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

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0x0000: 33ae bec3 3b0c 3a91 fd73 aa2b 8100 0ffa 3...;...s.+....
0x0010: 0806 0001 0800 0604 0001 5a34 1c40 ee70Z4.@.p
0x0020: fb1e d452 4370 9d51 6031 9d10 cf54 e164 ...RCp.Q`1...T.d
0x0030: d5f5 3cd2 d0d4 27ad acf4 5a39 5933 e192 ..<...'...Z9Y3..
0x0040: 0091 cb58 cadb 200a 6231 218c 80ec 2703 ...X....b1!...'.
0x0050: 2568 ab22 2733 5373 9b27 57c7 3350 c7a8 %h."'3Ss.'W.3P..
0x0060: c7f0 38bf 79ef e9d5 b134 657d c7bf 5802 ...8.y...4e}..X.
0x0070: 4178 cfb4 982c 1cd3 f407 008b 88d7 6f08 Ax...,...........
0x0080: 7749 d6a3 3eb5 7034 6da6 25c5 7ee0 338d wI..>.p4m.%.~.3.
0x0090: e0a3 98c4 388

Question	Field	Туре
ID		
ab	ARP request	Boolean: Answer Y or N
ac	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ad	ARP HTYPE	Integer: Answer with the decimal value of the field.
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	Frame is 802.1ad	Boolean: Answer Y or N
ag	Frame is MPLS	Boolean: Answer Y or N

```
# 0x0000: 998b 0d5c fdf1 40be 96b7 13ce 8848 0001 ...\.@.....H..

# 0x0010: 3d43 4500 006f 0000 0000 3e11 0000 f0b0 =CE..o...>....

# 0x0020: 3792 b6d1 3687 2691 97aa 008b 5aa7 457d 7...6.&....Z.E}

# 0x0030: b37d 3680 1d01 1cac b73d a145 37bd 5c3d .}6.....=.E7.\=

# 0x0040: 8628 e12d 246e e845 1e79 3601 8bc8 4733 .(.-$n.E.y6...G3

# 0x0050: 6034 6471 4ade 0b72 06e3 e9fa 3734 5c59 `4dqJ..r...74\Y

# 0x0060: 0372 44df 506f 0f1d ee6e b958 6813 cfee .rD.Po...n.Xh...

# 0x0070: ea85 66d7 d827 890c acb5 9edd 30e9 1524 ..f..'....0..$

# 0x0080: 22
```

Question	Field	Туре
ID		
ah	IP length	Integer: Answer with the decimal value of the field.
ai	Frame is 802.1q	Boolean: Answer Y or N
aj	IP Protocol of payload	Integer: Answer with the decimal value of the field.
ak	IP ECN	Integer: Answer with the decimal value of the field.
al	MPLS label	Integer: Answer with the decimal value of the field.
am	IP ToS	Integer: Answer with the decimal value of the field.

0x0000: 9d84 5c35 fb9c 19a6 40d7 9e43 8848 0000 ..\5....@..C.H..

0x0010: b1ca 4500 0046 0000 4000 3c06 0000 d72e ..E..F..@.<.....

0x0020: b56f 6848 5492 d5f1 89de 75fd 5287 0c24 .ohHT....u.R..\$

0x0030: a4e2 501d 5add 0000 0004 94ea dcde 0441 ..P.Z......A

0x0040: 767b 5c0b f3d8 e016 c2d3 8b71 83f2 51b6 $v\{\dots,q.Q.$

0x0050: 48fb c539 7414 6f66 H..9t.of

Question	Field	Туре
ID		
an	TCP PSH	Boolean: Answer Y or N
ao	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
ap	IP TTL	Integer: Answer with the decimal value of the field.
aq	TCP RST	Boolean: Answer Y or N
ar	IP ECN	Integer: Answer with the decimal value of the field.
as	IP TTL	Integer: Answer with the decimal value of the field.

- # 0x0000: 376c fa06 e4fb 1dd3 1c28 bdb6 88a8 521a 71.....(....R.
- # 0x0010: 0800 4500 0053 0000 4000 1a11 0000 40e0 ..E..S..@.....@.
- # 0x0020: cdf9 b7d1 8558 395d 872e 0107 f816 b296X9]......
- # 0x0030: 523c 0d84 a28c 1507 8201 8e73 bfd3 9704 R<....s....
- # 0x0040: 2a73 c41a cab4 a296 0204 bec6 5476 88ce *s.....Tv..
- # 0x0050: 9a81 6f9a 0a14 790f 41bb dcbb a823 4010 ..o...y.A....#@.
- # 0x0060: a910 7834 b2 ..x4.

Question	Field	Туре
ID		
at	UDP source port	Integer: Answer with the decimal value of the field.
au	IP More Frag- ments	Boolean: Answer Y or N
av	Frame is MPLS	Boolean: Answer Y or N
aw	IP ECN	Integer: Answer with the decimal value of the field.
ax	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
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: be0f ace2 4358 e87b 0330 63e0 0806 0001 ....CX.{.0c......

# 0x0010: 0800 0604 0001 74a8 201c 6576 27f2 9b82 .....t...ev'...

# 0x0020: edb2 6f08 c11a 5db4 40dc 83ef 93d0 0ab1 .....].@......

# 0x0030: 79b1 2ae8 e7e5 11a8 a758 d32a 7e7b d492 y.*....X.*~{...}

# 0x0040: 5126 0e24 7cea 52b3 bab3 e5e2 5659 8691 Q&.$|.R.....VY...
```

Question	Field	Туре
ID		
az	ARP source IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ba	ARP source	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bb	ARP reply	Boolean: Answer Y or N
bc	ARP HTYPE	Integer: Answer with the decimal value of the field.
bd	ARP request	Boolean: Answer Y or N
be	Frame is 802.1q	Boolean: Answer Y or N

0x0000: 9844 4cd8 c80f 7d8f 8f9d b72f 8848 0000 .DL...}..../.H..

0x0010: e7f7 4500 0052 0000 4000 0b11 0000 a0a8 ..E..R..@.....

0x0020: 05ea df67 0e8c 08f2 3e51 00d9 500e 3ba5 ...g....>Q..P.;.

0x0030: 54bc cd6e 5a1d e758 c560 28b5 d710 9716 T..nZ..X.`(.....

0x0040: 1431 d912 eb4f b907 ffe7 f20f a87f d7e6 .1...0.....

0x0050: 61b0 8702 5887 2f10 8918 1dc1 fb66 3d02 a...X./.....f=.

0x0060: 4589 59e4 E.Y.

Question	Field	Туре
ID		
bf	IP destination	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bg	IP ToS	Integer: Answer with the decimal value of the field.
bh	Frame is 802.1q	Boolean: Answer Y or N
bi	UDP source port	Integer: Answer with the decimal value of the field.
bj	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bk	IP DSCP	Integer: Answer with the decimal value of the field.

0x0000: 5b90 54d5 fad3 a51b 6346 08df 88a8 42f9 [.T....cF....B.

0x0010: 0800 4500 008c 0000 4000 1d11 0000 c800 ..E....@......

0x0020: 663a 33e5 e4d0 4a2c 7df1 0105 1769 3c1c f:3...J,}...i<.

0x0030: 1f12 6996 7d9f 52e9 327e bd1c bc92 c3d4 ..i.}.R.2~.....

0x0040: 0057 467a bb2c 57bc 0bd2 eedd 8a2a b389 .WFz.,W....*..

0x0050: 95ca 4394 6cd4 2c16 c22a 59e8 926c 8e85 ..C.l.,.*Y..l..

0x0060: 9c19 23ff 2185 ce2e 48c4 2a01 95e9 4600 ..#.!..H.*...F.

0x0070: 5d6f 6856 1201 bdda 98ed 590d d075 629c]ohV.....Y..ub.

0x0080: f89e 31f2 3d0a 0447 2f41 bb94 8bd6 9807 ..l.=..G/A.....

0x0090: 5d67 9938 69d0 808b 1de4 aa33 7cc4]g.8i....3|.

Question	Field	Туре
ID		
bl	Frame is 802.1q	Boolean: Answer Y or N
bm	IP ECN	Integer: Answer with the decimal value of the field.
bn	IP More Frag- ments	Boolean: Answer Y or N
ьо	UDP destination	Integer: Answer with the decimal value of the field.
pp	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
þq	IP source ad- dress	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

```
# 0x0000: 4fae e2e8 ba78 71eb 2fc9 f9f8 88a8 72f8 0....xq./....r.

# 0x0010: 0800 4500 003d 0000 4000 2b11 0000 6362 ..E..=..@.+...cb

# 0x0020: 9cd4 113e dceb 57a5 6be7 007b ba25 c945 ...>..W.k..{.%.E}

# 0x0030: d3f1 16ac 37d8 6e10 63dd 99d5 64c0 4420 ....7.n.c...d.D.

# 0x0040: 523f 1ab0 e13b 9bc5 c5a7 198e d4d8 2e R?...;......
```

Question	Field	Туре
ID		
br	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bs	IP destination	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bt	IP Don't Frag	Boolean: Answer Y or N
bu	IP ECN	Integer: Answer with the decimal value of the field.
bv	IP TTL	Integer: Answer with the decimal value of the field.
bw	IP ToS	Integer: Answer with the decimal value of the field.

Question	Field	Туре
ID		
bx	Frame is MPLS	Boolean: Answer Y or N
by	IP FLAGS	Integer: Answer with the decimal value of the field.
bz	IP TTL	Integer: Answer with the decimal value of the field.
ca	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cb	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
СС	TCP FIN	Boolean: Answer Y or N

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

```
# 0x0000: 811e afb4 4f64 9922 6a09 4bee 8847 0000 ....Od."j.K..G..

# 0x0010: 9110 4500 0083 0000 4000 3e06 0000 ebf1 ..E....@.>....

# 0x0020: 511b 979f e5c4 8ce9 1173 40fc c3d5 51ae Q......s@...Q.

# 0x0030: 9c17 5013 c2eb 0000 0008 be37 5439 9456 ..P......7T9.V

# 0x0040: 29d5 ebfa b52f 8654 c66b 1a1a 85fa 5b39 )..../.T.k...[9

# 0x0050: e383 a1a4 adf3 b044 2c84 a3fe 10be 6b2f ......D,....k/

# 0x0060: 20bc 7461 691b 3aab e520 bf4c 16d8 983f ..tai.:...L...?

# 0x0070: d6ae f469 c72b a12e 74e4 92e0 9eaf bbbf ...i.+..t.....

# 0x0080: 5359 27bd 351a ec99 09e7 b4d7 01ea 4b6d SY'.5......Km

# 0x0090: e6c8 c899 b7 .....
```

Question	Field	Туре
ID		
cj	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
ck	TCP PSH	Boolean: Answer Y or N
cl	Frame is 802.1q	Boolean: Answer Y or N
cm	IP ECN	Integer: Answer with the decimal value of the field.
cn	TCP SYN	Boolean: Answer Y or N
со	TCP CWR	Boolean: Answer Y or N

Question	Field	Туре
ср	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cq	ARP source	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cr	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cs	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.
ct	Frame is 802.1q	Boolean: Answer Y or N
cu	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

0x0000: f80a c8fa f4ab 203f b9ad 766b 8848 0000?..vk.H...

0x0010: f7fc 4500 0085 0000 4000 0506 0000 c456 ..E....@......V

0x0020: 3654 7c77 adac e65f d3b9 02c8 1f74 30f1 6T|w..._...to.

0x0030: 1015 501a 4f74 0000 0002 4c93 bcc1 34bf ..P.Ot...L...4.

0x0040: 08f3 8249 2cbc 41d9 379b 0628 8e1d 5ef8 ...I,.A.7..(..^.

0x0050: b688 9386 67de aab6 8a8a 5ffc b940 3dbfg...._.@=.

0x0060: c7c5 0853 85a6 d20f 0ce9 ca96 67d5 652f ...S......g.e/

0x0070: 21b4 dcb1 5420 568d d11f bffa 7978 b674 !...T.V....yx.t

0x0080: 4062 8076 99e9 4576 81f4 3138 b4b0 5370 @b.v..Ev..18..Sp

0x0090: 60bc 5ac7 4e37 ce ...Z.N7.

Question	Field	Туре
ID		
cv	TCP ACK	Boolean: Answer Y or N
CW	IP ECN	Integer: Answer with the decimal value of the field.
сх	Frame is 802.1q	Boolean: Answer Y or N
су	TCP RST	Boolean: Answer Y or N
CZ	ETH source ad- dress	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
da	TCP FIN	Boolean: Answer Y or N

```
# 0x0000: 653a 1874 2d67 93df e239 b3b0 8100 1b22 e:.t-g...9...."

# 0x0010: 0800 4500 0095 0000 4000 1306 0000 c9dd ..E....@......

# 0x0020: 5161 3e83 e0dc 1b3f e575 51ae 9cb7 4535 Qa>...?.uQ...E5

# 0x0030: ad0c 5085 3e67 0000 0001 c7e0 4a7d 4d39 ..P.>g....J}M9

# 0x0040: 8d8b 1511 13ae ef12 4bd6 c61b b36a b241 ......K...j.A

# 0x0050: 3a9b cd65 0f33 2ff3 6c4a 9310 efc1 247c :..e.3/.lJ...$|

# 0x0060: 7866 2201 6318 4c30 235c 6872 2f17 74d5 xf".c.L0#\hr/.t.

# 0x0070: 8b9a 361c c7e5 605b 5ad1 ec73 49be 5a77 ..6...[Z..sI.Zw]

# 0x0080: 0309 b433 f5f0 c7b1 2c51 fe5a 8cd9 9f6f ...3...,Q.Z...o

# 0x0090: d351 bb6b 8a8f 6fe7 882e 18d2 bb51 c2cf .Q.k..o....Q..
```

Question	Field	Туре
ID		
db	IP TTL	Integer: Answer with the decimal value of the field.
dc	IP Protocol of payload	Integer: Answer with the decimal value of the field.
dd	Frame is MPLS	Boolean: Answer Y or N
de	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.
df	TCP PSH	Boolean: Answer Y or N
dg	TCP destination	Integer: Answer with the decimal value of the field.

0x0000: 47d5 416a dfc0 884b 3f80 90c8 0806 0001 G.Aj...K?......

0x0010: 0800 0604 0001 149b fd4b 5b97 9465 d645K[..e.E

0x0020: fc6a 294e 1f97 0d78 f39a b8ee 8c4f 7bbf .j)N...x....0{.

0x0030: bef8 22f9 be6e 85d3 1346 eda4 5d67 bef9 .."..n...F..]g..

0x0040: 150c de18 a649 e270 6569 73cd 9082 9cc5I.peis....

0x0050: 3ab4 74eb 5a3f e56f e886 e564 52b2 1bfd :.t.Z?.o...dR...

0x0060: 6695 3536 e379 fd98 d9f1 30cb 48e8 504f f.56.y....0.H.PO

0x0070: 5a35 05eb 565f 8a84 3433 4855 4c86 c730 Z5..V_..43HUL..0

0x0080: b1bc 394b a00c 680d a948 7bf8 8e1b 4a6f ...9K..h..H{...Jo}

0x0090: dfa6 61d2 2a56 3cdf e7c2 8d1c d50b f766 ...a.*V<......f

Question	Field	Туре
ID		
dh	ETH destina- tion address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
di	ARP request	Boolean: Answer Y or N
dj	ARP HTYPE	Integer: Answer with the decimal value of the field.
dk	Frame is	Boolean: Answer Y or N
dl	ARP reply	Boolean: Answer Y or N
dm	ARP source	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

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 true statement about the content of Slide 92
	of Chapter 3
dp	Write a false statement about the content of Slide 66
	of Chapter 2
dq	Write a false statement about the content of Slide 69
	of Chapter 8
dr	Write a false statement about the content of Slide 64
	of Chapter 8
ds	Write a false statement about the content of Slide 74
	of Chapter 9
dt	Write a true statement about the content of Slide 83
	of Chapter 2
du	Write a false statement about the content of Slide 5
	of Chapter 8
dv	Write a true statement about the content of Slide 6
	of Chapter 2
dw	Write a false statement about the content of Slide 55
	of Chapter 9
dx	Write a false statement about the content of Slide 44
	of Chapter 6