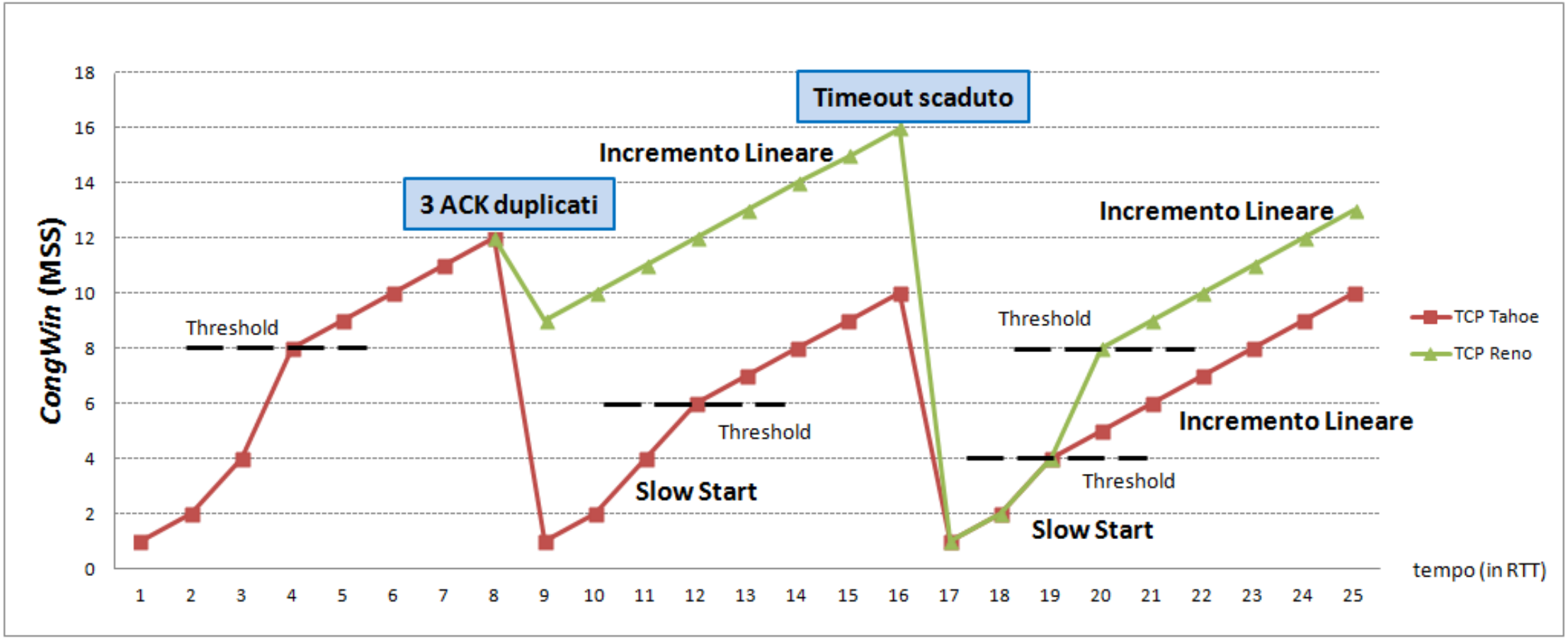
Congestion Control

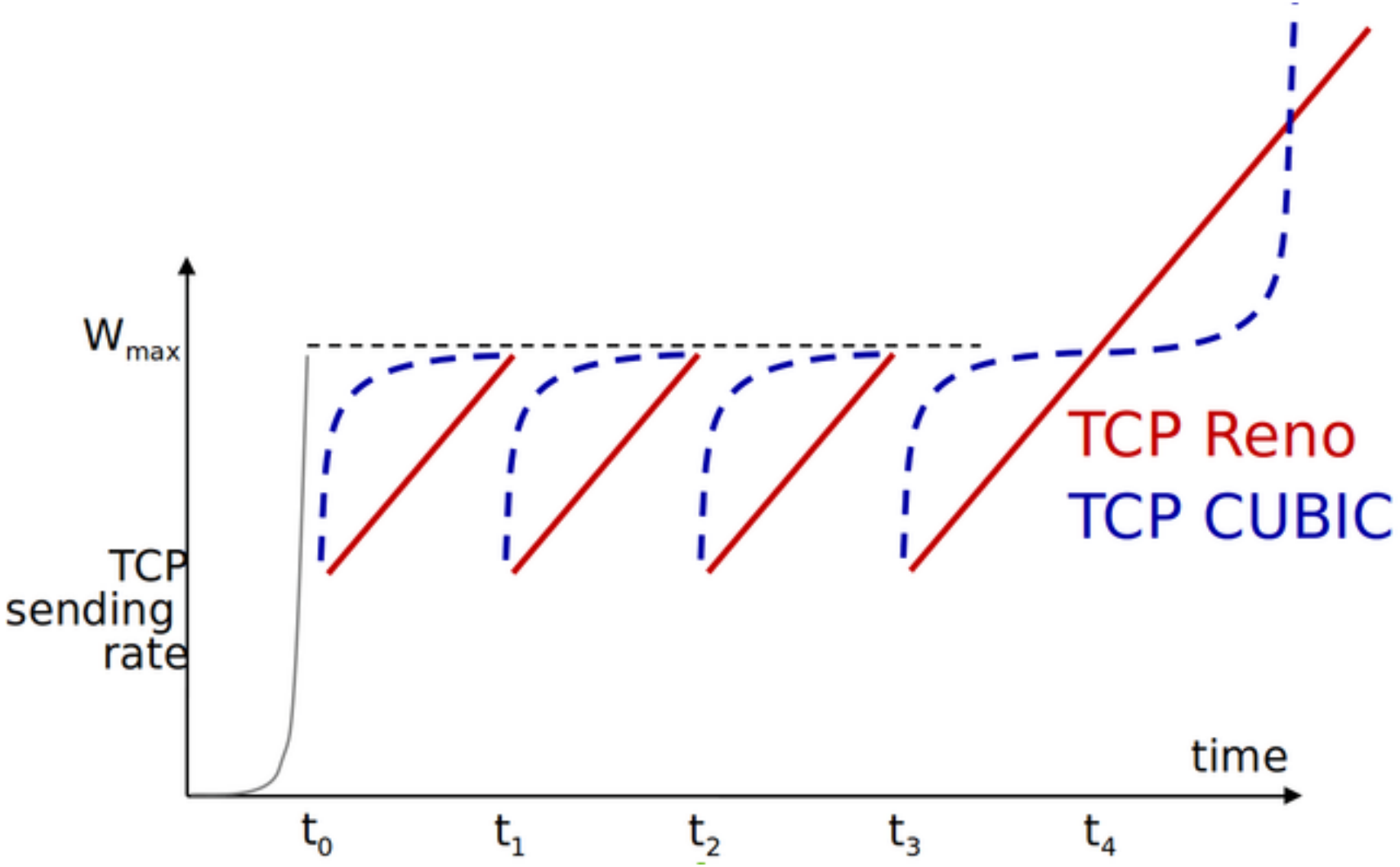
Transport layer protocols

- Transmission Control Protocol (TCP)
  - Connection-oriented
  - Three-way handshake
  - Congestion control
  - Flow control
  - Acknowledgement mechanism
  - Slow
- User Datagram Protocol (UDP)
  - Connection-less
  - No handshake mechanism
  - No congestion control
  - No flow control
  - No acknowledgement
  - Fast

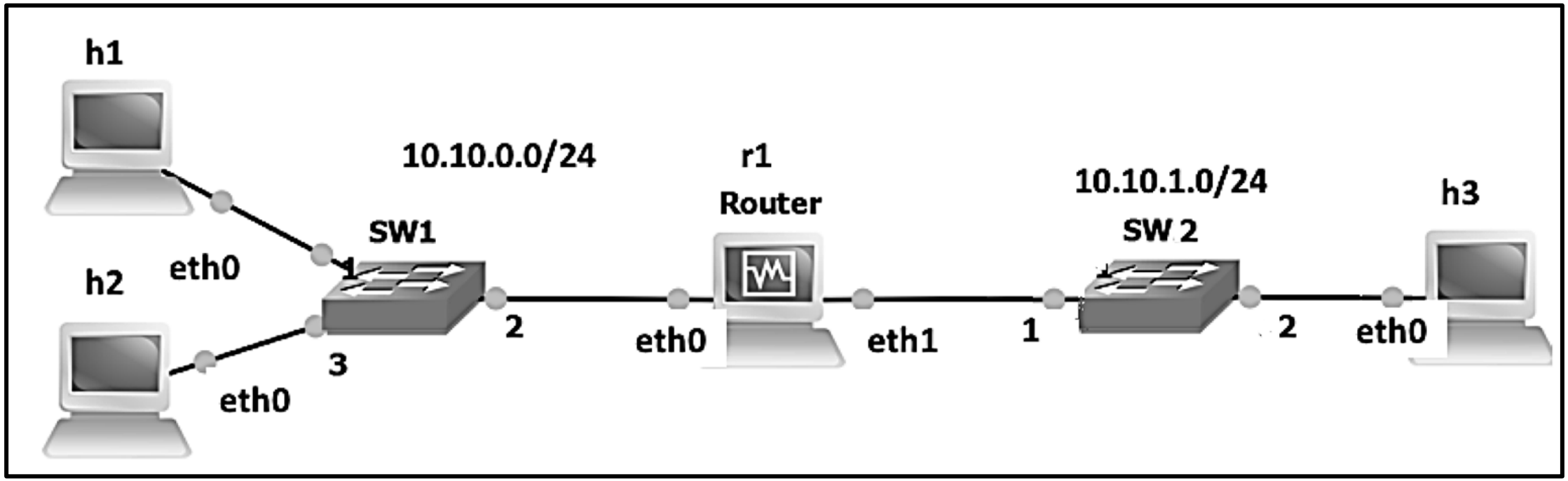
TCP congestion control



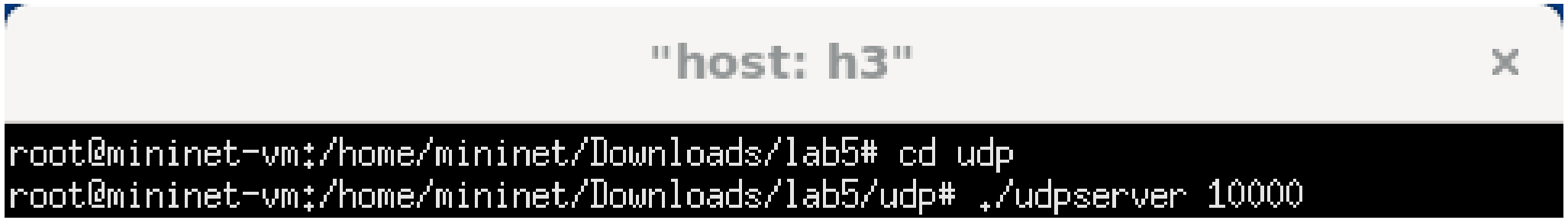
TCP congestion control



lab5.py

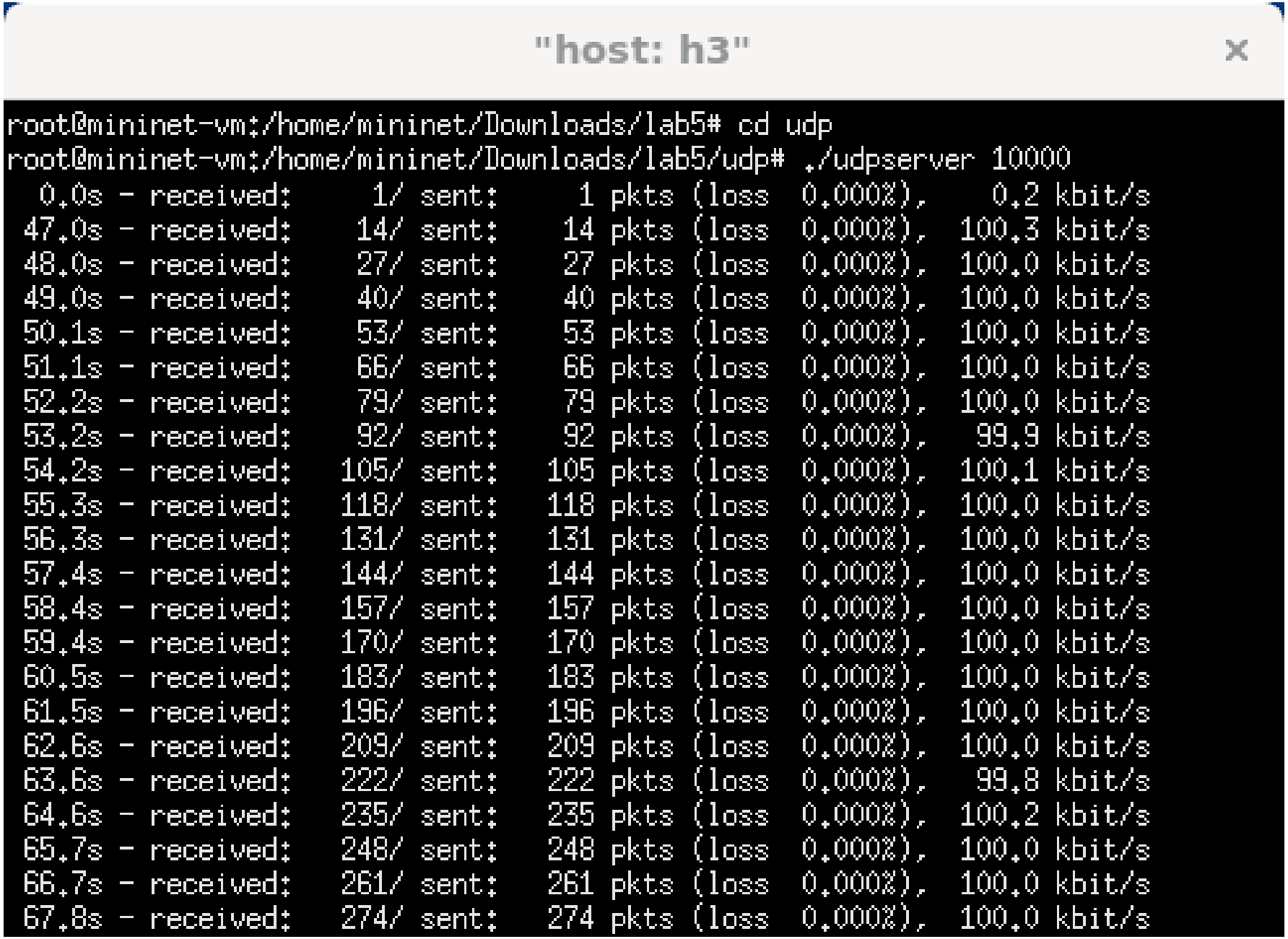

h1
h2
eth0
eth0
10.10.0.0/24
SW1
1
2
3
r1
Router
eth0
eth1
10.10.1.0/24
SW 2
1
2
h3
eth0

UDP connection

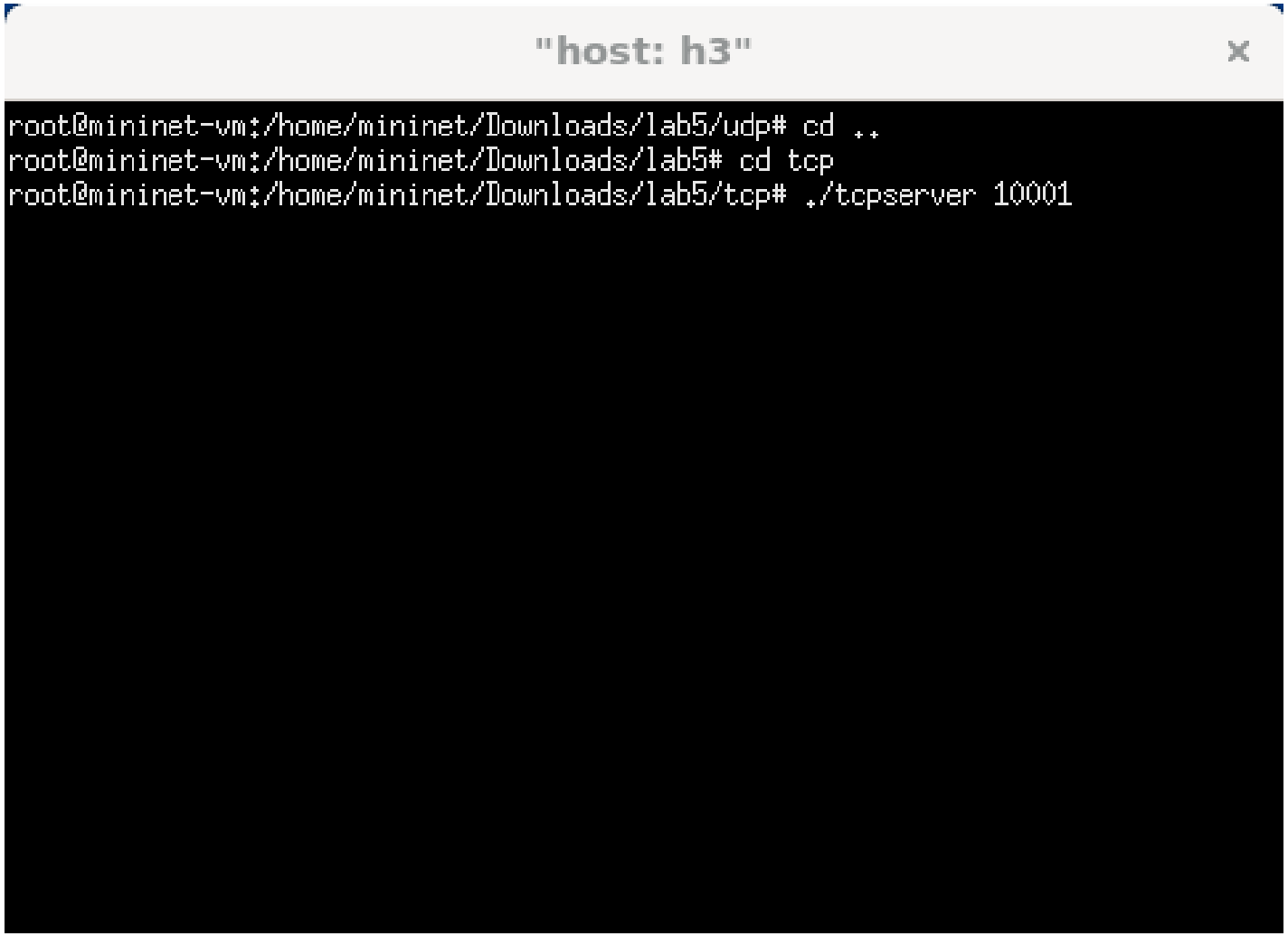


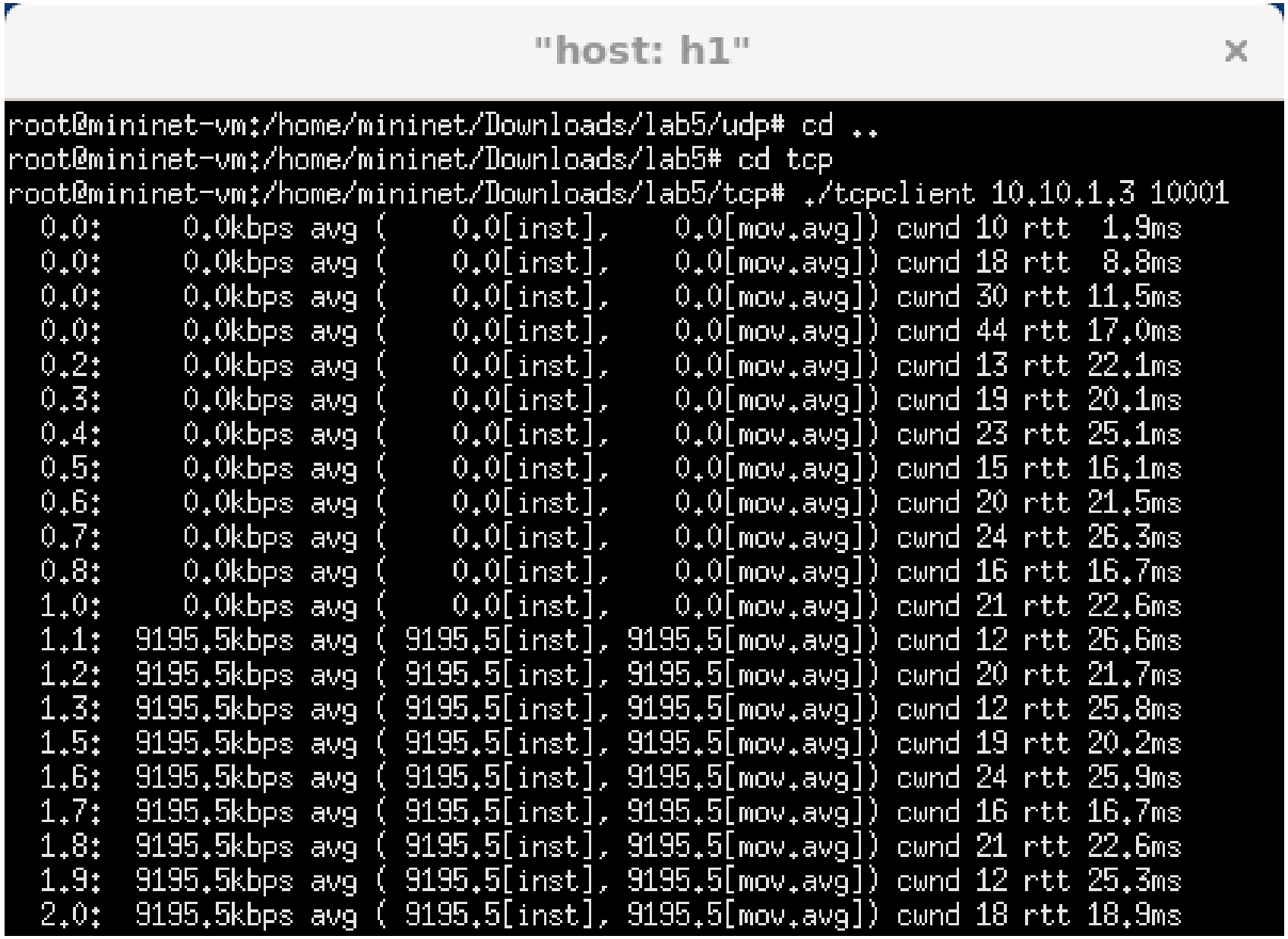
"host: h1"

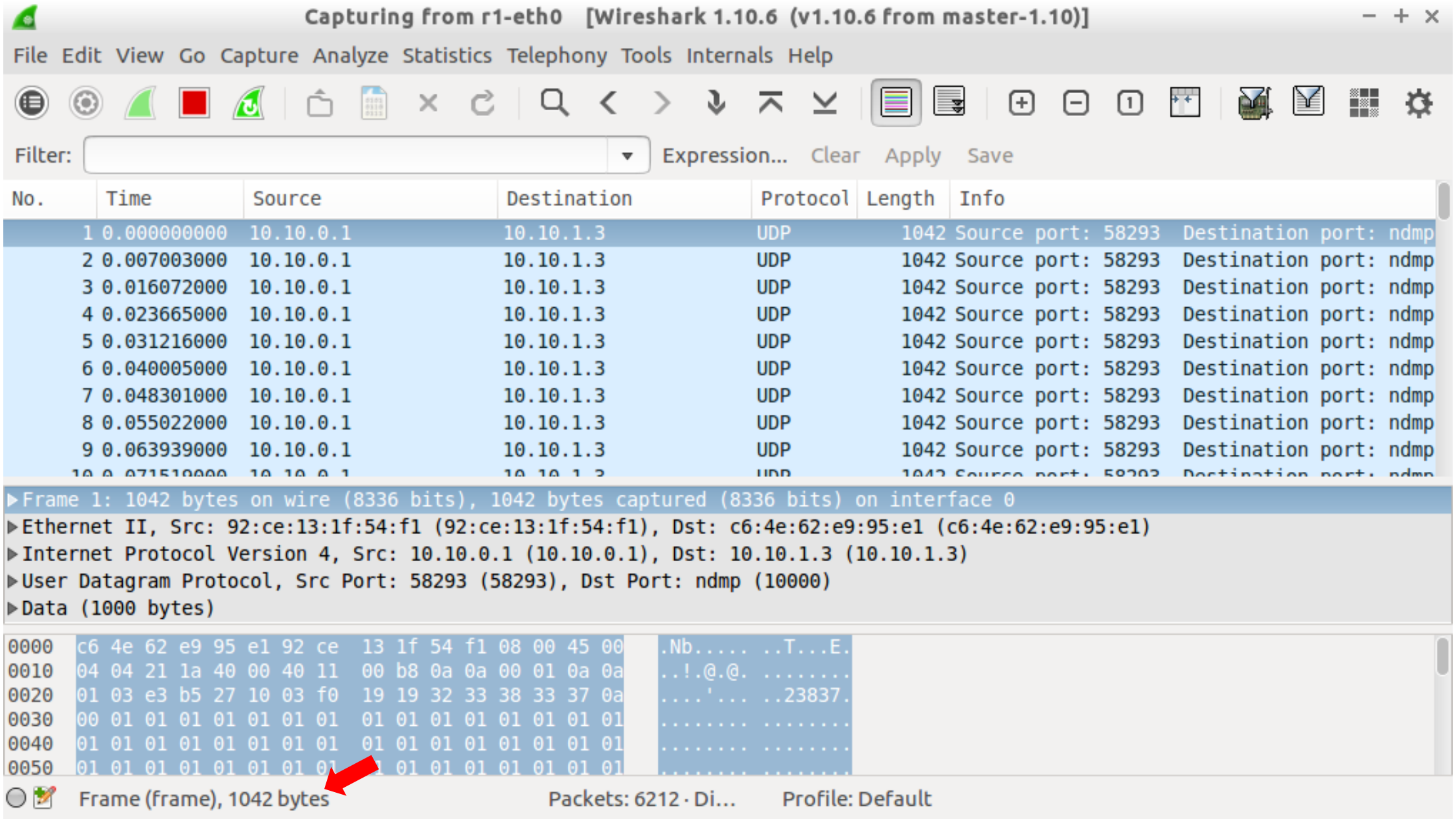
```
root@mininet-vm:/home/mininet/Downloads/lab5# cd udp
root@mininet-vm:/home/mininet/Downloads/lab5/udp# ./udpclient 10.10.1.3 10000 100
  1.0s - sent:    14 pkts,  107.6 kbits/s
  2.1s - sent:    27 pkts,  100.0 kbits/s
  3.1s - sent:    40 pkts,   99.8 kbits/s
  4.2s - sent:    53 pkts,  102.6 kbits/s
  5.2s - sent:    66 pkts,  100.0 kbits/s
  6.2s - sent:    79 pkts,  100.1 kbits/s
  7.3s - sent:    92 pkts,  100.3 kbits/s
  8.3s - sent:   105 pkts,  100.1 kbits/s
  9.4s - sent:   118 pkts,  100.2 kbits/s
 10.4s - sent:   131 pkts,  100.1 kbits/s
 11.4s - sent:   144 pkts,  100.1 kbits/s
 12.5s - sent:   157 pkts,  100.2 kbits/s
 13.5s - sent:   170 pkts,  100.2 kbits/s
 14.6s - sent:   183 pkts,  100.1 kbits/s
 15.6s - sent:   196 pkts,  100.1 kbits/s
 16.6s - sent:   209 pkts,  100.2 kbits/s
 17.7s - sent:   222 pkts,  100.3 kbits/s
 18.7s - sent:   235 pkts,   99.9 kbits/s
 19.8s - sent:   248 pkts,  100.1 kbits/s
 20.8s - sent:   261 pkts,  100.1 kbits/s
 21.8s - sent:   274 pkts,  100.3 kbits/s
```

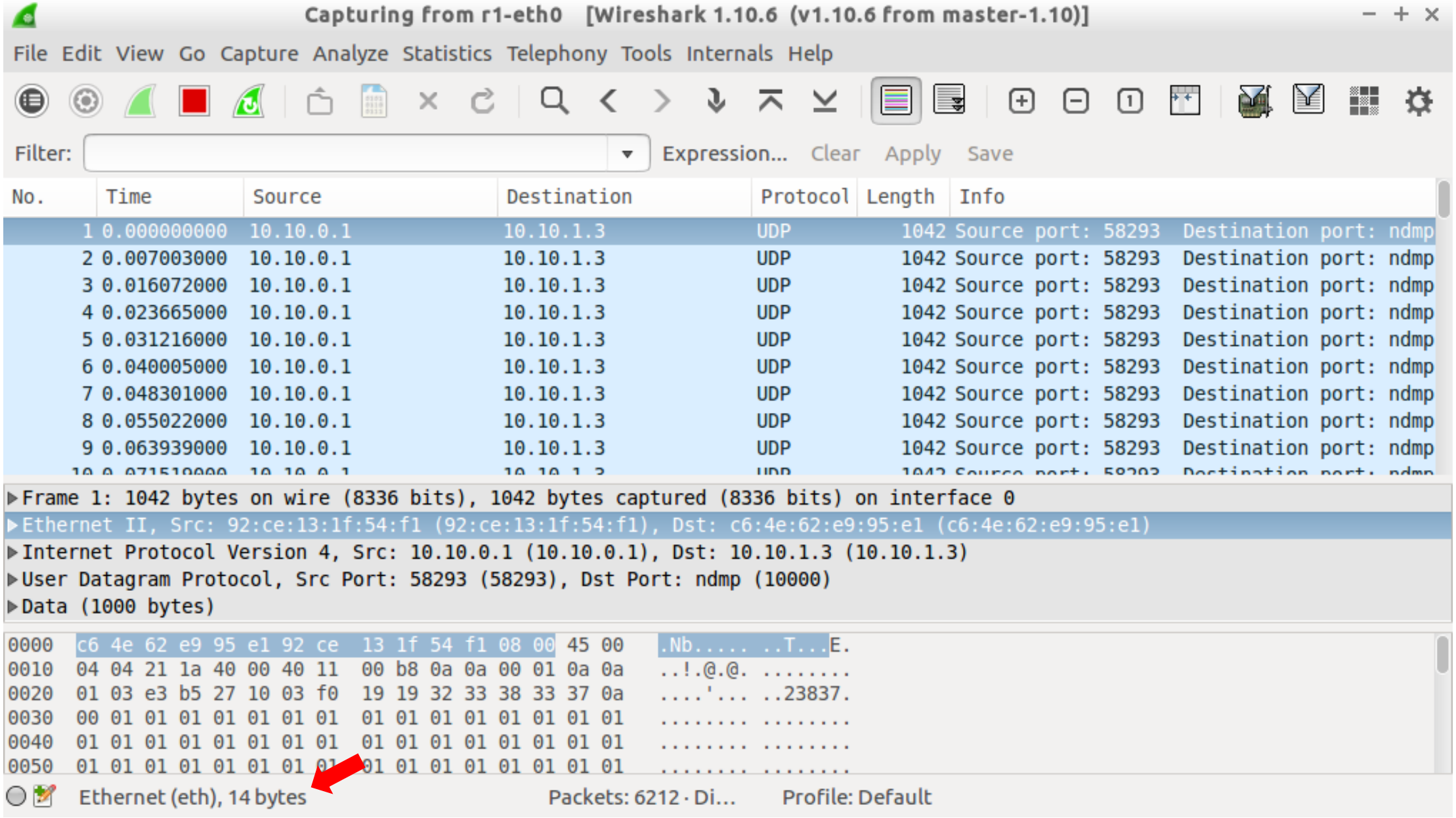

"host: h3"
root@mininet-vm:/home/mininet/Downloads/lab5# cd udp
root@mininet-vm:/home/mininet/Downloads/lab5/udp# ./udpserver 10000
  0.0s - received: 1/ sent: 1 pkts (loss 0.000%),   0.2 kbit/s
 47.0s - received: 14/ sent: 14 pkts (loss 0.000%), 100.3 kbit/s
 48.0s - received: 27/ sent: 27 pkts (loss 0.000%), 100.0 kbit/s
 49.0s - received: 40/ sent: 40 pkts (loss 0.000%), 100.0 kbit/s
 50.1s - received: 53/ sent: 53 pkts (loss 0.000%), 100.0 kbit/s
 51.1s - received: 66/ sent: 66 pkts (loss 0.000%), 100.0 kbit/s
 52.2s - received: 79/ sent: 79 pkts (loss 0.000%), 100.0 kbit/s
 53.2s - received: 92/ sent: 92 pkts (loss 0.000%),   99.9 kbit/s
 54.2s - received: 105/ sent: 105 pkts (loss 0.000%), 100.1 kbit/s
 55.3s - received: 118/ sent: 118 pkts (loss 0.000%), 100.0 kbit/s
 56.3s - received: 131/ sent: 131 pkts (loss 0.000%), 100.0 kbit/s
 57.4s - received: 144/ sent: 144 pkts (loss 0.000%), 100.0 kbit/s
 58.4s - received: 157/ sent: 157 pkts (loss 0.000%), 100.0 kbit/s
 59.4s - received: 170/ sent: 170 pkts (loss 0.000%), 100.0 kbit/s
 60.5s - received: 183/ sent: 183 pkts (loss 0.000%), 100.0 kbit/s
 61.5s - received: 196/ sent: 196 pkts (loss 0.000%), 100.0 kbit/s
 62.6s - received: 209/ sent: 209 pkts (loss 0.000%), 100.0 kbit/s
 63.6s - received: 222/ sent: 222 pkts (loss 0.000%),   99.8 kbit/s
 64.6s - received: 235/ sent: 235 pkts (loss 0.000%), 100.2 kbit/s
 65.7s - received: 248/ sent: 248 pkts (loss 0.000%), 100.0 kbit/s
 66.7s - received: 261/ sent: 261 pkts (loss 0.000%), 100.0 kbit/s
 67.8s - received: 274/ sent: 274 pkts (loss 0.000%), 100.0 kbit/s

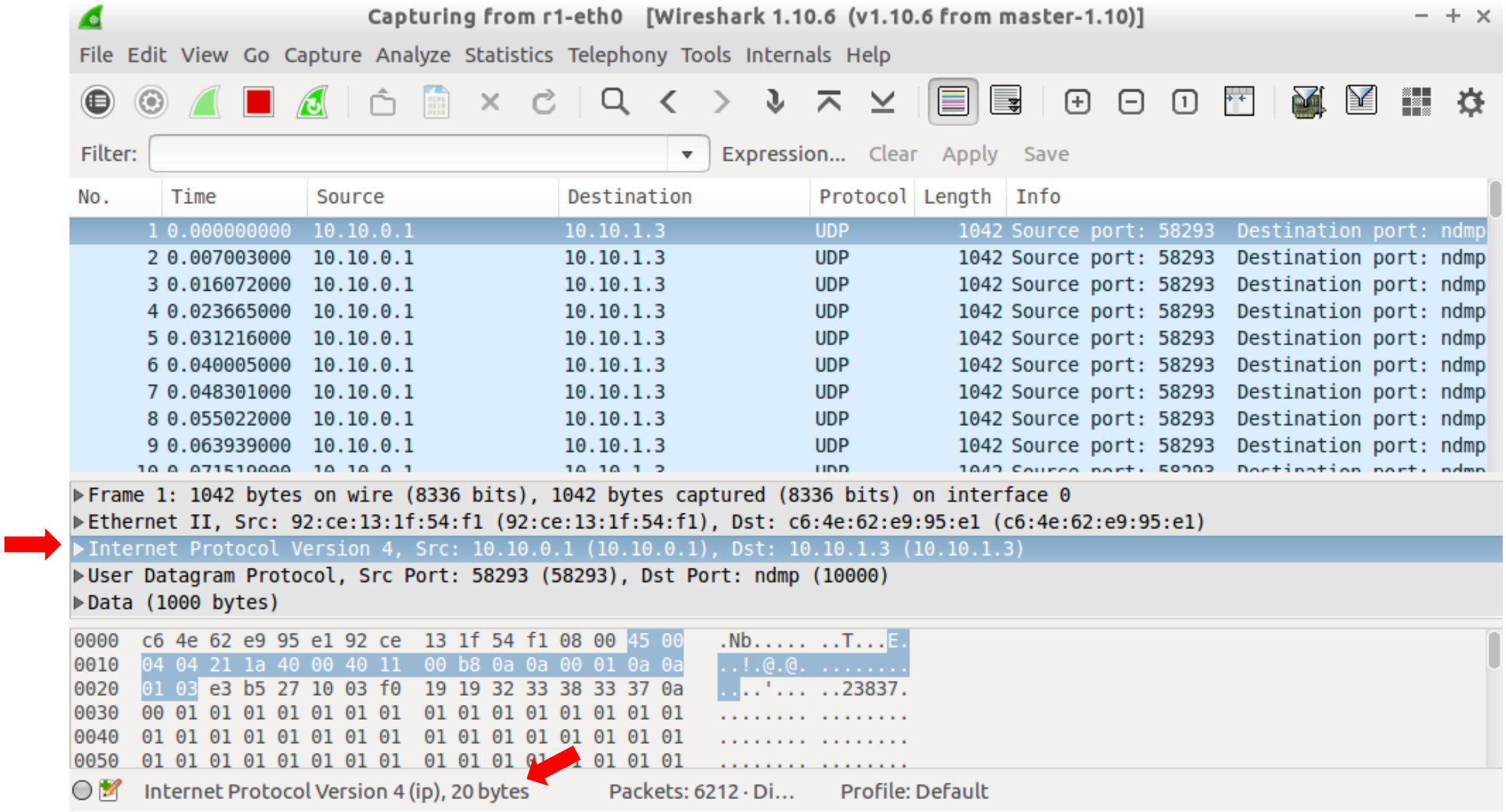
TCP connection




"host: h1"
root@mininet-vm:/home/mininet/Downloads/lab5/udp# cd ..
root@mininet-vm:/home/mininet/Downloads/lab5# cd tcp
root@mininet-vm:/home/mininet/Downloads/lab5/tcp# ./tcpclient 10.10.1.3 10001
0.0: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 10 rtt 1.9ms
0.0: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 18 rtt 8.8ms
0.0: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 30 rtt 11.5ms
0.0: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 44 rtt 17.0ms
0.2: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 13 rtt 22.1ms
0.3: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 19 rtt 20.1ms
0.4: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 23 rtt 25.1ms
0.5: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 15 rtt 16.1ms
0.6: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 20 rtt 21.5ms
0.7: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 24 rtt 26.3ms
0.8: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 16 rtt 16.7ms
1.0: 0.0kbps avg (0.0[inst], 0.0[mov.avg]) cwnd 21 rtt 22.6ms
1.1: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 12 rtt 26.6ms
1.2: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 20 rtt 21.7ms
1.3: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 12 rtt 25.8ms
1.5: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 19 rtt 20.2ms
1.6: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 24 rtt 25.9ms
1.7: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 16 rtt 16.7ms
1.8: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 21 rtt 22.6ms
1.9: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 12 rtt 25.3ms
2.0: 9195.5kbps avg (9195.5[inst], 9195.5[mov.avg]) cwnd 18 rtt 18.9ms


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
2 0.007003000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
3 0.016072000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
4 0.023665000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
5 0.031216000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
6 0.040005000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
7 0.048301000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
8 0.055022000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
9 0.063939000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
Frame 1: 1042 bytes on wire (8336 bits), 1042 bytes captured (8336 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
User Datagram Protocol, Src Port: 58293 (58293), Dst Port: ndmp (10000)
Data (1000 bytes)
0000 c6 4e 62 e9 95 e1 92 ce 13 1f 54 f1 08 00 45 00 .Nb..... ..T...E.
0010 04 04 21 1a 40 00 40 11 00 b8 0a 0a 00 01 0a 0a ..!.@.@. ....
0020 01 03 e3 b5 27 10 03 f0 19 19 32 33 38 33 37 0a ....'... ..23837.
0030 00 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0040 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0050 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
Frame (frame), 1042 bytes
Packets: 6212 · Di...
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
2 0.007003000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
3 0.016072000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
4 0.023665000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
5 0.031216000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
6 0.040005000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
7 0.048301000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
8 0.055022000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
9 0.063939000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
Frame 1: 1042 bytes on wire (8336 bits), 1042 bytes captured (8336 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
User Datagram Protocol, Src Port: 58293 (58293), Dst Port: ndmp (10000)
Data (1000 bytes)
0000 c6 4e 62 e9 95 e1 92 ce 13 1f 54 f1 08 00 45 00 .Nb..... ..T...E.
0010 04 04 21 1a 40 00 40 11 00 b8 0a 0a 00 01 0a 0a ..!.@.@. ....
0020 01 03 e3 b5 27 10 03 f0 19 19 32 33 38 33 37 0a ....'... ..23837.
0030 00 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0040 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0050 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
Ethernet (eth), 14 bytes
Packets: 6212 · Di...
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
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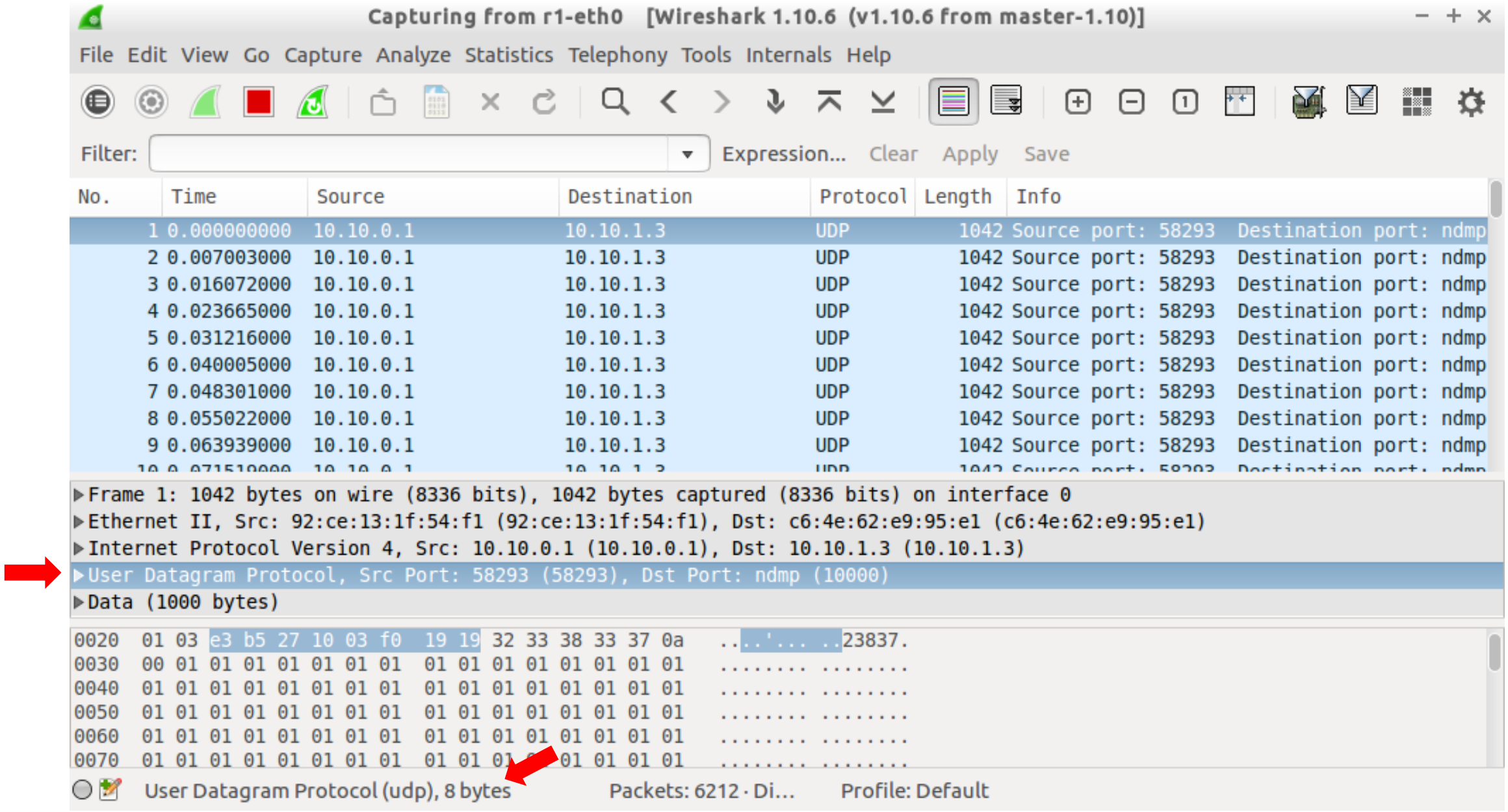
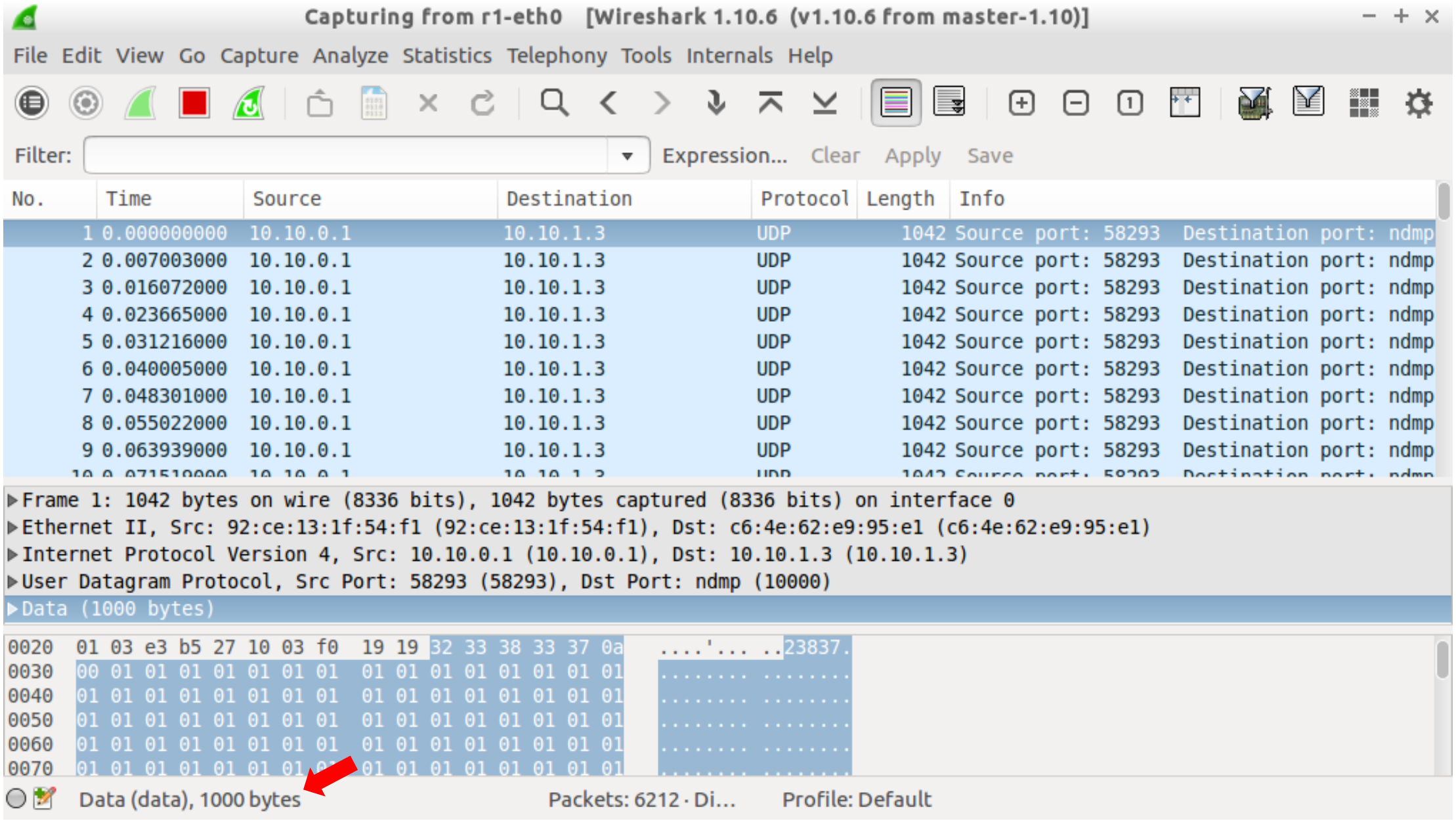
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
2 0.007003000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
3 0.016072000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
4 0.023665000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
5 0.031216000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
6 0.040005000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
7 0.048301000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
8 0.055022000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
9 0.063939000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
Frame 1: 1042 bytes on wire (8336 bits), 1042 bytes captured (8336 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
User Datagram Protocol, Src Port: 58293 (58293), Dst Port: ndmp (10000)
Data (1000 bytes)
0000 c6 4e 62 e9 95 e1 92 ce 13 1f 54 f1 08 00 45 00 .Nb..... ..T...E.
0010 04 04 21 1a 40 00 40 11 00 b8 0a 0a 00 01 0a 0a ..!.@.@. ....
0020 01 03 e3 b5 27 10 03 f0 19 19 32 33 38 33 37 0a ....'... ..23837.
0030 00 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0040 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0050 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
Internet Protocol Version 4 (ip), 20 bytes
Packets: 6212 · Di...
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
2 0.007003000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
3 0.016072000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
4 0.023665000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
5 0.031216000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
6 0.040005000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
7 0.048301000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
8 0.055022000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
9 0.063939000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
Frame 1: 1042 bytes on wire (8336 bits), 1042 bytes captured (8336 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
User Datagram Protocol, Src Port: 58293 (58293), Dst Port: ndmp (10000)
Data (1000 bytes)
0020 01 03 e3 b5 27 10 03 f0 19 19 32 33 38 33 37 0a ..'... ..23837.
0030 00 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0040 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0050 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0060 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0070 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
User Datagram Protocol (udp), 8 bytes
Packets: 6212 · Di...
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
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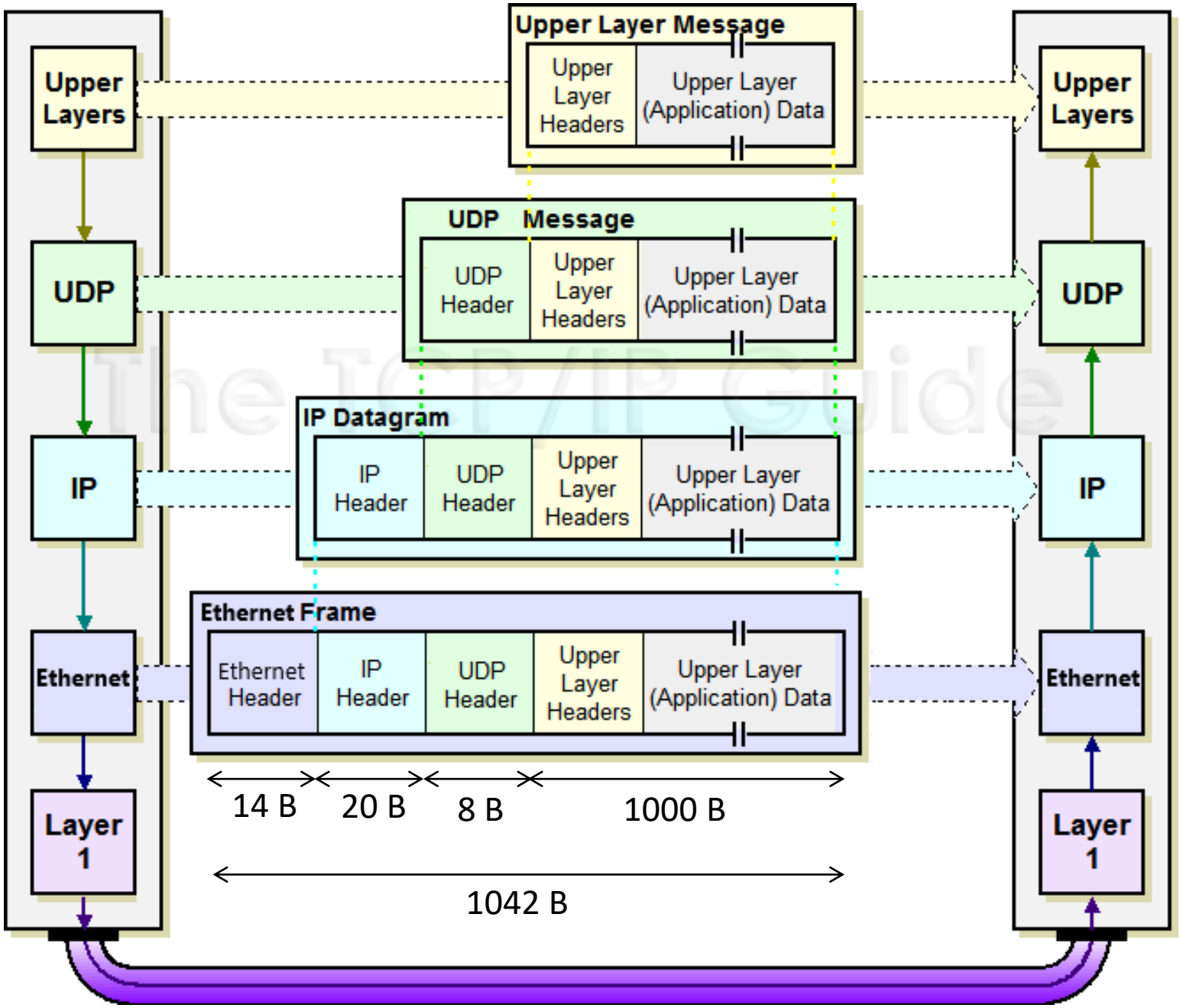
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
1 0.000000000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
2 0.007003000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
3 0.016072000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
4 0.023665000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
5 0.031216000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
6 0.040005000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
7 0.048301000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
8 0.055022000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
9 0.063939000 10.10.0.1 10.10.1.3 UDP 1042 Source port: 58293 Destination port: ndmp
Frame 1: 1042 bytes on wire (8336 bits), 1042 bytes captured (8336 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
User Datagram Protocol, Src Port: 58293 (58293), Dst Port: ndmp (10000)
Data (1000 bytes)
0020 01 03 e3 b5 27 10 03 f0 19 19 32 33 38 33 37 0a ....'... ..23837.
0030 00 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0040 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0050 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0060 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
0070 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 ....
Data (data), 1000 bytes
Packets: 6212 · Di...
Profile: Default

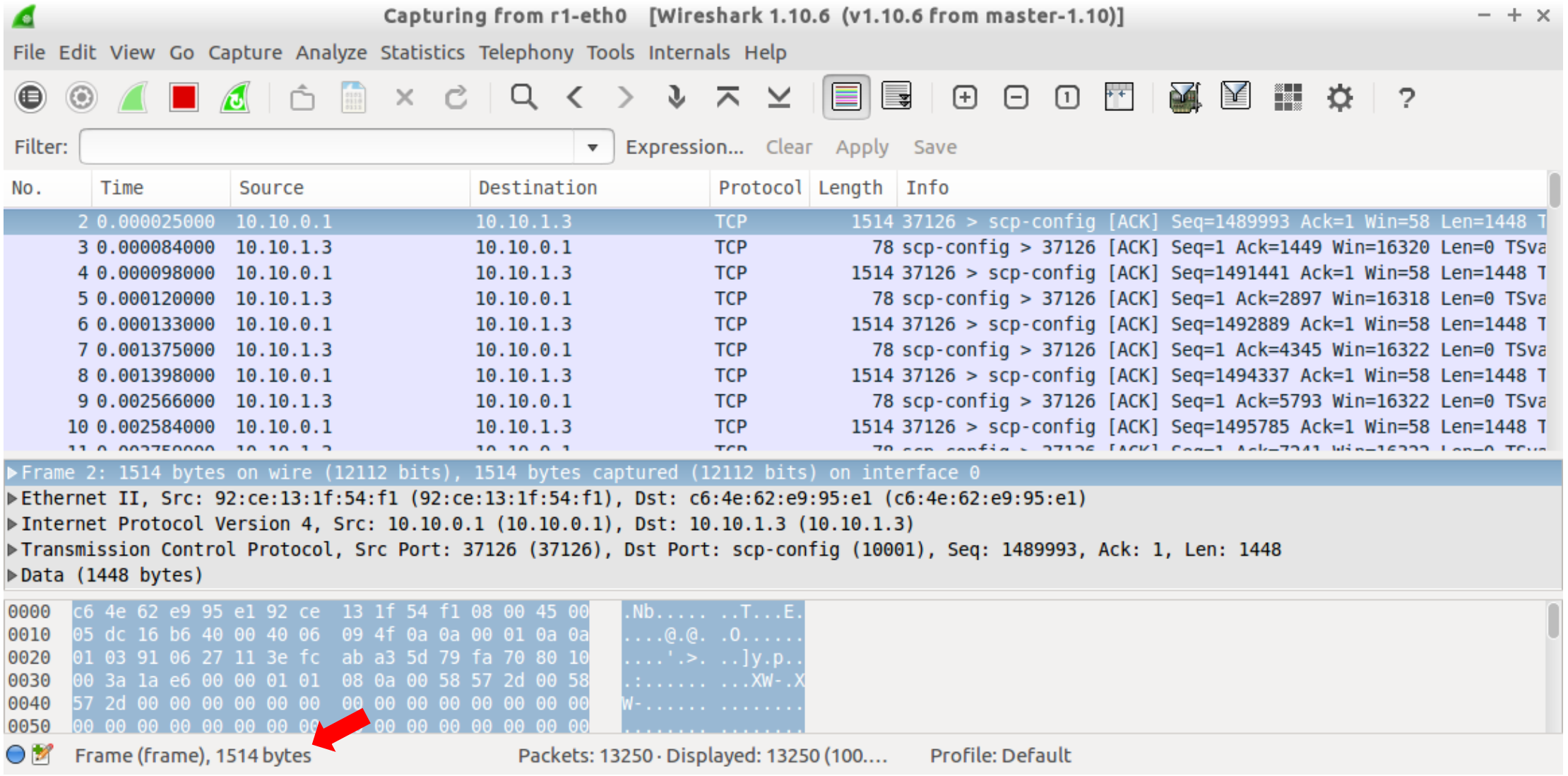
UDP connection

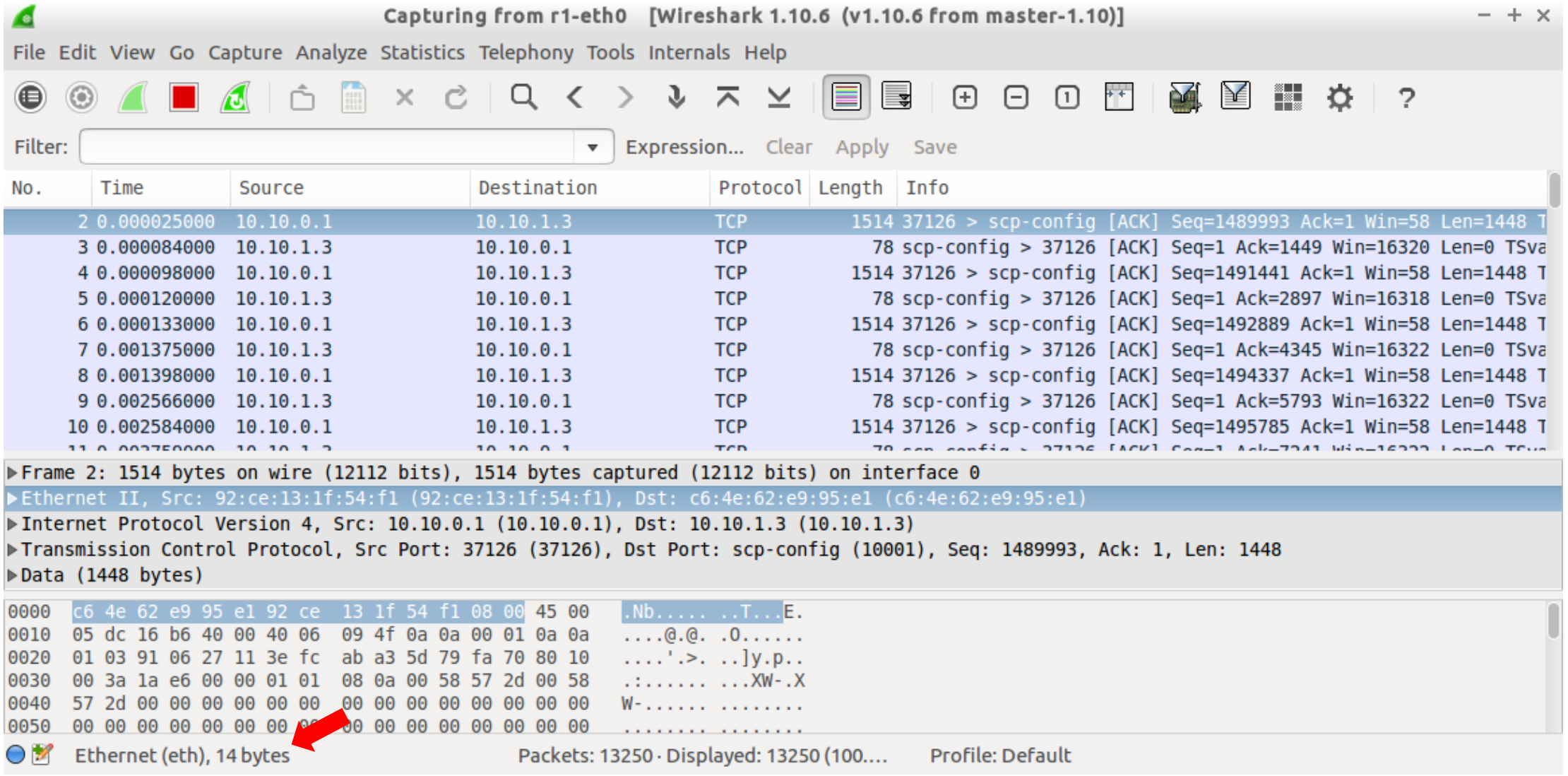
Max total rate $= 3$ Mbps

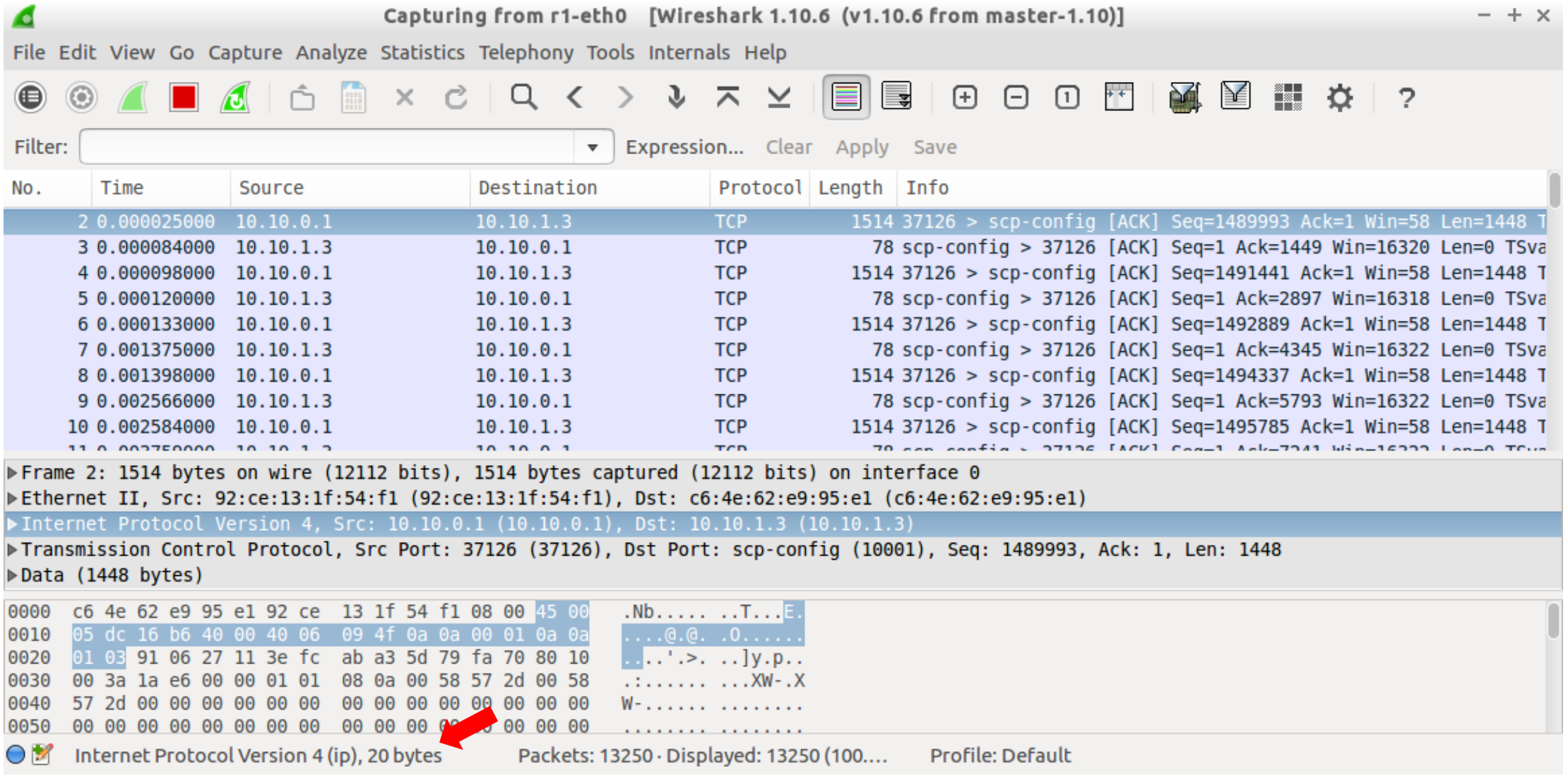
Goodput:

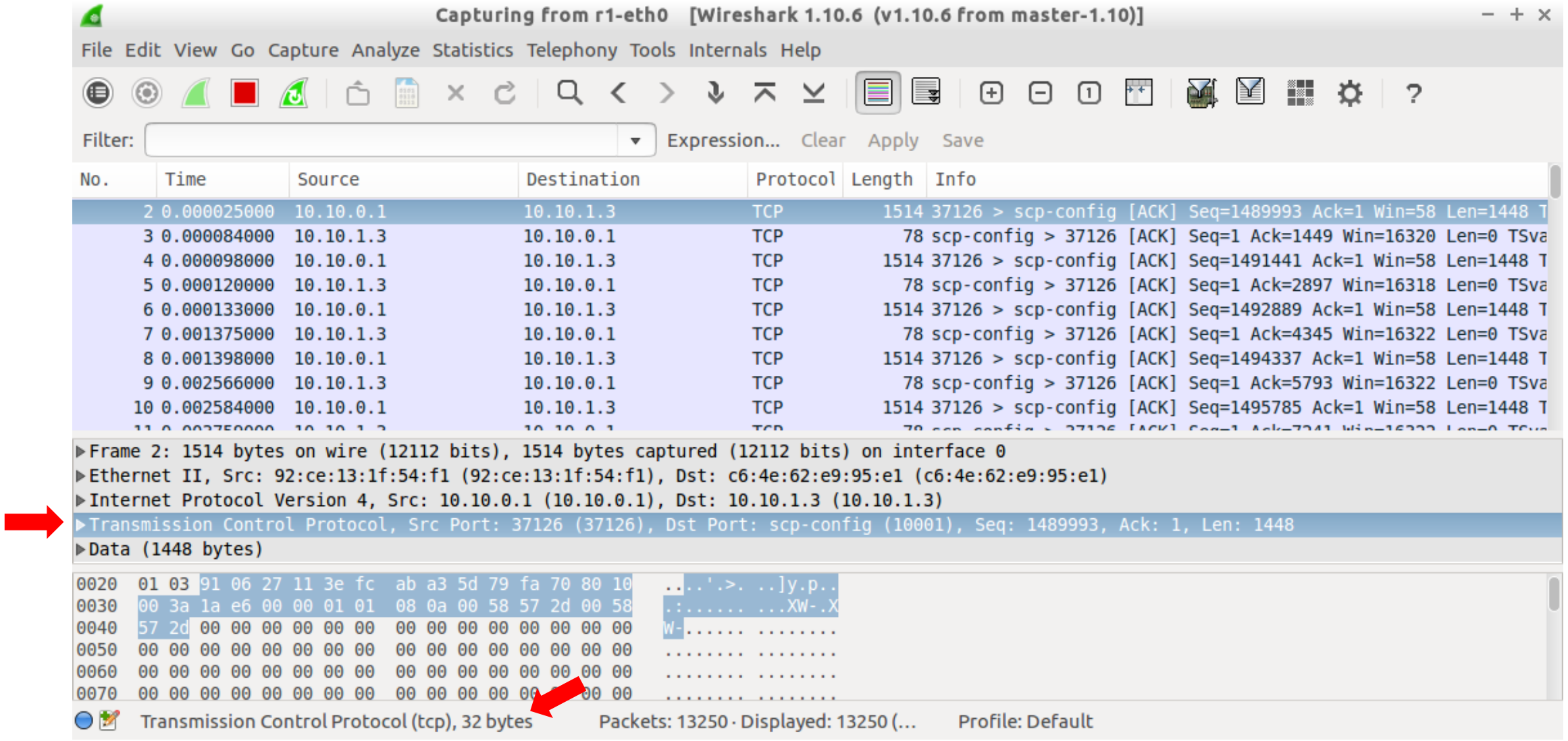
$$3 * \frac{1000}{1042} = 2879 \text{ kbps}$$

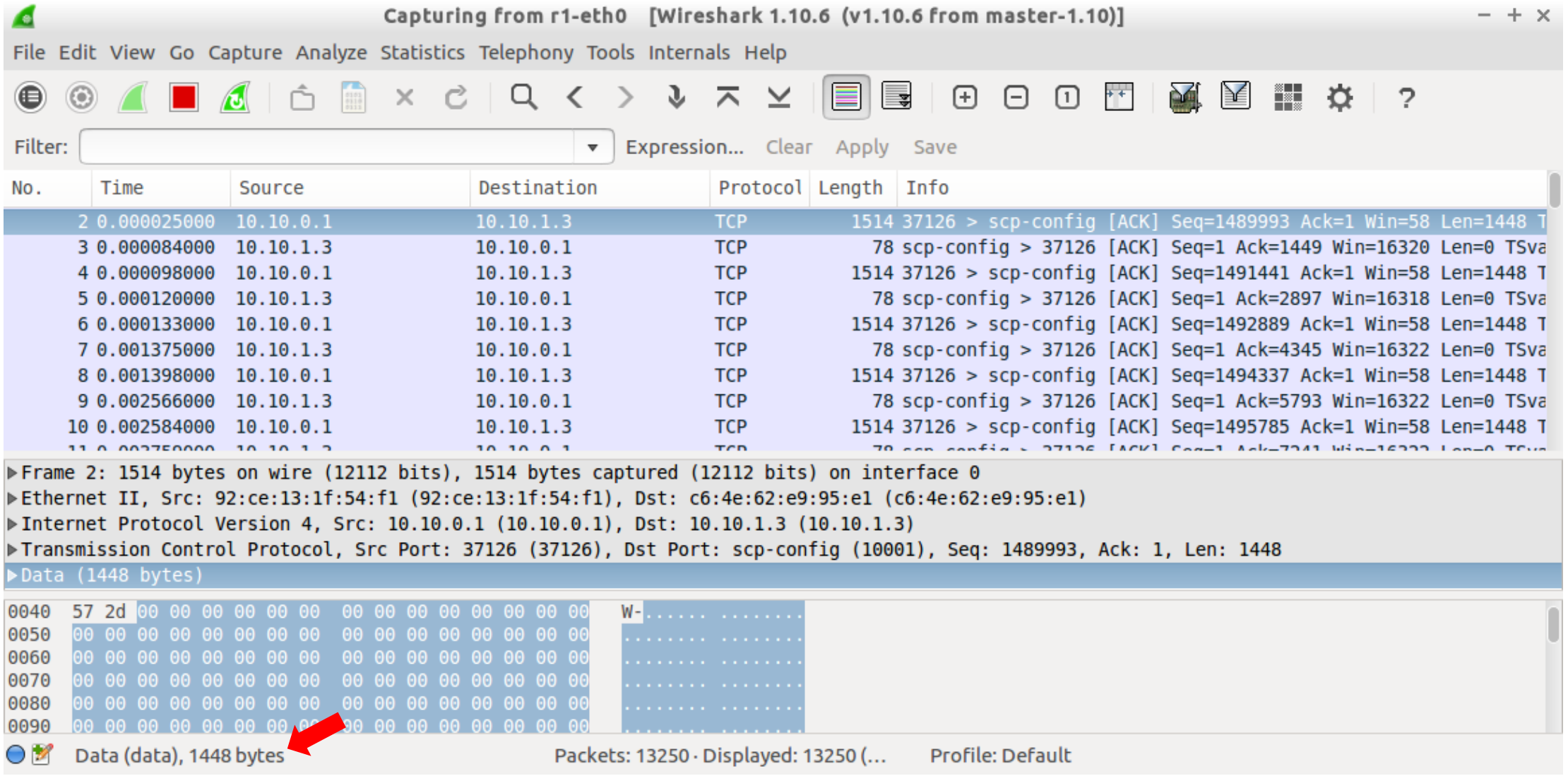



Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
2 0.000025000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1489993 Ack=1 Win=58 Len=1448 T
3 0.000084000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=1449 Win=16320 Len=0 TSva
4 0.000098000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1491441 Ack=1 Win=58 Len=1448 T
5 0.000120000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=2897 Win=16318 Len=0 TSva
6 0.000133000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1492889 Ack=1 Win=58 Len=1448 T
7 0.001375000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=4345 Win=16322 Len=0 TSva
8 0.001398000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1494337 Ack=1 Win=58 Len=1448 T
9 0.002566000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=5793 Win=16322 Len=0 TSva
10 0.002584000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1495785 Ack=1 Win=58 Len=1448 T
Frame 2: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
Transmission Control Protocol, Src Port: 37126 (37126), Dst Port: scp-config (10001), Seq: 1489993, Ack: 1, Len: 1448
Data (1448 bytes)
0000 c6 4e 62 e9 95 e1 92 ce 13 1f 54 f1 08 00 45 00 .Nb..... ..T...E.
0010 05 dc 16 b6 40 00 40 06 09 4f 0a 0a 00 01 0a 0a ....@.@. .O......
0020 01 03 91 06 27 11 3e fc ab a3 5d 79 fa 70 80 10 ....'.>. ..]y.p..
0030 00 3a 1a e6 00 00 01 01 08 0a 00 58 57 2d 00 58 .:..... ...XW-.X
0040 57 2d 00 00 00 00 00 00 00 00 00 00 00 00 00 00 W-...... ....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
Frame (frame), 1514 bytes
Packets: 13250 · Displayed: 13250 (100....
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
2 0.000025000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1489993 Ack=1 Win=58 Len=1448 T
3 0.000084000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=1449 Win=16320 Len=0 TSva
4 0.000098000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1491441 Ack=1 Win=58 Len=1448 T
5 0.000120000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=2897 Win=16318 Len=0 TSva
6 0.000133000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1492889 Ack=1 Win=58 Len=1448 T
7 0.001375000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=4345 Win=16322 Len=0 TSva
8 0.001398000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1494337 Ack=1 Win=58 Len=1448 T
9 0.002566000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=5793 Win=16322 Len=0 TSva
10 0.002584000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1495785 Ack=1 Win=58 Len=1448 T
Frame 2: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
Transmission Control Protocol, Src Port: 37126 (37126), Dst Port: scp-config (10001), Seq: 1489993, Ack: 1, Len: 1448
Data (1448 bytes)
0000 c6 4e 62 e9 95 e1 92 ce 13 1f 54 f1 08 00 45 00 .Nb..... ..T...E.
0010 05 dc 16 b6 40 00 40 06 09 4f 0a 0a 00 01 0a 0a ....@.@. .O......
0020 01 03 91 06 27 11 3e fc ab a3 5d 79 fa 70 80 10 ....'.>. ..]y.p..
0030 00 3a 1a e6 00 00 01 01 08 0a 00 58 57 2d 00 58 .:..... ...XW-.X
0040 57 2d 00 00 00 00 00 00 00 00 00 00 00 00 00 00 W-...... ....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
Ethernet (eth), 14 bytes
Packets: 13250 · Displayed: 13250 (100....
Profile: Default

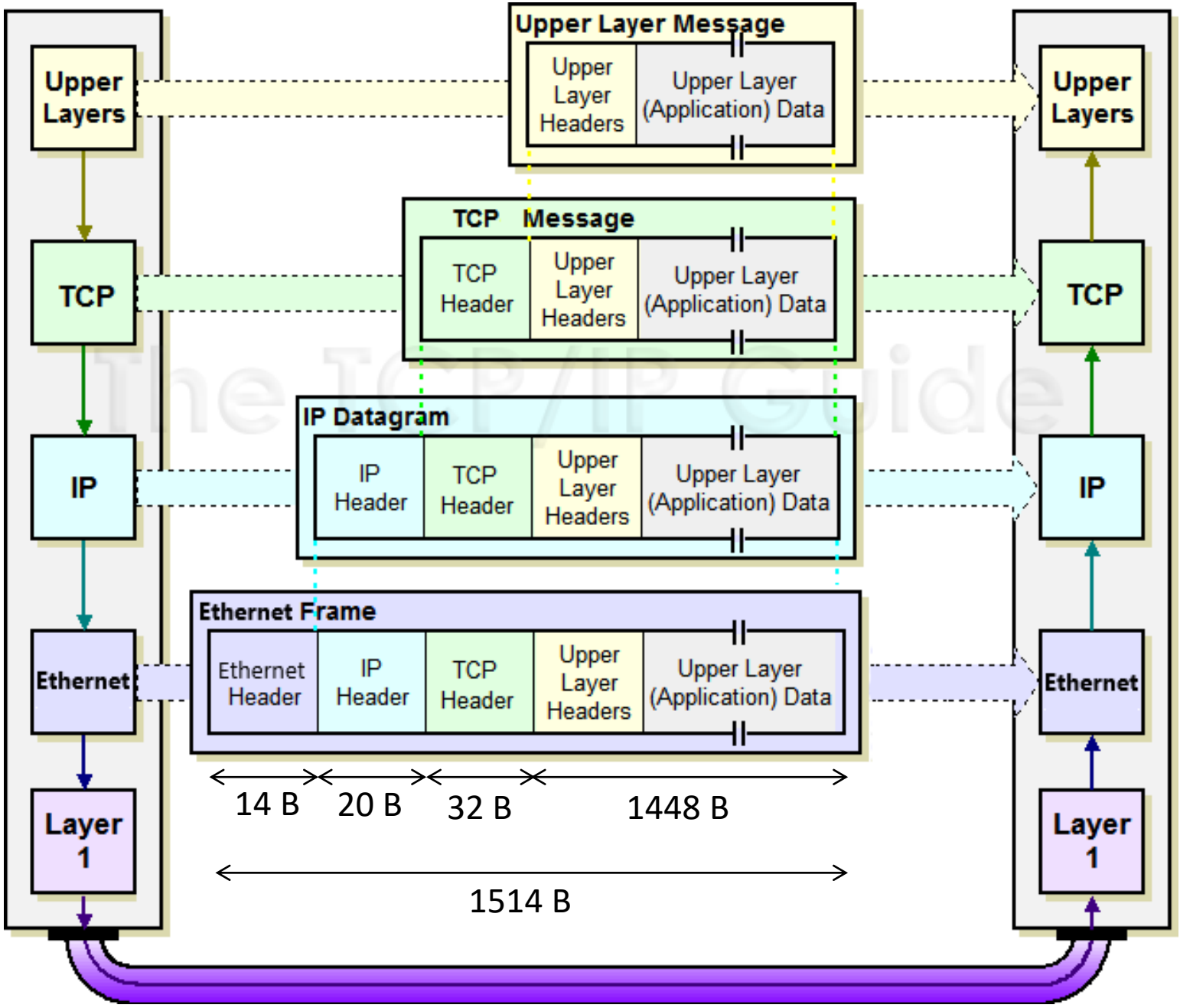

Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
2 0.000025000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1489993 Ack=1 Win=58 Len=1448 T
3 0.000084000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=1449 Win=16320 Len=0 TSva
4 0.000098000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1491441 Ack=1 Win=58 Len=1448 T
5 0.000120000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=2897 Win=16318 Len=0 TSva
6 0.000133000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1492889 Ack=1 Win=58 Len=1448 T
7 0.001375000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=4345 Win=16322 Len=0 TSva
8 0.001398000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1494337 Ack=1 Win=58 Len=1448 T
9 0.002566000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=5793 Win=16322 Len=0 TSva
10 0.002584000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1495785 Ack=1 Win=58 Len=1448 T
Frame 2: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
Transmission Control Protocol, Src Port: 37126 (37126), Dst Port: scp-config (10001), Seq: 1489993, Ack: 1, Len: 1448
Data (1448 bytes)
0000 c6 4e 62 e9 95 e1 92 ce 13 1f 54 f1 08 00 45 00 .Nb..... ..T...E.
0010 05 dc 16 b6 40 00 40 06 09 4f 0a 0a 00 01 0a 0a ....@.@. .O......
0020 01 03 91 06 27 11 3e fc ab a3 5d 79 fa 70 80 10 ....'.>. ..]y.p..
0030 00 3a 1a e6 00 00 01 01 08 0a 00 58 57 2d 00 58 .:..... ...XW-.X
0040 57 2d 00 00 00 00 00 00 00 00 00 00 00 00 00 00 W-...... ....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
Internet Protocol Version 4 (ip), 20 bytes
Packets: 13250 · Displayed: 13250 (100....
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
2 0.000025000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1489993 Ack=1 Win=58 Len=1448 T
3 0.000084000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=1449 Win=16320 Len=0 TSva
4 0.000098000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1491441 Ack=1 Win=58 Len=1448 T
5 0.000120000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=2897 Win=16318 Len=0 TSva
6 0.000133000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1492889 Ack=1 Win=58 Len=1448 T
7 0.001375000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=4345 Win=16322 Len=0 TSva
8 0.001398000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1494337 Ack=1 Win=58 Len=1448 T
9 0.002566000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=5793 Win=16322 Len=0 TSva
10 0.002584000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1495785 Ack=1 Win=58 Len=1448 T
Frame 2: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
Transmission Control Protocol, Src Port: 37126 (37126), Dst Port: scp-config (10001), Seq: 1489993, Ack: 1, Len: 1448
Data (1448 bytes)
0020 01 03 91 06 27 11 3e fc ab a3 5d 79 fa 70 80 10 ..'.>. ..]y.p..
0030 00 3a 1a e6 00 00 01 01 08 0a 00 58 57 2d 00 58 .:..... ...XW-.X
0040 57 2d 00 00 00 00 00 00 00 00 00 00 00 00 00 00 W-..... ....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
Transmission Control Protocol (tcp), 32 bytes
Packets: 13250 · Displayed: 13250 (...
Profile: Default


Capturing from r1-eth0 [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save
No. Time Source Destination Protocol Length Info
2 0.000025000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1489993 Ack=1 Win=58 Len=1448 T
3 0.000084000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=1449 Win=16320 Len=0 TSva
4 0.000098000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1491441 Ack=1 Win=58 Len=1448 T
5 0.000120000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=2897 Win=16318 Len=0 TSva
6 0.000133000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1492889 Ack=1 Win=58 Len=1448 T
7 0.001375000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=4345 Win=16322 Len=0 TSva
8 0.001398000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1494337 Ack=1 Win=58 Len=1448 T
9 0.002566000 10.10.1.3 10.10.0.1 TCP 78 scp-config > 37126 [ACK] Seq=1 Ack=5793 Win=16322 Len=0 TSva
10 0.002584000 10.10.0.1 10.10.1.3 TCP 1514 37126 > scp-config [ACK] Seq=1495785 Ack=1 Win=58 Len=1448 T
Frame 2: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: 92:ce:13:1f:54:f1 (92:ce:13:1f:54:f1), Dst: c6:4e:62:e9:95:e1 (c6:4e:62:e9:95:e1)
Internet Protocol Version 4, Src: 10.10.0.1 (10.10.0.1), Dst: 10.10.1.3 (10.10.1.3)
Transmission Control Protocol, Src Port: 37126 (37126), Dst Port: scp-config (10001), Seq: 1489993, Ack: 1, Len: 1448
Data (1448 bytes)
0040 57 2d 00 00 00 00 00 00 00 00 00 00 00 00 00 00 W-..... ....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....
Data (data), 1448 bytes
Packets: 13250 · Displayed: 13250 (...
Profile: Default

TCP connection

Max total rate $= 3$ Mbps

Goodput:

$$3 * \frac{1448}{1514} = 2869 \text{ kbps}$$