This lab session covers the usage of the Wireshark application to monitor and capture the outgoing and incoming packets from a network connection (WIFI, ethernet, etc.). Specifically, students should be able to analyze HTTP, HTTPS, TCP/IP, and UDP protocols using Wireshark, a network protocol analyzer, and draw conclusions.

**Pre-lab Preparation:**

1. Review the basics and the structure of HTTP, TCP/IP, and UDP protocols,
2. Install Wireshark and ensure it is running on your computer,
3. Create an online, *publically accessible* Git repository to host and upload your work in the labs. We recommend you use GitHub or GitLab.

**Lab Activities:**

**Part 1: Capturing HTTP Traffic.**

**Task 1: Start Wireshark and capture packets.**

Step 1: Open Wireshark.

Step 2: Select the network interface connected to the internet (e.g., Ethernet or Wi-Fi).

Step 3: Click the "Start Capturing Packets" button (the shark fin icon).

Step 4: Open your favorite web browser and navigate to (<http://neverssl.com/>) website.

Step 5: After the website has fully loaded, stop capturing packets by clicking the red stop button in Wireshark.

**Task 2: Filter HTTP packets and analyze them.**

Step 1: In the filter bar, type http and press Enter. This filters out only the HTTP packets from the capture.

Step 2: Select any HTTP packet to view its details.

Step 3: Observe the HTTP request and response messages. Note the method (GET, POST), URL, response codes (200 OK, 404 Not Found), etc.

A screenshot of a computer

Description automatically generated

**Part 2: Analyzing TCP/IP Traffic.**

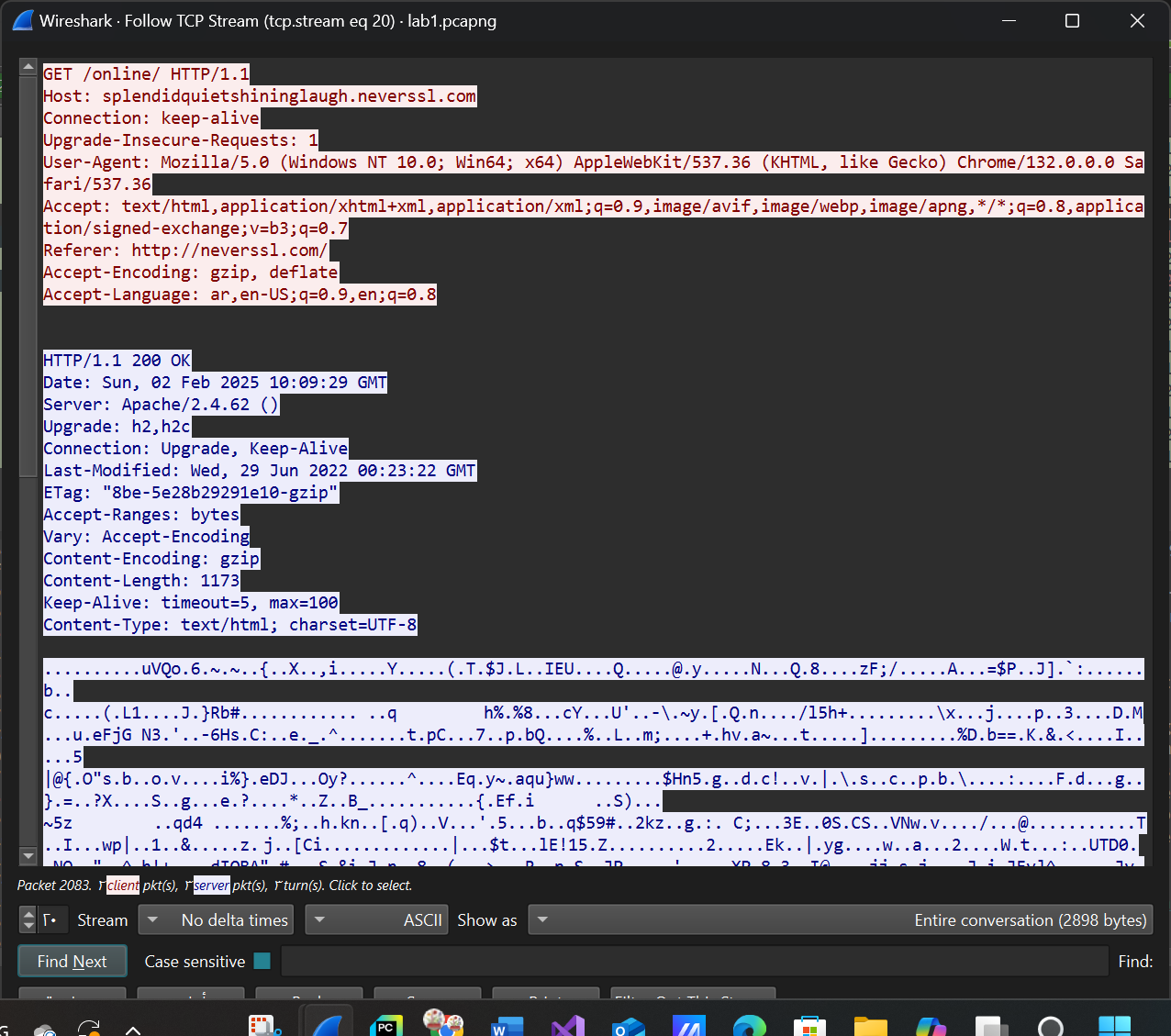
**Task 1: Filter TCP packets**

**Step 1:** Clear the previous filter and type TCP to focus on TCP packets.

**Step 2:** Select a TCP packet related to your HTTP request/response.

**Step 3:** Right-click on the packet and select "Follow" -> "TCP Stream".

**Step 4:** This shows the entire conversation between the client and server.

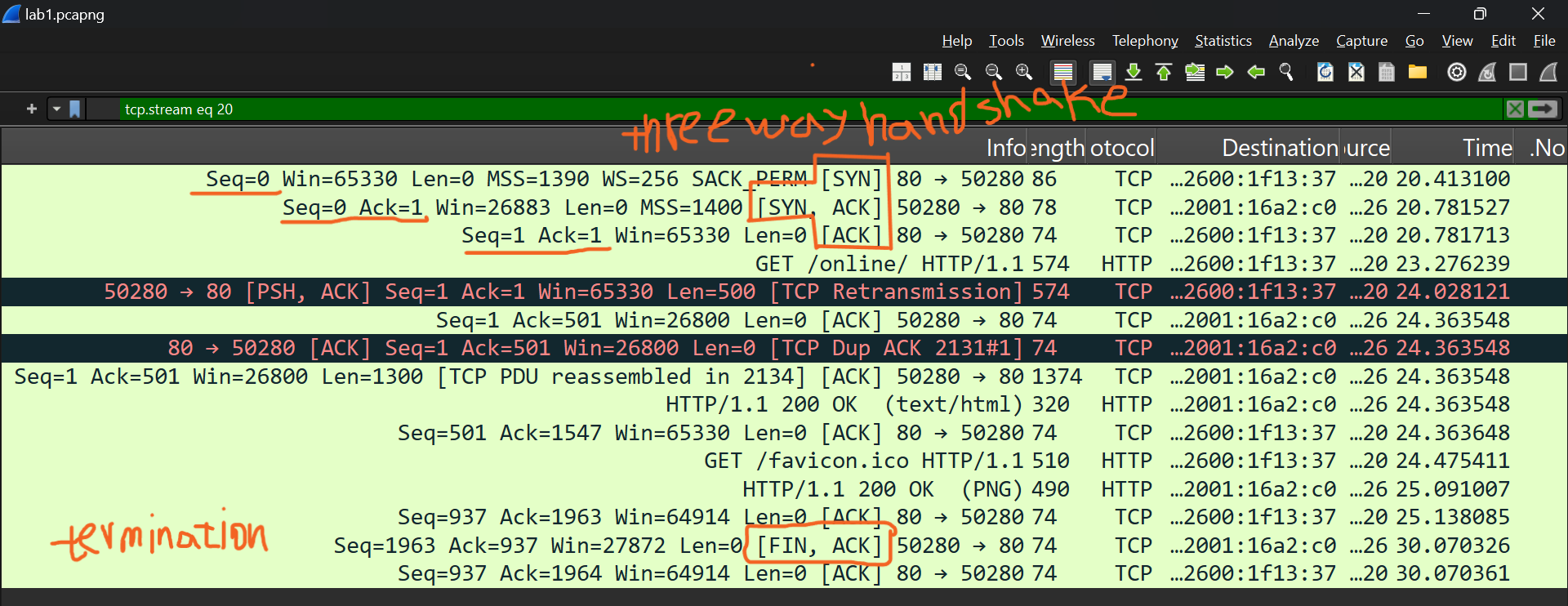


**Task 2: Analyze TCP handshake and investigate Data Transfer and Termination**

**Step 1:** Find and select packets related to the TCP three-way handshake:

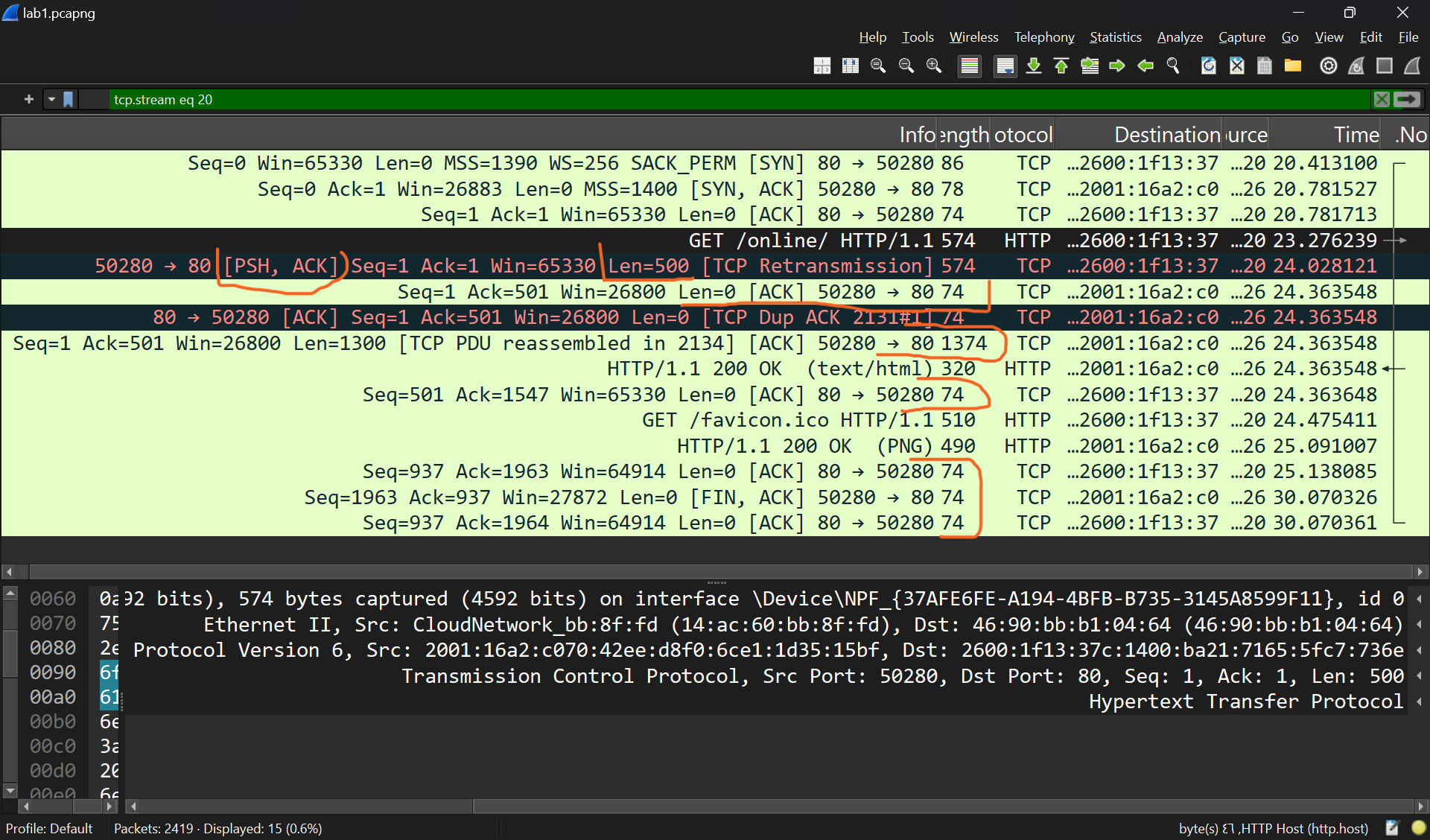
* + SYN: Initiates a connection.
  + SYN-ACK: Acknowledges and responds to the SYN.
  + ACK: Acknowledges the SYN-ACK and establishes the connection.

**Step 2:** Note the sequence and acknowledgment numbers. Screenshot and upload your image to your online git repository.



**Step 3:** Observe the data packets exchanged between the client and server. Take a screenshot and upload it to your online git repo.

**Step 4:** Look at the TCP termination process (FIN, ACK packets).



**Part 3: Capturing and Analyzing UDP Traffic**

**Task 1: Generate UDP traffic and capture packets**

**Step 1:** Open a network application that uses UDP (e.g., streaming video, VoIP software, or custom script).

**Step 2:** Start the application to generate UDP traffic.

**Step 3:** Start capturing packets in Wireshark while the UDP application is running.

**Step 4:** After sufficient traffic is generated, stop capturing packets.

**Task 2: Filter and analysis UDP Packets**

**Step 1:** In the filter bar, type UDP and press Enter.

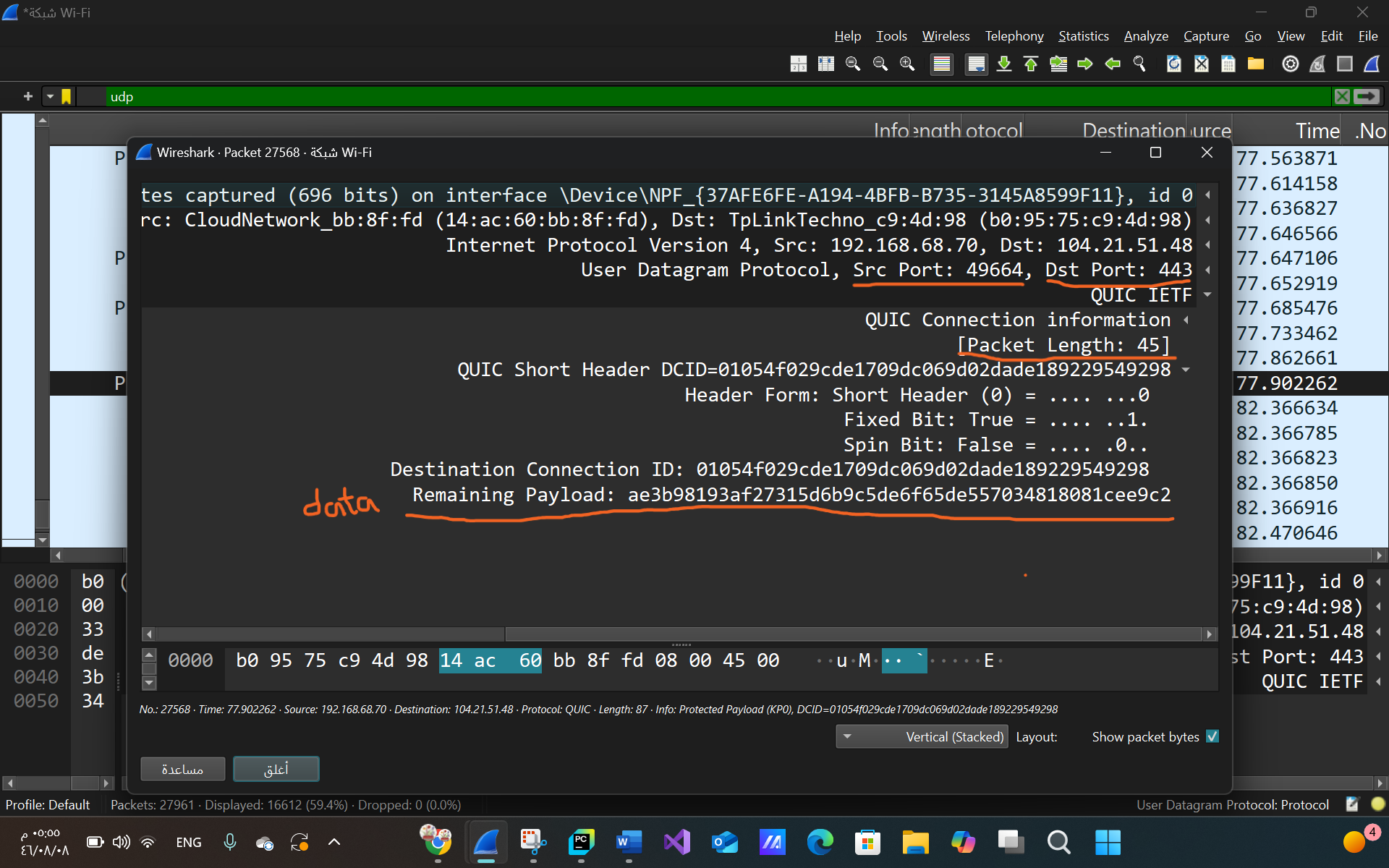
**Step 2:** This filters out only the UDP packets from the capture.

**Step 3:** Select any UDP packet to view its details.

**Step 4:** Observe the source and destination ports, length, and data.

**Step 5:** Compare the simplicity of UDP headers with TCP headers.

| **Feature** | **UDP Header** | **TCP Header** |
| --- | --- | --- |
| Size | **8 bytes** (fixed) | **20-60 bytes** (variable) |
| Fields | Only **4 fields**: Source Port, Destination Port, Length, and Checksum. | **At least 10 fields**, including Sequence Number, Acknowledgment Number, Flags, and more. |
| Complexity | Simple, minimal overhead, designed for speed and efficiency. | Complex, includes mechanisms for reliability, ordering, and congestion control. |
| Functionality | Provides only basic multiplexing and error detection. | Provides connection management, flow control, error correction, and reliable delivery. |



**Part 4: Comparing TCP and UDP by filling in the following tables. Save your work (e.g., in an MS Word document), and upload it to your online git repo.**

**Task 1: Fill in the following table and provide reasons.**

|  | **TCP or UDP** | **Reasons** |
| --- | --- | --- |
| Reliability and Connection Establishment | TCP | TCP provides reliability using acknowledgments (ACKs) and retransmissions. It also establishes a connection using the three-way handshake before data transfer. |
| Data Integrity and Ordering | TCP | TCP ensures data integrity and ordering by sequencing packets and retransmitting lost ones. UDP does not guarantee ordered or reliable delivery. |

**Task 2: Identify the use Cases and Performance of TCP and UDP.**

|  | **TCP** | **UDP** |
| --- | --- | --- |
| Use cases | Web browsing (HTTP/HTTPS), email (SMTP, IMAP, POP3), file transfers (FTP), and applications requiring reliable data delivery. | Online gaming, VoIP, video streaming, DNS lookups, and applications requiring low latency and fast transmission. |
| Performance | Slower due to connection establishment, error checking, and retransmissions, but ensures data reliability and ordering. | Faster since it has no connection setup, retransmissions, or ordering enforcement, making it ideal for real-time communication. |