

Exercises

TCP/IP Networking

With Solutions

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1 Module 1: TCP/IP Architecture

Exercise 1.1 *Elaine is sitting in front of lrcpc3 and connects to machine 'ezinfo.ethz.ch' by Telnet. A clairvoyant angel has read all the frames passing on the network. Here is the first packet resulting from this activity:*

```
ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 1 arrived at 19:03:32.39
ETHER: Packet size = 60 bytes
ETHER: Destination = ff:ff:ff:ff:ff:ff
ETHER: Source       = 0:0:c0:b8:c2:8d
ETHER: Ethertype   = 0806
ETHER:
ARP: ----- ARP/RARP Frame -----
ARP:
ARP: Hardware type = 1
ARP: Protocol type = 0800 (IP)
ARP: Length of hardware address = 6 bytes
ARP: Length of protocol address = 4 bytes
ARP: Opcode 1 (ARP Request)
ARP: Sender's hardware address = 0:0:c0:b8:c2:8d
ARP: Sender's protocol address = 128.178.156.7, lrcpc3.epfl.ch
ARP: Target hardware address = ?
ARP: Target protocol address = 128.178.156.1, in-inr-e4.epfl.ch
```

1. *What is this frame used for in this exchange?*

Solution:

The frame used is an ARP request.

2. *What stations receive this frame? What stations reply to it?*

Solution:

All the stations of this subnetwork will receive this frame. Only the router in-inr-e4.epfl.ch will answer with the MAC address that was requested with the ARP request.

3. How can we determine if a frame is an ARP frame?

Solution:

With the Ethernet type = 0806.

Exercise 1.2 Among the packets observed, shortly afterwards, we find the following two:

```
ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 2 arrived at 19:03:32.39
ETHER: Packet size = 74 bytes
ETHER: Destination = 0:0:c:2:78:36
ETHER: Source       = 0:0:c0:b8:c2:8d
ETHER: Ethertype = 0800
ETHER:
IP: ----- IP Header -----
IP:
IP: Version = 4
IP: Header length = 20 bytes
IP: Type of service = 0x00
IP:     xxx. .... = 0 (precedence)
IP:     ...0 .... = normal delay
IP:     .... 0... = normal throughput
IP:     .... .0.. = normal reliability
IP: Total length = 60 bytes
IP: Identification = 2947
IP: Flags = 0x0
IP:     .0.. .... = may fragment
IP:     ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 64 seconds/hops
IP: Protocol = 17
IP: Header checksum = c2ba
IP: Source address = 128.178.156.7
IP: Destination address = 128.178.15.8, IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 1267
UDP: Destination port = 53 (DNS)
UDP: Length = 40
UDP: Checksum = B672
UDP:
DNS: ----- DNS: -----
DNS:
DNS: " "
DNS:
```

```

ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 3 arrived at 19:03:32.40
ETHER: Packet size = 202 bytes
ETHER: Destination = 0:0:c0:b8:c2:8d, Western Digital
ETHER: Source      = 0:0:c:2:78:36, Cisco
ETHER: Ethertype = 0800
ETHER:
IP: ----- IP Header -----
IP:
IP: Version = 4
IP: Header length = 20 bytes
IP: Type of service = 0x00
IP:      xxx. .... = 0 (precedence)
IP:      ...0 .... = normal delay
IP:      .... 0... = normal throughput
IP:      .... .0.. = normal reliability
IP: Total length = 188 bytes
IP: Identification = 38579
IP: Flags = 0x0
IP:      .0.. .... = may fragment
IP:      ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 58 seconds/hops
IP: Protocol = 17
IP: Header checksum = 3d0a
IP: Source address = 128.178.15.8,
IP: Destination address = 128.178.156.7,
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 53
UDP: Destination port = 1267
UDP: Length = 168
UDP: Checksum = 0000
UDP:
DNS: ----- DNS: -----
DNS:
DNS: " "
DNS:

```

1. *What has happened?*

Solution:

Packet 2: lrcpc3 issues an UDP packet searching for the IP address of ezinfo.ethz.ch. This packet is

sent to the DNS server.

Packet 3: DNS server answers with the requested IP address.

2. What is lrpc3's IP address? and ezinfo.ethz.ch's? What is the source IP address of packet 3. Which is the source MAC?

Solution:

lrpc3: 128.178.156.7

ezinfo.ethz.ch is contained in the DNS part of packet 3 (not presented). It will be available in packet 4.

source IP of packet 3: 128.178.15.8

Source MAC address of packet 3: 0:0:c:2:78:36

3. What is UDP port 53 reserved for? 1267? How can a UDP packet be recognised?

Solution:

UDP port 53 is reserved for Name Server in DNS.

UDP port 1267 is not reserved.

A UDP packet can be recognized by the protocol field in the IP header (= 17)

4. Comment on the value of the TTL fields.

Solution:

Packet 2 has TTL=64 and packet 3 has TTL=58. Assuming that DNS server issues the packet with the same TTL as lrpc3 (that is 64), we can conclude that the routers between the DNS and lrpc3 have reduced the TTL by 6.

5. Comment on the UDP checksum.

Solution:

Checksum computation is not mandatory with UDP over IPv4; if no checksum is computed, the value 0 is written in the checksum field. This value cannot be obtained if a valid checksum is computed. We see that there was no checksum computed in Packet 3.

Exercise 1.3 The following packets are then observed.

1. What has happened?

Solution:

There has been established a TCP connection between lrpc3 and ezinfo.ethz.ch. Packets 4,5 and 6 form 3-way handshake procedure.

2. What is the length of the TCP payload contained in packets 5 to 9?

Solution:

In packet 7.

packetnumber	payload
5	0
6	0
7	24
8	0
9	30

3. What will the value of the sequence and acknowledgement fields be in the next packet sent by lrpc3?

Solution:

acknowledge field = 2068544031

sequence number = 2591304298

```
ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 4 arrived at 19:03:32.40
ETHER: Packet size = 60 bytes
ETHER: Destination = 0:0:c:2:78:36, Cisco
ETHER: Source      = 0:0:c0:b8:c2:8d, Western Digital
ETHER: Ethertype = 0800 (IP)
ETHER:
IP: ----- IP Header -----
IP:
IP: Version = 4
IP: Header length = 20 bytes
IP: Type of service = 0x00
IP:     xxx. .... = 0 (precedence)
IP:     ...0 .... = normal delay
IP:     .... 0... = normal throughput
IP:     .... .0.. = normal reliability
IP: Total length = 44 bytes
IP: Identification = 2948
IP: Flags = 0x0
IP:     .0.. .... = may fragment
IP:     ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 64 seconds/hops
IP: Protocol = 6 (TCP)
IP: Header checksum = cec2
IP: Source address = 128.178.156.7, lrcpc3.epfl.ch
IP: Destination address = 129.132.2.72, ezinfo.ethz.ch
IP: No options
IP:
TCP: ----- TCP Header -----
TCP:
TCP: Source port = 1268
TCP: Destination port = 23 (TELNET)
TCP: Sequence number = 2591304273
TCP: Acknowledgement number = 0
TCP: Data offset = 24 bytes
TCP: Flags = 0x02
TCP:     ..0. .... = No urgent pointer
TCP:     ...0 .... = No acknowledgement
TCP:     .... 0... = No push
TCP:     .... .0.. = No reset
TCP:     .... ..1. = Syn
TCP:     .... ...0 = No Fin
TCP: Window = 512
TCP: Checksum = 0x2fc4
TCP: Urgent pointer = 0
TCP: Options: (4 bytes)
```

```

TCP:      - Maximum segment size = 448 bytes
TCP:
TELNET:   ----- TELNET:   -----
TELNET:
TELNET:   " "
TELNET:

ETHER:    ----- Ether Header -----
ETHER:
ETHER:    Packet 5 arrived at 19:03:32.50
ETHER:    Packet size = 60 bytes
ETHER:    Destination = 0:0:c0:b8:c2:8d, Western Digital
ETHER:    Source       = 0:0:c:2:78:36, Cisco
ETHER:    Ethertype = 0800 (IP)
ETHER:
IP:       ----- IP Header -----
IP:
IP:       Version = 4
IP:       Header length = 20 bytes
IP:       Type of service = 0x00
IP:       xxx. .... = 0 (precedence)
IP:       ...0 .... = normal delay
IP:       .... 0... = normal throughput
IP:       .... .0.. = normal reliability
IP:       Total length = 40 bytes
IP:       Identification = 33316
IP:       Flags = 0x0
IP:       .0.. .... = may fragment
IP:       ..0. .... = last fragment
IP:       Fragment offset = 0 bytes
IP:       Time to live = 119 seconds/hops
IP:       Protocol = 6 (TCP)
IP:       Header checksum = 2126
IP:       Source address = 129.132.2.72, ezinfo.ethz.ch
IP:       Destination address = 128.178.156.7, lrcpc3.epfl.ch
IP:       No options
IP:
TCP:      ----- TCP Header -----
TCP:
TCP:      Source port = 23
TCP:      Destination port = 1268
TCP:      Sequence number = 2068544000
TCP:      Acknowledgement number = 2591304274
TCP:      Data offset = 20 bytes
TCP:      Flags = 0x12
TCP:      ..0. .... = No urgent pointer
TCP:      ...1 .... = Acknowledgement
TCP:      .... 0... = No push

```

```

TCP:      .... .0.. = No reset
TCP:      .... ..1. = Syn
TCP:      .... ...0 = No Fin
TCP: Window = 3000
TCP: Checksum = 0x4477
TCP: Urgent pointer = 0
TCP: No options
TCP:
TELNET:  ----- TELNET:  -----
TELNET:  " "
TELNET:

ETHER:  ----- Ether Header -----
ETHER:
ETHER:  Packet 6 arrived at 19:03:32.50
ETHER:  Packet size = 60 bytes
ETHER:  Destination = 0:0:c:2:78:36, Cisco
ETHER:  Source      = 0:0:c0:b8:c2:8d, Western Digital
ETHER:  Ethertype = 0800 (IP)
ETHER:
IP:  ----- IP Header -----
IP:
IP:  Version = 4
IP:  Header length = 20 bytes
IP:  Type of service = 0x00
IP:      xxx. .... = 0 (precedence)
IP:      ...0 .... = normal delay
IP:      .... 0... = normal throughput
IP:      .... .0.. = normal reliability
IP:  Total length = 40 bytes
IP:  Identification = 2949
IP:  Flags = 0x0
IP:      .0.. .... = may fragment
IP:      ..0. .... = last fragment
IP:  Fragment offset = 0 bytes
IP:  Time to live = 64 seconds/hops
IP:  Protocol = 6 (TCP)
IP:  Header checksum = cec5
IP:  Source address = 128.178.156.7, lrcpc3.epfl.ch
IP:  Destination address = 129.132.2.72, ezinfo.ethz.ch
IP:  No options
IP:
TCP:  ----- TCP Header -----
TCP:
TCP:  Source port = 1268
TCP:  Destination port = 23 (TELNET)
TCP:  Sequence number = 2591304274
TCP:  Acknowledgement number = 2068544001

```

```

TCP: Data offset = 20 bytes
TCP: Flags = 0x10
TCP:      ..0. .... = No urgent pointer
TCP:      ...1 .... = Acknowledgement
TCP:      .... 0... = No push
TCP:      .... .0.. = No reset
TCP:      .... ..0. = No Syn
TCP:      .... ...0 = No Fin
TCP: Window = 30619
TCP: Checksum = 0xd894
TCP: Urgent pointer = 0
TCP: No options
TCP:
TELNET: ----- TELNET: -----
TELNET:
TELNET:  " "
TELNET:

ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 7 arrived at 19:03:32.56
ETHER: Packet size = 78 bytes
ETHER: Destination = 0:0:c:2:78:36, Cisco
ETHER: Source      = 0:0:c0:b8:c2:8d, Western Digital
ETHER: Ethertype = 0800 (IP)
ETHER:
IP: ----- IP Header -----
IP:
IP: Version = 4
IP: Header length = 20 bytes
IP: Type of service = 0x00
IP:      xxx. .... = 0 (precedence)
IP:      ...0 .... = normal delay
IP:      .... 0... = normal throughput
IP:      .... .0.. = normal reliability
IP: Total length = 64 bytes
IP: Identification = 2950
IP: Flags = 0x0
IP:      .0.. .... = may fragment
IP:      ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 64 seconds/hops
IP: Protocol = 6 (TCP)
IP: Header checksum = ceac
IP: Source address = 128.178.156.7, lrcpc3.epfl.ch
IP: Destination address = 129.132.2.72, ezinfo.ethz.ch
IP: No options
IP:

```



```
TCP: ----- TCP Header -----
TCP:
TCP: Source port = 1268
TCP: Destination port = 23 (TELNET)
TCP: Sequence number = 2591304274
TCP: Acknowledgement number = 2068544001
TCP: Data offset = 20 bytes
TCP: Flags = 0x18
TCP:      ..0. .... = No urgent pointer
TCP:      ...1 .... = Acknowledgement
TCP:      .... 1... = Push
TCP:      .... .0.. = No reset
TCP:      .... ..0. = No Syn
TCP:      .... ...0 = No Fin
TCP: Window = 30719
TCP: Checksum = 0x7ebf
TCP: Urgent pointer = 0
TCP: No options
TCP:
TELNET: ----- TELNET: -----
TELNET:
TELNET:  " "
TELNET:
```

```
ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 8 arrived at 19:03:32.67
ETHER: Packet size = 60 bytes
ETHER: Destination = 0:0:c0:b8:c2:8d, Western Digital
ETHER: Source       = 0:0:c:2:78:36, Cisco
ETHER: Ethertype = 0800 (IP)
ETHER:
IP: ----- IP Header -----
IP:
IP: Version = 4
IP: Header length = 20 bytes
IP: Type of service = 0x00
IP:      xxx. .... = 0 (precedence)
IP:      ...0 .... = normal delay
IP:      .... 0... = normal throughput
IP:      .... .0.. = normal reliability
IP: Total length = 40 bytes
IP: Identification = 33319
IP: Flags = 0x0
IP:      .0.. .... = may fragment
IP:      ..0. .... = last fragment
IP: Fragment offset = 0 bytes
```

IP: Time to live = 119 seconds/hops
IP: Protocol = 6 (TCP)
IP: Header checksum = 2123
IP: Source address = 129.132.2.72, ezinfo.ethz.ch
IP: Destination address = 128.178.156.7, lrcpc3.epfl.ch
IP: No options
IP:
TCP: ----- TCP Header -----
TCP:
TCP: Source port = 23
TCP: Destination port = 1268
TCP: Sequence number = 2068544001
TCP: Acknowledgement number = 2591304298
TCP: Data offset = 20 bytes
TCP: Flags = 0x10
TCP: ..0. = No urgent pointer
TCP: ...1 = Acknowledgement
TCP: 0... = No push
TCP: 0.. = No reset
TCP: 0. = No Syn
TCP: 0 = No Fin
TCP: Window = 2976
TCP: Checksum = 0x4478
TCP: Urgent pointer = 0
TCP: No options
TCP:
TELNET: ----- TELNET: -----
TELNET:
TELNET: " "
TELNET:

ETHER: ----- Ether Header -----
ETHER:
ETHER: Packet 9 arrived at 19:03:32.72
ETHER: Packet size = 84 bytes
ETHER: Destination = 0:0:c0:b8:c2:8d, Western Digital
ETHER: Source = 0:0:c:2:78:36, Cisco
ETHER: Ethertype = 0800 (IP)
ETHER:
IP: ----- IP Header -----
IP:
IP: Version = 4
IP: Header length = 20 bytes
IP: Type of service = 0x00
IP: xxx. = 0 (precedence)
IP: ...0 = normal delay
IP: 0... = normal throughput

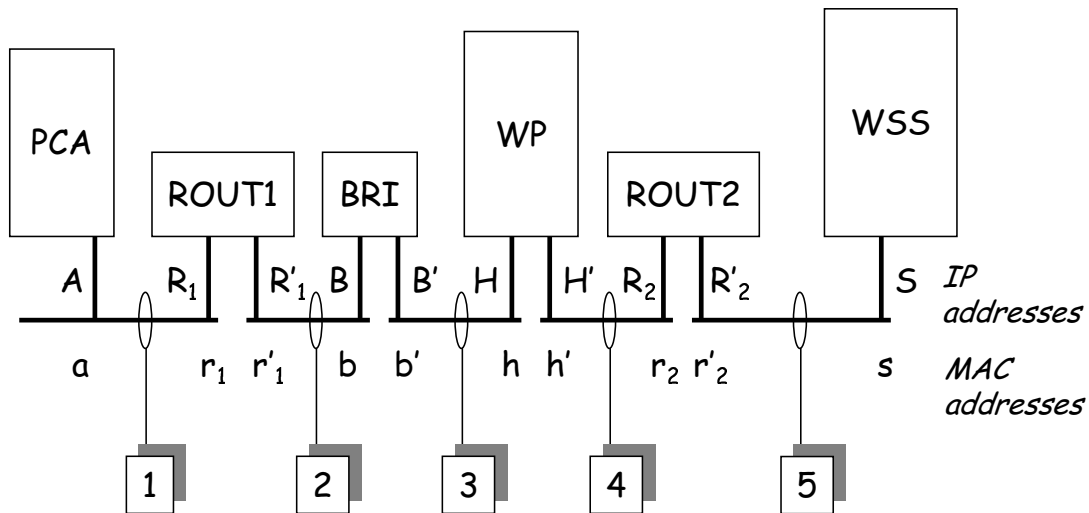
```

IP:      .... .0.. = normal reliability
IP: Total length = 70 bytes
IP: Identification = 33322
IP: Flags = 0x0
IP:      .0.. .... = may fragment
IP:      ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 119 seconds/hops
IP: Protocol = 6 (TCP)
IP: Header checksum = 2102
IP: Source address = 129.132.2.72, ezinfo.ethz.ch
IP: Destination address = 128.178.156.7, lrcpc3.epfl.ch
IP: No options
IP:
TCP: ----- TCP Header -----
TCP:
TCP: Source port = 23
TCP: Destination port = 1268
TCP: Sequence number = 2068544001
TCP: Acknowledgement number = 2591304298
TCP: Data offset = 20 bytes
TCP: Flags = 0x18
TCP:      ..0. .... = No urgent pointer
TCP:      ...1 .... = Acknowledgement
TCP:      .... 1... = Push
TCP:      .... .0.. = No reset
TCP:      .... ..0. = No Syn
TCP:      .... ...0 = No Fin
TCP: Window = 3000
TCP: Checksum = 0xb907
TCP: Urgent pointer = 0
TCP: No options
TCP:
TELNET: ----- TELNET: -----
TELNET:
TELNET:  " "
TELNET:

```

Exercise 1.7 Consider the configuration in Figure 1.

www.sovkom.an



0.4

Figure 1: The configuration with web browser on *PCA*, web proxy *WP* and web server on *WSS*. MAC addresses are called a, r_1, \dots . IP addresses are called A, R_1, \dots

1

- *PCA* is a host running a web browser. *WSS* is a web server, responding to URL=*www.sovkom.an*, and with IP address S .
- *WP* is a firewall acting as web proxy (application level gateway). *PCA* is configured to use *WP* by default.
- *ROUT1* and *ROUT2* are routers, *BRI* is a bridge.
- All links are Ethernet. All links between those systems are shown on the figure.
- MAC and IP addresses are shown on the figure.
- We assume that *PCA* already knows the IP addresses of *WP* and *WSS*. Thus, there will be no call to DNS. We also assume that ARP tables are already populated with the correct values, so there will be no ARP messages.

Assume that *PCA* sends an HTTP request with target URL = *www.sovkom.an* in order to transfer one single file. Assume that we do a TCPDump at points 1 to 5, and we capture a copy of all packets that correspond to the transfer of the file and that travel in the direction from *PCA* to *WSS*. Give the IP and MAC source and destination addresses that can be read in the packets. Give the solution in the table below.

Solution:

	MAC source	MAC destination	IP source	IP destination
at 1	a	r_1	A	H
at 2	r'_1	h	A	H
at 3	r'_1	h	A	H
at 4	h'	r_2	H'	S
at 5	r'_2	s	H'	S

Exercise 1.8 The following trace was captured with TCPDump. It was generated by a Web session. The *S*, *P*, and *F* letters indicate the corresponding TCP flags. Starting with the second packets in each direction, Sequence and Acknowledgement numbers are given by their offset from the values in the first packets. The notation 1:449(448) means that the packet sequence number is 1, it carries 448 bytes of data, and the last byte has sequence number 449 - 1.

1. Explain the use of the flags.

Solution:

S is the SYN flag, indicating establishment of a new connection

F is the FIN flag, indicating closing of a connection

P is the PSH flag, requesting immediate data delivery (to the application) at the receiver

2. Some packets have been mis-ordered. At which lines is that visible ?

Solution:

Note that by monitoring traffic by a third party, a retransmission and mis-ordering usually can't be distinguished with certainty. The answers given here therefore only indicate what is very likely to have happened.

Segment 10486:10934 would have been expected at or near line 81 but is received at line 94. Note that this could also be due to a retransmission after a timeout.

Expected at line 84, segment 11382:11830 is received at line 87, i.e. 11382:11830 and 11830:12278 appear to be swapped.

3. Which lines are retransmissions ?

Solution:

Segment 8246:8694 (expected at or near line 69) appears to be retransmitted at line 90.

Expected at line 176, segment 23926:24374 is apparently retransmitted at line 185.

4. Show the states (from the slide "TCP Finite State Machine") for each of the two ends of the connection, for the first and last 10 lines of the trace, after the packet has been received.

Solution:

<i>Line</i>	<i>lrcpc8</i>	<i>ezinfo</i>
<i>1</i>	<i>SYN_SENT</i>	<i>SYN_RCVD</i>
<i>3</i>	<i>ESTABLISHED</i>	<i>SYN_RCVD</i>
<i>5</i>	<i>ESTABLISHED</i>	<i>ESTABLISHED</i>
<i>6</i>	<i>ESTABLISHED</i>	<i>ESTABLISHED</i>
<i>8</i>	<i>ESTABLISHED</i>	<i>ESTABLISHED</i>
<i>9</i>	<i>ESTABLISHED</i>	<i>ESTABLISHED</i>
	<i>...</i>	
<i>181</i>	<i>ESTABLISHED</i>	<i>ESTABLISHED</i>
<i>182</i>	<i>CLOSE_WAIT</i>	<i>FIN_WAIT_1</i>
<i>184</i>	<i>CLOSE_WAIT</i>	<i>FIN_WAIT_1</i>
<i>185</i>	<i>CLOSE_WAIT</i>	<i>FIN_WAIT_1</i>
<i>187</i>	<i>CLOSE_WAIT</i>	<i>FIN_WAIT_2</i>
<i>188</i>	<i>CLOSE_WAIT</i>	<i>FIN_WAIT_2</i>
<i>189</i>	<i>LAST_ACK</i>	<i>TIME_WAIT</i>
<i>191</i>	<i>CLOSED</i>	<i>TIME_WAIT</i>

```
15:07:24.544104 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: S
3695173790:3695173790(0) win 512 <mss 448>
15:07:24.584105 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: S
1043264000:1043264000(0) ack 3695173791 win 4096
15:07:24.584105 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 1 win 14247
15:07:24.594105 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . 1:449(448) ack 1
win 14335
15:07:24.704107 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . ack 449 win 3648
15:07:24.704107 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: P 449:500(51) ack 1
win 14335
15:07:24.764108 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: P 1:182(181) ack 500
win 4096
15:07:24.764108 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 182 win 14159
15:07:24.804109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 182:630(448) ack
500 win 4096
15:07:24.804109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 630 win 14023
15:07:24.814109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 630:1078(448) ack
500 win 4096
15:07:24.814109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 1078 win 14023
15:07:24.814109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 1078:1526(448) ack
500 win 4096
15:07:24.814109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 1526 win 14023
15:07:24.834109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 1526:1974(448) ack
500 win 4096
15:07:24.834109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 1974 win 14023
15:07:24.834109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 1974:2422(448) ack
500 win 4096
15:07:24.834109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 2422 win 14023
15:07:24.844109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 2422:2870(448) ack
500 win 4096
15:07:24.844109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 2870 win 14023
15:07:24.844109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 2870:3318(448) ack
500 win 4096
15:07:24.844109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 3318 win 13711
15:07:24.844109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 3318 win 14335
15:07:24.844109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 3318:3766(448) ack
500 win 4096
15:07:24.844109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 3766 win 14023
15:07:24.844109 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 3766:4214(448) ack
```

500 win 4096
15:07:24.844109 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 4214 win 14023
15:07:24.864110 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 4214:4662(448) ack
500 win 4096
15:07:24.864110 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 4662 win 14023
15:07:24.874110 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 4662:5110(448) ack
500 win 4096
15:07:24.874110 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 5110 win 14023
15:07:24.914111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 5110:5558(448) ack
500 win 4096
15:07:24.914111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 5558 win 14023
15:07:24.914111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 5558:6006(448) ack
500 win 4096
15:07:24.914111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 6006 win 14023
15:07:24.914111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 6006:6454(448) ack
500 win 4096
15:07:24.914111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 6454 win 14023
15:07:24.914111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 6454:6902(448) ack
500 win 4096
15:07:24.914111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 6902 win 14023
15:07:24.924111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 6902:7350(448) ack
500 win 4096
15:07:24.924111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 7350 win 14023
15:07:24.924111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 7350:7798(448) ack
500 win 4096
15:07:24.924111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 7798 win 14023
15:07:24.924111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 7798:8246(448) ack
500 win 4096
15:07:24.924111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 8246 win 14023
15:07:24.934111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 8246:8694(448) ack
500 win 4096
15:07:24.934111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 8694 win 14023
15:07:24.944111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 8694:9142(448) ack
500 win 4096
15:07:24.944111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 9142 win 14023
15:07:24.944111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 9142:9590(448) ack
500 win 4096
15:07:24.944111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 9590 win 14023
15:07:24.954111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 9590:10038(448)
ack 500 win 4096
15:07:24.954111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 10038 win 14023
15:07:24.954111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 10038:10486(448)
ack 500 win 4096
15:07:24.954111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 10486 win 14023
15:07:24.964111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 10486:10934(448)
ack 500 win 4096
15:07:24.964111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 10934 win 14023
15:07:24.964111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 10934:11382(448)
ack 500 win 4096
15:07:24.964111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 11382 win 14023
15:07:24.964111 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 11382:11830(448)
ack 500 win 4096
15:07:24.964111 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 11830 win 14023
15:07:24.974112 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 11830:12278(448)
ack 500 win 4096
15:07:24.974112 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 12278 win 14023
15:07:24.984112 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 12278:8246(448) ack
500 win 4096
15:07:24.984112 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 8246 win 11839
15:07:24.984112 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 10486 win 13399
15:07:26.014129 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 10486:10934(448)
ack 500 win 4096
15:07:26.014129 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 12278 win 13087
15:07:26.014129 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 12278 win 14335
15:07:26.034129 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 12278:12276(448)

ack 500 win 4096
15:07:26.034129 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 12726 win 14023
15:07:26.034129 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 12726:13174(448)
ack 500 win 4096
15:07:26.034129 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 13174 win 14023
15:07:26.074130 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 13174:13622(448)
ack 500 win 4096
15:07:26.074130 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 13622 win 14023
15:07:26.074130 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 13622:14070(448)
ack 500 win 4096
15:07:26.074130 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 14070 win 14023
15:07:26.084130 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 14070:14518(448)
ack 500 win 4096
15:07:26.084130 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 14518 win 14023
15:07:26.114131 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 14518:14966(448)
ack 500 win 4096
15:07:26.114131 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 14966 win 14023
15:07:26.134131 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 14966:15414(448)
ack 500 win 4096
15:07:26.134131 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 15414 win 14023
15:07:26.144131 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 15414:15862(448)
ack 500 win 4096
15:07:26.144131 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 15862 win 14023
15:07:26.144131 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 15862:16310(448)
ack 500 win 4096
15:07:26.144131 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 16310 win 14023
15:07:26.144131 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 16310:16758(448)
ack 500 win 4096
15:07:26.144131 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 16758 win 14023
15:07:26.154131 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 16758:17206(448)
ack 500 win 4096
15:07:26.154131 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 17206 win 14023
15:07:26.164132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 17206:17654(448)
ack 500 win 4096
15:07:26.164132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 17654 win 14023
15:07:26.164132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 17654:18102(448)
ack 500 win 4096
15:07:26.164132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 18102 win 14023
15:07:26.164132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 18102:18550(448)
ack 500 win 4096
15:07:26.164132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 18550 win 14023
15:07:26.164132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 18550:18998(448)
ack 500 win 4096
15:07:26.164132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 18998 win 14023
15:07:26.174132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 18998:19446(448)
ack 500 win 4096
15:07:26.174132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 19446 win 14023
15:07:26.184132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 19446:19894(448)
ack 500 win 4096
15:07:26.184132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 19894 win 14023
15:07:26.194132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 19894:20342(448)
ack 500 win 4096
15:07:26.194132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 20342 win 14023
15:07:26.194132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 20342:20790(448)
ack 500 win 4096
15:07:26.194132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 20790 win 14023
15:07:26.204132 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 20790:21238(448)
ack 500 win 4096
15:07:26.204132 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 21238 win 14023

15:07:26.234133 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 21238:21686(448)
ack 500 win 4096
15:07:26.234133 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 21686 win 14023
15:07:26.234133 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 21686:22134(448)
ack 500 win 4096
15:07:26.234133 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 22134 win 14023
15:07:26.234133 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 22134:22582(448)
ack 500 win 4096
15:07:26.234133 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 22582 win 14023
15:07:26.234133 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 22582:23030(448)
ack 500 win 4096
15:07:26.234133 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 23030 win 14023
15:07:26.234133 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 23030:23478(448)
ack 500 win 4096
15:07:26.234133 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 23478 win 14023
15:07:26.244133 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 23478:23926(448)
ack 500 win 4096
15:07:26.244133 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 23926 win 14023
15:07:26.284134 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 24374:24822(448)
ack 500 win 4096
15:07:26.284134 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 23926 win 14023
15:07:26.284134 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 24822:25270(448)
ack 500 win 4096
15:07:26.284134 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 23926 win 14023
15:07:26.284134 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: FP 25270:25653(383)
ack 500 win 4096
15:07:26.284134 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 23926 win 14023
15:07:27.044146 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . 23926:24374(448)
ack 500 win 4096
15:07:27.044146 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 25654 win 13119
15:07:27.044146 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: . ack 25654 win 14335
15:07:27.064147 lrcpc8.epfl.ch.1071 > ezinfo.ethz.ch.www: F 500:500(0) ack
25654 win 14335
15:07:27.104147 ezinfo.ethz.ch.www > lrcpc8.epfl.ch.1071: . ack 501 win 409