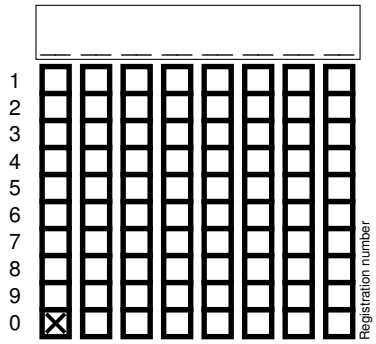
Chair of Distributed Systems and Security
School of Computation, Information and Technology
Technical University of Munich



Signature

Note:
- Cross your immatriculation number in the crossboxes. It will be evaluated automatically.
- Sign in the signature field.
- Allowed tools are only a pocket calculator and an analog dictionary English ↔ native language without notes.
- Potentially helpful number tables from the cheat sheet are printed at the end of the page.
- Do not write with red or green colors nor use pencils.

a)* Which of the following IPv4 subnet masks corresponds to a `/11` network?

☐ 255.248.0.0 ☐ 255.224.0.0 ☐ 255.255.248.0 ☐ 255.254.0.0

b)* Which of the following IPv4 addresses is part of the subnet `192.168.8.128/25` **and** usable as host address?

☐ 192.168.8.228 ☐ 192.168.8.128 ☐ 192.168.8.0 ☐ 192.168.8.29

c)* The headers of which protocols can occur immediately after an Ethernet header?

☐ ICMPv6 ☐ ARP ☐ UDP ☐ IPv6 ☐ ICMPv4 ☐ NDP

d)* What is/are changes of IPv6 **compared to** IPv4?

☐ No routing possible ☐ Coderate of 6/4 ☐ Fragmentation at routers

☐ Better Line Coding ☐ Fixed header length ☐ 128-times more addresses

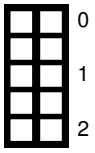
e)* What is/are correct short forms of the following IPv6 address according to the lecture?

`2001:0db8:0000:0000:0000:0f00:0000:1255`

☐ `2001:db8:0:0:0:f00:0:1255` ☐ `2001:db8::f00::1255` ☐ `2001:db8::f00:0:1255`

☐ `201:0db8::0f:0:1255` ☐ `21:db8::f::1255` ☐ `2001:db8::f00:0.0.18.85`

f)* An interface with MAC-Address `c0:de:de:ad:c0:de` creates Link-Local and Global Unique addresses using SLAAC and the prefix `2001:db8:0:42::/64`. Write down the generated addresses.

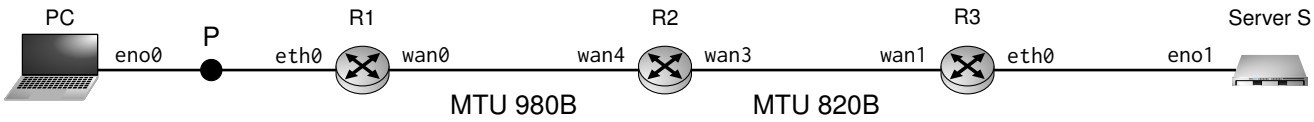


LL: _____

GU: _____

dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary	dec	hex	binary
128	80	10000000	144	90	10010000	160	a0	10100000	176	b0	10110000	192	c0	11000000	208	d0	11010000	224	e0	11100000	240	f0	11110000
129	81	10000001	145	91	10010001	161	a1	10100001	177	b1	10110001	193	c1	11000001	209	d1	11010001	225	e1	11100001	241	f1	11110001
130	82	10000010	146	92	10010010	162	a2	10100010	178	b2	10110010	194	c2	11000010	210	d2	11010010	226	e2	11100010	242	f2	11110010
131	83	10000011	147	93	10010011	163	a3	10100011	179	b3	10110011	195	c3	11000011	211	d3	11010011	227	e3	11100011	243	f3	11110011
132	84	10000100	148	94	10010100	164	a4	10100100	180	b4	10110100	196	c4	11000100	212	d4	11010100	228	e4	11100100	244	f4	11110100
133	85	10000101	149	95	10010101	165	a5	10100101	181	b5	10110101	197	c5	11000101	213	d5	11010101	229	e5	11100101	245	f5	11110101
134	86	10000110	150	96	10010110	166	a6	10100110	182	b6	10110110	198	c6	11000110	214	d6	11010110	230	e6	11100110	246	f6	11110110
135	87	10000111	151	97	10010111	167	a7	10100111	183	b7	10110111	199	c7	11000111	215	d7	11010111	231	e7	11100111	247	f7	11110111
136	88	10001000	152	98	10011000	168	a8	10101000	184	b8	10111000	200	c8	11001000	216	d8	11011000	232	e8	11101000	248	f8	11111000
137	89	10001001	153	99	10011001	169	a9	10101001	185	b9	10111001	201	c9	11001001	217	d9	11011001	233	e9	11101001	249	f9	11111001
138	8a	10001010	154	9a	10011010	170	aa	10101010	186	ba	10111010	202	ca	11001010	218	da	11011010	234	ea	11101010	250	fa	11111010
139	8b	10001011	155	9b	10011011	171	ab	10101011	187	bb	10111011	203	cb	11001011	219	db	11011011	235	eb	11101011	251	fb	11111011
140	8c	10001100	156	9c	10011100	172	ac	10101100	188	bc	10111100	204	cc	11001100	220	dc	11011100	236	ec	11101100	252	fc	11111100
141	8d	10001101	157	9d	10011101	173	ad	10101101	189	bd	10111101	205	cd	11001101	221	dd	11011101	237	ed	11101101	253	fd	11111101
142	8e	10001110	158	9e	10011110	174	ae	10101110	190	be	10111110	206	ce	11001110	222	de	11011110	238	ee	11101110	254	fe	11111110
143	8f	10001111	159	9f	10011111	175	af	10101111	191	bf	10111111	207	cf	11001111	223	df	11011111	239	ef	11101111	255	ff	11111111

Given the following network, we take a closer look at IPv4 fragmentation. The MTU of both of the local networks is 1500 B while the MTU on the links between the routers is smaller and given directly in the figure. The **payload** of Layer 3 is 1312 B long. Both the PC and the server send all IPv4 packets with an **initial TTL** of 65 and **without IPv4 options**.



The PC has previously initiated a connection with the server. In the following subproblems we consider **the second of two fragments at the position P** which are part of a response packet **sent from the server** to the PC. The Ethernet and IPv4 Header are given in the figures below. We use the notation *device.interface* to refer to the interface of a specific device (e.g. *R7.wan5* or *S.eth0*).

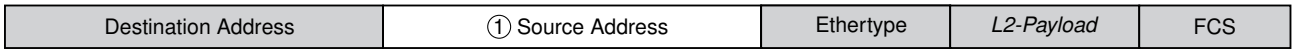


Figure 1.1: Ethernet header of the second fragment at point **P**

g)* The MAC address of which interface is set in field ① of the Ethernet header?

☐ R1.eth0 ☐ PC.eno0 ☐ R1.wan0 ☐ R2.wan3 ☐ R2.wan4 ☐ S.eno1

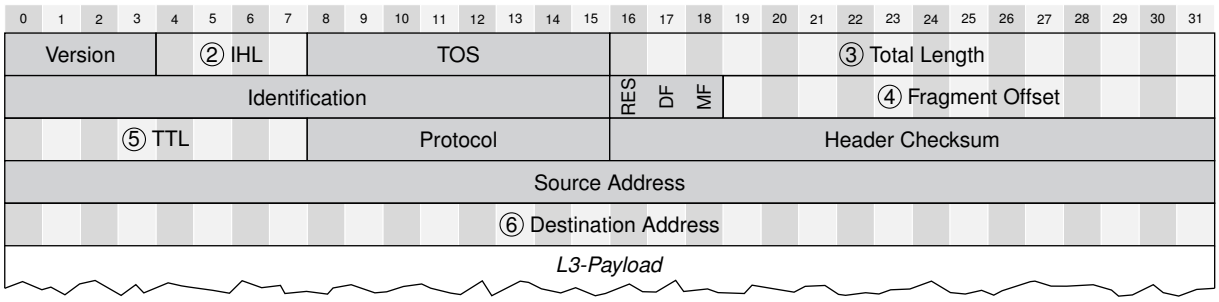


Figure 1.2: IPv4 header of the second fragment at point **P**

h)* Which value is set in field ② IHL in the IPv4 Header?

☐ $24_{(10)}$ ☐ $6_{(10)}$ ☐ $28_{(10)}$ ☐ $5_{(10)}$ ☐ $7_{(10)}$ ☐ $20_{(10)}$

i)* Which value is set in field ③ Total Length in the IPv4 Header?

☐ $512_{(10)}$ ☐ $542_{(10)}$ ☐ $372_{(10)}$ ☐ $532_{(10)}$ ☐ $1312_{(10)}$ ☐ $1332_{(10)}$

j)* Which value is set in field ④ Fragment Offset in the IPv4 Header?

☐ $0_{(10)}$ ☐ $800_{(10)}$ ☐ $980_{(10)}$ ☐ $100_{(10)}$ ☐ $820_{(10)}$ ☐ $960_{(10)}$

k)* Which value is set in field ⑤ TTL in the IPv4 Header?

☐ $0_{(10)}$ ☐ $61_{(10)}$ ☐ $64_{(10)}$ ☐ $63_{(10)}$ ☐ $62_{(10)}$ ☐ $65_{(10)}$

l)* The IPv4 address of which interface is set in field ⑥ Destination Address of the IPv4 header?

☐ S.eno1 ☐ R3.wan1 ☐ R2.wan4 ☐ R1.wan0 ☐ R1.eth0 ☐ PC.eno0

0 1

m)* Briefly argue whether the *Identification* field of the IPv4 header has changed in the observed second fragment, compared to the first fragment.