ECE435: Network Engineering – Homework 8

Internet Protocol v6

Due: Friday, 3 April 2026, 5:00pm

For this homework short answers will suffice.

To submit, create a document with your answers (text, pdf, libreoffice, MS Office if you must) and e-mail them to *vincent.weaver@maine.edu* by the homework deadline. Title your e-mail "ECE435 Homework 8" and be sure your name is included in the document.

1. **IPv6**

   (a) Which of the following are valid IPv6 addresses?

      i. 2607:f8b0:4009:0801:0000:0000:0000:200e
      ii. 2607:f8b0:4009:801::200e
      iii. 2607:f8b0::4009:801::200e
      iv. 123.45.67.189

   (b) We used tcpdump to gather the following network frame.

```
tcpdump port 53 -xe -i eth1 -XX
```

```
0x0000:  8875 563d 2a80 0030 18ab 1c39 86dd 6002  .uV=*..0...9..`.
0x0010:  2618 0031 1140 2610 0048 0100 08da 0230  &..1.@&..H.....0
0x0020:  18ff feab 1c39 2001 4860 4860 0000 0000  .....9..H`H`....
0x0030:  0000 0000 8844 e239 0035 0031 9c0e 8657  .....D.9.5.1...W
0x0040:  0120 0001 0000 0000 0001 0377 7777 0465  ...........www.e
0x0050:  7370 6e03 636f 6d00 0001 0001 0000 2910  spn.com.......).
0x0060:  0000 0000 0000 00
```

   The IP header starts at address 0xe. From the value found there you suspect this is an IPv6 packet, so use the class notes or RFC2460 to decode the various fields. Decode to decimal if it makes sense, report what fields or flags stand for, be sure to report units if necessary, report addresses in hex with colons.

BEGIN IPv6 HEADER			Name of Field	Decoded Value
0x000e:	6			
0x000f:	00			
0x0010:	2	2618		
0x0012:	0031			
0x0014:	11			
0x0015:	40			
0x0016:	2610 0048 0230 18ff	0100 08da feab 1c39		
0x0026:	2001 4860 0000 0000	4860 0000 0000 8844		
END IPv6 HEADER				

2. **Traceroute and Routing**

(a) You use ipv4 `traceroute www.cam.ac.uk` which is at Cambridge University in England. And get the following:

```
 1  bobcat.deaternet.vmw (192.168.8.1)  0.531 ms  0.455 ms  0.375 ms
 2  VL218.gw-um-pri.net.maine.edu (130.111.218.2)  0.567 ms  0.517 ms  0.506 ms
 3  be11.gw-oro.net.maine.edu (130.111.0.4)  1.200 ms  0.891 ms  0.914 ms
 4  * * *
 5  fourhundredge-0-0-0-0.4079.core1.hart2.net.internet2.edu (163.253.1.11)  19.283 ms  19.211 ms  19.152 m
 6  fourhundredge-0-0-0-0.4079.core1.newy32aoa.net.internet2.edu (163.253.1.229)  17.844 ms  17.833 ms  17.
 7  198.71.45.237 (198.71.45.237)  89.834 ms  89.682 ms  89.562 ms
 8  ae8.mx1.lon2.uk.geant.net (62.40.98.106)  101.424 ms  101.796 ms  101.597 ms
 9  janet-bckp-gw.mx1.lon2.uk.geant.net (62.40.125.58)  101.884 ms  101.794 ms  101.675 ms
10  ae31.erdiss-sbr2.ja.net (146.97.33.22)  105.984 ms  105.843 ms  105.626 ms
11  ae30.lowdss-sbr1.ja.net (146.97.33.26)  107.500 ms  107.941 ms  107.787 ms
12  ae26.lowdss-ban1.ja.net (146.97.35.246)  109.668 ms  107.610 ms  107.309 ms
13  uoc.ja.net (146.97.41.38)  109.475 ms  109.465 ms  109.345 ms
14  c-mi.b-jc.net.cam.ac.uk (131.111.6.182)  109.512 ms  110.400 ms  110.222 ms
15  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  110.916 ms  110.822 ms  110.754 ms
16  d-dw.s-dw.net.cam.ac.uk (193.60.88.2)  110.580 ms  110.489 ms  110.243 ms
17  s-dw.f-sv-net.net.cam.ac.uk (128.232.128.2)  110.032 ms  109.873 ms  109.747 ms
```

i. Can you tell which hop takes you across the Atlantic Ocean?

ii. Can you guess what city this happens in based on the hostnames?

(b) Back in 2018 you ran `traceroute6 www.cam.ac.uk` which traces the same connection, but with IPv6, and you get the following (for some reason IPv6 doesn't seem to be working from my office anymore and I never got around to researching why):

```
 1  vl218.gw-o-neville.net.maine.edu (2610:48:100:8da::1)  1.957 ms  1.908 ms  2.068 ms
 2  gi7-2.gw-orono.net.maine.edu (2610:48::25)  0.769 ms  0.680 ms  0.836 ms
 3  2610:48:0:a::9 (2610:48:0:a::9)  0.774 ms  1.004 ms  0.943 ms
 4  2610:48:0:a::2 (2610:48:0:a::2)  21.907 ms  21.967 ms  21.878 ms
 5  et-4-1-0.4072.rtsw.wash.net.internet2.edu (2001:468:ff:a02::2)  30.120 ms  30.076 ms  29.928 ms
 6  abilene-wash.mx1.fra.de.geant2.net (2001:798:14:10aa::11)  126.785 ms  130.140 ms  126.743 ms
 7  ae1.mx1.ams.nl.geant.net (2001:798:cc:1401:2201::a)  120.872 ms  124.076 ms  120.840 ms
 8  ae2.mx1.lon.uk.geant.net (2001:798:cc:2801:2201::1)  119.811 ms  116.640 ms  119.732 ms
 9  janet-gw.mx1.lon.uk.geant2.net (2001:798:28:10aa::2)  129.290 ms  116.694 ms  129.300 ms
10  ae29.londpg-sbr2.ja.net (2001:630:0:10::1ca)  120.310 ms  117.270 ms  117.199 ms
11  ae30.londtw-sbr2.ja.net (2001:630:0:10::1ce)  120.909 ms  139.899 ms  139.835 ms
12  2001:630:0:10::17e (2001:630:0:10::17e)  120.647 ms  123.732 ms  133.303 ms
13  2001:630:0:1000:10::75 (2001:630:0:1000:10::75)  120.475 ms  120.632 ms  120.669 ms
14  2001:630:0:9000::2 (2001:630:0:9000::2)  123.632 ms  120.554 ms  120.494 ms
15  b-ec.c-ce.net.cam.ac.uk (2001:630:210:3::1)  133.603 ms  133.565 ms  133.567 ms
16  c-ce.d-dr.net.cam.ac.uk (2001:630:210:19::2)  124.555 ms  124.511 ms  133.799 ms
17  d-dr.s-dw.net.cam.ac.uk (2001:630:210:2002::2)  133.760 ms  121.897 ms d-dr.s-dr.net.cam.ac.uk (2001:63
18  mws-83481.mws3.csx.cam.ac.uk (2001:630:212:8::8c:90)  133.478 ms  133.416 ms  133.175 ms
```

i. Why are there be a different number of hops compared to IPv4?

ii. Is the latency better or worse when using IPv6? Why might this be?

3. **Multicast / Anycast**

(a) Anycast is when multiple servers in different geographic areas have the same IP address, and BGP routing tables transparently route traffic to whichever server is closest. Give an example of a service that can benefit from this setup.

(b) What benefit is there to setting up a multicast connection from a server rather than multiple-unicast (a separate 1:1 connection to each client)?