

Computer Networks Homework 4

Spring 2020

Due: 6 April 2020

1. Indicate whether each of the following tasks is a responsibility of the control plane or the data plane of the Network Layer.

- (a) (2 points) Updating forwarding decisions when a link we used to transmit packets is now out of service.

Solution:

Control Plane

- (b) (2 points) Building the forwarding tables in the memory of a device.

Solution:

Control Plane

- (c) (2 points) Updating forwarding tables when new capacity has been added.

Solution:

Control Plane

- (d) (2 points) Forwarding a packet based on the forwarding table.

Solution:

Data Plane

2. (12 points) Suppose a router has three input flows and one output. It receives all of the packets listed in the table below at effectively the same time $S_i = 0$ the same time, in the order listed. Assume that all flow queues are otherwise empty. Give the order in which the packets are transmitted using fair queuing.

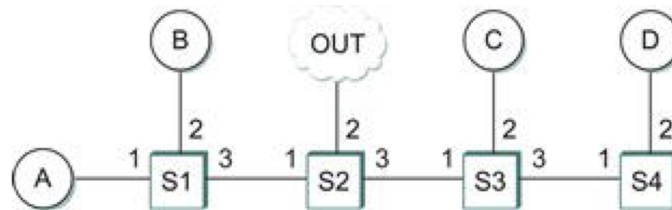
<i>Packet</i>	1	2	3	4	5	6	7	8
<i>Size</i>	100	100	100	100	190	200	110	50
<i>Flow</i>	1	1	1	1	2	2	3	3

Solution:

- Packet 8
- Packet 1

- Packet 5
- Packet 7
- Packet 2
- Packet 6
- Packet 3
- Packet 4

3. (6 points) Give the forwarding tables for switches S1 to S4 in the following network. In addition to entries A–D, each table should also have a default routing entry, chosen to forward packets with unrecognized destination addresses towards OUT.



Solution:

See "Table 1: Solution 3" below.

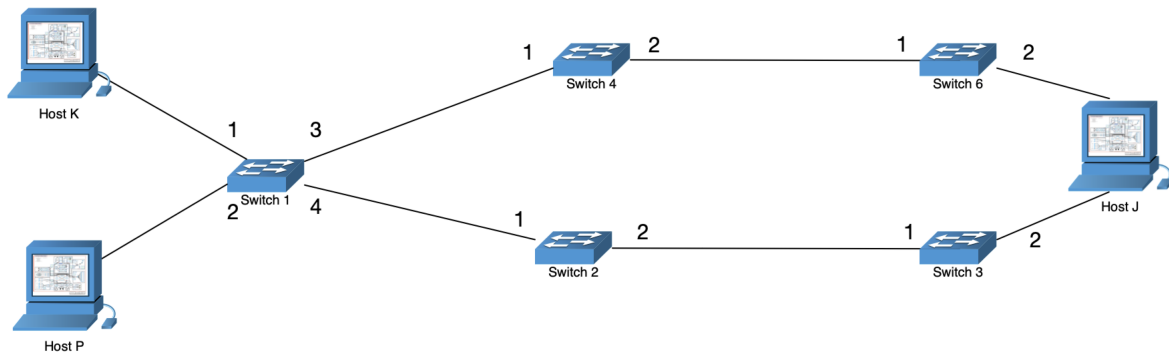
Weird formatting issues wouldn't allow the table to render in a solution tab due to "Float(s) lost" errors.

Table 1: Solution 3

Switch #1		Switch #2	
Destination	Out Port	Destination	Out Port
A	1	A	1
B	2	B	1
C	3	C	3
D	3	D	3
Unknown	3	Unknown	2

Switch #3		Switch #4	
Destination	Out Port	Destination	Out Port
A	1	A	1
B	1	B	1
C	2	C	1
D	3	D	2
Unknown	1	Unknown	1

4. (6 points) Create the forwarding table for switch 1 in the "fish" network below. How did you base your forwarding decisions?



Solution:

See "Table 2: Solution 4" below.

Weird formatting issues wouldn't allow the table to render in a solution tab due to "Float(s) lost" errors.

My decision to send traffic from to hosts P and K are trivially obvious as they are the only connection available. For Host J switch 2 (port 4) was select since it was a lower named switch and therefore should have a lower ID (by possibly common sense logic).

Alternatively, another option may be to route traffic from hosts K to J along Switch 4 (port 3) and traffic from hosts P to J along switch 2 (port 4) as a form of load balancing.

Table 2: Solution 3

Switch #1		Switch #2	
Destination	Out Port	Destination	Out Port
A	1	A	1
B	2	B	1
C	3	C	3
D	3	D	3
Unknown	3	Unknown	2

Switch #3		Switch #4	
Destination	Out Port	Destination	Out Port
A	1	A	1
B	1	B	1
C	2	C	1
D	3	D	2
Unknown	1	Unknown	1

5. (4 points) Some signaling errors can cause entire ranges of bits in a packet to be overwritten by all 0s or all 1s. Suppose all the bits in an IP packet, including the checksum are overwritten. Using what you know about the IPv4 packet header...
1. Could a packet with all 0s be a legal IPv4 packet?
 2. Could a packet with all 1s be a legal IPv4 packet?
 3. Would the checksum catch either error?

Recall: the IPv4 checksum is the binary complement of the one's complement sum of all 16-bit words in the header.

Solution:

1. No
2. No
3. Wouldn't need to

If the entire packet range is entirely overwritten with all 0's or 1's then the version field would either be 0 or 16 neither of which exist and should be instant grounds for throwing away the packet as illegitimate as how to parse the rest of it becomes a mystery.

6. (8 points) Suppose a TCP message that contains 1024 bytes of data and the 20 byte TCP header is passed to IP for delivery across two networks interconnected by a router (i.e., it travels from the source host to a router, and then from the router to the destination

host). The first network has an MTU of 1024 bytes; the second has an MTU of 576 bytes. Give the sizes and offsets of each packet that arrives at the network layer of the destination host, keeping in mind that the network may have to fragment the packets. You should assume that all IP headers are 20 bytes.

Solution:

To Switch from Host:

1. Packet 1:
 - (a) Size: $1004 + 20$ bytes for IP Header
 - (b) Offset: 0
2. Packet 2:
 - (a) Size: $20 + 20$ bytes for IP Header
 - (b) Offset: 1004

To Host from Switch:

1. Packet 1:
 - (a) Size: $556 + 20$ bytes for IP Header
 - (b) Offset: 0
2. Packet 2:
 - (a) Size: $448 + 20$ bytes for IP Header
 - (b) Offset: 556
3. Packet 3:
 - (a) Size: $20 + 20$ bytes for IP Header
 - (b) Offset: 1004

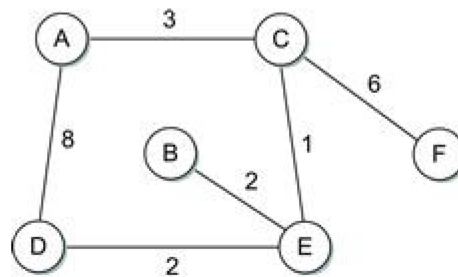
7. For the following network, give the global distance vector tables at each of the following time steps.

Table 3: Solution 4

Switch #1	
Destination Label	Destination Port
Host K	1
Host P	2
Host J	4

Table 4: Part a

Distance, Next Hop to Reach Node						
	A	B	C	D	E	F
A	0	∞	3 (C)	8 (D)	∞	∞
B	∞	0	∞	∞	2 (E)	∞
C	3 (A)	∞	0	∞	1 (E)	6 (F)
D	8 (A)	∞	∞	0	2 (E)	∞
E	∞	2 (B)	1 (C)	2 (D)	0	∞
F	∞	∞	6 (C)	∞	∞	0



- (a) (4 points) Step 1: each node knows only the distances to its immediate neighbors.

Solution:

See Table 3 part a below

- (b) (6 points) Step 2: each node has reported its distance vector from part (a) to its neighbors and updated.

Solution:

See Table 3 part b above

- (c) (6 points) Step 3: each node has reported its distance vector from part (b) to its neighbors and updates.

Solution:

See Table 3 part c below

Table 5: Part b

Distance, Next Hop to Reach Node						
	A	B	C	D	E	F
A	0	∞	3 (C)	8 (D)	4 (C)	9 (C)
B	∞	0	3 (E)	4 (E)	2 (E)	∞
C	3 (A)	3 (E)	0	3 (E)	1 (E)	6 (F)
D	8 (A)	4 (E)	3 (E)	0	2 (E)	∞
E	4 (C)	2 (B)	1 (C)	2 (D)	0	7 (C)
F	9 (C)	∞	6 (C)	∞	7 (C)	0

8. Suppose the network from the previous problem has been upgraded to use Link State routing.

(a) (4 points) Show the information sent out as part of the link state for each host.

Solution:

(b) (10 points) Run the forward search algorithm (not Dijkstra's search) for node C. Make sure you check your final answer against the network to ensure you arrived at the correct forwarding decisions. You should assume that all of the link state packets have been flooded through the network.

Solution:

9. (6 points) A particular organization is given the CIDR address range 210.81.112/20. What are all of the addresses owned by this organization? (List them as ranges, not individual values)

Solution:

210.81.112.0 - 210.81.127.255

10. A simple CIDR routing table is shown below. For each address, indicate which entry in the table it matches.

<i>Address Mask</i>	<i>Port</i>
10.19.0.0/16	1
10.19.128/17	2
10.19.192/18	3
10.19.192/19	4
0.0.0.0/1	5
1.0.0.0/1	6

(a) (2 points) 141.219.2.10

Solution:

None. Port 5 and 6 are closest, but they both are through 0.0.0.0 – 127.255.255.255. A 0 mask would be required for this.

- (b) (2 points) 10.10.10.10

Solution:

Port 5 and Port 6, Port 5 preferably since it comes first on the list.

- (c) (2 points) 10.19.86.141

Solution:

Port 1, Port 5, and Port 6; Port 1 preferably since it comes first on the list.

- (d) (2 points) 10.19.193.6

Solution:

Port 3, Port 4, Port 5, and Port 6; Port 3 preferably since it comes first on the list.

- (e) (2 points) 10.19.255.86

Solution:

Port 2, Port 3, Port 5, and Port 6; Port 2 preferably since it comes first on the list.

- (f) (2 points) 10.19.192.18

Solution:

Port 3, Port 4, Port 5, and Port 6; Port 3 preferably since it comes first on the list.

11. (8 points) Explain the software-defined networking approach to separating the routing and forwarding behavior. Why does it possibly lead to better routing decisions?

Solution:

SDN may lead to better routing decisions as it has much more capability to fix its own network routing by determining which links have better priorities, better timeouts, ability to create better and more well defined NATs, meter processing, and able to drastically rewrite packets.