

ECE435: Network Engineering – Homework 8
Internet Protocol v6

Due: Friday, 28 March 2025, 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:f8b0:4009:0801:0000:0000:200e
- 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 0100 08da 0230 18ff feab 1c39		
0x0026: 2001 4860 4860 0000 0000 0000 0000 8844		
END IPv6 HEADER		

2. Traceroute and Routing

- (a) You use `ipvs 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 ms
6 fourhundredge-0-0-0-0.4079.core1.newy32aoa.net.internet2.edu (163.253.1.229) 17.844 ms 17.833 ms 17.833 ms
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.erdis-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-m1.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
```

- Can you tell which hop takes you across the Atlantic Ocean?
 - 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.rts.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.geant2.net (2001:798:cc:1401:2201::a) 120.872 ms 124.076 ms 120.840 ms
8 ae2.mx1.lon.uk.geant2.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-dw.net.cam.ac.uk (2001:630:210:2002::2) 121.897 ms
18 mws-83481.mws3.csx.cam.ac.uk (2001:630:212:8::8c:90) 133.478 ms 133.416 ms 133.175 ms
```

- Why are there a different number of hops compared to IPv4?
- 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)?