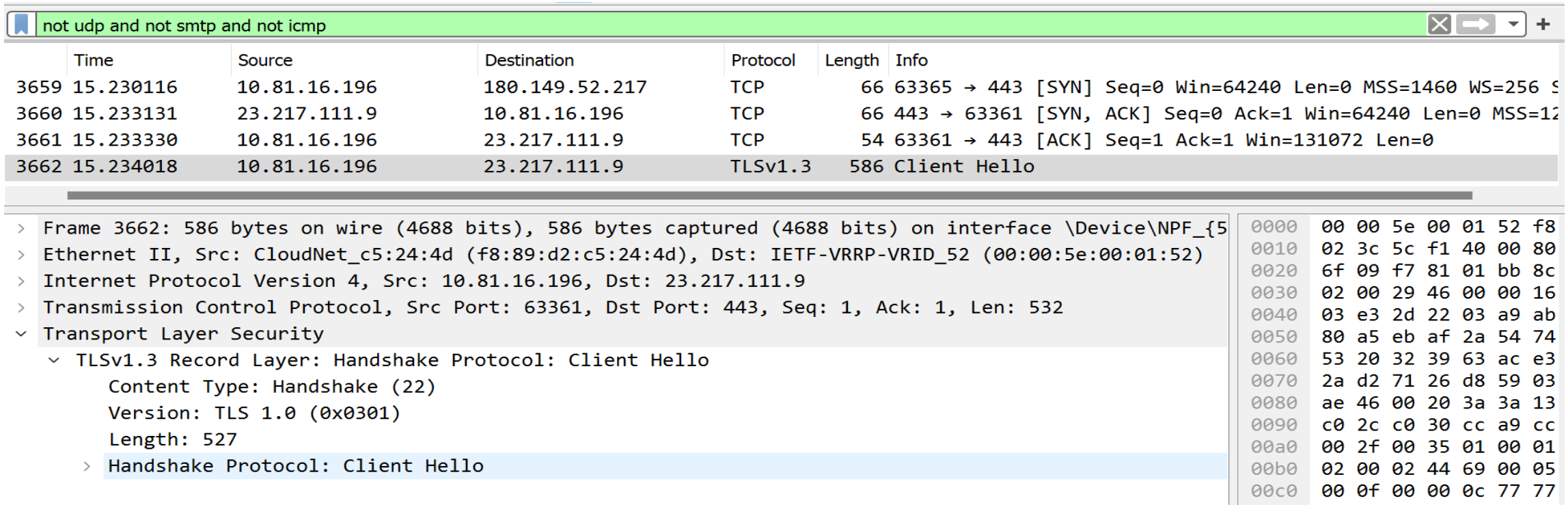
TFO(TCP Fast Open)

•TCP Fast Open (TFO) is a real protocol, and it is an extension to the traditional TCP (Transmission Control Protocol). TFO is designed to reduce latency in the establishment of a TCP connection.

• Normally, a TCP connection requires a three-way handshake (SYN, SYN-ACK, ACK) to establish a connection before any data can be exchanged.

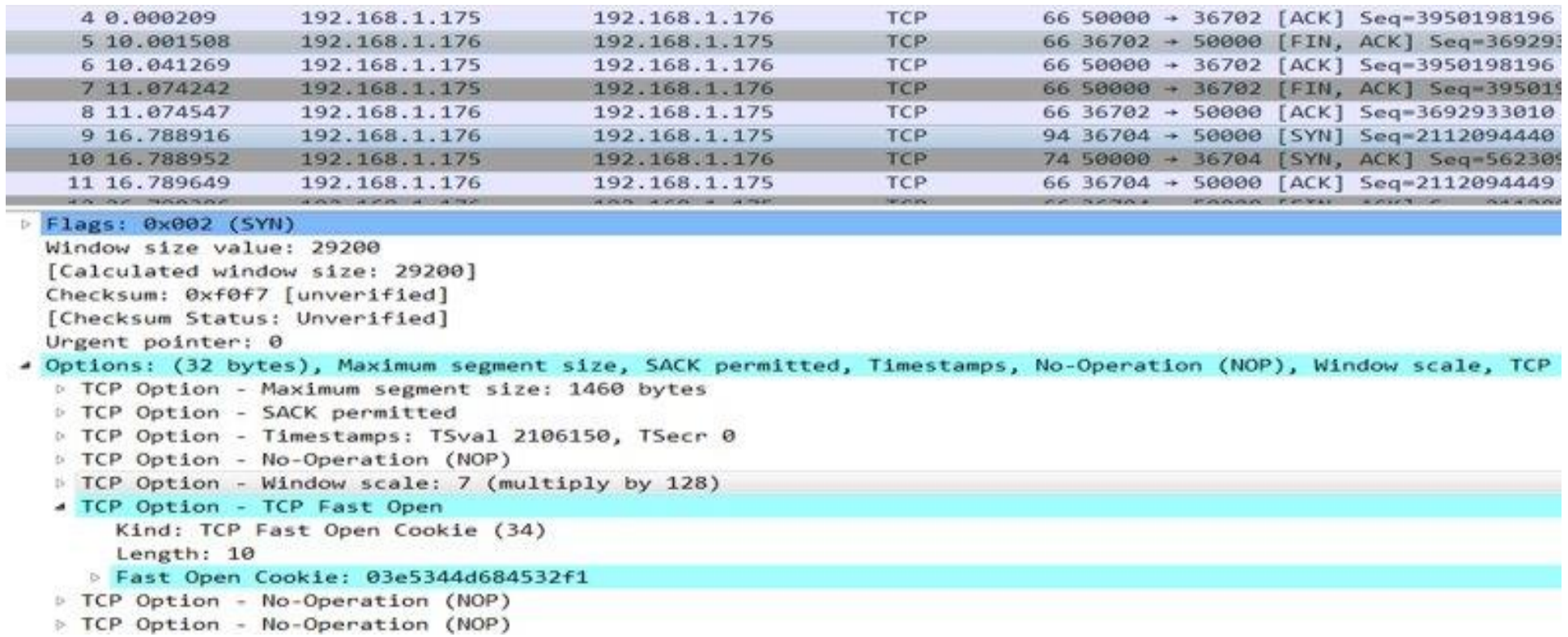
Demonstration of TCP:



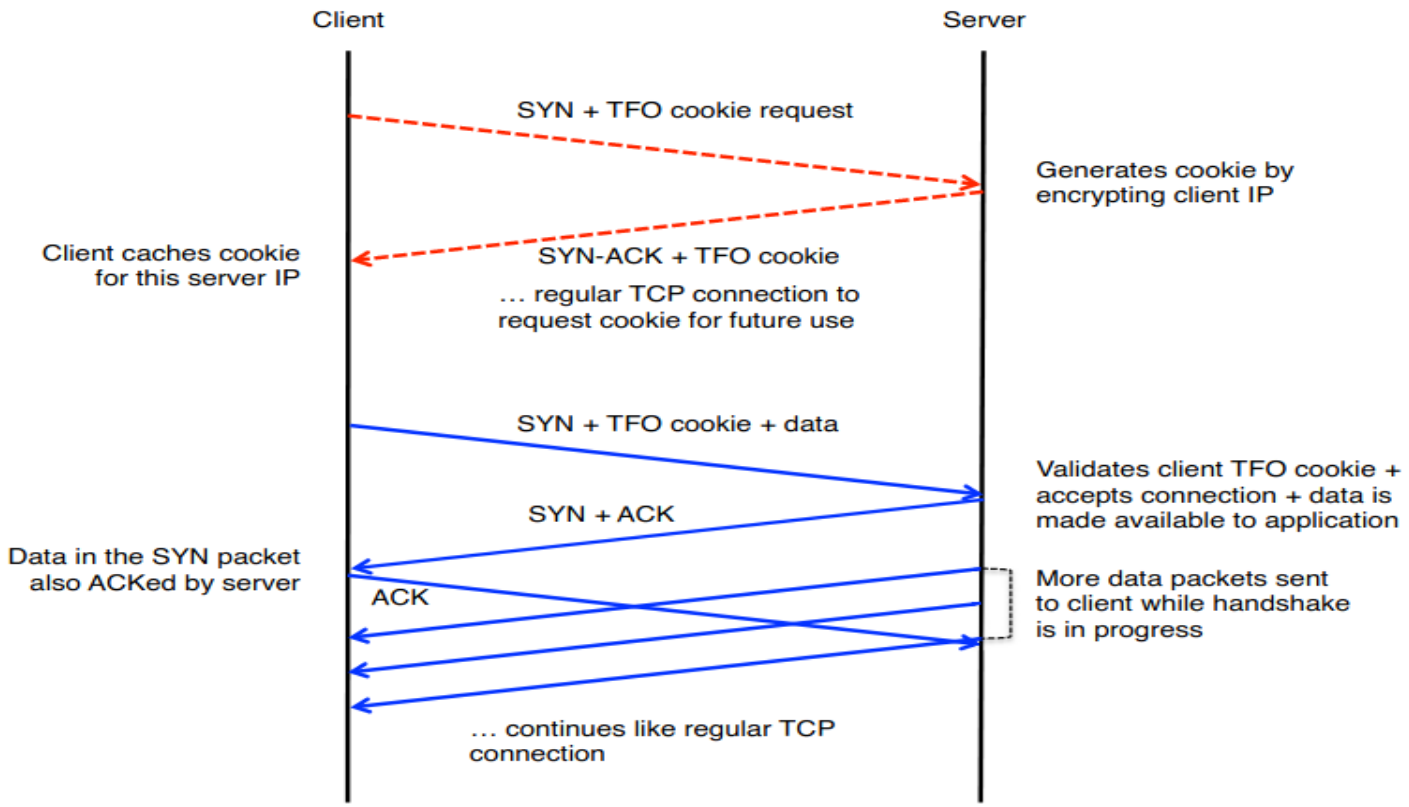
•In TCP Fast Open the sender sends data to the receiver along with the initial SYN. This allows for data transfer to begin immediately instead of waiting for the entire handshake process to take place.

•TFO works only for repeat connections because of the requirement of TFO cookie.

Demonstration of TFO:



•When a client sends the SYN packet to the server along with TFO cookies and data. And when the server sees the TFO cookies it understands that client supports TFO. The server generates a unique cookie and encrypts it using the IP address of the client so that each client has a unique cookie.



Performance of TFO over TCP

Page	RTT(ms)	PLT : non-TFO (s)	PLT : TFO (s)	Improv.
amazon.com	20	1.54	1.48	4%
	100	2.60	2.34	10%
	200	4.10	3.66	11%
nytimes.com	20	3.70	3.56	4%
	100	4.59	4.30	6%
	200	6.73	5.55	18%
wsj.com	20	5.74	5.48	5%
	100	7.08	6.60	7%
	200	9.46	8.47	11%
TCP wikipedia page	20	2.10	1.95	7%
	100	3.49	2.92	16%
	200	5.15	3.03	41%

Advantages of using TFO:

It generally used in web browsing and HTTP/HTTPS, Mobile networks and Content delivery Networks(CDNs).

It gives faster Page Loading : For web applications, TFO can lead to faster page loading because it allows the client to send an initial cookies along with the SYN packet. This can be especially helpful for loading small resources.

Reduce Latency: In TFO it reduces upto one RTT in compare with TCP.

It is more effective if multiple connections are there.