Covered Topics: -
Network Layer (IP) – Extra Problems

Problem 1

An organization has a class C network 200.1.1 and wants to form subnets for four departments, which hosts as follows: A – 72 hosts, B – 35 hosts, C – 20 hosts, D – 18 hosts. There are 145 hosts in all.

a) Give a possible arrangement of subnet masks to make this possible. What is the network address, subnet mask, broadcast address, maximum number of hosts for each subnet? Please also show the available IP address range for each subnet.
b) Suggest what the organization might do if department D grows to 34 hosts.

Solution:

a) Giving each department a single subnet, the nominal subnet sizes are 2^7, 2^6, 2^5, 2^5 respectively; we obtain these by rounding up to the nearest power of 2. A possible arrangement of subnet numbers is as follows.

200.1.1.0 -> 11001000.00000001.00000001.00000000

A: 72 hosts -> require 2^7 = 128, maximum number of hosts 2^7 – 2 = 126

11001000.00000001.00000001.00000000 -> 200.1.1.0/25 (network address)
11111111.11111111.11111111.10000000 -> 255.255.255.128/25 (subnet mask)
11001000.00000001.00000001.00000001 -> 200.1.1.1 (the 1st host IP in A)
11001000.00000001.00000001.01111110 -> 200.1.1.126 (the last host IP in A)
11001000.00000001.00000001.01111111 -> 200.1.1.127 (broadcast address)

B: 35 hosts -> require 2^6 = 64, maximum number of hosts 2^6 – 2 = 62

11001000.00000001.00000001.10000000 -> 200.1.1.128/26 (network address)
11111111.11111111.11111111.11000000 ->255.255.255.192/26 (subnet mask)
11001000.00000001.00000001.10000001 ->200.1.1.129 (the 1st host IP in B)

11001000.00000001.00000001.10111110 -> 200.1.1.190 (the last host IP in B)
11001000.00000001.00000001.10111111 ->200.1.1.191 (broadcast address)

C: 20 hosts -> require 2^5 = 32, maximum number of hosts 2^5 – 2 = 30

11001000.00000001.00000001.11000000 -> 200.1.1.192/27 (network address)
11111111.11111111.11111111.11100000 -> 255.255.255.224/27 (subnet mask)
11001000.00000001.00000001.11000001 -> 200.1.1.193 (the 1st host IP in C)
11001000.00000001.00000001.11011110 -> 200.1.1.222 (the last host IP in C)
11001000.00000001.00000001.11011111 -> 200.1.1.223 (broadcast address)

D: 18 hosts -> require 2^5 = 32, maximum number of hosts 2^5 – 2 = 30

11001000.00000001.00000001.11100000 -> 200.1.1.224/27 (network address)
11111111.11111111.11111111.11100000 -> 255.255.255.224/27 (subnet mask)
11001000.00000001.00000001.11100001 -> 200.1.1.225 (the 1st host IP in D)
11001000.00000001.00000001.11111110 -> 200.1.1.254 (the last host IP in D)
11001000.00000001.00000001.11111111 -> 200.1.1.255 (broadcast address)

b) We have two choices: either assign multiple subnets to single departments, or abandon subnets and buy a bridge. Here is a solution giving A two subnets, of sizes 64 and 32; every other department gets a single subnet of size the next highest power of 2:

A1: 34 hosts -> require 2^6 = 64, maximum number of hosts 2^6 – 2 = 62

11001000.00000001.00000001.01000000 -> 200.1.1.64/26 (network address)
11111111.11111111.11111111.11000000 -> 255.255.255.192/26 (subnet mask)
11001000.00000001.00000001.01000001 -> 200.1.1.65 (the 1st host IP in A1)
11001000.00000001.00000001.01111110 -> 200.1.1.126 (the last host IP in A1)
11001000.00000001.00000001.01111111 -> 200.1.1.127 (broadcast address)

A2: 20 hosts -> require 2^5 = 32, maximum number of hosts 2^5 – 2 = 30

11001000.00000001.00000001.00100000 -> 200.1.1.32/27 (network address)
11111111.11111111.11111111.11100000 -> 255.255.255.224/27 (subnet mask)
11001000.00000001.00000001.00100001 -> 200.1.1.28 (the 1st host IP in A2)

11001000.00000001.00000001.00111110 -> 200.1.1.62 (the last host IP in A2)
11001000.00000001.00000001.00111111 -> 200.1.1.63 (broadcast address)

B is the same as in (a)

C: 20 hosts (require 2^5 = 32, maximum number of hosts 2^5 – 2 = 30

11001000.00000001.00000001.00000000 -> 200.1.1.0/27 (network address)
11111111.11111111.11111111.11100000 -> 255.255.255.224/27 (subnet mask)
11001000.00000001.00000001.00000001 -> 200.1.1.1 (the 1st host IP in C)
11001000.00000001.00000001.00011110 -> 200.1.1.30 (the last host IP in C)
11001000.00000001.00000001.00011111 -> 200.1.1.31 (broadcast address)

D: 34 hosts -> require 2^6 = 64, maximum number of hosts 2^6 – 2 = 62

11001000.00000001.00000001.11000000 -> 200.1.1.192/26 (network address)
11111111.11111111.11111111.11000000 -> 255.255.255.192/26 (subnet mask)
11001000.00000001.00000001.11000001 -> 200.1.1.192 (the 1st host IP in D)
11001000.00000001.00000001.11111110 -> 200.1.1.254 (the last host IP in D)
11001000.00000001.00000001.11111111 -> 200.1.1.255 (broadcast address)