Communications and Computer Networks

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Exercise 4

Information: If necessary, remove the suffix *.sec* of files downloaded from ILIAS.

1 IPv4

1. Sketch the individual fields of an IPv4 datagram and explain their meaning.

2. You have the following bit stream in the network

```
5c 49 79 8e 23 a3 5c e9  1e ae 7c ef 08 00 45 00
00 54 a8 ac 00 00 40 01  35 d0 c0 a8 0a 51 c1 19
10 1a 08 00 44 a6 2e 1c  00 03 64 4b cf d7 00 0a
66 0a 08 09 0a 0b 0c 0d  0e 0f 10 11 12 13 14 15
16 17 18 19 1a 1b 1c 1d  1e 1f 20 21 22 23 24 25
26 27 28 29 2a 2b 2c 2d  2e 2f 30 31 32 33 34 35
36 37
```

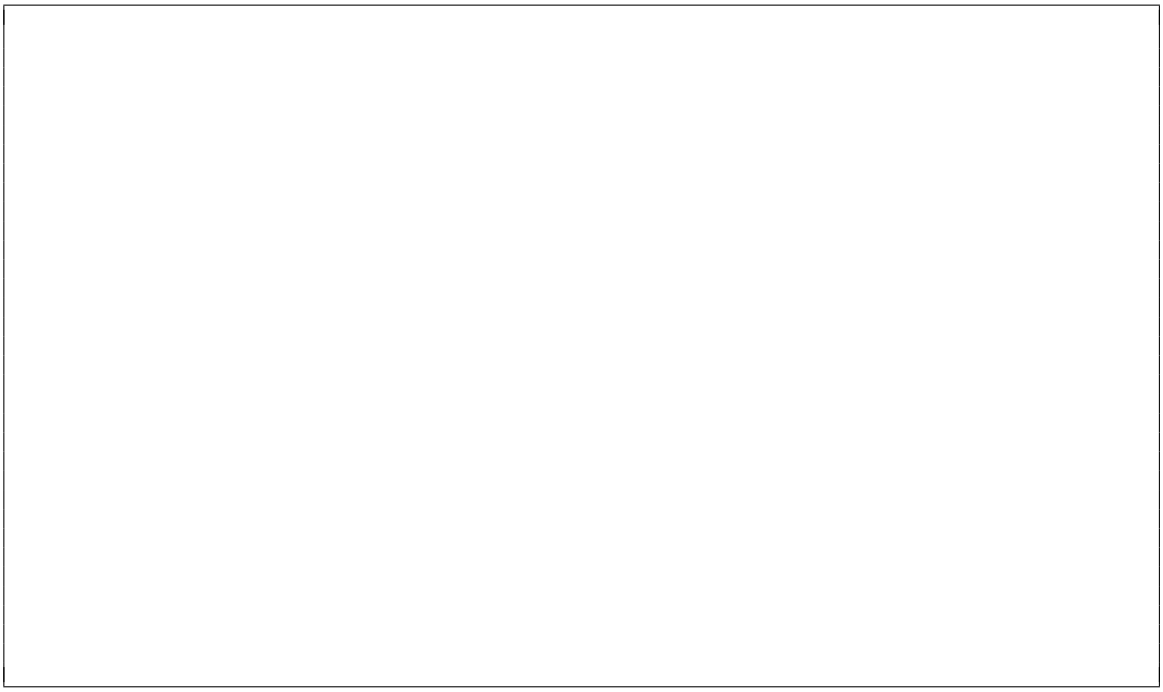
   Interpret the blue marked hex code.

3. Why is the maximum packet size of an ipv4-packet is 65.535?

4. You see an IHL value of 10. How long is the header? What is a reason for this length?

2 Adressing

5. Calculate the network address, broadcast address and address range for the hosts and the number of usable host addresses of the following addresses:
   - 10.0.3.0/8
   - 10.0.3.7/19
   - 171.13.9.47/28
   - 88.94.0.0/21
   - 66.91.119.8/30



3 Fragmentation

6. An ICMP Echo Reply packet with 2000 bytes of user data is sent over a standard Ethernet (MTU = 1500 bytes). What is the size of the associated Ethernet frames (including preamble and FCS)?

7. Assume you want to transfer a icmp packet with a size of 5800 bytes. Fill in the relevant value in the following fields:

Packet no	Length	DF	MF	Offset	proto
Packet no	Length	DF	MF	Offset	proto
Packet no	Length	DF	MF	Offset	proto
Packet no	Length	DF	MF	Offset	proto
Packet no	Length	DF	MF	Offset	proto
Packet no	Length	DF	MF	Offset	proto

4 ICMP

8. *Reconstruct* the path of your host to

- www.google.coom
- www.dortmund.de
- www.wireshark.org

What is striking?

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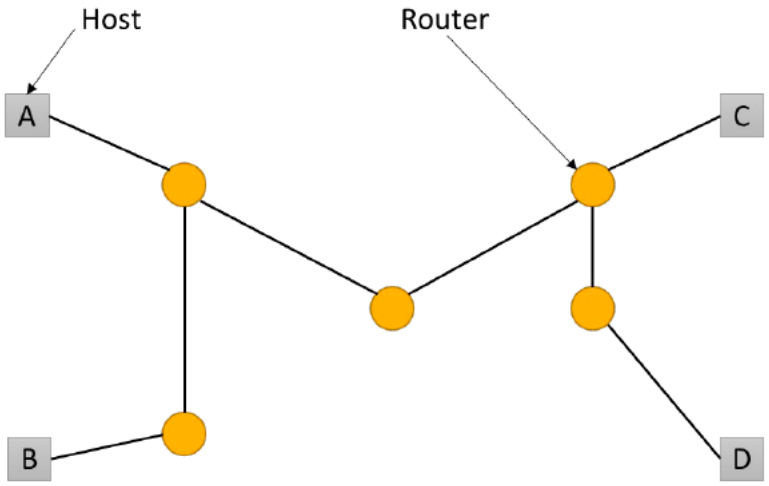
9. The data packets of a network trace with *Wireshark* are shown below. Which command was used to generate the traffic? Also include any command options that were used.

```
Frame 1: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface en0, id 0
Ethernet II, Src: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Address Resolution Protocol (request)

Frame 2: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface en0, id 0
Ethernet II, Src: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18), Dst: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef)
Address Resolution Protocol (reply)

Frame 3: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
Ethernet II, Src: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef), Dst: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18)
Internet Protocol Version 4, Src: 192.168.10.81, Dst: 192.168.10.76
Data (1480 bytes)

Frame 4: 162 bytes on wire (1296 bits), 162 bytes captured (1296 bits) on interface en0, id 0
Ethernet II, Src: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef), Dst: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18)
Internet Protocol Version 4, Src: 192.168.10.81, Dst: 192.168.10.76
Internet Control Message Protocol

Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
Ethernet II, Src: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18), Dst: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef)
Internet Protocol Version 4, Src: 192.168.10.76, Dst: 192.168.10.81
Data (1480 bytes)

Frame 6: 162 bytes on wire (1296 bits), 162 bytes captured (1296 bits) on interface en0, id 0
Ethernet II, Src: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18), Dst: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef)
Internet Protocol Version 4, Src: 192.168.10.76, Dst: 192.168.10.81
Internet Control Message Protocol

Frame 7: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
Ethernet II, Src: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef), Dst: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18)
Internet Protocol Version 4, Src: 192.168.10.81, Dst: 192.168.10.76
Data (1480 bytes)

Frame 8: 162 bytes on wire (1296 bits), 162 bytes captured (1296 bits) on interface en0, id 0
Ethernet II, Src: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef), Dst: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18)
Internet Protocol Version 4, Src: 192.168.10.81, Dst: 192.168.10.76
Internet Control Message Protocol

Frame 9: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
Ethernet II, Src: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18), Dst: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef)
Internet Protocol Version 4, Src: 192.168.10.76, Dst: 192.168.10.81
Data (1480 bytes)

Frame 10: 162 bytes on wire (1296 bits), 162 bytes captured (1296 bits) on interface en0, id 0
Ethernet II, Src: Raspberr_a1:c6:18 (b8:27:eb:a1:c6:18), Dst: Apple_ae:7c:ef (5c:e9:1e:ae:7c:ef)
Internet Protocol Version 4, Src: 192.168.10.76, Dst: 192.168.10.81
Internet Control Message Protocol
```

10. The figure below shows a network with multiple routers (yellow circles) and hosts A, B, C and D. Determine the minimum required TTL for IPv4 communication between A-B, A-C, A-D and B-D. What would happen if the TTL is too small?



5 IPv6

11. Sketch the individual fields of an IPv6 datagram and explain their meaning.

12. Calculate the address range of the following addresses:

    - fe80::/10
    - 2001:3211:7600:9/48
    - 2001:AABB:4000::0312:6641/28

13. Assign cases A - G to the given IPv6 prefixes/addresses:

    - A: IPv6-Multicast- Address
    - B: IPv6-Link-Local- Address
    - C: Ipv6-Global-Unicast- Address
    - D: IPv6-Loopback-Address
    - E: IPv6-Unique Local Unicast- Address

- F: IPv6 embedded IPv4 Address
- G: Unspecified Address
- H: Reserved

- 2001:db8::8d3:0:8a2e:70:7344
- fd6a:291c:f971::/48
- ff15:faad:7741:88a:874:33::11
- ::
- fe80::456:489d:4afa:b00a
- ::1/128
- 20a0:faaf:1411:77aa:99::33
- fdca:9f01:549b::/48
- 64:ff9b::192.168.0.1

14. Your provider assigns the following subnet to you.

    201f:3300:da11:7000::/56

    You want to create at least 22 networks. Which subnetmask is needed, which are the netaddresses of these networks?

15. After autoconfiguration in the LAN, an interface has the IPv6 address 2001:200:0:8002:203:47FF:FEA5:3085/64 What are the Link-Local IPv6 address and the MAC address (when EUI-64 is used)?

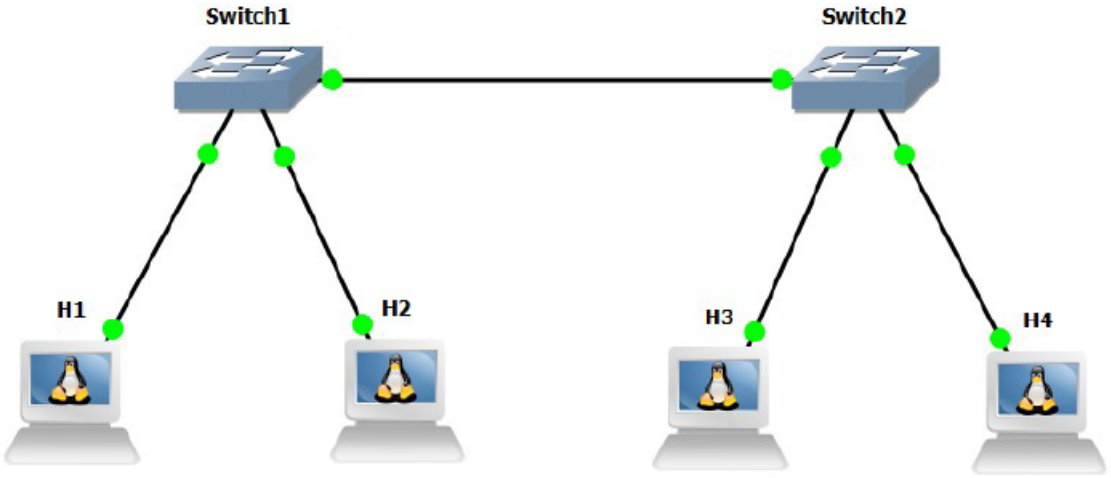
16. Check you local IP-configuration and extract the ip-address and routing configuration. Which commands do you use?

6 Tools

17. Create a GNS3 project with two switches and four hosts (no VPCs, please use hosts) and connect the components as shown in the figure. Start a capturing with Wireshark on all connections. Configure different IP addresses on all four hosts in the same network. Add the following code in the file */etc/networking/interfaces*, change the address on each host.

```
auto eth0
iface eth0 inet static
address 192.168.0.1
netmask 255.255.255.0
broadcast 192.168.0.255
```

H1 gets 192.168.0.1, H2 gets 192.168.0.2, H3 gets 192.168.0.3 and H4 gets 192.168.0.4.



Configure a separate broadcast domain for Host 1 and 3 and a separate broadcast domain for host 2 and host 4.

7 Routing

18. Shown are the routing table and the ARP table of the computer (R) with the two IP addresses of the interfaces eth1 and eth0: 193.25.22.65 and 192.168.44.1

    Routing Table

Destination	Gateway	Genmask	Iface
193.25.22.0	0.0.0.0	255.255.255.0	eth1
192.168.44.0	0.0.0.0	255.255.255.0	eth0
127.0.0.1	0.0.0.0	255.255.255.0	lo
0.0.0.0	193.25.22.1	0.0.0.0	eth1

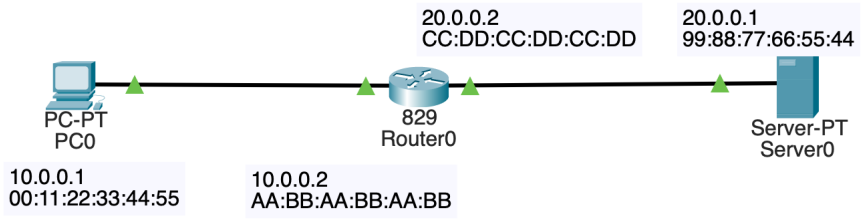
    ARP Cache

Address	HWType	HWAddress	Iface
192.168.44.11	Ether	00:50:DA:4B:F9:5E	eth0
192.168.44.20	Ether	00:D0:B7:D4:87:6D	eth0
193.25.22.197	Ether	00:A0:C9:D5:AC:7B	eth1
193.25.22.1	Ether	00:D0:BC:F4:8C:E4	eth1

    Sketch the network in which this computer is located and the neighbouring networks with hosts and routers.

19. Load the pcapng-file *net1.pcapng* with *Wireshark* and determine the involved devices of the network. Draw a plan of the network resting upon the information of the capture file. *Additional information: the capture was done on two different positions in the network, and subsequently merged to a single file*

20. Assume you have a network as shown in the next figure. The PC wants to ping the server. Router0



performs routing.
Fill in the missing values in the boxes:

Left of Router0:

source ip-address	
destination ip address	
source mac-address	
destination mac-address	

Right of Router0:

source ip-address	
destination ip address	
source mac-address	
destination mac-address	

21. Now assume the router0 performs network address translation.
Fill in the missing values in the boxes:

Left of Router0:

source ip-address	
destination ip address	
source mac-address	
destination mac-address	

Right of Router0:

source ip-address	
destination ip address	
source mac-address	
destination mac-address	

22. You have this routing table of a router in a network.

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, + - replicated route

Gateway of last resort is not set

O     10.0.0.0/8 [110/2] via 14.0.0.1, 00:31:16, FastEthernet0/0
      14.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        14.0.0.0/8 is directly connected, FastEthernet0/0
L        14.0.0.2/32 is directly connected, FastEthernet0/0
O     15.0.0.0/8 [110/2] via 14.0.0.1, 00:31:16, FastEthernet0/0
      20.0.0.0/24 is subnetted, 1 subnets
O        20.0.0.0 [110/4] via 45.0.0.2, 00:00:03, FastEthernet1/0
O     23.0.0.0/8 [110/3] via 45.0.0.2, 00:00:03, FastEthernet1/0
      30.0.0.0/8 is variably subnetted, 3 subnets, 3 masks
C        30.0.0.0/8 is directly connected, FastEthernet1/1
O        30.0.0.0/24 [110/3] via 45.0.0.2, 00:00:03, FastEthernet1/0
L        30.0.0.2/32 is directly connected, FastEthernet1/1
O     35.0.0.0/8 [110/2] via 45.0.0.2, 00:00:03, FastEthernet1/0
      40.0.0.0/24 is subnetted, 1 subnets
O        40.0.0.0 [110/2] via 45.0.0.2, 00:25:28, FastEthernet1/0
      45.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        45.0.0.0/8 is directly connected, FastEthernet1/0
L        45.0.0.1/32 is directly connected, FastEthernet1/0
```

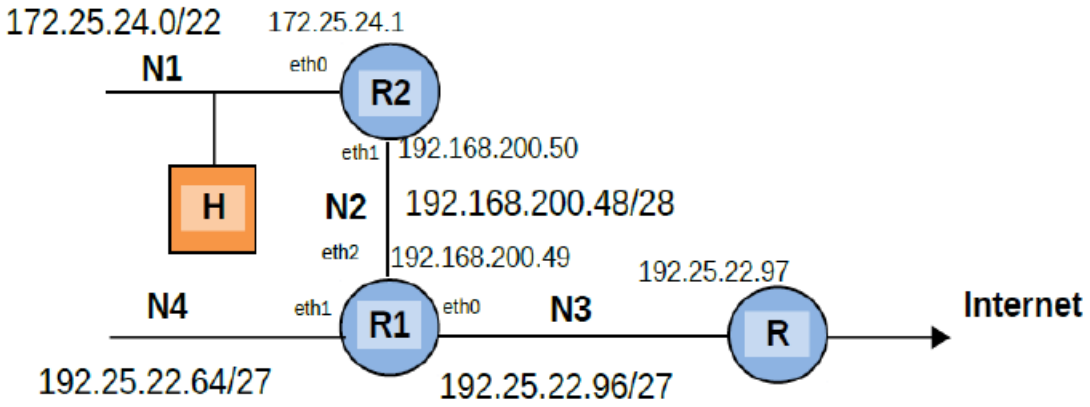
Create a GNS3-project resulting in such a routing table.

23. Open the GNS3-project static-routing.gnsproject and configure H3 as a router. Configure H1 and H2 with the following ip-addresses:

- H1: 10.0.0.1/24
- H2: 10.3.0.3/24

Configure all hosts to route the traffic properly. After the configuration, H1 should be able to ping H2.

24. Given is the network structure shown with the routers R1, R2 and R as well as the host H.



Specify the routing tables of R1, R2 and H.