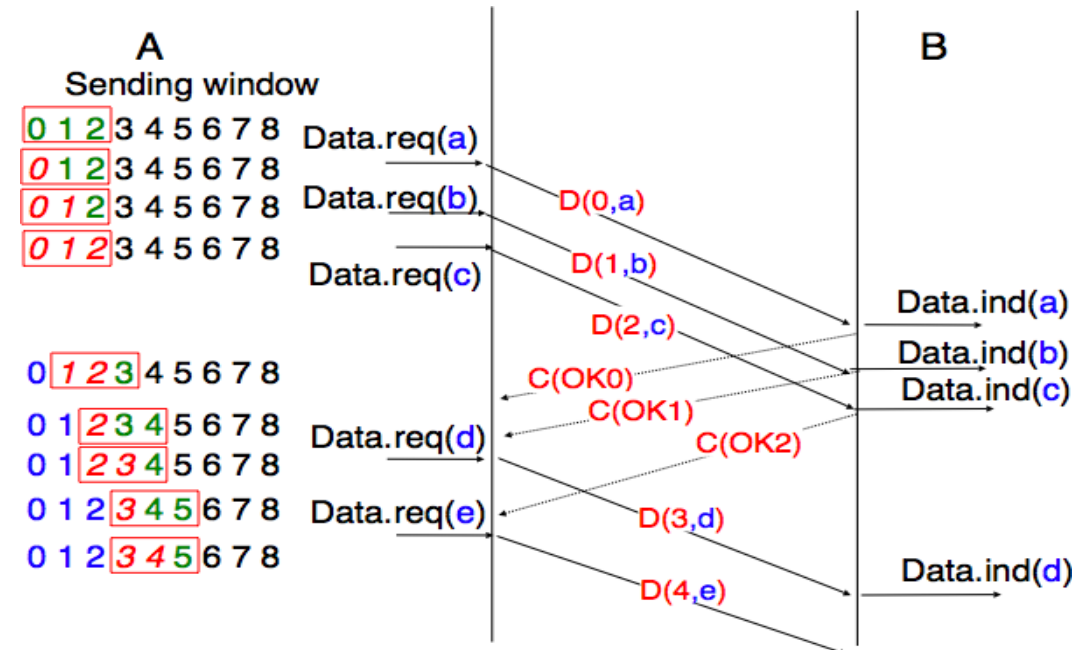
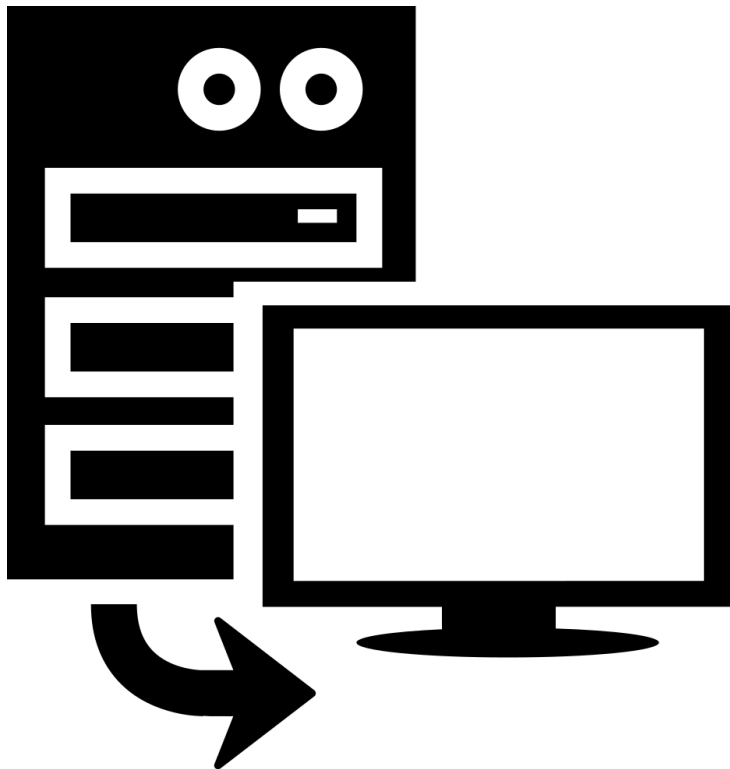


PROGRAMMATION, RÉSEAU & SYSTÈMES

BEN LTAIFA ADAM, PANIAH MARLON-BRADLEY

NOTRE IMPLÉMENTATION



PARAMÈTRES À FAIRE VARIER

- Taille des **paquets** (Fragmentation Ethernet)
- Taille de la **fenêtre**
- S'adapter au **comportement du client**

LA FRAGMENTATION, C'EST LE MAL

The figure displays two windows from the Wireshark network protocol analyzer. The left window shows a list of captured packets, and the right window shows a detailed view of a selected packet (Frame 793).

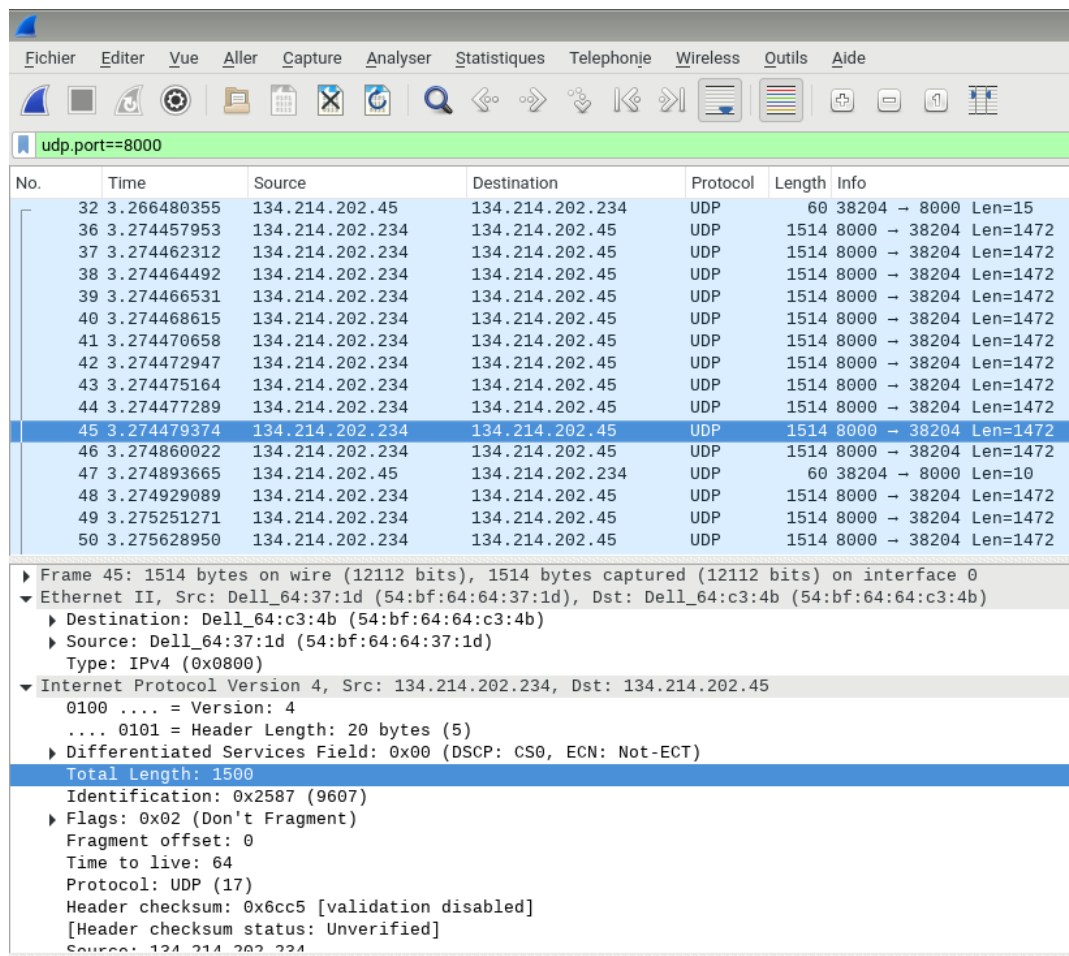
Packet List (Left Window):

No.	Time	Source	Destination	Protocol	Length	Info
778	15.995601105	134.214.202.221	134.214.202.234	UDP	60	41395 → 8000 Len=15
783	16.003884033	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
785	16.003887632	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
787	16.003890446	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
789	16.003893129	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
791	16.003895990	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
793	16.003899174	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
795	16.003902132	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
797	16.003904930	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
799	16.003908015	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
801	16.003910797	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
803	16.004275103	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
804	16.004368496	134.214.202.221	134.214.202.234	UDP	60	41395 → 8000 Len=10
806	16.004391122	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
808	16.004648250	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506
810	16.005009012	134.214.202.234	134.214.202.221	UDP	68	8000 → 41395 Len=1506

Packet Details (Right Window - Frame 793):

- Frame 793: 68 bytes on wire (544 bits), 68 bytes captured (544 bits) on interface 0
- Ethernet II, Src: Dell_64:37:1d (54:bf:64:64:37:1d), Dst: Dell_65:ff:5e (54:bf:64:65:ff:5e)
 - Destination: Dell_65:ff:5e (54:bf:64:65:ff:5e)
 - Source: Dell_64:37:1d (54:bf:64:64:37:1d)
 - Type: IPv4 (0x0800)
- Internet Protocol Version 4, Src: 134.214.202.234, Dst: 134.214.202.221
 - 0100 = Version: 4
 - 0101 = Header Length: 20 bytes (5)
 - Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 - Total Length: 54
 - Identification: 0x735f (29535)
 - Flags: 0x00
 - Fragment offset: 1480
 - Time to live: 64
 - Protocol: UDP (17)
 - Header checksum: 0x632a [validation disabled]
 - [Header checksum status: Unverified]
 - Source: 134.214.202.234
 - Destination: 134.214.202.221
 - [Source GeoIP: Unknown]
 - [Destination GeoIP: Unknown]
- [2 IPv4 Fragments (1514 bytes): #792(1480), #793(34)]
 - [Frame: 792, payload: 0-1479 (1480 bytes)]
 - [Frame: 793, payload: 1480-1513 (34 bytes)]
 - [Fragment count: 2]
 - [Reassembled IPv4 length: 1514]
 - [Reassembled IPv4 data: 1f40a1b305eaf22030303030303605000140005000140005...]
- User Datagram Protocol, Src Port: 8000, Dst Port: 41395
 - Source Port: 8000
 - Destination Port: 41395
 - Length: 1514
 - Checksum: 0xf220 [unverified]
 - [Checksum Status: Unverified]
 - [Stream index: 10]
- Data (1506 bytes)

LA FRAGMENTATION, C'EST LE MAL



The image shows a Wireshark packet capture. The top pane displays a list of 50 UDP packets. The bottom pane shows the detailed view of packet 45, which is an IPv4 packet with a total length of 1500 bytes. The packet is not fragmented (Flags: 0x02 (Don't Fragment)).

No.	Time	Source	Destination	Protocol	Length	Info
32	3.266480355	134.214.202.45	134.214.202.234	UDP	60	38204 → 8000 Len=15
36	3.274457953	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
37	3.274462312	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
38	3.274464492	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
39	3.274466531	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
40	3.274468615	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
41	3.274470658	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
42	3.274472947	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
43	3.274475164	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
44	3.274477289	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
45	3.274479374	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
46	3.274860022	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
47	3.274893665	134.214.202.45	134.214.202.234	UDP	60	38204 → 8000 Len=10
48	3.274929089	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
49	3.275251271	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472
50	3.275628950	134.214.202.234	134.214.202.45	UDP	1514	8000 → 38204 Len=1472

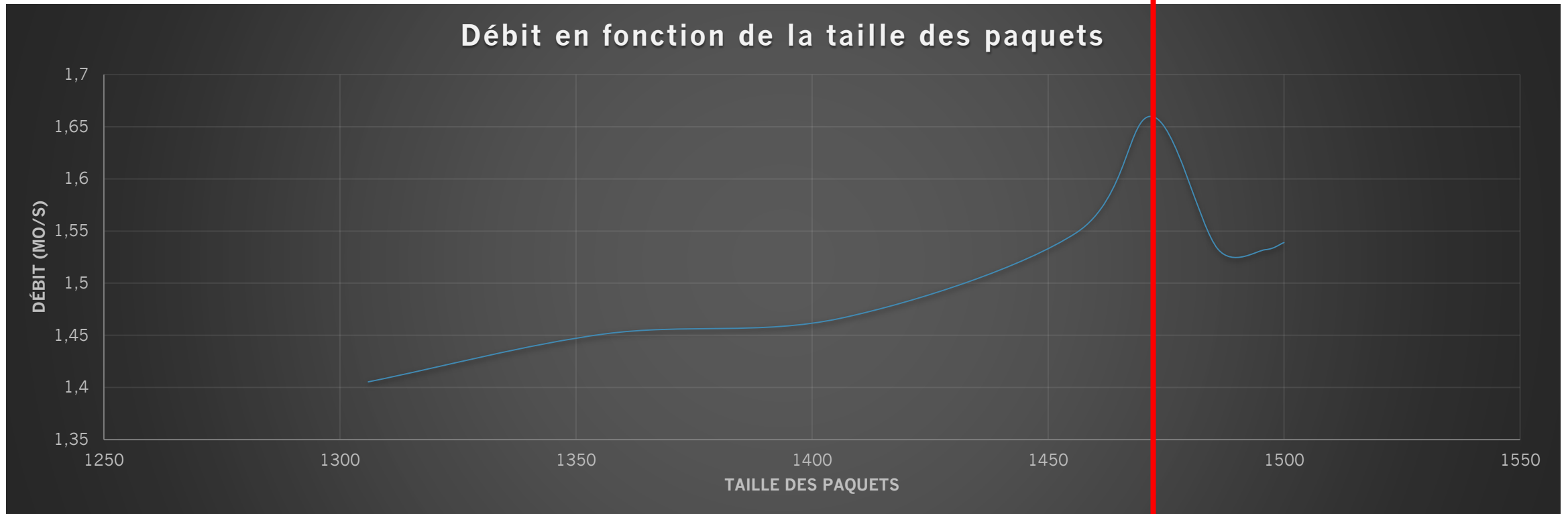
Frame 45: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: Dell_64:37:1d (54:bf:64:64:37:1d), Dst: Dell_64:c3:4b (54:bf:64:64:c3:4b)
Destination: Dell_64:c3:4b (54:bf:64:64:c3:4b)
Source: Dell_64:37:1d (54:bf:64:64:37:1d)
Type: IPv4 (0x0800)
Internet Protocol Version 4, Src: 134.214.202.234, Dst: 134.214.202.45
0100 = Version: 4
... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 1500
Identification: 0x2587 (9607)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 64
Protocol: UDP (17)
Header checksum: 0x6cc5 [validation disabled]
[Header checksum status: Unverified]
Source: 134.214.202.234

En-tête **UDP** = 8 bytes
En-tête **IP** = 20 bytes
(En-tête **Ethernet** = 14 bytes)

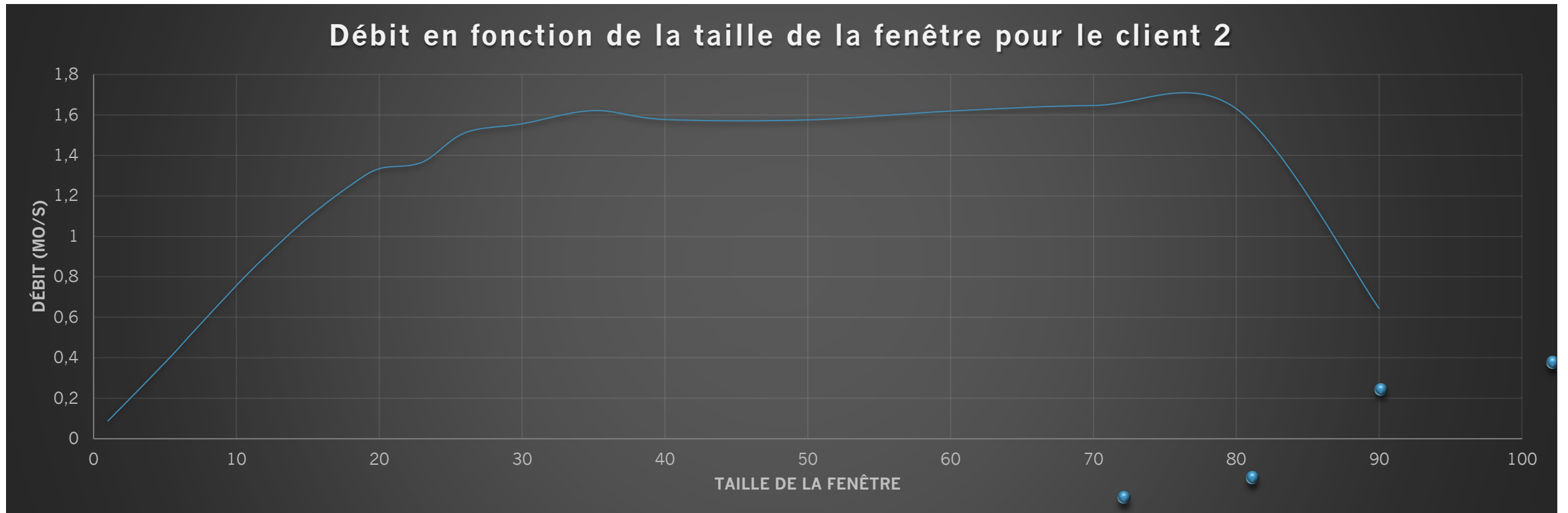
$$1500 (\text{data} + \text{num_sequence}) - 8(\text{udp}) - 20(\text{IP}) = 1472$$

FRAGMENTATION – COMPARAISON DES DÉBITS

1472 bytes



FENÊTRE GLISSANTE



ANALYSE DES CLIENTS – CLIENT 1

- Le client 1 simule des pertes (fréquentes) des paquets par le réseau
- Plus avantageux d'avoir un timeout faible ?

ANALYSE DES CLIENTS – CLIENT 2

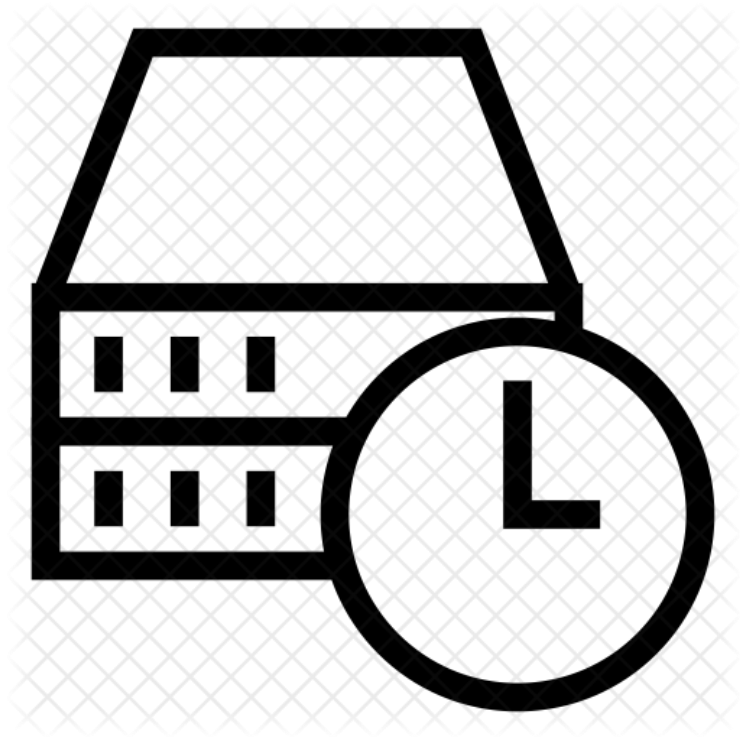
- Les ACKs du client 2 par le réseau sont perdus par le réseau
- Proposition 1 : Ne plus faire de Fast Retransmit
- Proposition 2 : Tout envoyer d'un coup

ANALYSE DES CLIENTS - MULTICLIENT

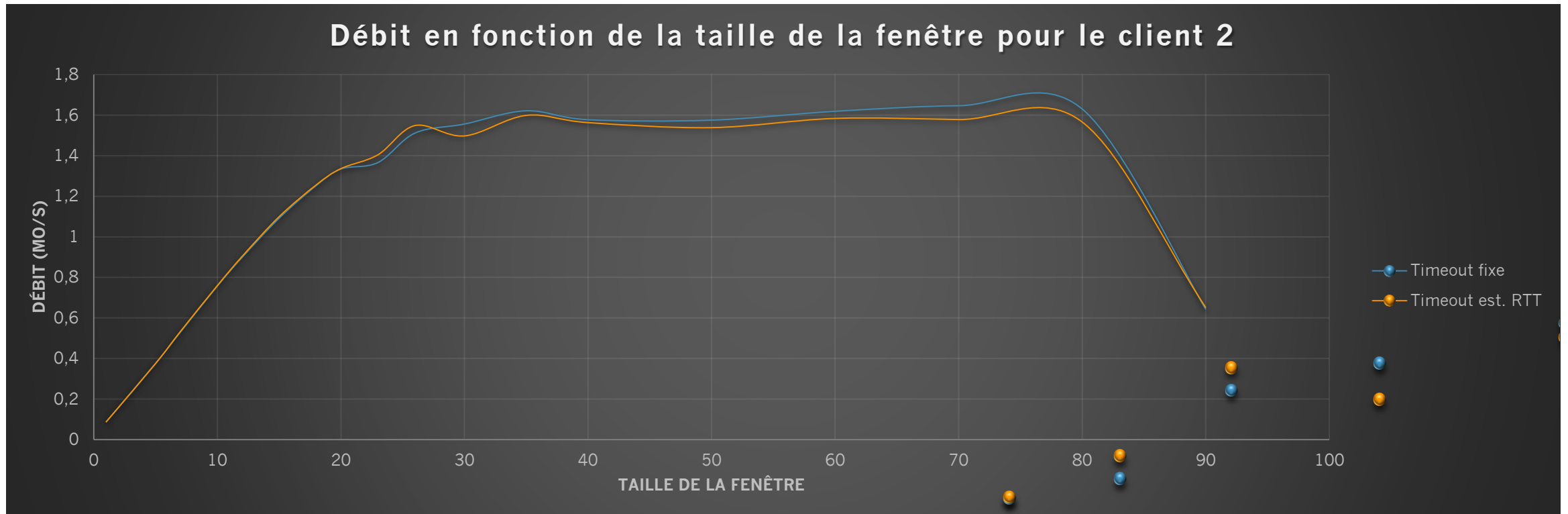
- Plusieurs clients 1
- Réseau susceptible d'être congestionné
- Proposition : Lors d'un Fast Retransmit, renvoi du paquet perdu 2 fois

ET LE TEMPS DANS TOUT ÇA ?

- Tests de timeouts
- Estimation du RTT



DÉBIT EN IMPLÉMENTANT LE TIMEOUT EN FONCTION DU RTT



CONCLUSION ET COMMENT ALLER PLUS LOIN

- Un réseau difficile – Résultats à mettre en perspective
- Envoyer deux paquets après un timeout
- Faire varier la taille de la fenêtre (intéressant en cas de multiciens)