CLIENT-SERVER EVALUATION USING SOCKETS

Before issuing any commands, initialize the server. As an aside, in Wireshark I have indicated the packet trace that interests us in blue, to make it more intuitive.

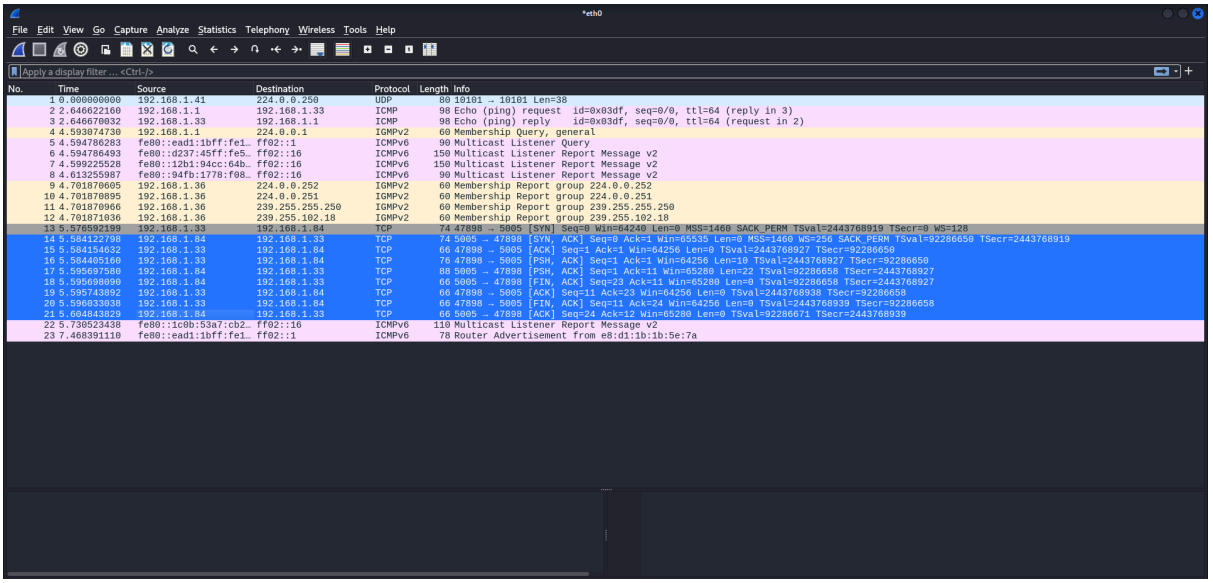
```
PS C:\Users\solos\Desktop\REDES> python .\servidor.py
Servidor configurado, esperando conexiones por el puerto 5005
```

LIST_FILES command

Send the CmdLine:

```
┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84 LIST_FILES
Mandando el comando: LIST_FILES a la IP: 192.168.1.84
Respuesta del servidor:
 cliente.py
servidor.py
```

Exchange showed on Wireshark:



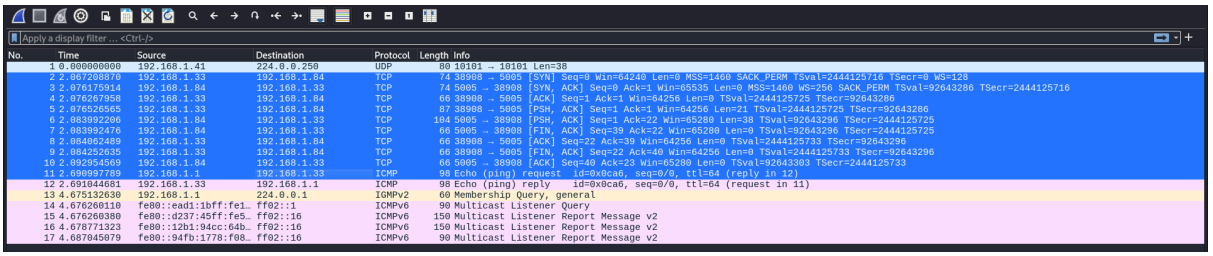
This trace shows a complete TCP session between two hosts: 192.168.1.33 (client) and 192.168.1.84 (server), communicating over port 5005. The exchange includes connection setup, data transfer, and graceful termination.

- Connection Establishment The client initiates the TCP three-way handshake with a SYN packet. The server responds with SYN-ACK, and the client completes the handshake with an ACK. This successfully establishes the connection.

- Data Transfer The client sends a small payload (10 bytes) using a PSH, ACK packet. The server replies with a larger payload (22 bytes), also using PSH, ACK. The client acknowledges receipt with an ACK.

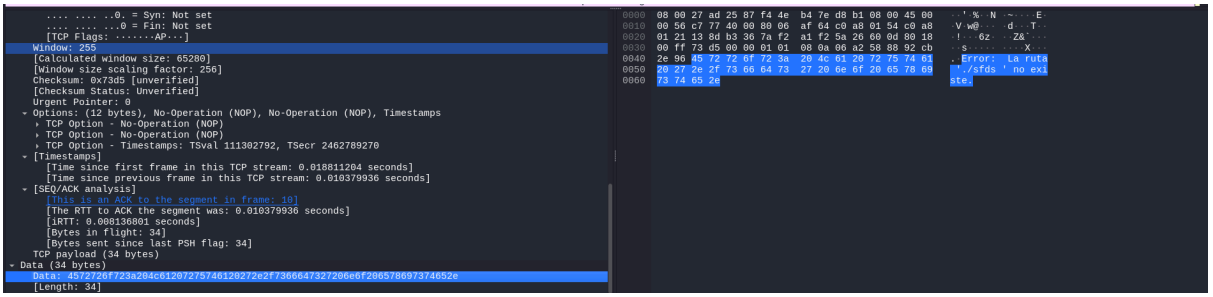
- Connection Termination The server initiates connection teardown with a FIN, ACK. The client responds with its own FIN, ACK, and the server confirms with a final ACK. This completes a clean four-step TCP termination.

If the path doens't exist:



This trace shows a TCP connection between 192.168.1.33 (client) and 192.168.1.41 (server) over port 59005. The session includes a standard three-way handshake, a short data exchange, and an abnormal termination.

We found this packet where it shows that the route doesn't exist



DOWNLOAD_FILE command

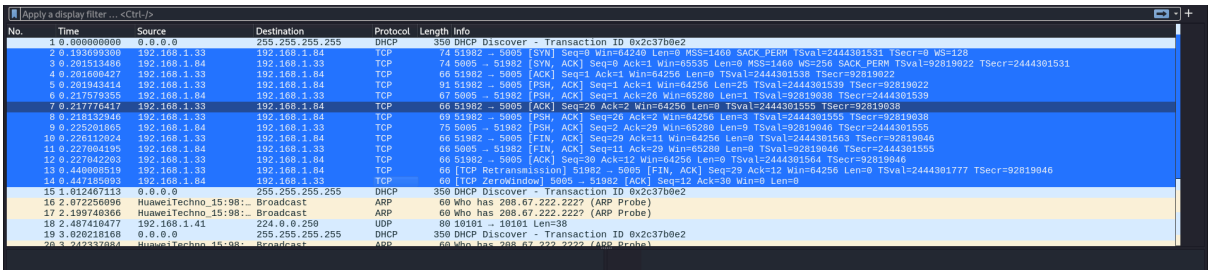
Command Line execution :

```
┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84  DOWNLOAD_FILE numeros.txt
Mandando el comando: DOWNLOAD_FILE numeros.txt a la IP: 192.168.1.84
Tamaño recibido: 9 bytes
Descargado correctamente
Fichero 'numeros.txt' guardado en la ruta actual
```

It downloads correctly.

```
┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ ls
cliente.py  numeros.txt
```

Packet trace on Wireshark:



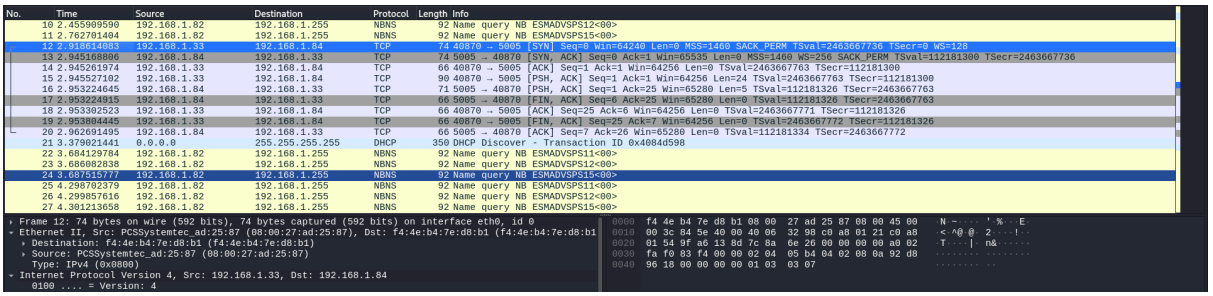
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	0.0.0.0	255.255.255.255	DHCP	350	DHCP Discover - Transaction ID 0x2c37b0e2
2	0.193699300	192.168.1.33	192.168.1.84	TCP	74	51982 → 5005 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=2444301531 TSecr=0 WS=128
3	0.201513486	192.168.1.84	192.168.1.33	TCP	74	5005 → 51982 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM TSval=92819022 TSecr=2444301531
4	0.201600427	192.168.1.33	192.168.1.84	TCP	66	51982 → 5005 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=2444301538 TSecr=92819022
5	0.201943414	192.168.1.33	192.168.1.84	TCP	91	51982 → 5005 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=25 TSval=2444301539 TSecr=92819022
6	0.217579355	192.168.1.84	192.168.1.33	TCP	67	5005 → 51982 [PSH, ACK] Seq=1 Ack=26 Win=65280 Len=1 TSval=92819038 TSecr=2444301539
7	0.217778417	192.168.1.33	192.168.1.84	TCP	66	51982 → 5005 [ACK] Seq=26 Ack=2 Win=64256 Len=0 TSval=2444301555 TSecr=92819038
8	0.218132946	192.168.1.33	192.168.1.84	TCP	69	51982 → 5005 [PSH, ACK] Seq=26 Ack=2 Win=64256 Len=3 TSval=2444301555 TSecr=92819038
9	0.225201865	192.168.1.84	192.168.1.33	TCP	75	5005 → 51982 [PSH, ACK] Seq=2 Ack=29 Win=65280 Len=9 TSval=92819046 TSecr=2444301555
10	0.226112024	192.168.1.33	192.168.1.84	TCP	66	51982 → 5005 [FIN, ACK] Seq=29 Ack=11 Win=64256 Len=0 TSval=2444301563 TSecr=92819046
11	0.227004195	192.168.1.84	192.168.1.33	TCP	66	5005 → 51982 [FIN, ACK] Seq=11 Ack=29 Win=65280 Len=0 TSval=92819046 TSecr=2444301555
12	0.227042203	192.168.1.33	192.168.1.84	TCP	66	51982 → 5005 [ACK] Seq=30 Ack=12 Win=64256 Len=0 TSval=2444301564 TSecr=92819046
13	0.440008519	192.168.1.33	192.168.1.84	TCP	66	[TCP Retransmission] 51982 → 5005 [FIN, ACK] Seq=29 Ack=12 Win=64256 Len=0 TSval=2444301777 TSecr=92819046
14	0.447185093	192.168.1.84	192.168.1.33	TCP	60	[TCP ZeroWindow] 5005 → 51982 [ACK] Seq=12 Ack=30 Win=0 Len=0
15	1.012467113	0.0.0.0	255.255.255.255	DHCP	350	DHCP Discover - Transaction ID 0x2c37b0e2
16	2.077256096	HuaweiTechno_15:98:…	Broadcast	ARP	60	Who has 208.67.222.222? (ARP Probe)
17	2.199740366	HuaweiTechno_15:98:…	Broadcast	ARP	60	Who has 208.67.222.222? (ARP Probe)
18	2.487410477	192.168.1.41	224.0.0.250	UDP	80	10101 → 10101 Len=38
19	3.020218168	0.0.0.0	255.255.255.255	DHCP	350	DHCP Discover - Transaction ID 0x2c37b0e2

This trace captures a complete TCP session between two hosts: 192.168.1.33 (client) and 192.168.1.84 (server), communicating over port 5005. The session includes connection setup, data exchange, and termination.

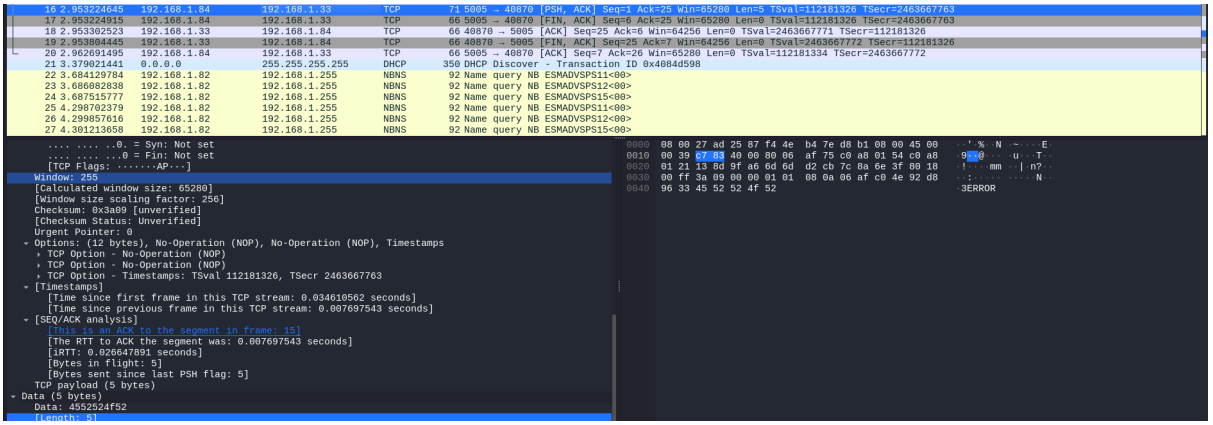
- Connection Establishment The client initiates the connection with a SYN packet. The server responds with SYN-ACK, and the client completes the handshake with an ACK. This establishes a reliable TCP connection.
- Data Transfer Immediately after the handshake, the client sends 25 bytes of data using a PSH, ACK packet. The server acknowledges the data and replies with 9 bytes of its own. The client confirms receipt with an ACK. The server then sends another 9-byte payload, which the client also acknowledges.
- Connection Termination The client initiates termination with a FIN, ACK packet. The server responds with an ACK and later sends its own FIN, ACK. The client replies with a final ACK, completing the four-step TCP termination process.

Command execution in case of error. In this case, I will declare a file that does not exist on the server:

Packet trace on Wireshark:



The TCP session between 192.168.1.33 and 192.168.1.84 completes a full handshake and terminates gracefully using the standard FIN/ACK sequence. This confirms that the connection was closed properly at the transport layer. Any error encountered during the file download must originate from the application layer and would be visible in the payload content, not in the TCP flags.



The key indicator of failure appears in the TCP segment where the server (192.168.1.34) sends a 5-byte payload containing the string "ERROR". This message is embedded in the TCP payload and signals that the server encountered a problem while processing the client's request.

Following this error message, the subsequent packets contain minimal control information and no additional data. This behavior suggests an abrupt termination of the session, likely

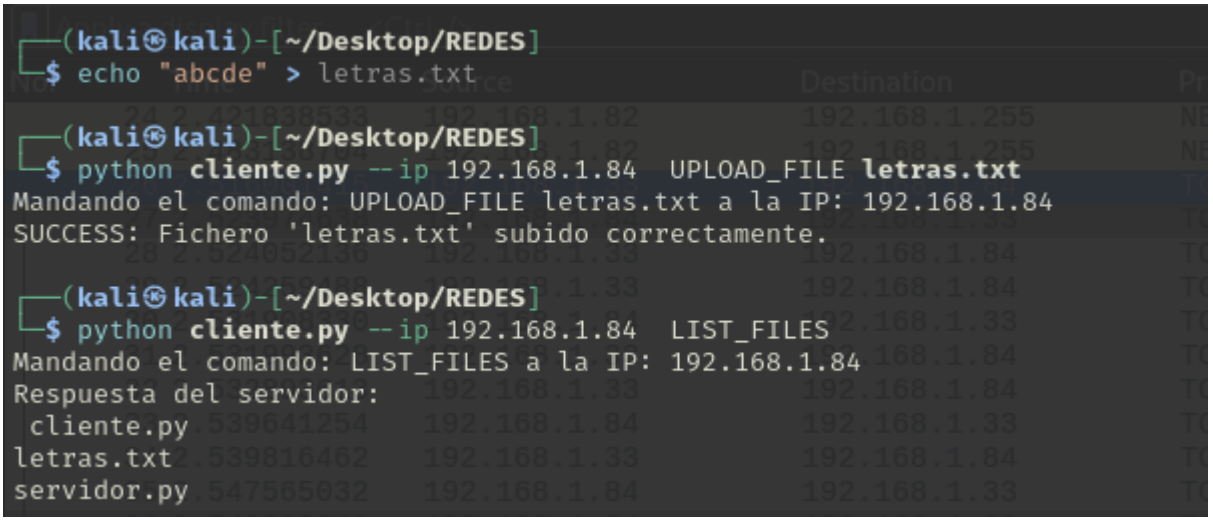
triggered by the application logic rather than a transport-level fault. No TCP reset (RST) flags are present, and the connection closes using the standard FIN/ACK sequence, indicating that the transport layer remained stable.

UPLOAD_FILE command

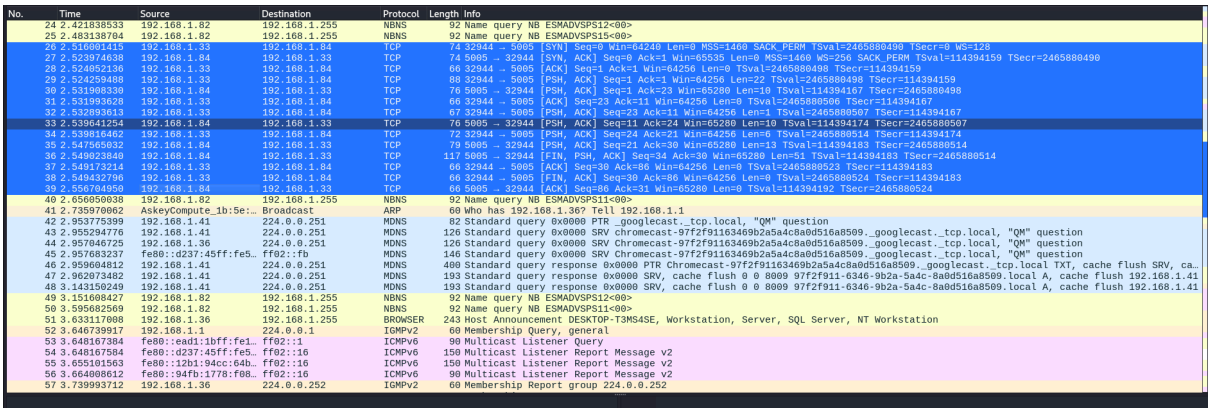
The test scenario begins on the client side, where we first create a simple text file named letras.txt. This file serves as the sample payload for validating the upload functionality of the client–server application.

Once the file is prepared, we execute the UPLOAD_FILE command from the client. The file is transmitted to the server, which processes the request and responds with the message SUCCESS. This confirmation indicates that the server has correctly received and stored the file, and that the upload procedure has completed without errors at the application level.

To verify the integrity of the operation, we then issue the LIST_FILES command. This command queries the server for the current directory contents. The server responds with a list of available files, where letras.txt appears among the entries. The presence of the file in the server's directory confirms that the upload was successful and that the file is now accessible from the server side.

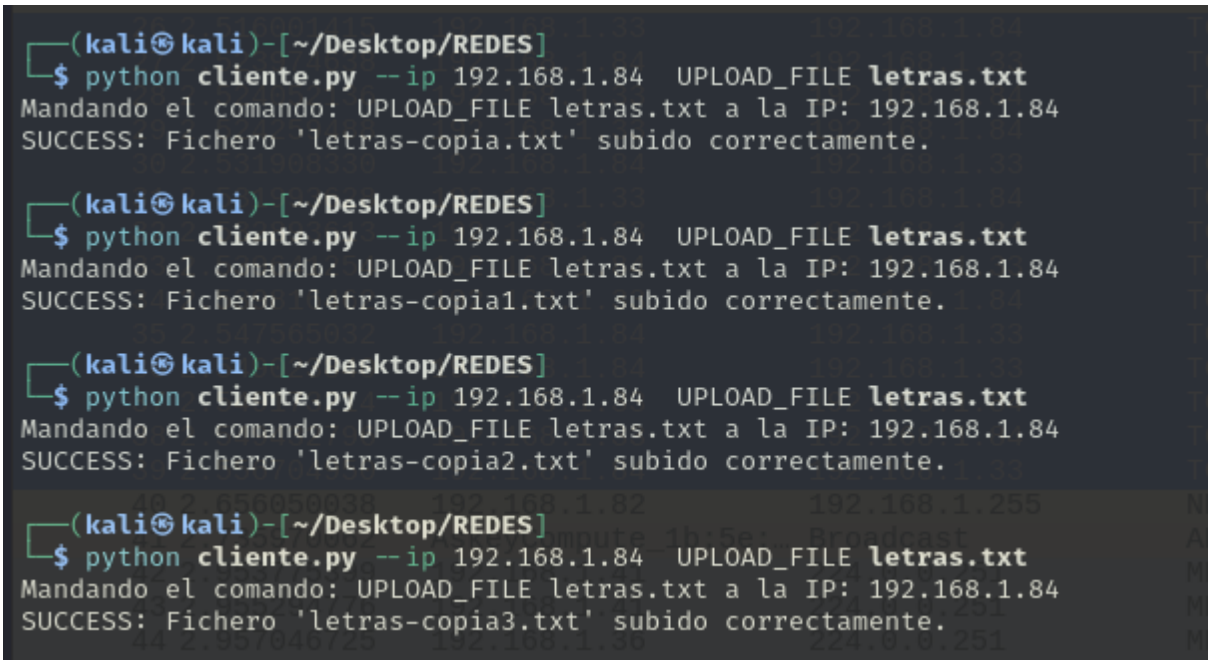


The trace shows a complete TCP session between 192.168.1.33 and 192.168.1.84, starting with a standard three-way handshake and followed by a sequence of data exchanges. The client uploads the file letras.txt, and the server responds with a “SUCCESS” message, confirming correct reception. The connection is then closed gracefully using FIN and ACK flags.



No.	Time	Source	Destination	Protocol	Length	Info
24	2.421838533	192.168.1.82	192.168.1.255	NBNS	92	Name query NB ESMADVSPS12<00>
25	2.483138704	192.168.1.82	192.168.1.255	NBNS	92	Name query NB ESMADVSPS15<00>
26	2.516001415	192.168.1.33	192.168.1.84	TCP	74	32944 → 5005 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=2465880490 TSecr=0 WS=128
27	2.523974638	192.168.1.84	192.168.1.33	TCP	74	5005 → 32944 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM TSval=114394159 TSecr=2465880490
28	2.524052136	192.168.1.33	192.168.1.84	TCP	66	32944 → 5005 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=2465880498 TSecr=114394159
29	2.524259488	192.168.1.33	192.168.1.84	TCP	88	32944 → 5005 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=22 TSval=2465880498 TSecr=114394159
30	2.531908330	192.168.1.84	192.168.1.33	TCP	76	5005 → 32944 [PSH, ACK] Seq=1 Ack=23 Win=65280 Len=10 TSval=114394167 TSecr=2465880498
31	2.531993628	192.168.1.33	192.168.1.84	TCP	66	32944 → 5005 [ACK] Seq=23 Ack=11 Win=64256 Len=0 TSval=2465880506 TSecr=114394167
32	2.532893613	192.168.1.33	192.168.1.84	TCP	67	32944 → 5005 [PSH, ACK] Seq=23 Ack=11 Win=64256 Len=1 TSval=2465880507 TSecr=114394167
33	2.539641254	192.168.1.84	192.168.1.33	TCP	76	5005 → 32944 [PSH, ACK] Seq=11 Ack=24 Win=65280 Len=10 TSval=114394174 TSecr=2465880507
34	2.539816402	192.168.1.33	192.168.1.84	TCP	72	32944 → 5005 [PSH, ACK] Seq=24 Ack=21 Win=64256 Len=6 TSval=2465880514 TSecr=114394174
35	2.547565632	192.168.1.84	192.168.1.33	TCP	79	5005 → 32944 [PSH, ACK] Seq=21 Ack=30 Win=65280 Len=13 TSval=114394183 TSecr=2465880514
36	2.549023840	192.168.1.84	192.168.1.33	TCP	117	5005 → 32944 [FIN, PSH, ACK] Seq=34 Ack=30 Win=65280 Len=51 TSval=114394183 TSecr=2465880514
37	2.549173214	192.168.1.33	192.168.1.84	TCP	66	32944 → 5005 [ACK] Seq=30 Ack=86 Win=64256 Len=0 TSval=2465880523 TSecr=114394183
38	2.549432796	192.168.1.33	192.168.1.84	TCP	66	32944 → 5005 [FIN, ACK] Seq=30 Ack=86 Win=64256 Len=0 TSval=2465880524 TSecr=114394183
39	2.556704950	192.168.1.84	192.168.1.33	TCP	66	5005 → 32944 [ACK] Seq=86 Ack=31 Win=65280 Len=0 TSval=114394192 TSecr=2465880524
40	2.656050038	192.168.1.82	192.168.1.255	NBNS	92	Name query NB ESMADVSPS11<00>
41	2.735970062	AskeyCompute_1b:5e:…	Broadcast	ARP	60	Who has 192.168.1.36? Tell 192.168.1.1
42	2.953775399	192.168.1.41	224.0.0.251	MDNS	82	Standard query 0x0000 PTR _googlecast._tcp.local, "QM" question
43	2.955294776	192.168.1.41	224.0.0.251	MDNS	126	Standard query 0x0000 SRV chromecast-97f2f91163469b2a5a4c8a0d516a8509._googlecast._tcp.local, "QM" question
44	2.957046725	192.168.1.36	224.0.0.251	MDNS	126	Standard query 0x0000 SRV chromecast-97f2f91163469b2a5a4c8a0d516a8509._googlecast._tcp.local, "QM" question
45	2.957683237	fe80::d237:45ff:fe5…	ff02::fb	MDNS	146	Standard query 0x0000 SRV chromecast-97f2f91163469b2a5a4c8a0d516a8509._googlecast._tcp.local, "QM" question
46	2.959604812	192.168.1.41	224.0.0.251	MDNS	400	Standard query response 0x0000 PTR chromecast-97f2f91163469b2a5a4c8a0d516a8509._googlecast._tcp.local TXT, cache flush SRV, ca…
47	2.962073482	192.168.1.41	224.0.0.251	MDNS	193	Standard query response 0x0000 SRV, cache flush 0 0 8009 97f2f911-6346-9b2a-5a4c-8a0d516a8509.local A, cache flush 192.168.1.41
48	3.143150249	192.168.1.41	224.0.0.251	MDNS	193	Standard query response 0x0000 SRV, cache flush 0 0 8009 97f2f911-6346-9b2a-5a4c-8a0d516a8509.local A, cache flush 192.168.1.41
49	3.151608427	192.168.1.82	192.168.1.255	NBNS	92	Name query NB ESMADVSPS12<00>
50	3.595682569	192.168.1.82	192.168.1.255	NBNS	92	Name query NB ESMADVSPS11<00>
51	3.633117008	192.168.1.36	192.168.1.255	BROWSER	243	Host Announcement DESKTOP-T3MS4SE, Workstation, Server, SQL Server, NT Workstation
52	3.646739917	192.168.1.1	224.0.0.1	IGMPv2	60	Membership Query, general
53	3.648167384	fe80::ead1:1bff:fe1…	ff02::1	ICMPv6	90	Multicast Listener Query
54	3.648167584	fe80::d237:45ff:fe5…	ff02::16	ICMPv6	150	Multicast Listener Report Message v2
55	3.655101563	fe80::12b1:94cc:64b…	ff02::16	ICMPv6	150	Multicast Listener Report Message v2
56	3.664008612	fe80::94fb:1778:f08…	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
57	3.739993712	192.168.1.36	224.0.0.252	IGMPv2	60	Membership Report group 224.0.0.252

If the file already exists on the server, it will be duplicated under a new name by appending a digit at the end. The naming convention follows the format *name-copia1.ext*, *name-copia2.ext*, and so on, ensuring that the original file is preserved while each subsequent upload is stored as a separate version. This mechanism prevents overwriting and guarantees that multiple copies of the same file can coexist safely on the server.

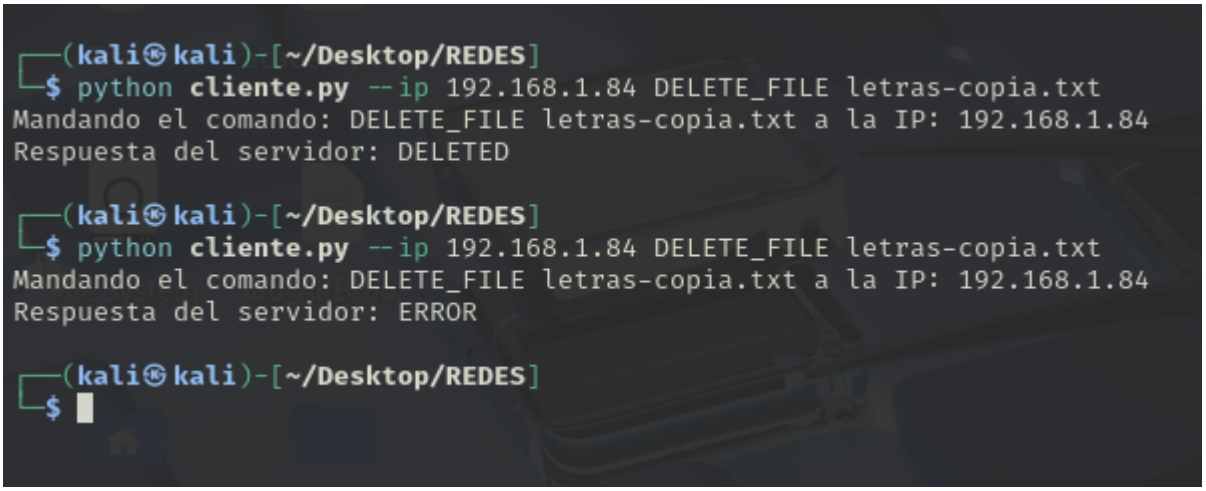


```
┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84  UPLOAD_FILE letras.txt
Mandando el comando: UPLOAD_FILE letras.txt a la IP: 192.168.1.84
SUCCESS: Fichero 'letras-copia.txt' subido correctamente.

┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84  UPLOAD_FILE letras.txt
Mandando el comando: UPLOAD_FILE letras.txt a la IP: 192.168.1.84
SUCCESS: Fichero 'letras-copia1.txt' subido correctamente.

┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84  UPLOAD_FILE letras.txt
Mandando el comando: UPLOAD_FILE letras.txt a la IP: 192.168.1.84
SUCCESS: Fichero 'letras-copia2.txt' subido correctamente.

┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84  UPLOAD_FILE letras.txt
Mandando el comando: UPLOAD_FILE letras.txt a la IP: 192.168.1.84
SUCCESS: Fichero 'letras-copia3.txt' subido correctamente.
```

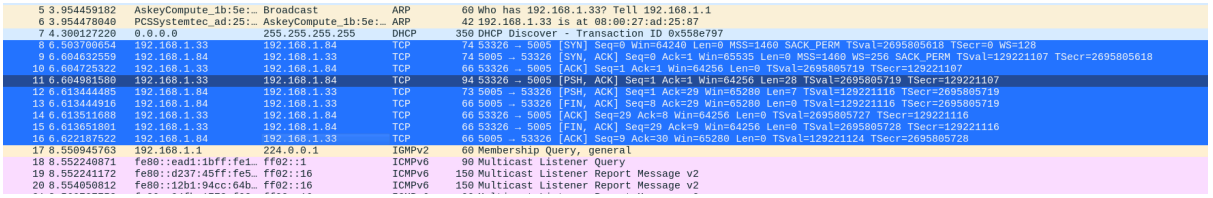
DELETE_FILE command

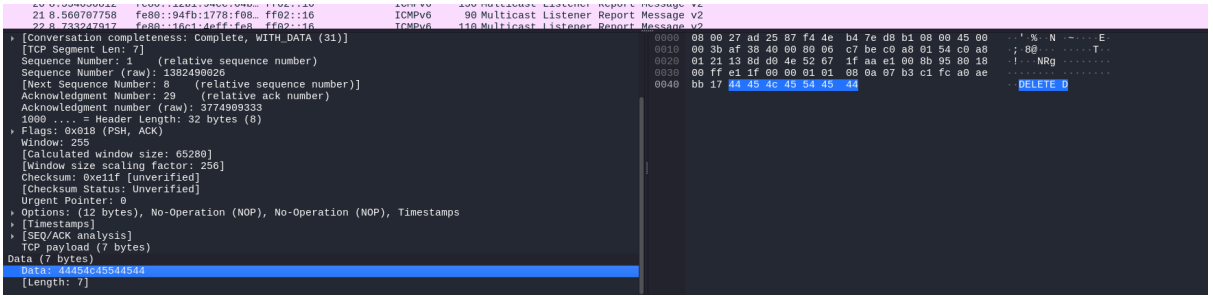
When the DELETE_FILE command is executed from the client, it sends a request to the server to remove a specified file. On the first attempt, the file (letras-copia.txt) exists on the server, so the deletion is successful and the server responds with DELETED. On subsequent attempts, since the file has already been removed, the server returns an

ERROR message indicating that the file no longer exists or cannot be deleted. No additional information is displayed, as per the professor's instructions to keep the output minimal and focused.

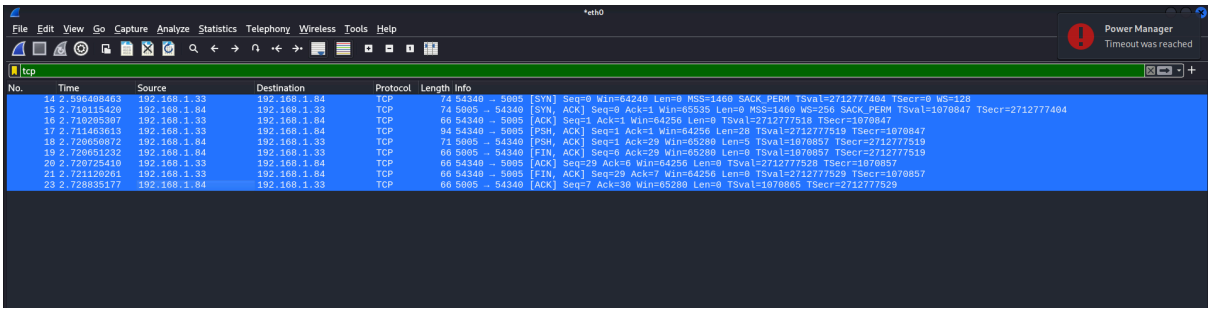


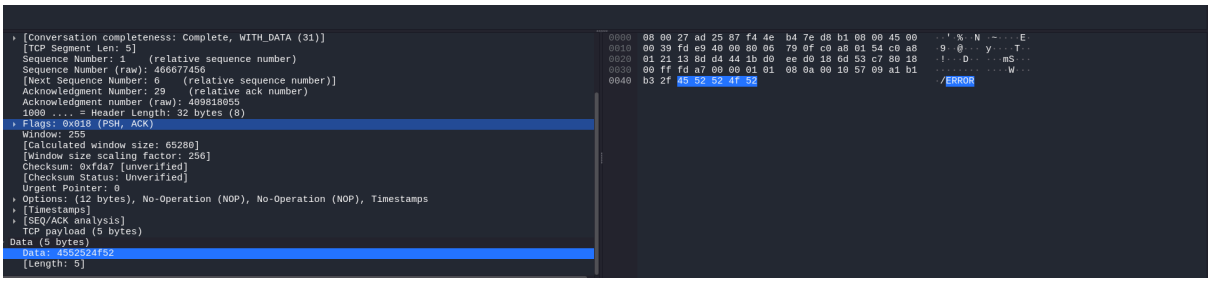
The Wireshark trace of the DELETE_FILE command shows the complete TCP exchange between the client and the server. The communication begins with the standard three-way handshake, where the client initiates the connection with a SYN packet, the server responds with SYN-ACK, and the client completes the handshake with an ACK. Once the connection is established, the client immediately sends the application data containing the DELETE_FILE request. The server processes this request and replies with the message DELETED, confirming that the file was successfully removed.





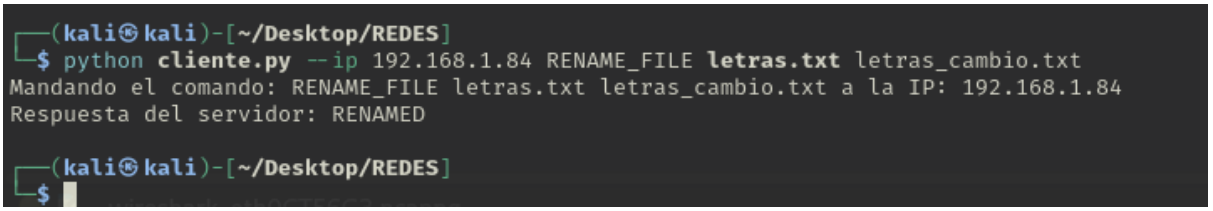
The Wireshark trace of the failed DELETE_FILE execution shows the same initial TCP handshake as in the successful case, with the client and server establishing a connection through SYN, SYN-ACK, and ACK packets. After the handshake, the client sends the application data containing the DELETE_FILE letras-copia.txt request. Since the file no longer exists on the server, the server responds with the message ERROR instead of DELETED.

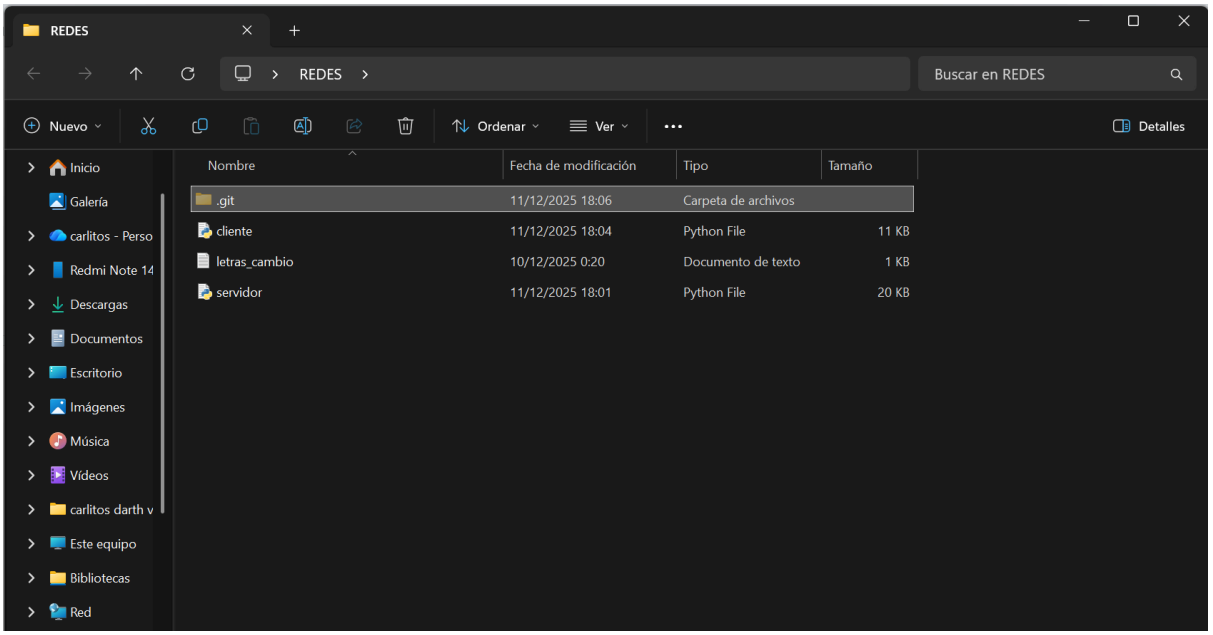




RENAME_FILE command

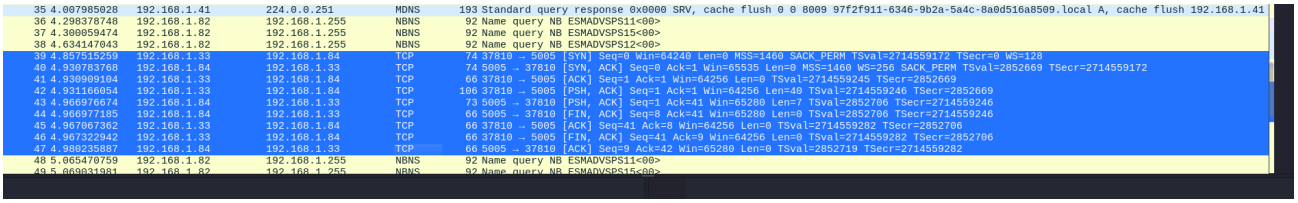
The RENAME_FILE <original_name> <new_name> command instructs the server to rename an existing file. When the server receives this request, it attempts to change the file's name from the original to the new one provided by the client. If the operation is successful, the server responds with the message RENAMED, confirming that the file name has been changed correctly. This ensures clear feedback to the client about the outcome of the rename operation.

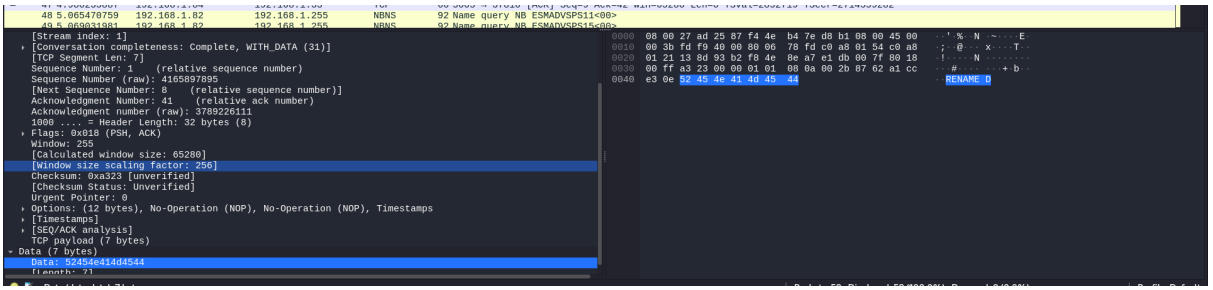




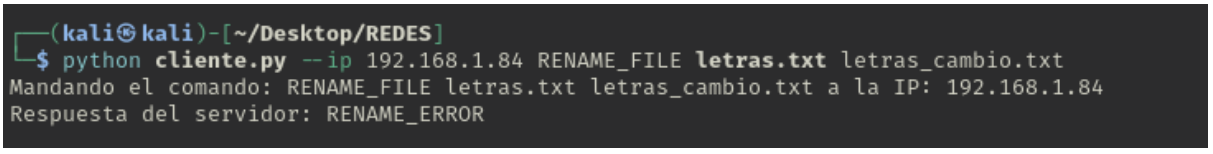
SERVER'S FOLDER

The trace shows the execution of the RENAME_FILE command between the client at 192.168.1.33 and the server at 192.168.1.84. After the connection is established through the three-way handshake, the client sends the request and the server replies with the message RENAMED, confirming the change. The exchange is completed with acknowledgments and a clean termination of the TCP session. The sequence numbers and acknowledgments progress correctly, and the communication ends without retransmissions or errors, showing a clean and orderly TCP flow.

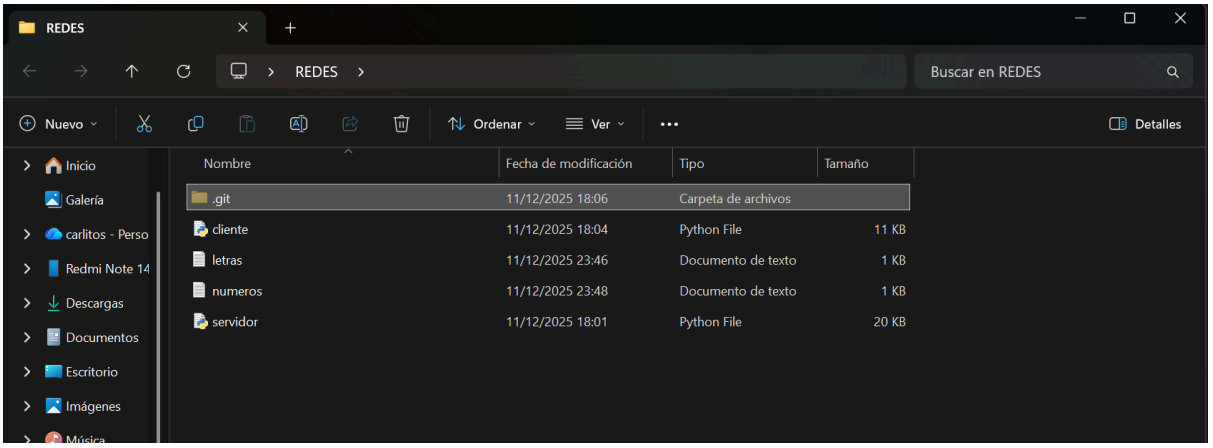




The server will send the message RENAME_ERROR if the file specified as <original_name> does not exist, or if there is already another file with the same name as the one provided in <new_name>. This response ensures that the client is informed whenever the rename operation cannot be completed, either because the source file is missing or because renaming would cause a conflict with an existing file.

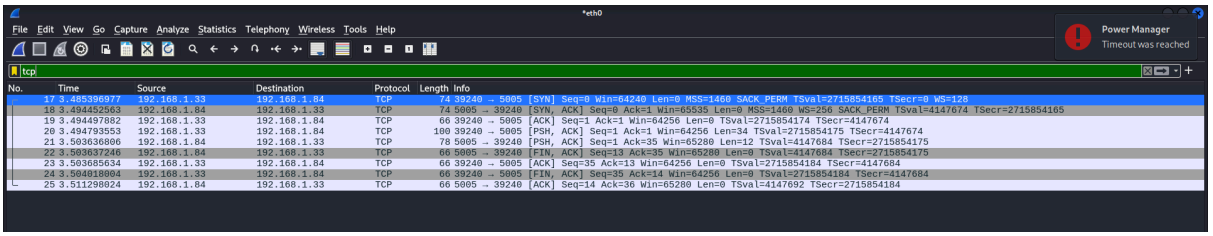


ACTUAL SERVER'S FOLDER

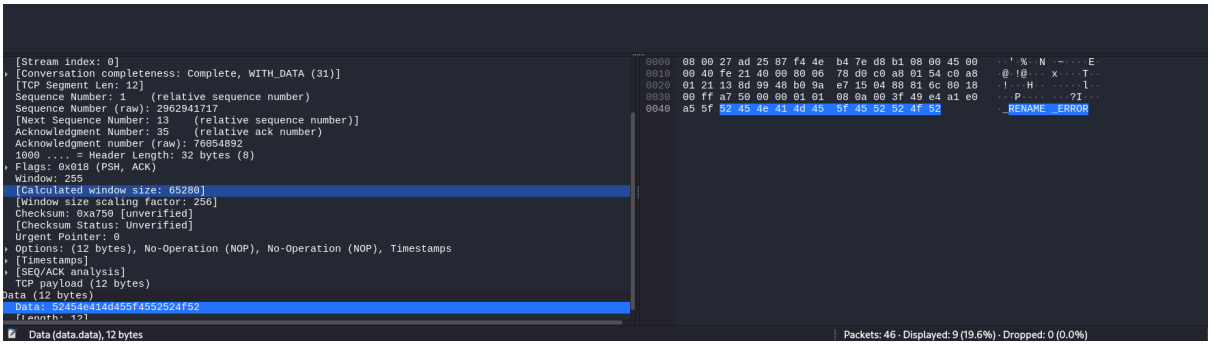



```
┌──(kali㉿kali)-[~/Desktop/REDES]
└─$ python cliente.py --ip 192.168.1.84 RENAME_FILE numeros.txt  letras.txt
Mandando el comando: RENAME_FILE numeros.txt letras.txt a la IP: 192.168.1.84
Respuesta del servidor: RENAME_ERROR
```

The server returns RENAME_ERROR when there is already a file with the same name as the one specified in <new_name>.

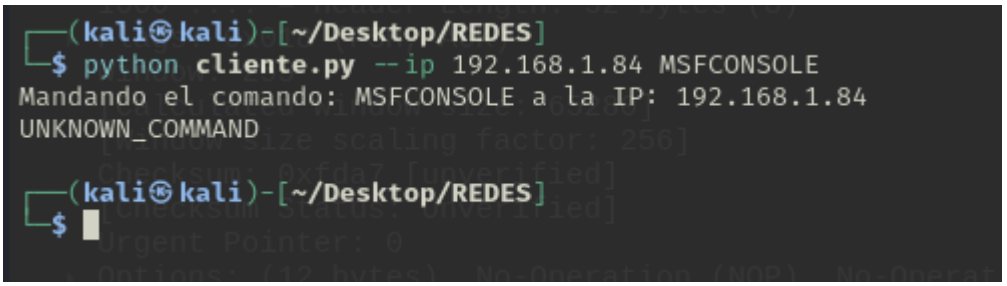


The Wireshark trace shows a complete TCP session between the client at 192.168.1.33 and the server at 192.168.1.84 during the execution of the RENAME_FILE command. After the three-way handshake, the client sends a 34-byte payload containing the rename request. The server responds with an ACK and immediately closes the connection using a FIN, ACK packet. No additional data is sent, indicating that the server did not return the expected RENAMED message. This behavior suggests that the server encountered an error, likely because the original file did not exist or the new name was already taken, and responded with RENAME_ERROR before terminating the session. The TCP flow is clean, with no retransmissions or anomalies, confirming that the error was handled at the application level.



UNKNOWN_COMMAND

In all the previous cases, if the server receives an incorrect or unrecognized command name, it must respond to the client with the message **"UNKNOWN_COMMAND"**. This ensures that the client is explicitly informed that the request could not be processed because the command does not match any of the valid operations defined in the protocol. By returning this standardized error message, the server maintains consistency in communication and provides clear feedback to the client about invalid input.



The connection begins with the standard three-way handshake: the client sends a SYN packet, the server replies with SYN-ACK, and the client completes the handshake with an ACK. Immediately after establishing the connection, the client sends a small payload containing the invalid command using a PSH, ACK packet. The server processes the request and responds with a PSH, ACK packet containing the message UNKNOWN_COMMAND, indicating that the received instruction does not match any valid protocol operations. The client acknowledges the response, and both sides proceed to terminate the connection gracefully using FIN and ACK packets. The trace confirms that the server correctly identifies and handles invalid input, maintaining protocol integrity and providing clear feedback to the client.