Computer Networks 2021 Exercises - Unit 5

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NOTE: Each student's work unit is unique. You must use the work that has been generated for

your FAN. If you do not, then you will fail this work unit.

NOTE: You must record your answers in the answer file EXACTLY as required, and commit and

make sure your changes have been pushed to the github server, as they will otherwise not be

counted.

NOTE: The topic coordinator will periodically run the automatic marking script, which will cause

a file called unit5-results.pdf to be updated in your repository. You should check this file to make

sure that your answers have been correctly counted. That file will contain the time and date

that the marking script was last run, so that you can work out if it has been run since you last

changed your answers. You are free to update your answers as often as you wish, until the

deadline for the particular work unit.

1 TCP/IP And Related Protocol Packet Formats and Header Fields

For each question, you must record your answer in the unit5-answers.txt file in your git reposi-

tory. Templates for each answer are provided in unit5-answers.txt for your convenience.

You will find information on the packet header formats in many places, including:

 $\bullet \ \ https://en.wikipedia.org/wiki/Ethernet_frame\#Header$

• https://en.wikipedia.org/wiki/IPv4#Header

 $\bullet \ \ https://en.wikipedia.org/wiki/Address_Resolution_Protocol$

https://en.wikipedia.org/wiki/Transmission_Control_Protocol#TCP_segment_structure

https://en.wikipedia.org/wiki/User_Datagram_Protocol#UDP_datagram_structure

1

0x0000: eb32 7f58 fa8f b914 ecd2 ba4d 0800 4500 .2.X.....M..E.

0x0010: 0055 0000 4000 2b11 0000 7bb4 6212 6252 .U..@.+...{.b.bR

0x0020: a09d 1ae6 c953 006e 58d1 de6e d542 a3b0S.nX..n.B..

0x0030: 5735 3ea3 f993 057f 812d 517c 42b2 f2e9 W5>.....-Q|B...

0x0040: f6c5 8e09 1cc2 bdc1 0e9c cb24 eb6e 72b4\$.nr.

0x0050: 3bab 9e7a 11d8 2e05 eb9f 8959 bc2d 5bed ;..z.....Y.-[.

0x0060: a9cc 4c ..L

Question	Field	Туре
ID		
ab	UDP destination	Integer: Answer with the decimal value of the field.
ac	IP Don't Frag	Boolean: Answer Y or N
ad	IP More Frag- ments	Boolean: Answer Y or N
ae	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
af	IP destination	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ag	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

```
# 0x0000: 3cdc 2a2a 5d7e 3af3 564a 39f9 8847 0000 <.**]~:.VJ9..G..

# 0x0010: ffef 4500 0082 0000 0000 3006 0000 f8ee ..E......0....

# 0x0020: b824 0f9b 95e1 2fbb 5c78 5a06 f558 14f6 .$.../.\xZ..X..

# 0x0030: 5308 5030 9e16 0000 0004 78bf c639 7d70 S.P0.....x..9}p

# 0x0040: fadc feec da84 3023 08ab f99d 65ec 9aba .....0#...e...

# 0x0050: d2ef 7a5d 935d 3254 bd3f 4256 3fa1 720d ..z].]2T.?BV?.r.

# 0x0060: 0179 bcb7 7c85 2a6b 460d 03aa 1aab 4075 .y..|.*kF.....@u

# 0x0070: 5b1d 2b3f 9ff3 1167 00a1 e431 9ff8 514a [.+?...g...1..QJ

# 0x0080: fd37 8d11 3f1d 689b f358 6aa5 4f23 4a1c .7..?.h..Xj.O#J.

# 0x0090: 7d37 2e38
```

Question	Field	Туре
ID		
ah	MPLS TTL	Integer: Answer with the decimal value of the field.
ai	IP Protocol of payload	Integer: Answer with the decimal value of the field.
aj	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
ak	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
al	TCP URG	Boolean: Answer Y or N
am	TCP PSH	Boolean: Answer Y or N

```
# 0x0000: 3a32 99da 2ce3 f513 397b adce 0806 0001 :2..,..9{......

# 0x0010: 0800 0604 0001 558c 559e 87a4 8d5c 984f .....U.U....\.0

# 0x0020: b6d1 9ed6 e2cf b0c1 8b2a 03c0 6335 d4c7 .....*..c5..

# 0x0030: 03a6 61ea 4930 1f14 4b02 17df 1dd9 132e ..a.IO..K......

# 0x0040: f123 dfa2 0917 cdb7 bacd ec9b 322e 6619 .#......2.f.

# 0x0050: 5c31 cb35 e51d fc6c e53e ccef e8f0 4e4e \1.5...l.>...NN

# 0x0060: 19c8 d552 5dff cb1e 9bbd 3519 d235 4e27 ...R].....5..5N'

# 0x0070: 4cae 3979 37be a0f6 56dc a099 d686 79c7 L.9y7...V....y.

# 0x0080: 6ad6 873f 640d e982 ebff cbab e9a0 ee j..?d.......
```

Question	Field	Туре
ID		
an	ARP source	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ao	ARP PTYPE	Integer: Answer with the decimal value of the field.
ap	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
aq	ARP request	Boolean: Answer Y or N
ar	ARP HTYPE	Integer: Answer with the decimal value of the field.
as	Frame is 802.1ad	Boolean: Answer Y or N

```
# 0x0000: f29e c801 de8b dce4 2202 d3a9 8848 0000 ......"....H...

# 0x0010: 3526 4500 0051 0000 4000 3806 0000 d499 5&E..Q..@.8.....

# 0x0020: 5406 d1cb f554 a454 9398 7c59 c688 7756 T....T.T..|Y..wV

# 0x0030: 6522 5019 0757 0000 0006 71bc 17e3 f03a e"P..W....q....:

# 0x0040: 858e b342 900c b404 3cb5 b68d 05c4 44ca ...B....<br/>
.....D.

# 0x0050: ecfb 60fa e30d 142c 458e ccdd 5e62 8643 ....,E...^b.C
```

Question	Field	Туре
ID		
at	MPLS label	Integer: Answer with the decimal value of the field.
au	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
av	TCP ACK	Boolean: Answer Y or N
aw	MPLS last la- bel?	Boolean: Answer Y or N
ax	MPLS TTL	Integer: Answer with the decimal value of the field.
ay	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

0x0000: 794d aa8b 477f 7075 2400 55ef 8847 0000 yM..G.pu\$.U..G..

0x0010: 3b51 4500 0088 0000 4000 0f11 0000 76cb ;QE.....@....v.

0x0020: ef07 c9a8 ba19 c3da 2d55 00fa cee6 6e06-U...n.

0x0030: 3764 189e 6409 c94a faa8 4233 4279 8303 7d..d..J..B3By..

0x0040: 4ddf 4b07 6155 2fad 63c6 2f60 d90a ee99 M.K.aU/.c./`...

0x0050: ff0f d51a 0f21 08c7 65c8 b03f 2ca4 b745!.e..?,..E

0x0060: 7ef6 d8b4 f268 7e03 ed25 713f 0adf c4e5 ~....h~..%q?....

0x0070: 00b4 1248 bb3f 1726 9c0c 88e7 26c1 6dca ...H.?.&...&m.

0x0080: 0470 36ee 7b59 92ae 1a92 7b25 df10 d2b8 .p6.{Y....{%....}

0x0090: f8d3 3195 a30b 9eb5 e6c6 ...1.....

Question	Field	Туре
ID		
az	MPLS last la- bel?	Boolean: Answer Y or N
ba	Frame is 802.1q	Boolean: Answer Y or N
bb	IP ECN	Integer: Answer with the decimal value of the field.
bc	UDP destination	Integer: Answer with the decimal value of the field.
bd	MPLS TTL	Integer: Answer with the decimal value of the field.
be	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

```
# 0x0000: a7b2 448e 28f4 69c7 4d87 7ea6 8100 20a0 ..D.(.i.M.~.....

# 0x0010: 0800 4500 004d 0000 4000 3306 0000 1c02 ..E..M..@.3.....

# 0x0020: 30b5 f07d 613f fa67 fc74 713f 0529 6223 0..}a?.g.tq?.)b#

# 0x0030: 07e6 500b dedf 0000 0003 6d35 4528 08bf ..P.....m5E(..

# 0x0040: 9ae6 733e ecf4 b2fa c1ee 2bff 18d2 87e0 ..s>....+....

# 0x0050: 0cb8 0fc1 5cd8 666b b445 2d85 8e22 4c ....\.fk.E-.."L
```

Question	Field	Туре
ID		
bf	Frame is MPLS	Boolean: Answer Y or N
bg	TCP FIN	Boolean: Answer Y or N
bh	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or \$ on the front of the hexadecimal number.
bi	IP DSCP	Integer: Answer with the decimal value of the field.
bj	TCP ACK	Boolean: Answer Y or N
bk	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

0x0000: 2bd1 5a9a 8c8f 7e5a 29fb 274d 88a8 2d3f +.Z...~Z).'M..-?

0x0040: e2ea 5ef9 3362 6941 a338 125b b62a 5f9e ..^.3biA.8.[.*_.

0x0050: 12b5 a6cc 6cd5 3b98 f14b 826d f5d4 6be9l.;..K.m..k.

0x0060: b7fb 90 ...

Question	Field	Туре
ID		
bl	ARP PTYPE	Integer: Answer with the decimal value of the field.
bm	Frame is	Boolean: Answer Y or N
bn	ARP source IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bo	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bp	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bq	ARP HTYPE	Integer: Answer with the decimal value of the field.

Question	Field	Туре
ID		
br	ARP request	Boolean: Answer Y or N
bs	ARP reply	Boolean: Answer Y or N
bt	ARP source	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bu	Frame is	Boolean: Answer Y or N
bv	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bw	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

```
# 0x0000: bfc4 c323 bc68 fede 8948 32d7 0806 0001 ...#.h...H2.....

# 0x0010: 0800 0604 0001 2767 4b2b b9a6 90af 9418 .....'gK+......

# 0x0020: 8ae4 f22c 3c83 8d6a 618c cc8b 2bfe c9cd ...,<...ja...+...

# 0x0030: c486 22ba 46d3 f9ef c793 f6e4 7484 6545 ..".F......t.eE

# 0x0040: 2bfc c0a2 c395 73dd 78cd c25e 3a43 ab0a +....s.x..^:C..

# 0x0050: 404e c057 0c66 f9e3 1f72 7e2e 5969 8589 @N.W.f...r~.Yi..

# 0x0060: 392b 2ee6 1da6 1b1a 937f b230 035d 49e9 9+.....0.]I.

# 0x0070: 425a 5e29 4687 64f1 BZ^)F.d.
```

Question	Field	Туре
ID		
bx	ARP HTYPE	Integer: Answer with the decimal value of the field.
by	Frame is	Boolean: Answer Y or N
bz	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or \$ on the front of the hexadecimal number.
ca	ARP source IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cb	Frame is MPLS	Boolean: Answer Y or N
сс	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

Question	Field	Туре
ID		
cd	IP Don't Frag	Boolean: Answer Y or N
се	IP ECN	Integer: Answer with the decimal value of the field.
cf	IP DSCP	Integer: Answer with the decimal value of the field.
cg	Frame is 802.1q	Boolean: Answer Y or N
ch	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ci	Frame is MPLS	Boolean: Answer Y or N

```
# 0x0000: df68 4125 3fd3 2cdf 95d3 7641 0800 4500 .hA%?.,...vA..E.

# 0x0010: 0064 0000 0000 1811 0000 cc73 5cb9 5002 .d......s\.P.

# 0x0020: a71b 8081 b992 00e6 7050 25c6 41e2 359b .....pP%.A.5.

# 0x0030: f648 d348 13e8 dcb0 69a3 4d1f 85e4 acb3 .H.H...i.M....

# 0x0040: 9af2 31d6 94b0 8e9e a443 91a5 ecec c8ae ..1.....C.....

# 0x0050: 35eb 6c63 7f38 6349 1e68 73d2 4aba 82c4 5.lc.8cI.hs.J...

# 0x0060: 5d81 48f6 0c4b 0dfe 57a4 dd3d b7dd 42d2 ].H..K..W..=..B.

# 0x0070: 6c33
```

Question	Field	Туре
ID		
cj	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ck	IP Don't Frag	Boolean: Answer Y or N
cl	IP length	Integer: Answer with the decimal value of the field.
cm	UDP destination	Integer: Answer with the decimal value of the field.
cn	Frame is MPLS	Boolean: Answer Y or N
со	IP TTL	Integer: Answer with the decimal value of the field.

```
# 0x0000: d472 f043 40ac 81f2 cac9 e643 8847 0000 .r.C@.....C.G..

# 0x0010: f905 4500 0066 0000 0000 0706 0000 8f85 ..E..f.......

# 0x0020: dae9 a302 5f1c 4771 4ebc 43d1 8265 0356 ..._..GqN.C..e.V

# 0x0030: 90eb 508a 5295 0000 0003 1422 7ed2 11ba ..P.R......"~...

# 0x0040: 8ffe c493 d469 9a25 d77f 775a b696 8d50 ....i.%..wZ...P

# 0x0050: f8de c38d 7fcf e263 f842 10c4 4313 f6fc .....c.B..C...

# 0x0060: 2a5a f9af 921a ae7c c9e0 cd66 9eaf 8c6b *Z....|..f...k

# 0x0070: 5ff4 ab1b d7a0 5334 __....S4
```

Question	Field	Туре
ID		
ср	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cq	TCP FIN	Boolean: Answer Y or N
cr	IP TTL	Integer: Answer with the decimal value of the field.
cs	TCP destination	Integer: Answer with the decimal value of the field.
ct	IP length	Integer: Answer with the decimal value of the field.
cu	Frame is 802.1q	Boolean: Answer Y or N

0x0000: fed4 412c 4ca1 2042 da3a 2371 0800 4500 ..A,L..B.:#q..E.

0x0010: 004c 0000 4000 2911 0000 08a6 9b00 f625 .L..@.)......%

0x0020: 3070 c283 10f8 00b2 71d5 9413 61f9 6d7a 0p.....q...a.mz

0x0030: c925 ad2b bcd2 ed6e 07bf 014d 8e7d c6ba .%.+...n...M.}..

0x0040: 5b17 09f9 a00e d972 de9b a6e6 3047 cd9d [.....r....0G...

0x0050: 69da 3e4e cb2e 6dba 3183 i.>N..m.1.

Question	Field	Туре
ID		
cv	IP Don't Frag	Boolean: Answer Y or N
CW	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
сх	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
су	IP Protocol of payload	Integer: Answer with the decimal value of the field.
cz	IP DSCP	Integer: Answer with the decimal value of the field.
da	Frame is MPLS	Boolean: Answer Y or N

```
# 0x0000: e7ba 29da 1e9e 4196 1582 6b1e 8848 0000 ..)..A...k..H..

# 0x0010: a9ef 4500 0075 0000 4000 0006 0000 07c2 ..E..u..@......

# 0x0020: 84c0 9100 8ae9 2042 1cd7 2c83 a658 385d .....B..,.X8]

# 0x0030: cc4f 503b 6f90 0000 0006 bdad 1936 163b .OP;o......6.;

# 0x0040: 3264 ed79 090b c247 f8cc 7286 2574 b31a 2d.y...G..r.%t..

# 0x0050: bb85 c27e 3758 c48e 2387 96de 04b2 4eb8 ...~7X..#....N.

# 0x0060: 5be2 b7c2 12f6 d572 a6fe d20b b82e 583d [.....r....X=

# 0x0070: 4d6a b9a9 343d f845 82e4 8f4c 566c 0199 Mj..4=.E...LV1..

# 0x0080: cfc0 eda0 50d7 a0 ....P..
```

Question	Field	Туре
ID		
db	TCP ACK	Boolean: Answer Y or N
dc	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or \$ on the front of the hexadecimal number.
dd	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
de	TCP PSH	Boolean: Answer Y or N
df	IP More Frag- ments	Boolean: Answer Y or N
dg	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

```
# 0x0000: 4014 cf2e fc4f 8699 a2bc d149 88a8 3618 @....O....I...6.

# 0x0010: 0800 4500 0034 0000 0000 3311 0000 aeaa ..E..4...3.....

# 0x0020: e4b6 a24c 00ca 581f leed 0044 3396 058e ...L..X...D3...

# 0x0030: b638 9def 88ca 12f1 leea f419 f2b6 4800 .8......H.

# 0x0040: 53f8 484a 60dc S.HJ`.
```

Find the value of the following fields:

Question	Field	Туре
ID		
dh	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
di	Frame is 802.1ad	Boolean: Answer Y or N
dj	IP length	Integer: Answer with the decimal value of the field.
dk	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
dl	IP Protocol of payload	Integer: Answer with the decimal value of the field.
dm	IP TTL	Integer: Answer with the decimal value of the field.

2 Lecture Material Comprehension

The following questions are designed with two purposes in mind:

1. To help you engage with the lecture materials; and

2. To help generate a wide range of questions for the quizzes in this topic.

The second goal is not mandatory for you. However, if you are willing for the answers you provide to the questions in this section to be used in future quizzes in this topic, you are requested to answer the following question as follows you will not be penalised if you do not give this permission

Question#	Description
dn	Are you willing to release your following answers in
	this section from all copyrights, i.e., release them
	into the public domain, including so that they can be
	included in quizzes in this topic? you will not be
	penalised or treated any differently if you do not
	choose to give this permission

It is important that you answer this question with 'y', if you do decide that you would like to do this (but again, you have no obligation to do so, and you will not be treated differently whether or not you give permission).

The entry in unit5-answers.txt would thus look like:

```
# Question 'dn': Do you commit the following answers to the public domain
# and disclaim all copyrights in them?
dn=y
```

For each question, you must record your answer in the unit5-answers.txt file in your git repository. For each question, you are required to write a statement that is either true or false about the material in the indicated lecture slide.

For example, if you were asked 'write a **true** statement about the content of Slide 2 of Chapter 1', you would put the statement at the end of the rj= line in the file unit5-answers.txt. For example, if your statement was 'One of the problems addressed in this chapter is how to build scalable networks', you would write:

Question#	Description
pz	Write a true statement about the content of Slide 2
	of Chapter 1

The entry in unit5-answers.txt would thus look like:

Question 'pz': Write a true statement about the content of Slide 2 of Chapter 1

pz=One of the problems addressed in this chapter is how to build scalable networks

Templates for each answer are provided in unit5-answers.txt for your convenience.

If you are asked to write a statement that is false, i.e., untrue, think about statements that someone who has not worked through the material might think would be true. Be creative! Be devious!

Question#	Description
do	Write a false statement about the content of Slide 98
	of Chapter 6
dp	Write a true statement about the content of Slide 59
	of Chapter 3
dq	Write a true statement about the content of Slide 86
	of Chapter 3
dr	Write a false statement about the content of Slide 42
	of Chapter 6
ds	Write a false statement about the content of Slide 29
	of Chapter 8
dt	Write a true statement about the content of Slide 36
	of Chapter 5
du	Write a false statement about the content of Slide 67
	of Chapter 9
dv	Write a false statement about the content of Slide 94
	of Chapter 2
dw	Write a true statement about the content of Slide 7
	of Chapter 4
dx	Write a false statement about the content of Slide 81
	of Chapter 2