

EE122–Spring 2013 — Solutions to Homework 1

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Q1.

We can match up the IP addresses to the router's prefix using the following information:

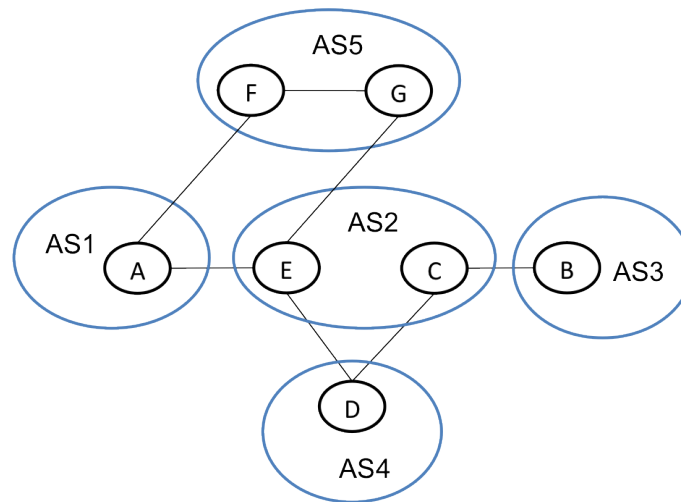
```
R2 128.96.39.0/25 10000000 01100000 00100111 00000000
R3 128.96.39.0/27 10000000 01100000 00101000 00000000
R4 128.96.40.0/25 10000000 01100000 00101000 00000000
R5 192.4.153.0/26 11000000 00000100 10011001 00000000
R6 (default)
```

IP Addresses:

```
128.96.40.12    10000000 01100000 00101000 00001100
128.96.39.10    10000000 01100000 00100111 00001010
128.96.39.48    10000000 01100000 00100111 00110000
192.4.153.17    11000000 00000100 10011001 00010001
192.4.153.90    11000000 00000100 10011001 01011010
```

- (a.) **R4**
- (b.) **R3**
- (c.) **R2**
- (d.) **R5**
- (e.) **R6**

Q2.



- (a.) Shortest path from A-B through routers: A-E-D-C-D-B
Shortest path from A-B through ASes: 1-2-4-2-3

- (b.) A-E-D-C-B

RIP routers, assuming that it has converged, would pick this path because it is the shortest path from A to B. The routers would not route through the nodes in AS5 because that adds to the path and we would have to go through E just like in the shortest path.

- (c.) 1-2-4-2-3 or 1-5-2-4-2-3

BGP routers forward packets based on their policy. Since we don't know what policy each AS has, there are two possible paths from A to B. It might be more expensive to route traffic between AS1 and AS2 which causes us to take the second path or it might be more expensive to route traffic between AS1 and AS5 which would cause us to take the first path.

Q3.

(a.) **6 packets**

$$\text{transmissiondelay} = 1kb * 8/160kbps = 50ms$$

Assuming that there is no transmission delay for the ACK packet, the rtt is $50 + 125 + 125 = 300ms$. So the number of packets we can transmit is $300/50 = 6$

(b.) **Leia**

$W_R = 1$ is inefficient because we have to wait and ACK a packet one by one. $W_R \gg W_S$ doesn't give any advantages over $W_R = W_S$ because the sender only sends at most W_R packets at a time and the sender can only ACK back at most W_R packets. In other words, the sender won't send anymore packets unless W_R packets were ACKed back.

(c.) **Leia**

$W_R = 1$ is inefficient because we have to wait and ACK a packet one by one. $W_R \gg W_S$ still doesn't give any advantages over $W_R = W_S$ because, although we send less ACKS, the sender can still only send at most W_R packets at a time because of the senders window size.

Q4.

b, c, e

For (a), Y cannot forward to Z because Y is a peer to Z. Peers only forward packets to customers. For (d), Z is a peer to W and so Z will only forward to its customers, which is z1.

Q5.

- (a.) $t = 1$ to $t = 6$ and $t = 22$ to $t = 25$
Slow start occurs between these times because sender increases the send rate exponentially
- (b.) $t = 6$ to $t = 14$ and $t = 15$ to $t = 21$
Congestion avoidance occurs between these times because it additively increases.
- (c.) triple duplicate ACK
- (d.) 20
Assuming at $t = 0$ we came from congestion avoidance, $sshtresh = 40/2$
- (e.) 20
- (f.) 12
- (g.) $sshtresh = 4$ and $cwnd = 4$
Before the ack, $cwnd = 8$ after the ack, $cwnd = 8/2 = 4$ and $sshtresh = cwnd/2 = 4$

Q6.

(a.) Traceroute uses a packets ttl field and pings gateways to a destination until it receives an ICMP TIME_EXCEEDED. Based on the ttl, we can order the ttl times to find how many hops away we are from the destination.

(b.) See output below on next page.

(c.) AS# OrgName
[AS25] University of California, Berkeley
[AS2152] Cenic
[AS6939] Hurricane Electric
[AS46841] Hurricane Electric
[AS6939] Hurricane Electric
[AS21513] Beagle networks

Hurricane Electric and Cenic are ISPs.

(d.) University of California–Berkeley, Cenic, Hurricane Electric, Beagle networks

(e.) Whats going in here is that the server isn't sending an ICMP timeout. So we don't know what is at that server.

traceroute to 216.81.59.173 (216.81.59.173), 64 hops max, 52 byte packets

```

1  * * *
2  xe-0-2-0-1965.inr-341-mulcev.berkeley.edu (136.152.148.1)  3.915 ms  4.217 ms  1.779 ms
3  t5-5.inr-201-sut.berkeley.edu (128.32.0.84)  1.719 ms  3.184 ms  1.503 ms
4  xe-4-1-0.inr-001-sut.berkeley.edu (128.32.0.64)  1.706 ms  2.039 ms  1.769 ms
5  dc-sfo-agg-1--ucb-10ge.cenic.net (137.164.50.16)  2.210 ms  2.199 ms  2.544 ms
6  oak-agg2--sfo-agg1-10g.cenic.net (137.164.22.25)  3.509 ms  3.767 ms  4.113 ms
7  dc-paix-px1--oak-core1-ge.cenic.net (137.164.47.174)  5.883 ms  4.257 ms  6.503 ms
8  hurricane--paix-px1-ge.cenic.net (198.32.251.70)  5.839 ms  4.638 ms  4.862 ms
9  10gigabitethernet3-1.core1.sjc2.he.net (72.52.92.70)  4.931 ms  18.072 ms  5.070 ms
10 10gigabitethernet14-7.core1.lax2.he.net (184.105.213.5)  12.700 ms  14.424 ms  24.863 ms
11 10gigabitethernet2-3.core1.phx2.he.net (184.105.222.85)  30.351 ms  25.921 ms  23.734 ms
12 10gigabitethernet5-3.core1.dal1.he.net (184.105.222.78)  55.023 ms  49.798 ms  52.187 ms
13 10gigabitethernet5-4.core1.atl1.he.net (184.105.213.114)  65.132 ms  67.895 ms  63.675 ms
14 216.66.0.26 (216.66.0.26)  64.840 ms  65.634 ms  66.400 ms
15 * * *
16 episode.iv (206.214.251.1)  109.734 ms  104.120 ms  104.890 ms
17 a.new.hope (206.214.251.6)  109.914 ms  105.201 ms  105.832 ms
18 it.is.a.period.of.civil.war (206.214.251.9)  104.029 ms  104.033 ms  105.119 ms
19 rebel.spaceships (206.214.251.14)  104.305 ms  107.745 ms  104.741 ms
20 striking.from.a.hidden.base (206.214.251.17)  104.524 ms  105.060 ms  104.726 ms
21 have.won.their.first.victory (206.214.251.22)  104.715 ms  104.820 ms  109.556 ms
22 against.the.evil.galactic.empire (206.214.251.25)  106.173 ms  110.754 ms  105.306 ms
23 during.the.battle (206.214.251.30)  104.211 ms  106.732 ms  106.343 ms
24 rebel.spies.managed (206.214.251.33)  105.632 ms  105.376 ms  107.610 ms
25 to.steal.secret.plans (206.214.251.38)  108.485 ms  104.901 ms  105.463 ms
26 to.the.empires.ultimate.weapon (206.214.251.41)  107.013 ms  110.851 ms  106.629 ms
27 the.death.star (206.214.251.46)  112.632 ms  107.514 ms  117.430 ms
28 an.armored.space.station (206.214.251.49)  114.204 ms  117.200 ms  124.417 ms
29 with.enough.power.to (206.214.251.54)  111.415 ms  111.660 ms  121.322 ms
30 destroy.an.entire.planet (206.214.251.57)  127.725 ms  110.220 ms  136.048 ms
31 pursued.by.the.empires (206.214.251.62)  137.677 ms  111.692 ms  118.035 ms
32 sinister.agents (206.214.251.65)  216.410 ms  358.046 ms  111.243 ms
33 princess.leia.races.home (206.214.251.70)  113.181 ms  111.011 ms  141.262 ms
34 aboard.her.starship (206.214.251.73)  120.387 ms  174.607 ms  178.062 ms
35 custodian.of.the.stolen.plans (206.214.251.78)  474.600 ms  207.096 ms  109.430 ms
36 that.can.save.her (206.214.251.81)  134.725 ms  112.658 ms  114.332 ms
37 people.and.restore (206.214.251.86)  128.163 ms  108.737 ms  116.432 ms
38 freedom.to.the.galaxy (206.214.251.89)  222.440 ms  108.675 ms  111.629 ms
39 0-----i-----i-----0 (206.214.251.94)  105.897 ms  105.250 ms  107.040 ms
40 0-----0 (206.214.251.97)  111.564 ms  144.463 ms  122.610 ms

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```
41 0-----0 (206.214.251.102) 378.353 ms 110.096 ms 191.894 ms
42 0-----0 (206.214.251.105) 106.679 ms 107.895 ms 136.144 ms
43 0-----0 (206.214.251.110) 124.932 ms 108.438 ms 106.814 ms
44 0-----0 (206.214.251.113) 110.118 ms 118.585 ms 118.825 ms
45 0-----0 (206.214.251.118) 107.223 ms 107.961 ms 111.643 ms
46 0-----0 (206.214.251.121) 115.472 ms 112.181 ms 114.825 ms
47 0-----0 (206.214.251.126) 109.415 ms 106.850 ms 107.602 ms
48 0-----0 (206.214.251.129) 108.703 ms 106.657 ms 108.140 ms
49 0-----0 (206.214.251.134) 107.985 ms 109.357 ms 109.801 ms
50 0-----0 (206.214.251.137) 106.893 ms 111.594 ms 128.541 ms
51 0-----0 (206.214.251.142) 106.626 ms 106.653 ms 107.099 ms
52 0-----0 (206.214.251.145) 107.945 ms 116.798 ms 112.961 ms
53 0-----0 (206.214.251.150) 110.877 ms 106.334 ms 107.445 ms
54 0----0 (206.214.251.153) 106.143 ms 108.049 ms 106.902 ms
55 0---0 (206.214.251.158) 106.969 ms 107.215 ms 106.917 ms
56 0--0 (206.214.251.161) 106.386 ms 109.973 ms 107.437 ms
57 0-0 (206.214.251.166) 106.816 ms 107.241 ms 112.182 ms
58 00 (206.214.251.169) 141.245 ms 128.777 ms 108.391 ms
59 i (206.214.251.174) 107.549 ms 109.398 ms 110.350 ms
60 by.ryan.werber (206.214.251.177) 117.435 ms 122.467 ms 119.518 ms
61 blizzards.breed.ccie.creativity (206.214.251.182) 111.896 ms 144.451 ms 152.818 ms
62 please.try.again.tracerote.to.obiwane.scrye.net (206.214.251.185) 134.414 ms 171.098 m
63 read.more.at.beaglenetworks.net (206.214.251.190) 107.420 ms * 113.591 ms
```