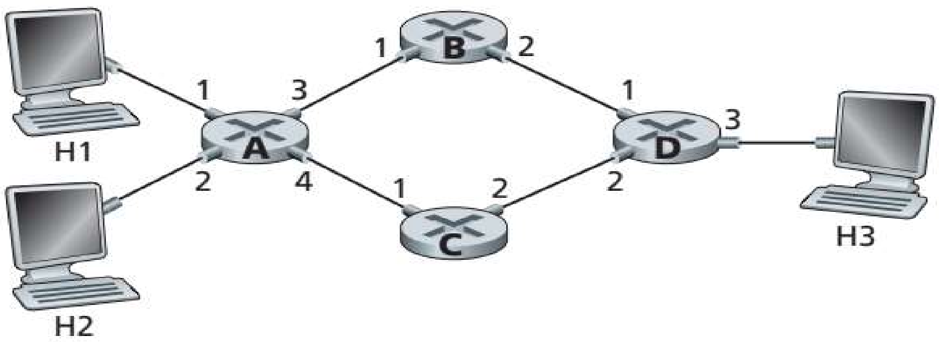
Tutorial_Network_Layer

a. Suppose that this network is a datagram network. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.

b. Suppose that this network is a datagram network. Can you write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4? (Hint: this is a trick question.)

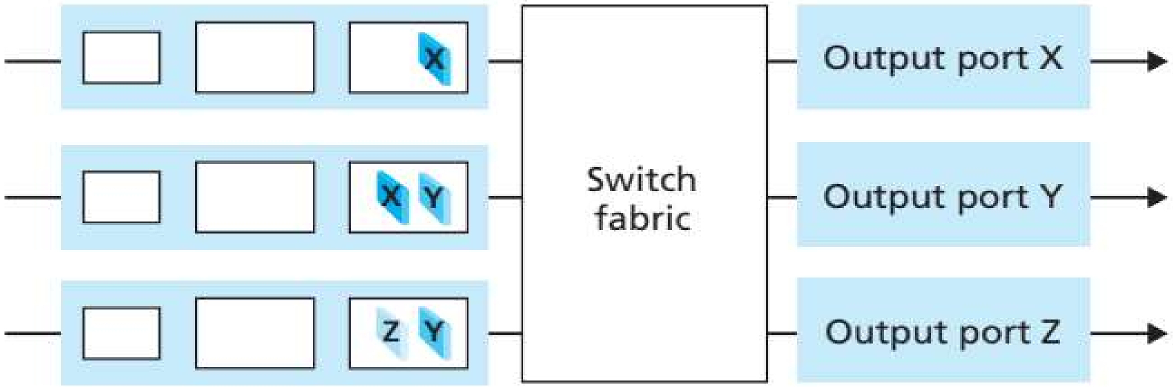
c. Now suppose that this network is a virtual circuit network and that there is one ongoing call between H1 and H3, and another ongoing call between H2 and H3. Write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.

d. Assuming the same scenario as (c), write down the forwarding tables in nodes B, C, and D.



P8. In Section 4.3, we noted that the maximum queuing delay is $(n-1)D$ if the switching fabric is n times faster than the input line rates. Suppose that all packets are of the same length, n packets arrive at the same time to the n input ports, and all n packets want to be forwarded to *different* output ports. What is the maximum delay for a packet for the (a) memory, (b) bus, and (c) crossbar switching fabrics?

P9. Consider the switch shown below. Suppose that all datagrams have the same fixed length, that the switch operates in a slotted, synchronous manner, and that in one time slot a datagram can be transferred from an input port to an output port. The switch fabric is a crossbar so that at most one datagram can be transferred to a given output port in a time slot, but different output ports can receive datagrams from different input ports in a single time slot. What is the minimal number of time slots needed to transfer the packets shown from input ports to their output ports, assuming any input queue scheduling order you want (i.e., it need not have HOL blocking)? What is the largest number of slots needed, assuming the worst-case scheduling order you can devise, assuming that a non-empty input queue is never idle?



Tutorial_Network_Layer

P10. Consider a datagram network using 32-bit host addresses. Suppose a router has four links, numbered 0 through 3, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11100000 00000000 00000000 00000000 through 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 through 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 through 11100001 01111111 11111111 11111111	2
otherwise	3

a. Provide a forwarding table that has five entries, uses longest prefix matching, and forwards packets to the correct link interfaces.

b. Describe how your forwarding table determines the appropriate link interface for datagrams with destination addresses:

11001000 10010001 01010001 01010101
11100001 01000000 11000011 00111100
11100001 10000000 00010001 01110111

Tutorial_Network_Layer

P11. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix Match	Interface
00	0
010	1
011	2
10	2
11	3

For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range.

P13. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 interfaces, and Subnet 3 is to support at least 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.

Tutorial_Network_Layer

P19. Consider sending a 2400-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

P19. Consider sending a 2400-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

Tutorial_Network_Layer

Chapter - 4

P4 :

a) Data to host H_3 $\longrightarrow$ interface 3

Destination Address (H_3) | Link Interface 3

b) Forwarding rule :- destination address

$H_1 \to H_3 \to$ interface

Dest Address | Link interface

$H_1 \to$ {(H_3) is fixed}
$H_2 \to$ {(H_3)}

{Cannot be different}

c) For VC diagram

Incoming interface	Incoming VC	Outgoing interface	Outgoing VC
1	12	3	22
2	63	4	18

P8

* Single datagram in both Memory and Shared bus.

(a) & (b) $\longrightarrow$ delay. $(n-1)D$

(c) * Cross-bar

Parallel flows for different i/p $\longrightarrow$ o/p pairs

No Queuing delay

P9 :

Slot-1 : i/p-1 → X
i/p-2 → Y Port

Slot-2 : i/p-3 → Y Port (o/p)

Slot-3 : i/p-2 → X
i/p-3 → Z

Total- 3 slots

Even worst case scheduling is 3 slots.

P10

a)

Prefix	Interface
11100000 00	0
11100000 01000000	1
1110000	2
11100001 1	3
otherwise	3

b) (First address) → 5th → Interface-3
(Second address) → 3rd → Interface-2
(third address) → 4th → " -3

P11

8-bit	Interface	Address
00 000000 – 00 111111	0	(6 bit) 2^6 = 64
010 00000 – 010 11111	1	(5 bit) 2^5 = 32
011 00000 – 011 11111	2	(5 bit) 2^5 + (6 bit) 2^6 = 32 + 64 = 96
10 000000 – 10 111111	2	
11 000000 – 11 111111	3	2^6 = 64/256

P18

Given Prefix : 223.1.17/24

Subnet-1 to support = 60
Subnet-2 " " = 90
Subnet-3 " " = 12

Sub Net-1 ⟹ 60 ⟶ $2^6 = 64$ 32 − 6 = 26

223.1.17.0 /26

Sub Net-2 ⟹ 90 ⟶ $2^7 = 128$ 32 − 7 = 25

223.1.17.128/25

Subnet-3 ⟹ 12 ⟶ $2^4 = 16$ 32 − 4 = 28

223.1.17.192/28

P19

Assume header = 20

700 − 20 = 680

$= \frac{2400-20}{680} = 4$

Data gram 1, 2 & 3 ⟶ 700
" — 4 ⟶ 360

	offset	flag	bytes	seq NO
D-1 :	0	1	700	422
D2 :	85	1	700	422
D-3 :	170	1	700	422
D-4 :	255	0	360	422