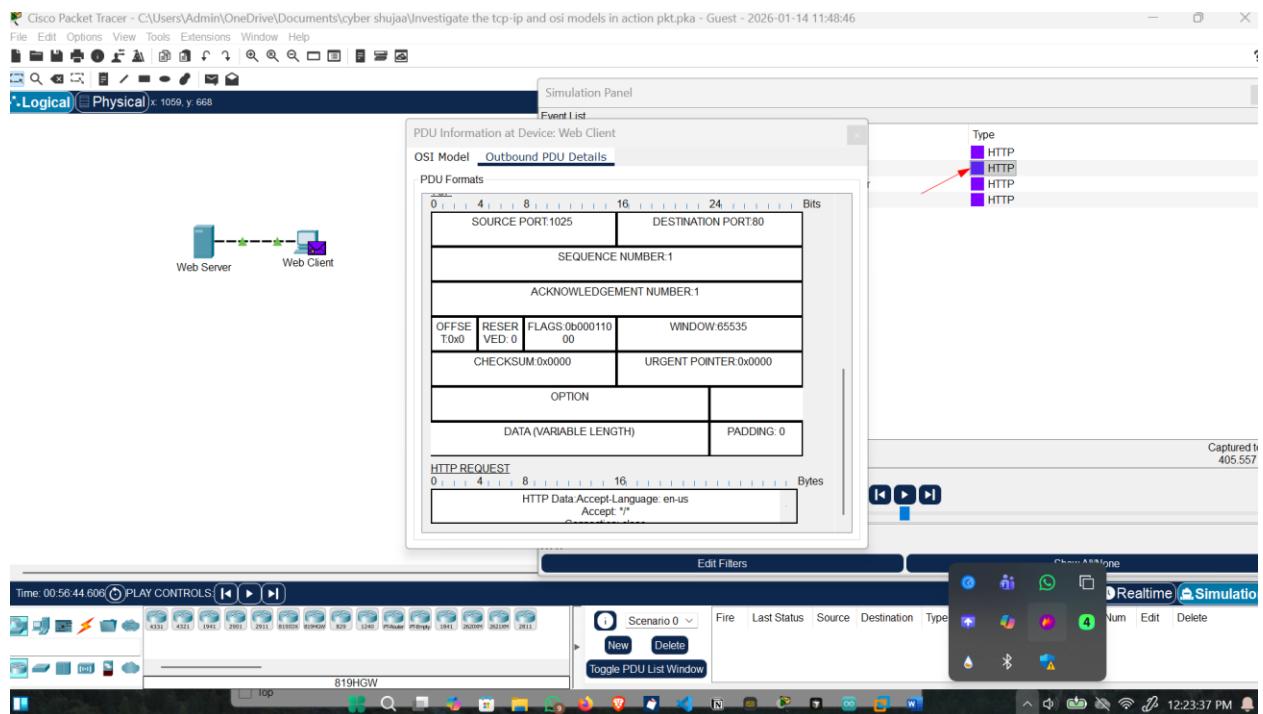


Figure 5.9 Explore the contents of HTTP packets 4

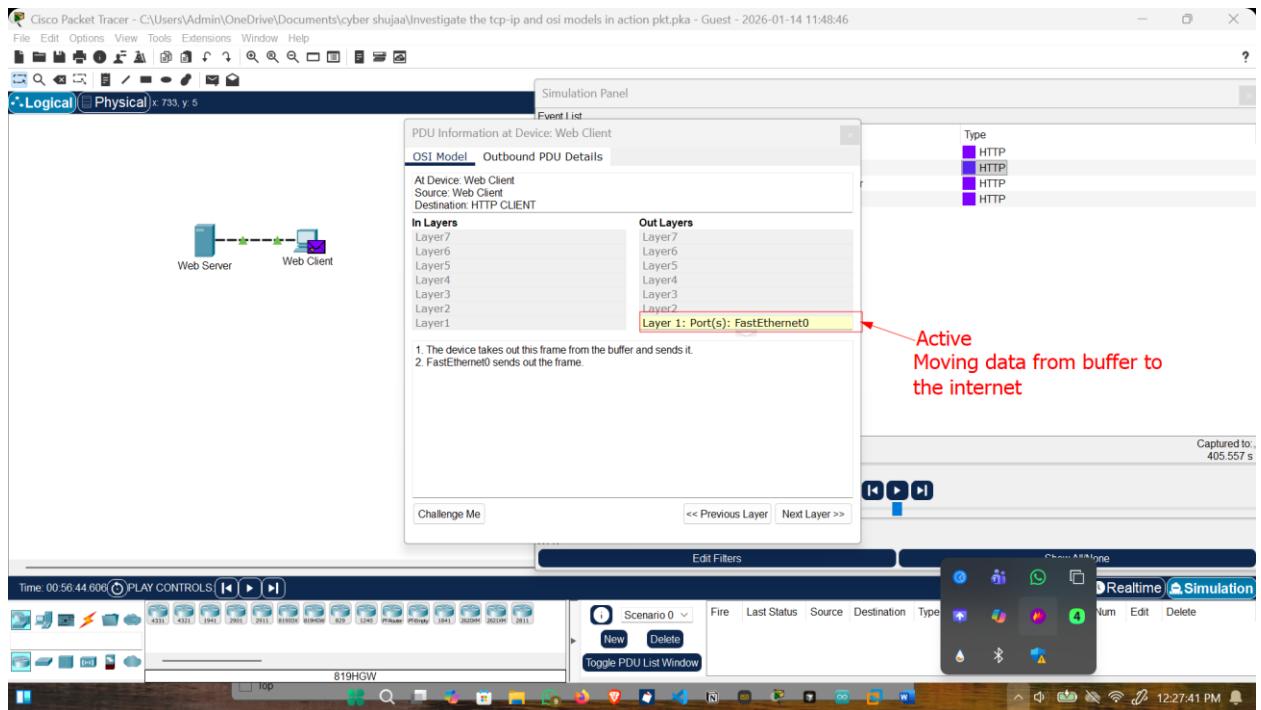


Figure 5.10 Explore the contents of HTTP packets 5

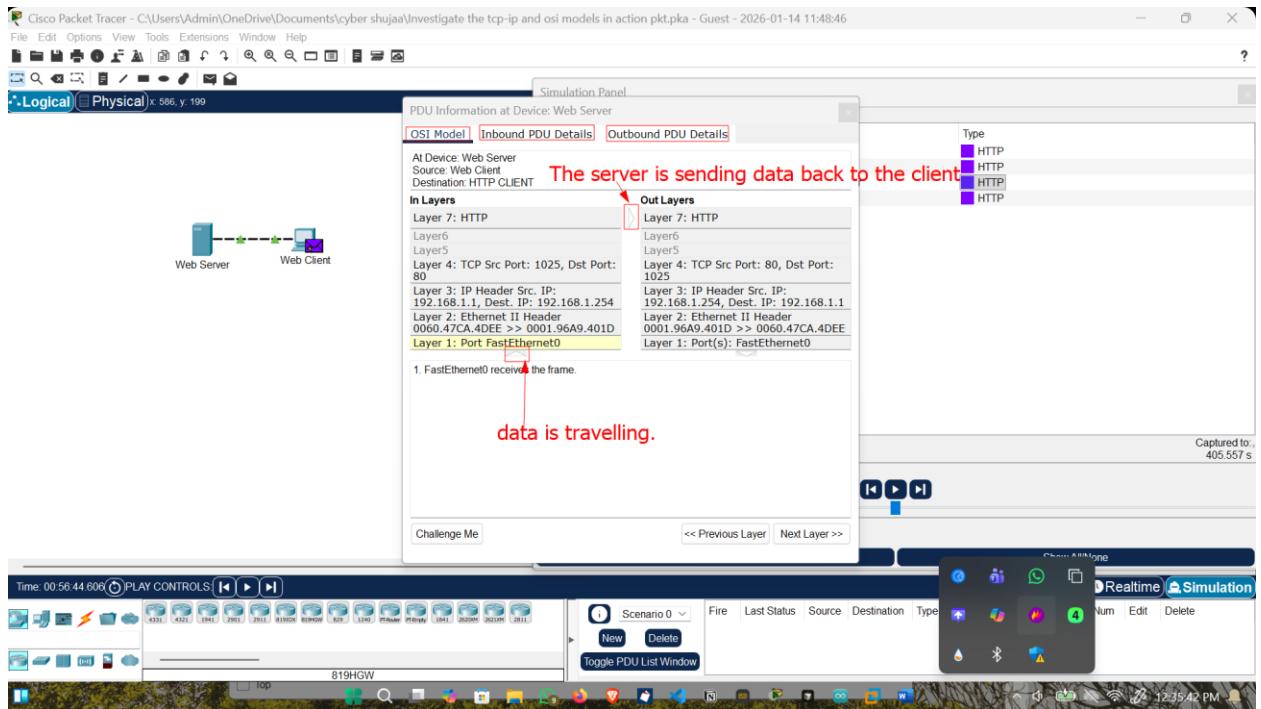


Figure 5.11 Explore the contents of HTTP packets 6

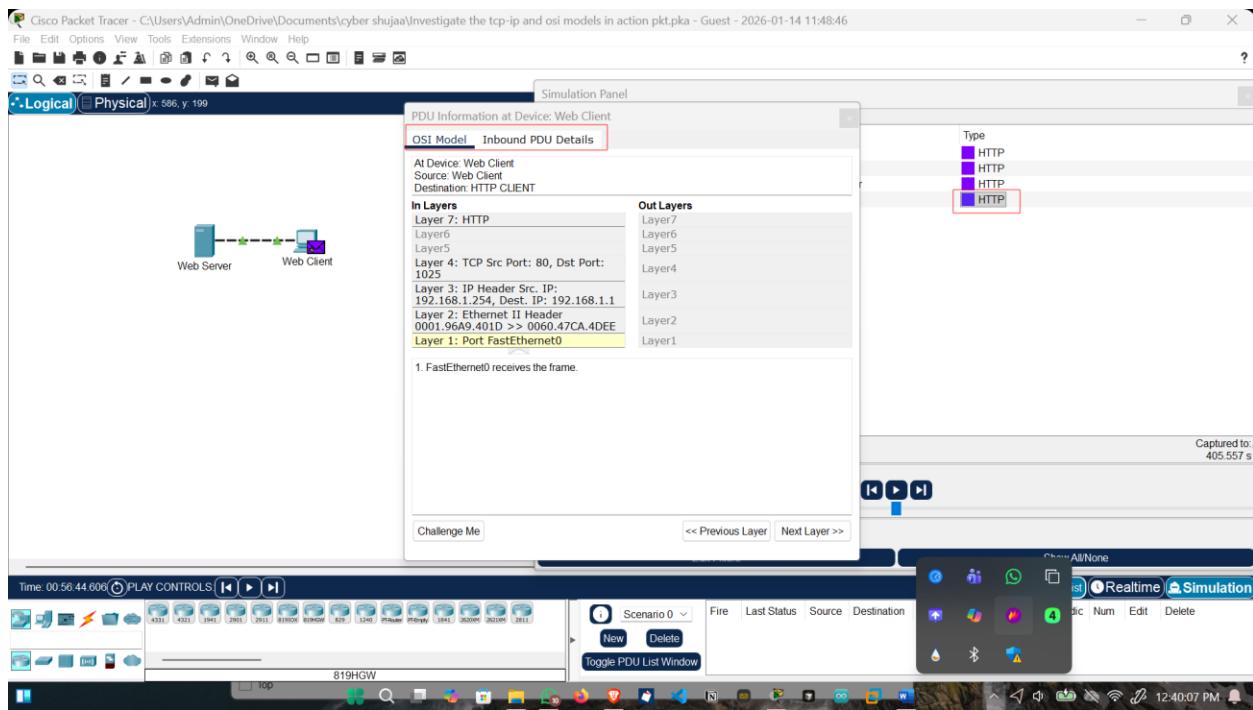


Figure 5.12 Explore the contents of HTTP packets 7

The client accessed: www.osi.local

After clicking **Capture/Forward**, four HTTP events appeared.

5.4 Observation

Question:

Did anything change on the browser?

Answer:

No visible page content appeared initially because DNS resolution and TCP session establishment were still in progress. Thereafter, on the fourth click, the browser displayed

“Web Server

You have successfully accessed the home page for Web Server.

”

5.4.1 Layer Analysis

Layer 7: The HTTP client sends an HTTP GET request to the web server.

Layer 4: Destination Port = 80 (This confirms HTTP uses TCP port 80.)

Layer 3: The destination IP corresponds to the web server IP obtained from DNS.

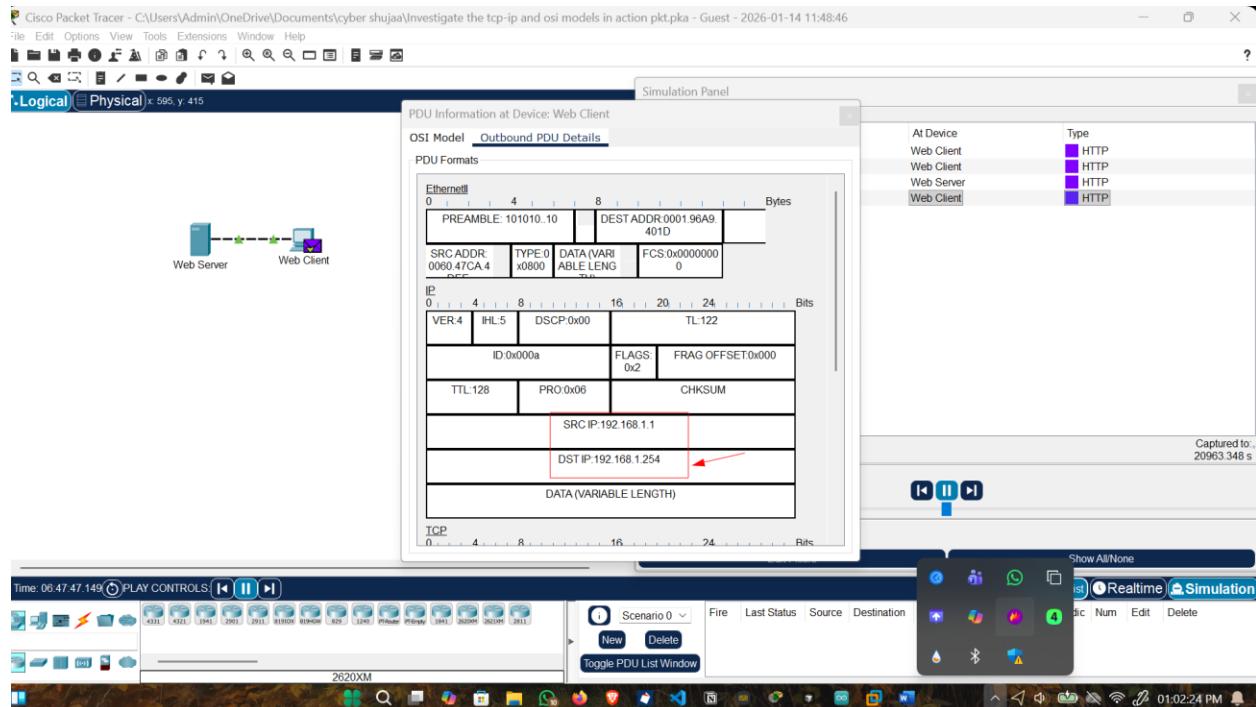


Figure 5.13 Confirmation of DNS server IP Address 1

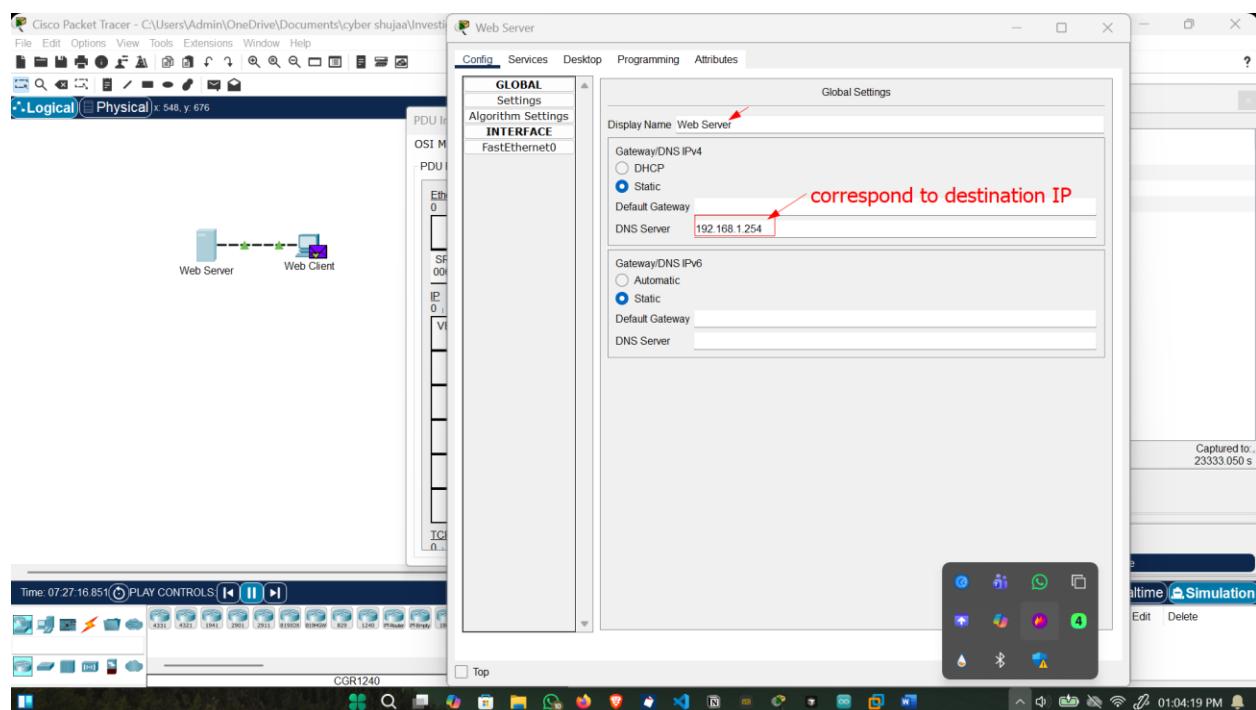


Figure 5.14 Confirmation of DNS server IP Address 2

Layer 2: MAC Addressing (Destination MAC Address, Source MAC Address)

5.4.2 PDU Details Comparison

Table 5.1 PDU Details Comparison

PDU Section	OSI Layer
Network Access	Layer 2,1 (Data link /Physical)
IP Section	Layer 3 (Network)
TCP Section	Layer 4 (Transport)
HTTP Section	Layer 7,6,5 (Application, Presentation, Session)

HTTP Host Field

Host:www.osi.local

Associated with OSI Layer 7.

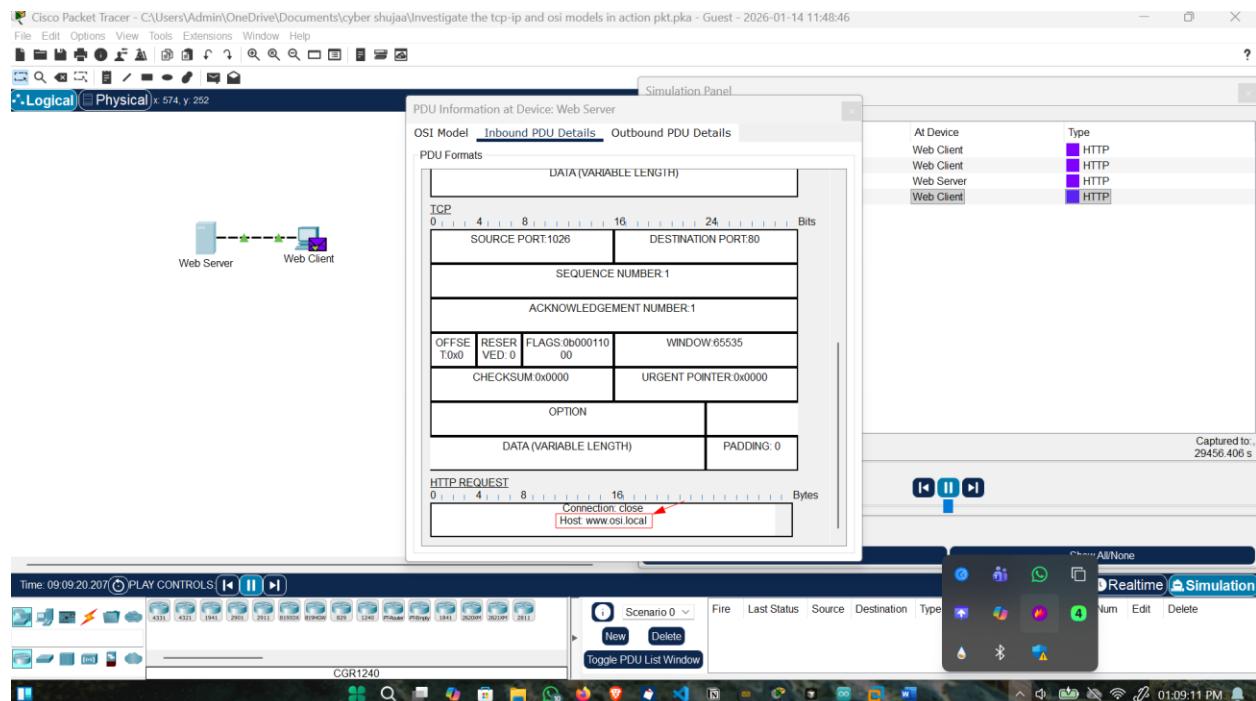


Figure 5.15 HTTP Host

5.4.3 Inbound vs Outbound Layers

Differences Observed:

- IP and MAC addresses are reversed.
- Direction arrows change.
- Client → Server becomes Server → Client.

5.4.4 Final Event Tabs

Answer:

Only **two tabs** are displayed because the packet is only being received (Inbound PDU) and no further transmission occurs.

6 Part 2: Display Elements of the TCP/IP Protocol Suite

6.1 Step 1: View Additional Events

1. Close any open PDU information windows.
2. In the Event List Filters > Visible Events section, click Show All/None.
3. Click the first DNS event in the Type column to Explore the OSI Model and PDU Detail tabs and note the encapsulation process.
4. Click the Outbound PDU Details tab.
5. Click the last DNS Info colored square box in the event list.
6. Find the first HTTP event in the list and click the colored square box of the TCP event immediately following this event. Highlight Layer 4 in the OSI Model tab.
7. Click the last TCP event. Highlight Layer 4 in the OSI Model tab. Examine the steps listed directly below In Layers and Out Layers.

Additional Event Types displayed are:

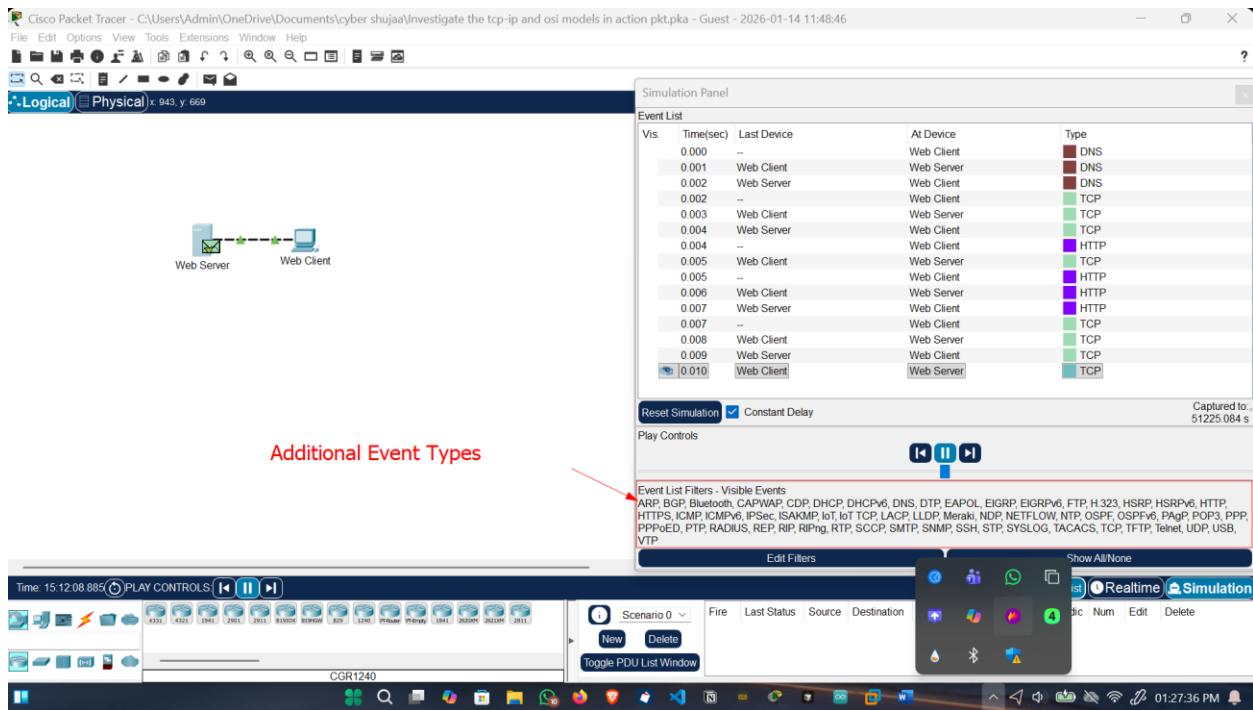


Figure 6.1 Additional Event Types

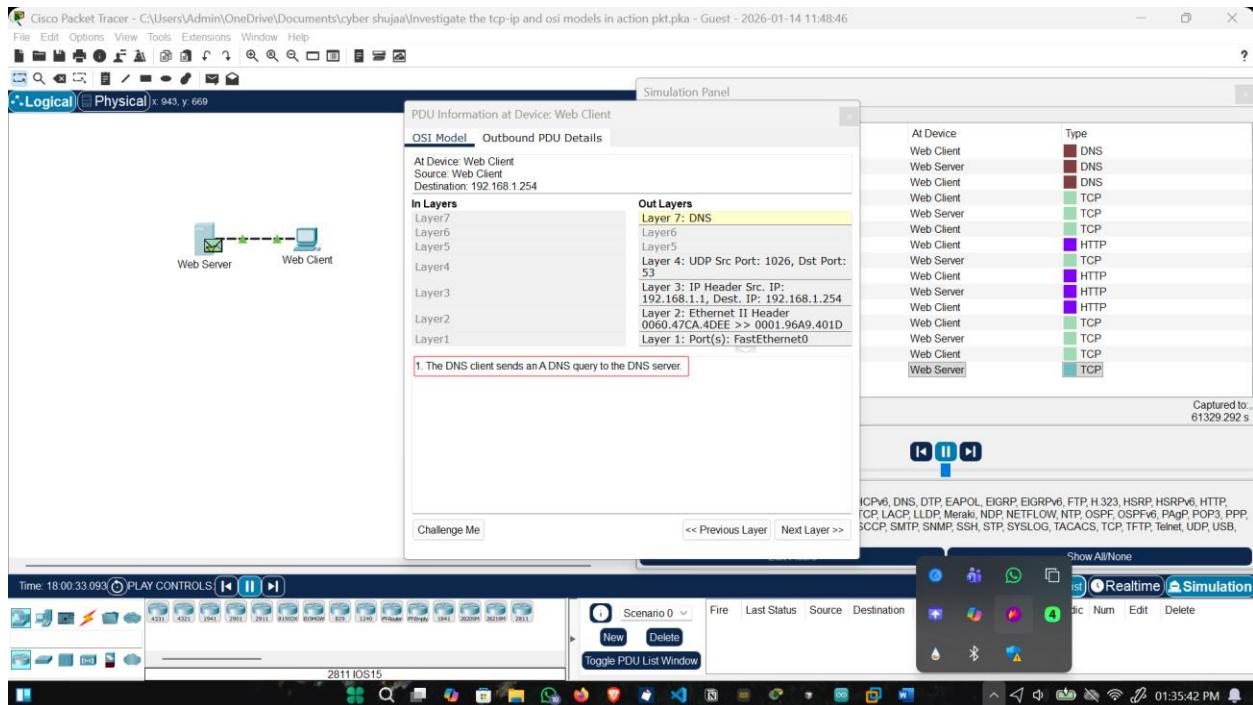


Figure 6.2 DNS Query

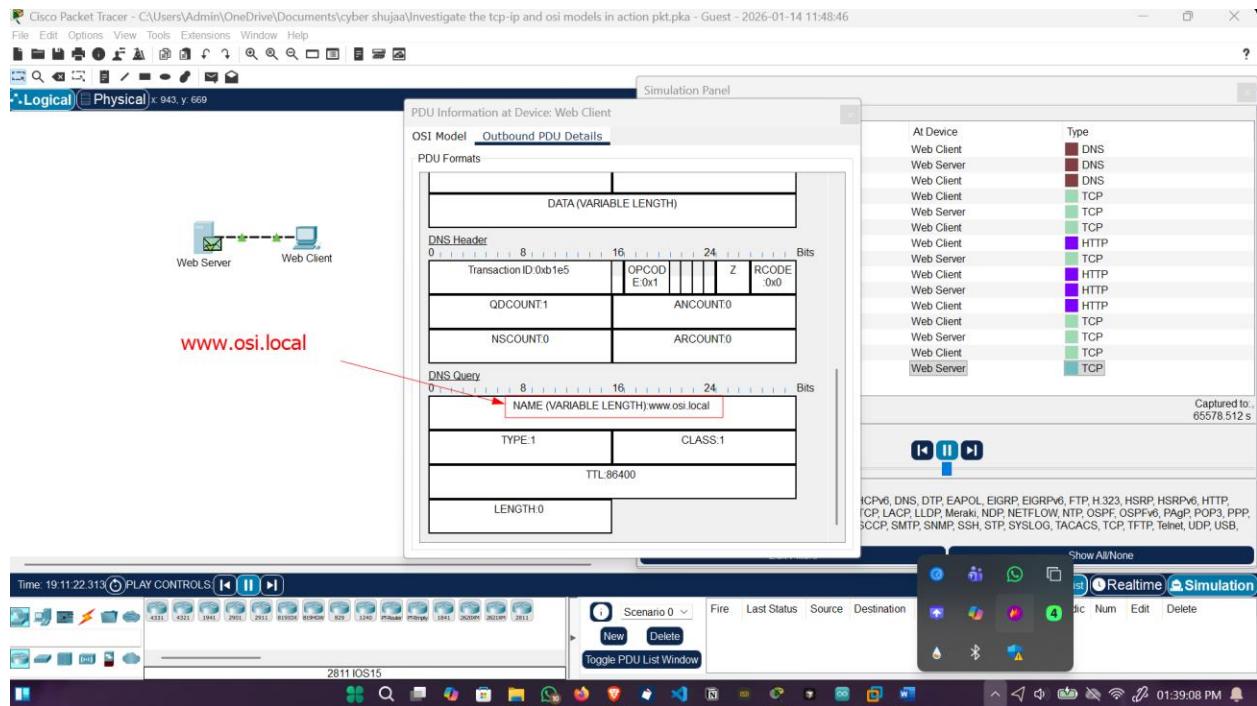


Figure 6.3 DNS Query Name

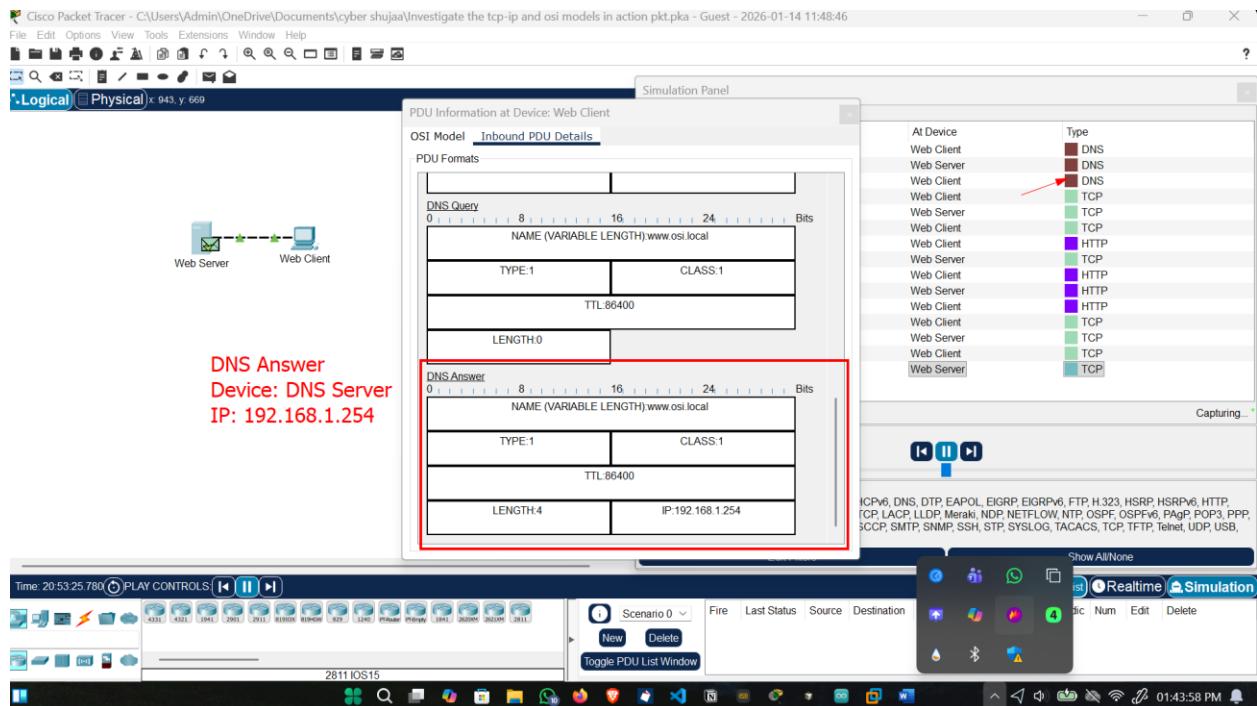


Figure 6.4 DNS Answer

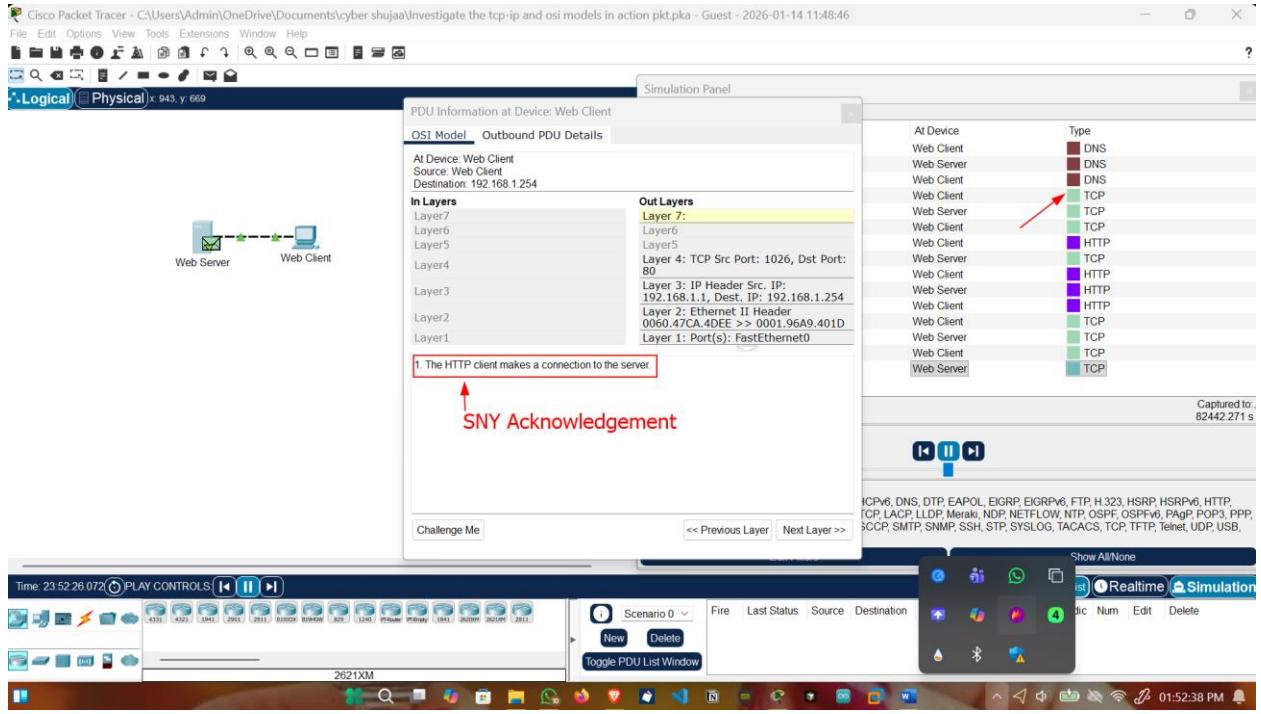


Figure 6.5 SYN ACK

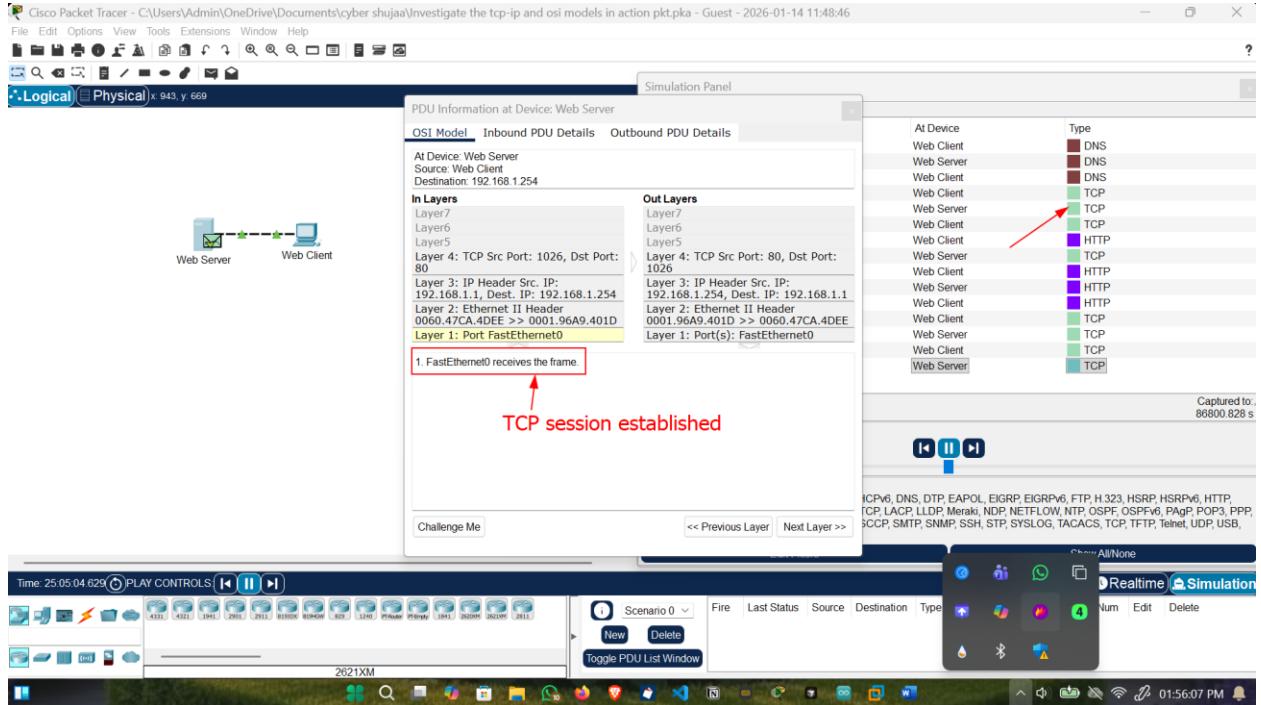


Figure 6.6 TCP Session establishment

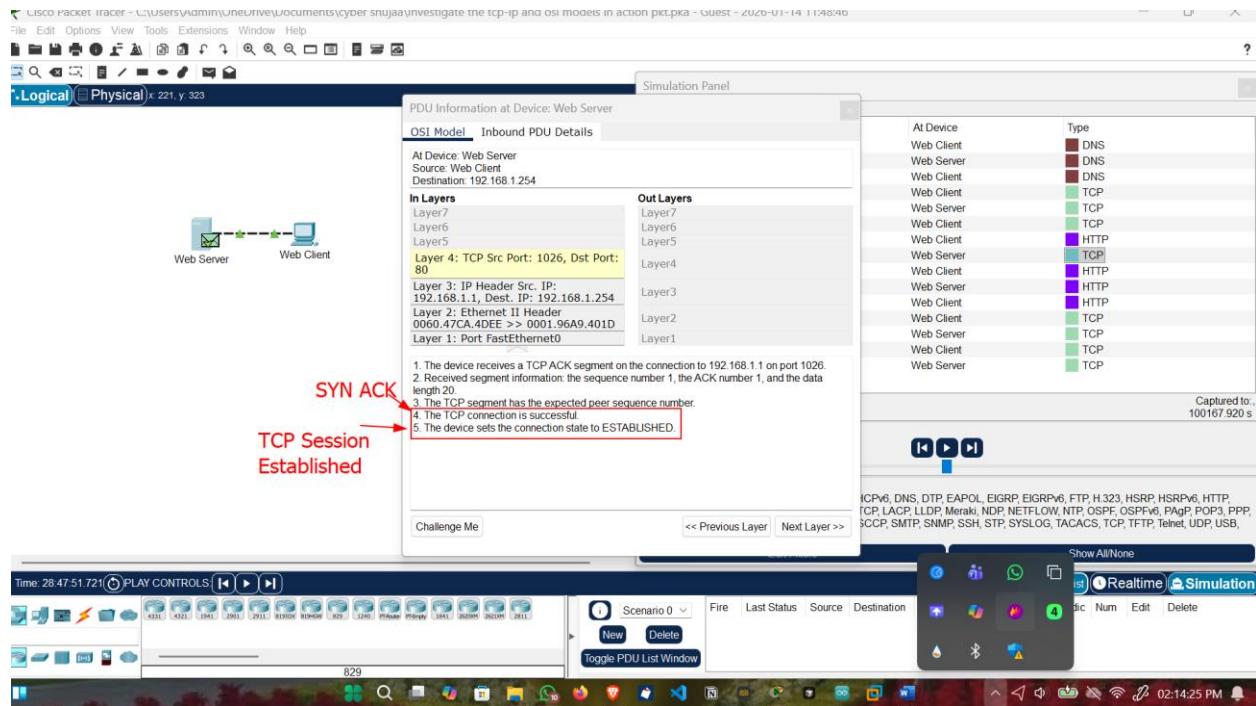


Figure 6.7 SYN & TCP Session Establishment

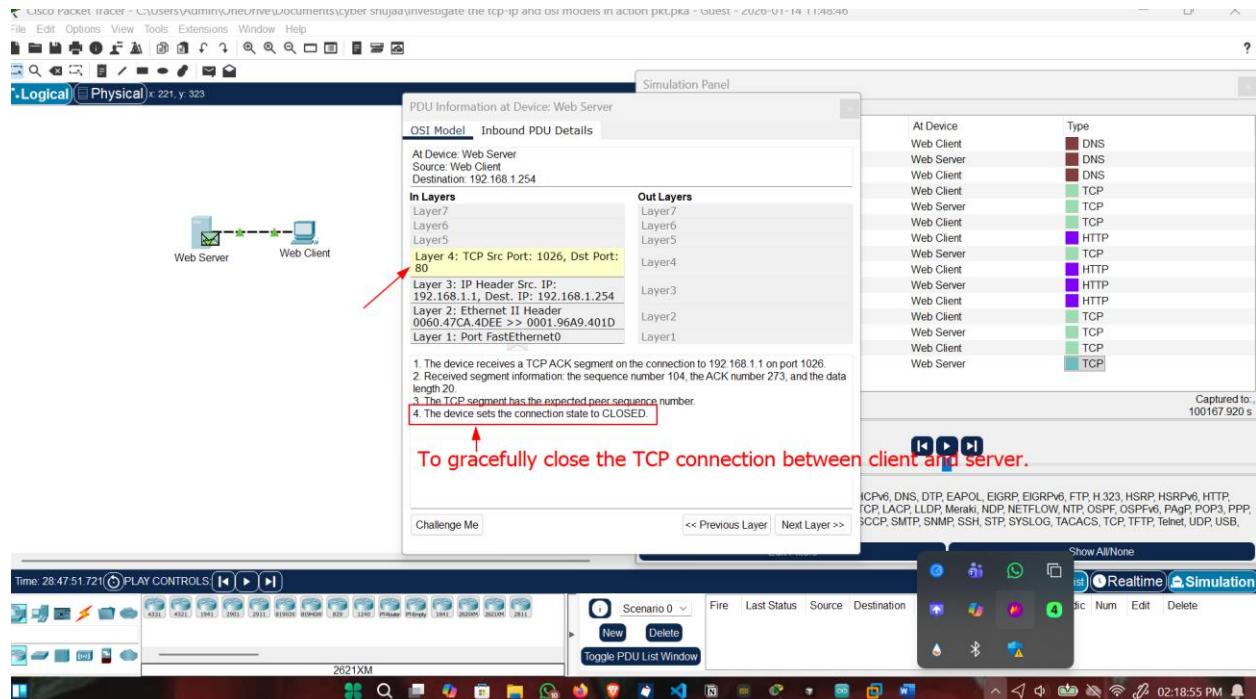


Figure 6.8 TCP Termination

6.2 Challenge Questions

The Web Server Listening PORT: 80

The Web Server Listening PORT for DNS request: 53

6.3 Encapsulation Process Summary

Table 6.1 Encapsulation Process Summary

Layer	PDU
Application	Data
Transport	Segment
Network	Packet
Data Link	Frame
Physical	Bits

6.4 Importance of the Layered Model

- Simplifies troubleshooting
- Enables interoperability
- Improves scalability
- Supports security segmentation

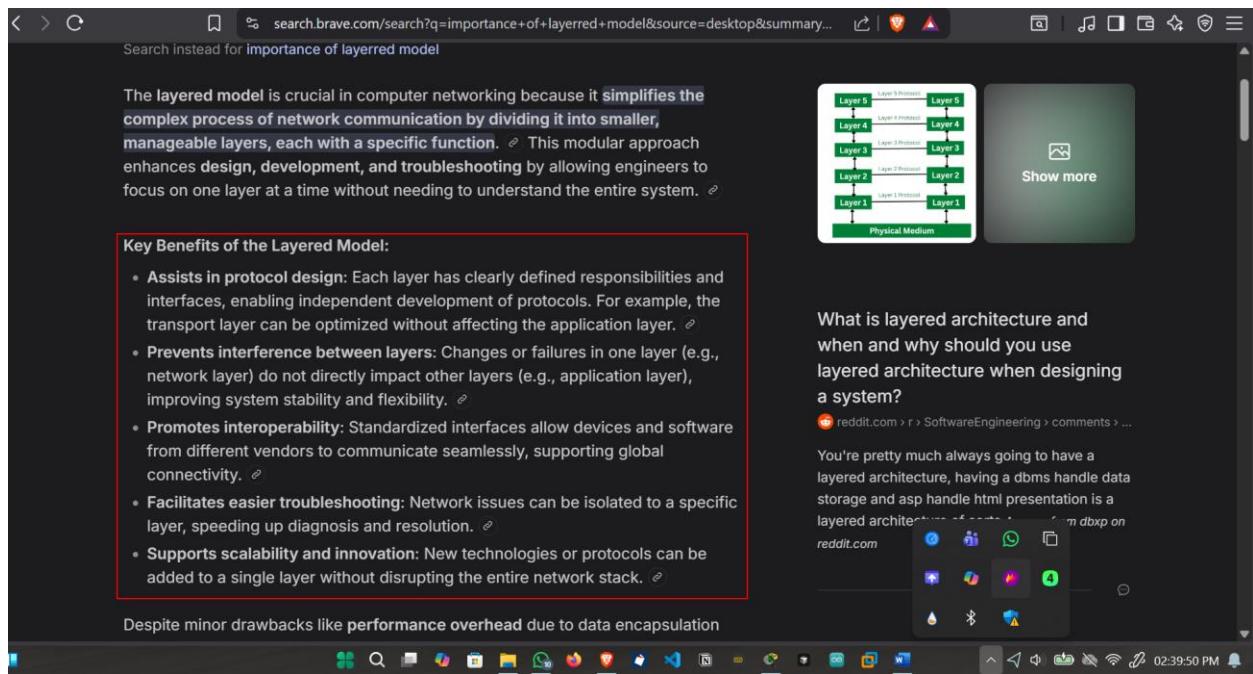


Figure 6.9 Google search

6.5 Real-World Applications

- Network troubleshooting
- Cybersecurity investigations
- Packet analysis
- Firewall rule creation
- Network design

7 CONCLUSION

This simulation successfully demonstrated how HTTP communication is established using DNS resolution and TCP session management. Packet Tracer provided a clear visualization of the encapsulation and decapsulation processes across OSI layers. The experiment reinforced theoretical networking concepts with practical observation, enhancing understanding of real-world network operations.

