Sample Solution for Exercise Communication Networks I

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General Remarks

Welcome to the exercise for Communication Networks I. Please adhere to the following general remarks regarding the organization of the exercise during this summer term.

- One week before the tutorial, a new exercise will be published at the Exercise area of the KN1 Moodle (`https://moodle.tu-darmstadt.de/course/view.php?id=5268`)

- The exercise serves as your hands-on experience in addition to the lecture and as a preparation for the exam

- The questions in the exercise can be discussed at the tutorial date

- The sample solution for the exercise is available at the Exercise area of KN1 Moodle in addition to the corresponding tutorial. Nevertheless, we encourage students to try to solve the exercise themselves before the tutorial date without looking into the solution as a good practice to understand the subject of the lecture

Problem 1 - Multiple Choice

a) How long is the IP header in minimum?

A) 32 bit

B) 20 bit

C) 32 byte

D) 20 byte

E) 40 bit

Solution: Answer D

b) Which field does not belong to the IPv4 Datagram Format?

A) Version

B) Total Length

C) Time to Live

D) Protocol

E) Payload Length

Solution: Answer E

c) Which of the following is a class C IP address?

A) 168.192.1.1

B) 172.192.11.1

C) 192.168.11.1

D) 11.192.168.1

E) 1.168.192.11

Solution: Answer C

d) If station A sends out a RARP_REQUEST, what is station A trying to learn?

A) its own physical address

B) its own logical address

C) physical address of another station

D) logical address of another station

E) DNS address of another station

Solution: Answer B

e) What is not an IP routing protocol?

A) BGP

B) EGP

C) OSPF

D) RIP

E) LLC

Solution: Answer E

f) What to do with a packet for a Station which is not on the local network?

A) Send packet to gateway specified in the routing table.
B) Discard packet.
C) Use ARP to get physical address of the Station and send packet directly.
D) Send packet to all stations using broadcast.
E) Flood packet into all directions.

Solution: Answer A

g) What is not an advantage of IPv6?

A) longer addresses
B) mobility is supported
C) increased security
D) better checksum algorithms
E) support of realtime data traffic

Solution: Answer D

h) Which IP protocol is used to implement "ping"?

A) IGMP
B) ICMP
C) CGMP
D) BGP
E) RARP

Solution: Answer B

Problem 2 - Internet Protocols

a) A host in a subnet has the IP address 130.83.126.10. How many hosts can be addressed in this subnet?

Solution: Address in binary form: 10000010.01010011.01111110.00001010
$\Rightarrow$ Class B address $\Rightarrow$ 16 bits for host address: $2^{16} = 65536$
-1 adress for network (all host bits 0)
-1 adress for broadcast (all host bits 1)
$\Rightarrow$ 65534 hosts

b) A sub-function of the Network Layer is segmentation/reassembling of packets.

I) Why is segmentation needed?

Solution: An internet is composed of different networks, which can have different MTU (Maximal Transfer Units)
$\rightarrow$ packets from one network can be too large for another network.

II) Which additional information in the header (of each fragment) is needed for segmentation?

Solution:
- more fragments flag
- fragment offset

III) Which type of segmentation is used in IPv4?

Solution: non-transparent segmentation

IV) Where can packets be fragmented in IPv4, where are they reassembled?

Solution:
- fragmented on every intermediate system
- reassembled at the destination

V) Which additional overhead can occure when using segmentation?

Solution: If one of the fragments gets lost, the whole packet must be retransmitted, because the sender can not know, if and how the packet was fragmented.

VI) Typically reassembly algorithms use timeouts so that when fragments are lost the rest of the paket is removed from the memory. Assume that 3 of 4 fragments of a paket arrived and were deleted after the timeout since the $4th$ was delayed. If now the $4th$ fragment arrives, what happens?

Solution: Looks like the fragment of a new packet $\rightarrow$ store until timeout, then discard

c) One of the Internet control protocols is ICMP.

I) What is ICMP used for?

Solution: to communicate network layer information

II) Give at least 3 types of ICMP messages!

Solution:

Message Type	Description
Destination unreachable	Packet could not be delivered
Time exeeded	Time to live field hit 0
Parameter problem	Invalid header field
Source quench	Choke packet
Redirect	Teach a router about geography
Echo request	Ask a machine if it is alive ("ping")
Echo reply	Yes, I am alive
Timestamp request	Same as Echo request, but with timestamp
Timestamp reply	Same as Echo reply, but with timestamp

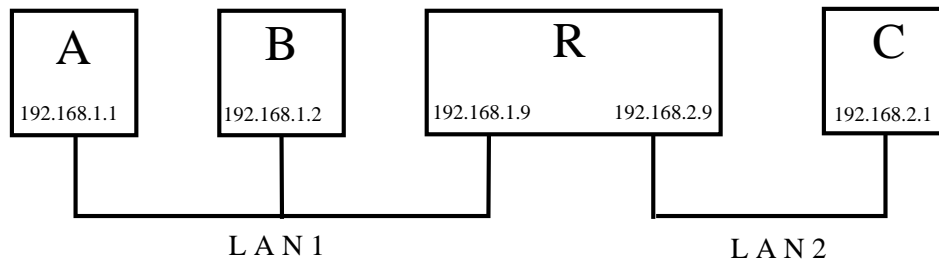III) What other Internet control protocols do you know?

Solution: ARP, RARP, BOOTP

Problem 3 - ARP - RARP

Look at the following network topology:

a) When station A wants to send data to station B. What does A need to send the data to B?

Solution: B's IP address
B's physical address (MAC address)

b) A knows only B's IP address (there is no entry for B in the ARP cache). How does A determine B's Ethernet address?

Solution:

- A broadcasts an ARP request datagram on LAN 1

- B receives ARP request

- B answers with its MAC address (directly to A, no broadcast)

- A sends data to B

c) Where is the problem, when A wants to send data to C?

Solution: A will not receive a response for its ARP request, because Ethernet broadcasts are not rerouted over a router

d) How can this problem be solved?

Solution: Router R knows remote networks (only LAN 2 in this case) and acts as **ARP** proxy:

- A broadcasts an ARP request datagram on LAN 1

- R receives ARP request

- R knows, that C is on remote network

- R answers the ARP request with its own Ethernet address

- A sends frame to router R

- R forwards the data

e) What about the following statement: "ARP offers a service to the Network Layer and is therefore a part of the Data Link Layer"?

Solution: No, ARP is part of the Network Layer. The Data Link Layer does not deal with IP addressing.

f) ARP and RARP map address spaces and are therefore similar. What is the big difference in the implementation?
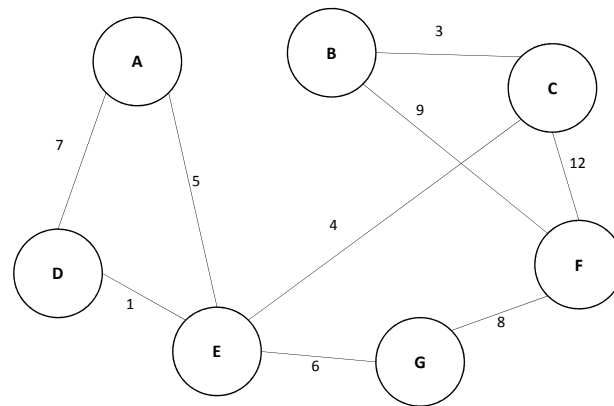
Solution: ARP: every machine checks, if the IP address in the request is its own and answers, if this is the case
RARP: server answers
⇒ RARP needs a server. ARP does not.

a) Calculate the shortest paths from vertex G to all the other vertices by using Dijkstra's Shortest Path Algorithm

	P	A	B	C	D	E	F
1	{G}	∞	∞	∞	∞	6	8
2	{G,E}	11	∞	10	7	6	8
3	{G,E,D}	11	∞	10	7	6	8
4	{G,E,D,F}	11	17	10	7	6	8
5	{G,E,D,F,C}	11	13	10	7	6	8
6	{G,E,D,F,C,A}	11	13	10	7	6	8
7	{G,E,D,F,C,A,B}	11	13	10	7	6	8