

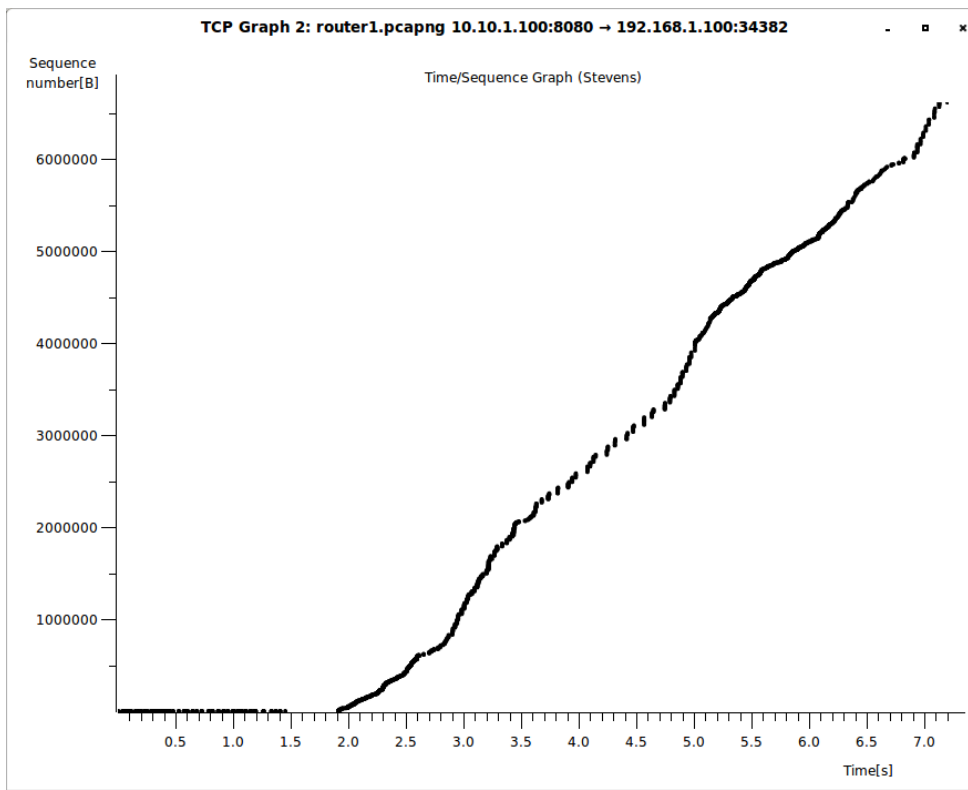
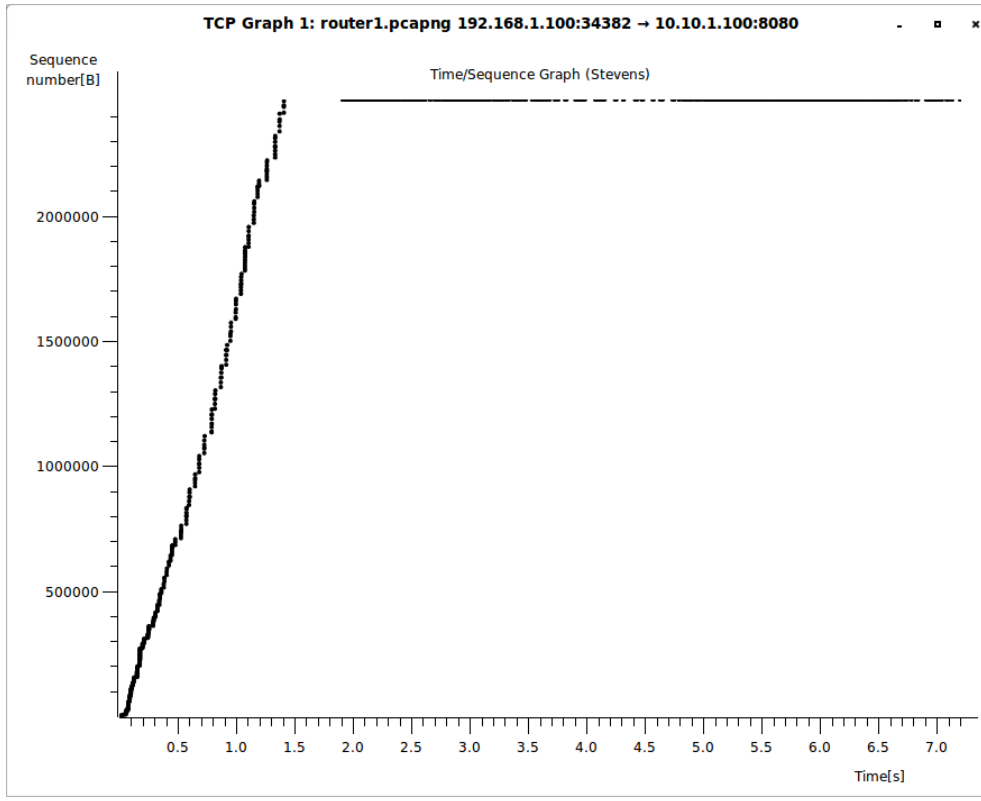
1. No Loss (see Conversation screenshot) :  
Number of transmitted packets at host a: 1172  
Number of received packets at host a: 2211  
Number of transmitted packets at host b: 2211  
Number of received packets at host b: 1172
2. With 20% Loss (See Conversation and Retransmitted Packets screenshots):  
Number of transmitted packets at host a: 1937  
Number of received packets at host a: 4181  
Number of transmitted packets at host b: 4181  
Number of received packets at host b: 1937  
Total number of retransmitted packets: 156  
Number of retransmitted packets at host a: 147  
Number of retransmitted packets at host b: 9
3. When there was no loss at the router, the lines in the TCP Stream Graphs from Host A to Host B and from Host B to Host A were both mostly solid and without gaps. They also both increased at about a linear rate. This indicates that everything is fine and there weren't many losses so TCP didn't need to adjust the rate at which it was sending packets. The line of Graph 2 (Host B to Host A) only begins increasing after the line of Graph 1 (Host A to Host B) stop increasing, which shows how Host B only sends to the unzipped file back to Host A after it fully receives the zipped file.  
From the IO Graph, we see that the packets/tick only decreased to close to 0 a few times.

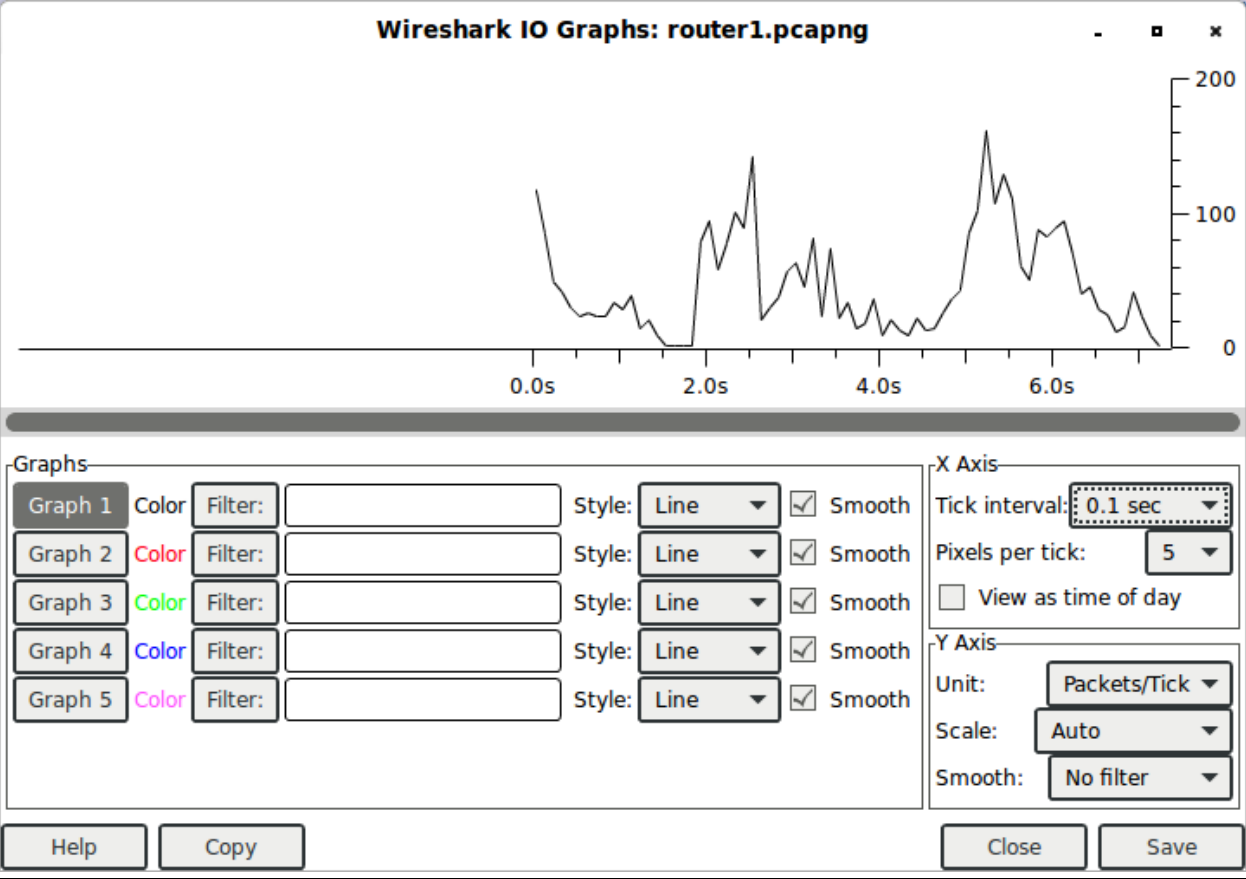
There was a significant increase in the number of transmitted packets at both hosts when there was 20% loss at the router. This is because TCP is a reliable protocol, which means that it will make sure that every packet will get to the receiver. So if every 2 out of 10 packets are dropped at the router, the sender will have to retransmit many packets to ensure that all the data arrives intact.

The line in the TCP Stream Graph from Host A to Host B in particular had many gaps in it and was not linear. This indicates that there were many losses and therefore many retransmissions. We can see this as the number of packets Host A retransmitted was 147 while the number of packets Host B retransmitted was 9. When the sender was waiting for a timeout to occur, there was a gap in the line as it would not send anything. From the changing slope of the line, we can see that TCP was changing the rate at which it was sending packets. Since many packets were being dropped, this could mean that the network is congested so TCP backed off as part of its congestion control mechanism.

From the IO Graph, we see that the packets/tick was close to 0 for about 25 seconds.

## No Loss





Conversations: router1.pcapng

Ethernet: 1

Fibre Channel

FDDI

IPv4: 1

IPv6

IPX

JXTA

NCP

RSVP

SCTP

TCP: 1

Token Ring

UDP

USB

WLAN

TCP Conversations

Address A	Port A	Address B	Port B	Packets	Bytes	Packets A	Bytes A-B	Packets A	Bytes A-B	Rel Start	Duration	bps A-B	bps A-B
192.168.1.100	34382	10.10.1.100	8080	3 383	9 332 714	1 172	2 550 951	2 211	6 781 763	0.000000000	7.2025	2833388.30	7532629.19

☒ Name resolution

☐ Limit to display filter

Help

Copy

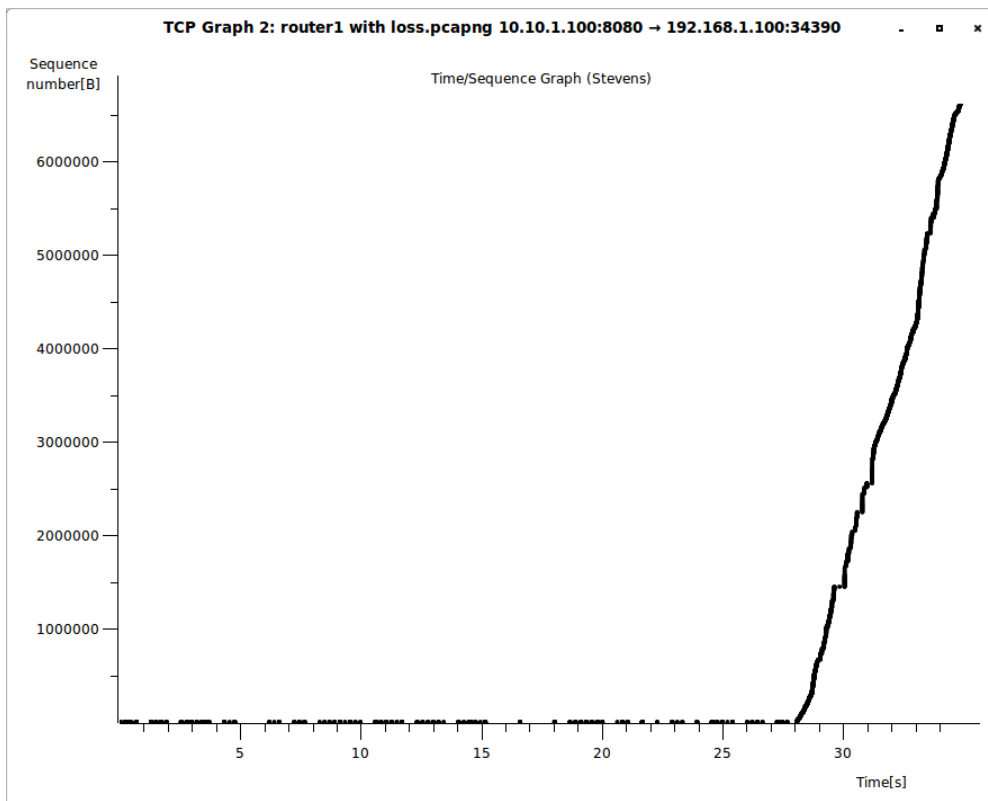
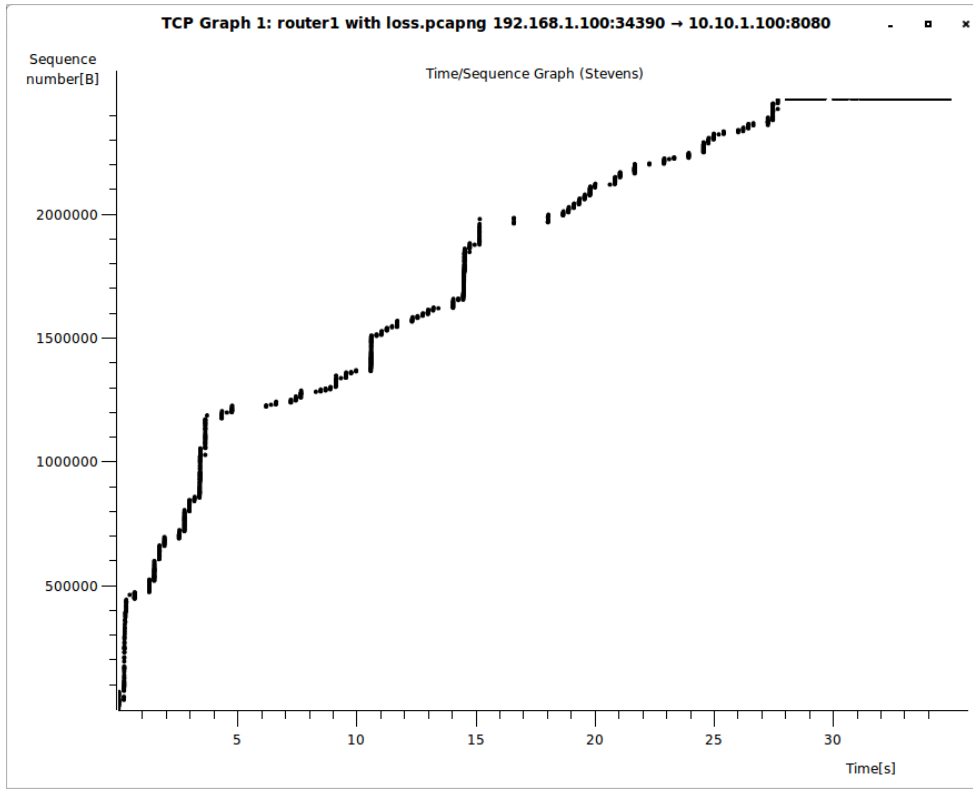
Follow Stream

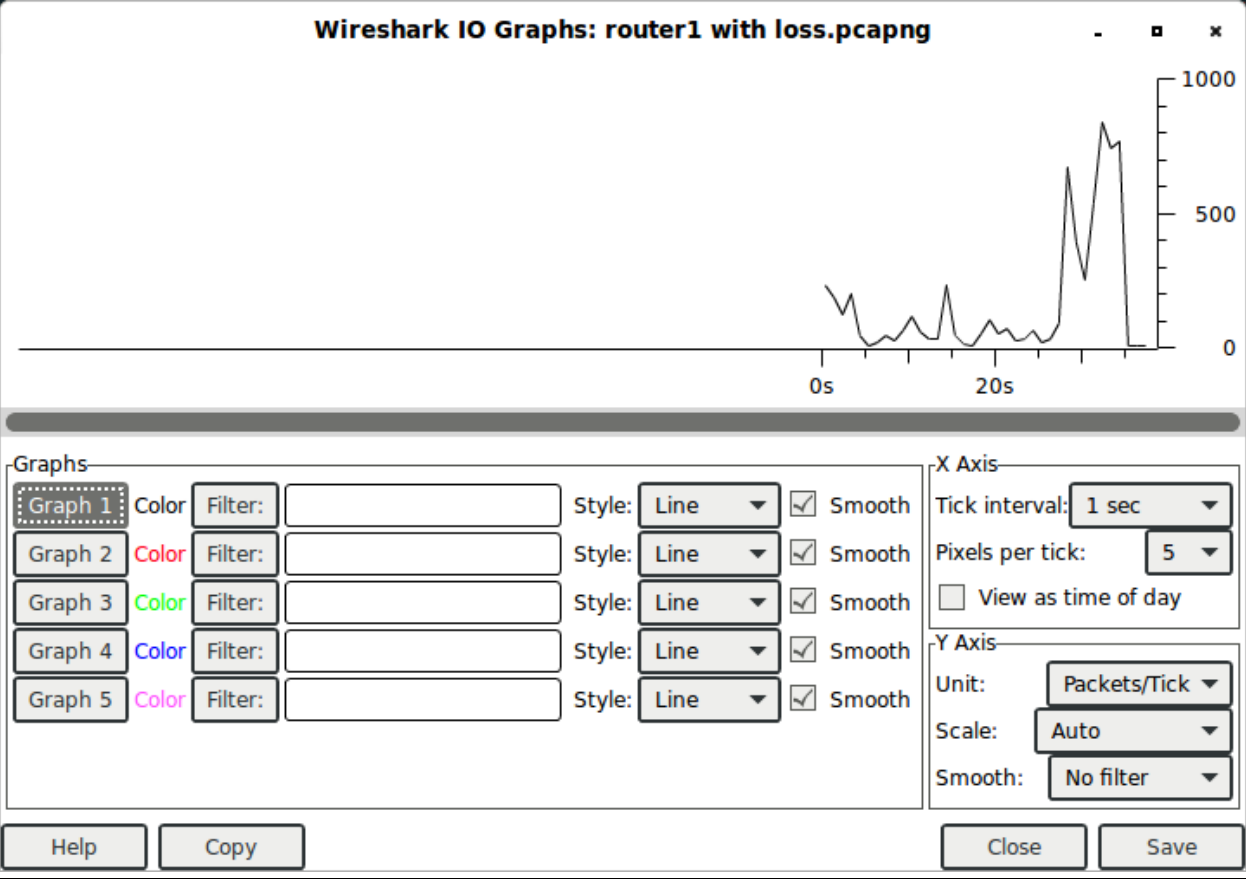
Graph A-B

Graph A-B

Close

## With Loss





**Conversations: router1 with loss.pcapng**

Ethernet: 1 | Fibre Channel | FDDI | IPv4: 1 | IPv6 | IPX | JXTA | NCP | RSVP | SCTP | **TCP: 1** | Token Ring | UDP | USB | WLAN

Address A	Port A	Address B	Port B	Packets	Bytes	Packets A	Bytes A→B	Packets B	Bytes B→A	Rel Start	Duration	bps A→B	bps B→A
192.168.1.100	34390	10.10.1.100	8080	6 118	9 523 296	1 937	2 600 365	4 181	6 922 931	0.000000000	34.9359	595459.84	1585287.99

☒ Name resolution ☐ Limit to display filter

Help Copy Follow Stream Graph A→B Graph B→A Close

## Retransmitted packets in total, at Host A and at Host B:

router1 with loss pcapng [Wireshark 1.12.1 (64-bit)]

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tcp.analysis.retransmission

No.	Time	Source	Destination	Protocol	Length	Info
75	0.832819976	192.168.1.100	10.10.1.100	TCP	242	[TCP Fast Retransmission] 34390 → 8080 [PSH, ACK] Seq=31577 Ack=1 Win=29248 Len=176 TSval=488589 TSecr=488639
77	0.23650203	192.168.1.100	10.10.1.100	TCP	1514	[TCP Retransmission] 34390 → 8080 [ACK] Seq=37545 Ack=1 Win=29248 Len=1448 TSval=488640 TSecr=488639
87	0.241261219	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=37545 Ack=1 Win=29248 Len=1448 TSval=488641 TSecr=488711
95	0.245514011	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=37545 Ack=1 Win=29248 Len=1448 TSval=488642 TSecr=488712
133	0.250484446	192.168.1.100	10.10.1.100	TCP	4418	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=35352 Ack=1 Win=29248 Len=4344 TSval=488645 TSecr=488713
140	0.250484798	192.168.1.100	10.10.1.100	TCP	13908	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=238129 Ack=1 Win=29248 Len=13032 TSval=488647 TSecr=488717
185	0.259949662	192.168.1.100	10.10.1.100	TCP	7366	[TCP Retransmission] 34390 → 8080 [ACK] Seq=351761 Ack=1 Win=29248 Len=7248 TSval=488655 TSecr=488725
187	0.370931338	192.168.1.100	10.10.1.100	TCP	5488	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=408489 Ack=1 Win=29248 Len=5392 TSval=488660 TSecr=488735
193	0.380548312	192.168.1.100	10.10.1.100	TCP	2962	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=432849 Ack=1 Win=29248 Len=2896 TSval=488666 TSecr=488736
290	0.488484161	192.168.1.100	10.10.1.100	TCP	1514	[TCP Retransmission] 34390 → 8080 [ACK] Seq=458881 Ack=1 Win=29248 Len=1448 TSval=488751 TSecr=488772
298	1.312550434	192.168.1.100	10.10.1.100	TCP	1514	[TCP Retransmission] 34390 → 8080 [ACK] Seq=518281 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.313226262	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=519729 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.313613067	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=520693 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.318147181	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=528417 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.323470474	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=545792 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
365	1.732248514	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=616745 Ack=1 Win=29248 Len=1448 TSval=489013 TSecr=489083
365	1.732455551	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=616745 Ack=1 Win=29248 Len=1448 TSval=489013 TSecr=489083

Frame 75: 242 bytes on wire (1936 bits), 242 bytes captured (1936 bits) on interface 0  
Ethernet II, Src: RealtekU\_af:f8:64 (52:54:00:af:f8:64), Dst: RealtekU\_af:f8:64 (52:54:00:af:f8:64)  
Internet Protocol Version 4, Src: 192.168.1.100 (192.168.1.100), Dst: 10.10.1.100 (10.10.1.100)  
Transmission Control Protocol, Src Port: 34390, Dst Port: 8080 (8080), Seq: 31577, Ack: 1, Len: 176

0000 52 54 00 af f8 64 52 54 00 af f8 61 08 00 45 00 RT...aRT...a...E.  
0010 00 e4 87 08 40 00 3f 06 e5 59 c8 a8 01 64 0a 0a ...B...f...d...  
0020 01 64 0a 56 1f 90 26 94 66 7f 25 33 7a 75 80 18 ...d...n...S32u...  
0030 01 c9 ce 50 80 00 01 01 08 0a 00 07 74 5d 00 07 ...f...n...f...  
0040 74 43 00 5e 9f 70 01 08 a3 6e 8e 71 f1 50 80 53 ...t...B...d...f...S  
0050 12 12 ce 48 21 bc 13 fd c9 8e d1 e8 72 ce a0 ...M...f...f...  
0060 b0 80 a7 fe 48 a4 0f c1 6d 7c 9d 90 91 e1 6f ...e...B...d...  
0070 7f 6f 9b 39 61 63 64 db 9c 17 6c 19 93 4f 95 ...d...B...d...  
0080 f9 e1 f0 5d c2 b4 bd 46 63 24 f2 67 0e 90 9d f7 ...f...f...S...B...  
0090 52 64 30 76 14 66 13 a1 54 78 07 92 93 55 c8 0a ...R...f...f...  
00a0 ec 5d 57 c8 13 e1 6c a0 d7 a2 30 fc da 3c bc 08 ...e...l...r...  
00b0 cc 33 90 01 a2 9f 72 ce 77 f7 4d 46 85 31 e4 61 ...f...r...w...h...  
00c0 b9 ea 48 4e 4d 53 85 67 94 6f 86 bc e5 90 5f ...H...M...S...g...o...  
00d0

router1 with loss pcapng

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tcp.analysis.retransmission and p.src=192.168.1.100

No.	Time	Source	Destination	Protocol	Length	Info
75	0.832819976	192.168.1.100	10.10.1.100	TCP	242	[TCP Fast Retransmission] 34390 → 8080 [PSH, ACK] Seq=31577 Ack=1 Win=29248 Len=176 TSval=488589 T...
77	0.23650203	192.168.1.100	10.10.1.100	TCP	1514	[TCP Retransmission] 34390 → 8080 [ACK] Seq=37545 Ack=1 Win=29248 Len=1448 TSval=488640 TSecr=4886...
87	0.241261219	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=37545 Ack=1 Win=29248 Len=1448 TSval=488641 TSecr...
95	0.245514011	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=37545 Ack=1 Win=29248 Len=1448 TSval=488642 TSecr...
133	0.250484446	192.168.1.100	10.10.1.100	TCP	4418	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=35352 Ack=1 Win=29248 Len=4344 TSval=488645 TSecr...
140	0.250484798	192.168.1.100	10.10.1.100	TCP	13908	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=238129 Ack=1 Win=29248 Len=13032 TSval=488647 TSecr...
185	0.259949662	192.168.1.100	10.10.1.100	TCP	7366	[TCP Retransmission] 34390 → 8080 [ACK] Seq=351761 Ack=1 Win=29248 Len=7248 TSval=488655 TSecr=488725
187	0.370931338	192.168.1.100	10.10.1.100	TCP	5488	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=408489 Ack=1 Win=29248 Len=5392 TSval=488660 TSecr=488735
193	0.380548312	192.168.1.100	10.10.1.100	TCP	2962	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=432849 Ack=1 Win=29248 Len=2896 TSval=488666 TSecr=488736
290	0.488484161	192.168.1.100	10.10.1.100	TCP	1514	[TCP Retransmission] 34390 → 8080 [ACK] Seq=458881 Ack=1 Win=29248 Len=1448 TSval=488751 TSecr=488772
298	1.312550434	192.168.1.100	10.10.1.100	TCP	1514	[TCP Retransmission] 34390 → 8080 [ACK] Seq=518281 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.313226262	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=519729 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.313613067	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=520693 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.318147181	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=528417 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979
298	1.323470474	192.168.1.100	10.10.1.100	TCP	1514	[TCP Fast Retransmission] 34390 → 8080 [ACK] Seq=545792 Ack=1 Win=29248 Len=1448 TSval=488959 TSecr=488979

Frame 75: 242 bytes on wire (1936 bits), 242 bytes captured (1936 bits) on interface 0  
Ethernet II, Src: RealtekU\_af:f8:64 (52:54:00:af:f8:64), Dst: RealtekU\_af:f8:64 (52:54:00:af:f8:64)  
Internet Protocol Version 4, Src: 192.168.1.100 (192.168.1.100), Dst: 10.10.1.100 (10.10.1.100)  
Transmission Control Protocol, Src Port: 34390, Dst Port: 8080, Seq: 31577, Ack: 1, Len: 176

0000 52 54 00 af f8 64 52 54 00 af f8 61 08 00 45 00 RT...aRT...a...E.  
0010 00 e4 87 08 40 00 3f 06 e5 59 c8 a8 01 64 0a 0a ...B...f...d...  
0020 01 64 0a 56 1f 90 26 94 66 7f 25 33 7a 75 80 18 ...d...n...S32u...  
0030 01 c9 ce 50 80 00 01 01 08 0a 00 07 74 5d 00 07 ...f...n...f...  
0040 74 43 00 5e 9f 70 01 08 a3 6e 8e 71 f1 50 80 53 ...t...B...d...f...S  
0050 12 12 ce 48 21 bc 13 fd c9 8e d1 e8 72 ce a0 ...M...f...f...  
0060 b0 80 a7 fe 48 a4 0f c1 6d 7c 9d 90 91 e1 6f ...e...B...d...  
0070 7f 6f 9b 39 61 63 64 db 9c 17 6c 19 93 4f 95 ...d...B...d...  
0080 f9 e1 f0 5d c2 b4 bd 46 63 24 f2 67 0e 90 9d f7 ...f...f...S...B...  
0090 52 64 30 76 14 66 13 a1 54 78 07 92 93 55 c8 0a ...R...f...f...  
00a0 ec 5d 57 c8 13 e1 6c a0 d7 a2 30 fc da 3c bc 08 ...e...l...r...  
00b0 cc 33 90 01 a2 9f 72 ce 77 f7 4d 46 85 31 e4 61 ...f...r...w...h...  
00c0 b9 ea 48 4e 4d 53 85 67 94 6f 86 bc e5 90 5f ...H...M...S...g...o...  
00d0

router1 with loss pcapng

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tcp.analysis.retransmission and p.src=10.10.1.100

No.	Time	Source	Destination	Protocol	Length	Info
2571	28.987291173	10.10.1.100	192.168.1.100	TCP	1514	[TCP Fast Retransmission] 8080 → 34390 [ACK] Seq=684169 Ack=2465548 Win=185792 Len=1448 TSval=495878 TSecr=495878
2599	29.541825317	10.10.1.100	192.168.1.100	TCP	418	[TCP Spurious Retransmission] 8080 → 34390 [PSH, ACK] Seq=1234949 Ack=2465548 Win=185792 Len=352 TSval=495878 TSecr=495878
2699	30.406637973	10.10.1.100	192.168.1.100	TCP	5474	[TCP Window Full] [TCP Retransmission] 8080 → 34390 [PSH, ACK] Seq=1442225 Ack=2465548 Win=185792 Len=1448 TSval=495878 TSecr=495878
3245	30.999617016	10.10.1.100	192.168.1.100	TCP	626	[TCP Spurious Retransmission] 8080 → 34390 [ACK] Seq=2526225 Ack=2465548 Win=185792 Len=568 TSval=496408 TSecr=496408
3835	32.875276936	10.10.1.100	192.168.1.100	TCP	1514	[TCP Spurious Retransmission] 8080 → 34390 [ACK] Seq=3464873 Ack=2465548 Win=185792 Len=1448 TSval=496664 TSecr=496664
5128	33.497865188	10.10.1.100	192.168.1.100	TCP	1514	[TCP Fast Retransmission] 8080 → 34390 [ACK] Seq=5148817 Ack=2465548 Win=185792 Len=1448 TSval=497825 TSecr=497825
5225	33.709754543	10.10.1.100	192.168.1.100	TCP	1426	[TCP Spurious Retransmission] 8080 → 34390 [ACK] Seq=5401545 Ack=2465548 Win=185792 Len=1368 TSval=497906 TSecr=497906
5254	33.811124430	10.10.1.100	192.168.1.100	TCP	1514	[TCP Fast Retransmission] 8080 → 34390 [ACK] Seq=5466617 Ack=2465548 Win=185792 Len=1448 TSval=497189 TSecr=497189
5335	33.967607574	10.10.1.100	192.168.1.100	TCP	954	[TCP Spurious Retransmission] 8080 → 34390 [PSH, ACK] Seq=5881165 Ack=2465548 Win=185792 Len=888 TSval=497189 TSecr=497189

Frame 2571: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0  
Ethernet II, Src: RealtekU\_af:f8:64 (52:54:00:af:f8:64), Dst: RealtekU\_af:f8:61 (52:54:00:af:f8:61)  
Internet Protocol Version 4, Src: 10.10.1.100, Dst: 192.168.1.100  
Transmission Control Protocol, Src Port: 8080, Dst Port: 34390, Seq: 684169, Ack: 2465548, Len: 1448

0000 52 54 00 af f8 61 52 54 00 af f8 64 00 00 45 00 RT...aRT...d...E.  
0010 05 dc 14 55 48 00 40 06 53 4d 0a 0a 01 64 c8 a8 ...U...B...S...d...  
0020 02 64 1f 90 06 25 32 62 7d 2e 93 32 08 10 ...d...V...K...  
0030 00 57 43 48 00 00 01 01 08 0a 00 07 91 0e 00 07 ...W...H...  
0040 90 bf 20 77 68 69 63 68 20 66 69 6e 61 6c 6e 79 ...which finally  
0050 20 63 61 72 72 69 65 64 20 74 6d 65 20 70 65 6f ...carried the pec  
0060 70 6c 65 73 2c 20 74 68 65 6d 6e 69 6e 73 74 69 ...ples, the e...insti  
0070 74 75 74 69 6f 6e 73 2c 20 61 6e 64 20 74 68 65 ...tutions, and the  
0080 20 74 72 61 64 65 20 6f 66 20 65 73 6f 78 65 ...trade of Europe  
0090 20 74 6f 20 74 68 65 20 76 65 72 79 20 65 6e 64 ...to the very end  
00a0 73 20 6f 66 20 74 68 65 20 65 61 72 74 68 2e 8d ...s of the earth.  
00b0 0a 0d 0a 49 6e 20 6f 6e 65 20 70 6e 70 61 6c 20 ...in on a vital  
00c0 70 6f 69 6e 74 2c 20 69 74 20 6d 75 73 74 20 62 ...point, it must b  
00d0 65 20 6f 64 64 2c 20 61 6d 65 72 69 63 61 ...e noted, America