Computer Networks

Lesson 04 - Internet Layer -- Data Plane

P5. 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.

Ans Below is the derived forward table:

Prefix Match	Interface
11100000 00	0
11100000 01000000	1
11100001 0	2

Prefix Match	Interface
11100001 1	3
otherwise	3

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

Ans Below is the result of longest prefix matching and forwarded destination link interface:

Destination Address	Longest Prefix Matched	Link Interface Forwarded
11001000 10010001 01010001 01010101	otherwise	3
11100001 01000000 11000011 00111100	11100001 0	2
11100001 10000000 00010001 01110111	11100001 1	3

P6. 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.

Ans Below is the result of destination address association for each link interface

Link Interface	Destination Address Range	Num. of Addresses
0	0000 0000 through 0011 1111	64
1	0100 0000 through 0101 1111	32
2	0110 0000 through 1011 1111	96
3	1100 0000 through 1111 1111	64

P8. 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.

Ans Below is the result of network address allocation.

First, round up the minimum number of required interface addresses to the minimum sum of 2's exponentials. The result is as follows:

Subnet	Min. Num. of Interfaces	Min. Sum of 2's Exponential
1	60	64
2	90	96
3	12	16

Next, partition the available address space according to the above 2's exponentials. Since address 223.1.17.0 & 223.1.17.225 cannot be used, here the address allocation will start from 223.1.17.16. Below is the final result:

Subnet	Address Range	Network Address
1	223.1.17.128 through 223.1.17.191	223.1.17.128/26
2	223.1.17.32 through 223.1.17.127	223.1.17.32/27 & 223.1.17.64/26
3	223.1.17.16 through 223.1.17.31	223.1.17.16/28

P12. Consider the topology shown in Figure 4.20 . Denote the three subnets with hosts (starting clockwise at 12:00) as Networks A, B, and C. Denote the subnets without hosts as Networks D, E, and F.

a. Assign network addresses to each of these six subnets, with the following constraints: All addresses must be allocated from 214.97.254/23; Subnet A should have enough addresses to support 250 interfaces; Subnet B should have enough addresses to support 120 interfaces; and Subnet C should have enough addresses to support 120 interfaces. Of course, subnets D, E and F should each be able to support two interfaces. For each subnet, the assignment should take the form a.b.c.d/x or a.b.c.d/x – e.f.g.h/y.

Ans Below is the result of network address attained using the same approach in P8:

Subnet	Min. Num. of Interfaces	Min. Sum of 2's Exponential	Address Range	Network Address
A	250	256	214.97.254.0 through 214.97.254.251	214.97.254.0/24 - 214.97.254.252/30

Subnet	Min. Num. of Interfaces	Min. Sum of 2's Exponential	Address Range	Network Address
B	120	128	214.97.255.0 through 214.97.255.127	214.97.255.0/25 - 214.97.255.124/30
C	120	128	214.97.255.128 through 214.97.255.255	214.97.255.128/25 - 214.97.255.252/30
D	2	2	214.97.254.252 through 214.97.254.255	214.97.254.252/30
E	2	2	214.97.255.124 through 214.97.255.127	214.97.255.124/30
F	2	2	214.97.255.252 through 214.97.255.255	214.97.255.252/30

b. Using your answer to part (a), provide the forwarding tables (using longest prefix matching) for each of the three routers.

Ans Denote the three interfaces of each router (staring clockwise at 12:00) as 0, 1, and 2. The forward tables for the three routers are as follows.

First is the forward table for R1

Prefix Match	Interface
214.97.254.0/24	0
214.97.255.0/25	1
214.97.255.128/25	2

Then is the forward table for R2

Prefix Match	Interface
214.97.254.0/24	0
214.97.255.0/25	1
214.97.255.128/25	2

Finally is the forward table for R3

Prefix Match	Interface
214.97.254.0/24	0
214.97.255.0/25	1
214.97.255.128/25	2

Due to the network topology, the three forward tables are in fact the same.