Chapter 4 Review Questions

1. Datagram-based network layer: forwarding; routing. Additional function of VC-based network layer: call setup.

2.

3. Forwarding is about moving a packet from a router's input link to the appropriate output link. Routing is about determining the end-to-routes between sources and destinations.

4.

5.

6.

7. Packet loss occurs if queue size at the input port grows large because of slow switching fabric speed and thus exhausting router's buffer space. It can be eliminated if the switching fabric speed is at least ***n*** times as fast as the input line speed, where ***n*** is the number of input ports.

8. Switching via memory; switching via a bus; switching via an interconnection network

9.

10. HOL blocking – a queued packet in an input queue must wait for transfer through the fabric because it is blocked by another packet at the head of the line. It occurs at the input port.

11.

12. Yes. They have one address for each interface.

13.

14. 8 interfaces; 3 forwarding tables

15.

16. 50% overhead

17.

18.

19.

20. Typically the wireless router includes a DHCP server. DHCP is used to assign IP addresses to the 5 PCs and to the router interface. Yes, the wireless router also uses NAT as it obtains only one IP address from the ISP.

21.

22. Link state algorithms: Computes the least-cost path between source and destination using complete, global knowledge about the network. Distance-vector routing: The calculation of the least-cost path is carried out in an iterative, distributed manner. A node only knows the neighbor to which it should forward a packet in order to reach given destination along the least-cost path, and the cost of that path from itself to the destination.

23.

24.

25. No. The advertisement tells D that it can get to z in 11 hops by way of A. However, D can already get to z by way of B in 7 hops. Therefore, there is no need to modify the entry for z in the table. If, on the other hand, the advertisement said that A were only 4 hops away from z by way of C, then D would indeed modify its forwarding table.

26.

27.

28.

29. With OSPF, a router periodically broadcasts routing information to all other routers in the AS, not just to its neighboring routers. This routing information sent by a router has one entry for each of the router's neighbors; the entry gives the distance from the router to the neighbor. A RIP advertisement sent by a router contains information about all the networks in the AS, although this information is only sent to its neighboring routers.

Chapter 4 Problems

Problem 2

a) No VC number can be assigned to the new VC; thus the new VC can be established in the network.
b) Each link has two available VC numbers. There are four links. So the number of combinations is $2^4 = 16$. One example combination is (10,00,00,10).

Problem 4

For a VC forwarding table, the columns are : Incoming Interface, Incoming VC Number, Outgoing Interface, Outgoing VC Number. For a datagram forwarding table, the columns are: Destination Address, Outgoing Interface.

Problem 6

a) No. To have no input port queuing, the switching fabric should operated at a speed at least 2 times the line speed.

b) No. To have no input port queuing, the switching fabric should operated at a speed at least 2 times the line speed.

Problem 8

a)

Prefix Match	**Link Interface**
11100000	0
11100001 00000000	1
11100001	2
otherwise	3

b) Prefix match for first address is 4th entry: link interface 3
Prefix match for second address is 2nd entry: link interface 1
Prefix match for first address is 3rd entry: link interface 2

Problem 10

223.1.17.0/25
223.1.17.128/26
223.1.17.192/26

Problem 11

Destination Address Range	Link Interface
10000000 through (64 addresses) 10111111	0
11000000 through(32 addresses) 11011111	1
11100000 through (32 addresses) 11111111	2
00000000 through (128 addresses) 3 01111111	

Problem 13

Any IP address in range 101.101.101.65 to 101.101.101.127

Four equal size subnets: 101.101.101.64/28, 101.101.101.80/28, 101.101.101.96/28, 101.101.101.112/28

Problem 16

From 214.97.254/23, possible assignments are

a) Subnet A: 214.97.255/24 (256 addresses)
Subnet B: 214.97.254.0/25 - 214.97.254.0/29 (128-8 = 120 addresses)
Subnet C: 214.97.254.128/25 (128 addresses)

Subnet D: 214.97.254.0/31 (2 addresses)
Subnet E: 214.97.254.2/31 (2 addresses)
Subnet F: 214.97.254.4/30 (4 addresses)

b) To simplify the solution, assume that no datagrams have router interfaces as ultimate destinations. Also, label D, E, F for the upper-right, bottom, and upper-left interior subnets, respectively.

<u>Router 1</u>

Longest Prefix Match **Outgoing Interface**

11010110 01100001 11111111

Subnet A

11010110 01100001 11111110 0000000

Subnet D

11010110 01100001 11111110 000001

Subnet F

<u>Router 2</u>

Longest Prefix Match **Outgoing Interface**

11010110 01100001 11111111 0000000

Subnet D

11010110 01100001 11111110 0

Subnet B

11010110 01100001 11111110 0000001

Subnet E

<u>Router 3</u>

Longest Prefix Match **Outgoing Interface**

11010110 01100001 11111111 000001

Subnet F

11010110 01100001 11111110 0000001

Subnet E

11010110 01100001 11111110 1

Subnet C

Problem 17

The maximum size of data field in each fragment = 480 (20 bytes IP header). Thus the number of required fragments $= \left\lceil \frac{3000-20}{480} \right\rceil = 7$

Each fragment will have Identification number 422. Each fragment except the last one will be of size 500 bytes (including IP header). The last datagram will be of size 120 bytes (including IP header). The offsets of the 7 fragments will be 0, 60, 120, 180, 240, 300, 360. Each of the first 6 fragments will have flag=1; the last fragment will have flag=0.

Problem 23

		Cost to				
		u	v	x	y	z
	v	∞	∞	∞	∞	∞
From	x	∞	∞	∞	∞	∞
	z	∞	6	2	∞	0

Cost to

		u	v	x	y	z
	v	1	0	3	∞	6
From	x	∞	3	0	3	2
	z	7	5	2	5	0

Cost to

		u	v	x	y	z
	v	1	0	3	3	5
From	x	4	3	0	3	2
	z	6	5	2	5	0

Cost to

		u	v	x	y	z
	v	1	0	3	3	5
From	x	4	3	0	3	2
	z	6	5	2	5	0

Problem 25

Step	*N'*	*D(t),p(t)*	*D(u),p(u)*	*D(v),p(v)*	*D(w),p(w)*	*D(y),p(y)*	*D(z),p(z)*
0	x	∞	∞	3,x	6,x	6,x	8,x
1	xv	7,v	6,v	3,x	6,x	6,x	8,x
2	xvu	7,v	6,v	3,x	6,x	6,x	8,x
3	xvuw	7,v	6,v	3,x	6,x	6,x	8,x
4	xvuwy	7,v	6,v	3,x	6,x	6,x	8,x
5	xvuwyt	7,v	6,v	3,x	6,x	6,x	8,x
6	xvuwytz	7,v	6,v	3,x	6,x	6,x	8,x

Problem 26

Node x table

		Cost to		
		x	y	z
	x	0	5	2
From	y	∞	∞	∞
	z	∞	∞	∞

		Cost to		
		x	y	z
	x	0	5	2
From	y	5	0	6
	z	2	6	0

Node y table

		Cost to		
		x	y	z
	x	∞	∞	∞
From	y	5	0	6
	z	∞	∞	∞

		Cost to		
		x	y	z
	x	0	5	2
From	y	5	0	6
	z	2	6	0

Node z table

Cost to

		x	y	z
	x	∞	∞	∞
From	y	∞	∞	∞
	z	2	6	0

Cost to

		x	y	z
	x	0	5	2
From	y	5	0	6
	z	2	6	0

Problem 27

a.

Step	*N'*	*D(x), p(x)*	*D(u),p(u)*	*D(v),p(v)*	*D(w),p(w)*	*D(t),p(t)*	*D(z),p(z)*
	y	6,y	∞	8,y	∞	7,y	12,y
	yx	6,y	∞	8,y	12,x	7,y	12,y
	yxt	6,y	9,t	8,y	12,x	7,y	12,y
	yxtv	6,y	9,t	8,y	12,x	7,y	12,y
	yxtvu	6,y	**9,t**	8,y	12,x	7,y	12,y
	yxtvuw	6,y	9,t	8,y	12,x	7,y	12,y
	yxtvuwz	6,y	9,t	8,y	12,x	7,y	12,y

b.

Step	*N'*	*D(x), p(x)*	*D(u),p(u)*	*D(v),p(v)*	*D(w),p(w)*	*D(y),p(y)*	*D(z),p(z)*
0	t	∞	2,t	4,t	∞	7,t	∞
1	tu	∞	2,t	4,t	5,u	7,t	∞
2	tuv	7,v	2,t	4,t	5,u	7,t	∞
3	tuvw	7,v	2,t	4,t	5,u	7,t	∞
4	tuvwx	7,v	2,t	4,t	5,u	7,t	15,x
5	tuvwxy	7,v	2,t	4,t	5,u	7,t	15,x
6	tuvwxyz	7,v	2,t	4,t	5,u	7,t	15,x

c. s does not exist.

d.

Step	*N'*	*D(x), p(x)*	*D(t),p(t)*	*D(v),p(v)*	*D(w),p(w)*	*D(y),p(y)*	*D(z),p(z)*
	u	∞	2,u	3,u	3,u	∞	∞
	ut	∞	2,u	3,u	3,u	9,t	∞
	utv	6,v	2,u	3,u	3,u	9,t	∞
	utvw	6,v	2,u	3,u	3,u	9,t	∞
	utvwx	6,v	2,u	3,u	3,u	9,t	14,x
	utvwxy	6,v	2,u	3,u	3,u	9,t	14,x
	utvwxyz	6,v	2,u	3,u	3,u	9,t	14,x

e.

Step	*N'*	*D(x), p(x)*	*D(u),p(u)*	*D(v),p(v)*	*D(t),p(t)*	*D(y),p(y)*	*D(z),p(z)*
	w	6,w	3,w	4,w	∞	∞	∞
	wu	6,w	3,w	4,w	5,u	∞	∞
	wuv	6,w	3,w	4,w	5,u	12,v	∞
	wuvt	6,w	3,w	4,w	5,u	12,v	∞
	wuvtx	6,w	3,w	4,w	5,u	12,v	14,x
	wuvtxy	6,w	3,w	4,w	5,u	12,v	14,x
	wuvtxyz	6,w	3,w	4,w	5,u	12,v	14,x

f.

Step	*N'*	*D(x), p(x)*	*D(u),p(u)*	*D(t),pt)*	*D(w),p(w)*	*D(y),p(y)*	*D(z),p(z)*
	v	3,v	3,v	4,v	4,v	8,v	∞
	vx	3,v	3,v	4,v	4,v	8,v	11,x
	vxu	3,v	3,v	4,v	4,v	8,v	11,x
	vxut	3,v	3,v	4,v	4,v	8,v	11,x
	vxutw	3,v	3,v	4,v	4,v	8,v	11,x

	vxutwy	3,v	3,v	4,v	4,v	8,v	11,x
	vxutwyz	3,v	3,v	4,v	4,v	8,v	11,x

g.

Step	*N'*	*D(x), p(x)*	*D(u),p(u)*	*D(v),p(v)*	*D(w),p(w)*	*D(y),p(y)*	*D(t),p(t)*
	z	8,z	∞	∞	∞	12,z	∞
	zx	8,z	∞	11,x	14,x	12,z	∞
	zxv	8,z	14,v	**11,x**	14,x	12,z	15,v
	zxvy	8,z	14,v	11,x	14,x	**12,z**	15,v
	zxvyu	8,z	**14,v**	11,x	14,x	12,z	15,v
	zxvyuw	8,z	14,v	11,x	**14,x**	12,z	15,v
	zxvyuwt	8,z	14,v	11,x	**14,x**	12,z	15,v