A shortcut way to IP Subnetting using VLSM

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In this tutorial, I will show you how to subnet using VLSM in a very easy way. Suppose we are given an address block of 192.168.0.0/20 and we have different departments whose IP requirements are given in Table 1.

Department	IP required
HR	100
Sales	58
Accounting	50
Admin	25
Link1	2
Link2	2
Link3	2

Table 1: IP requirements by different departments.

We will need to assign IP blocks to different departments. VLSM allows us to do this very efficiently. In VLSM, each department will be assigned the minimum number of IPs that is required. This prevents wastage of IP addresses which occurs when fixed length subnetting is used. Below we describe the steps to subnet a given network using VLSM;

Step 1) Order the requirements table from largest to smallest.

First, we will need to order the different departments according to their IP requirements. Largest department will come first, then second largest, and so on. The smallest department will come at the end. Since Table 1 data are already ordered according to size, we need not do anything here.

Step 2) Find the block size (host bit size) required for each department.

We create Table 2 that shows the number of host bits in each block required by the different departments.

Department	IP required	IP to be given	Host bit
HR	100	128	7
Sales	58	64	6
Accounting	50	64	6
Admin	25	32	5
Link1	2	4	2
Link2	2	4	2
Link3	2	4	2

Table 2: Host bit requirements for each department.

HR department requires 100 IP address. We know that an IP address block contains 2^H IP address where H is the number of host bits. So, we will need to assign a block that has 7 host bits ($H = 7$) to HR deparment. In this case, number of IPs will be $2^7 = 128$ that will be sufficient. Note that we can't assign a block of 6 host bits because $2^6 = 64 < 100$. In this way, we find the host bit requirements for all departments as shown in Table 2.

Step 3) Create IP block (subnet) for each department starting from largest one.

In this step, we will partition the given block 192.168.0.0/20 using VLSM. First, we will write the given block in X-format notation as shown below:

```
192.168.0.0/20

=192.168.0000 0000.0000 0000/24

=192.168.0000|XXXX.XXXX XXXX
```

Note that the third and fourth octets have been written in binary because the partition of network and host falls in the third octet. Then all host bits are shown by 'X'. A vertical bar (|) symbol is used to separate the network portion and host portion of the given block.

Using the above written X-format notation, we will create blocks for different departments as follows.

I. Write down the block assigned to the previous subnet (Write down the original block if this is the first subnet you are creating)

II. Starting from the right, keep *H* X's intact where *H* is the number of host bits required. Replace rest X's with 0. (if any)

III. Add 1 with the binary segment after the original network boundary (indicated with |) (if any)

Example:

Consider the largest department, i.e., HR department that requires a block of 7 host bits. We create a block for HR department starting with the original block:

```
192.168.0000|XXXX.XXXX XXXX (original block)

=192.168.0000|0000.0XXX XXXX (Keep 7 X's and rest X's are replaced with 0)

=192.168.0000|0000.0XXX XXXX (We do not add 1 here because no such segment exists)
```

So, HR department will get the block `192.168.0000|0000.0XXX XXXX`

Now, consider the second largest department, i.e., Sales department that requires a block of 6 host bits. We create the block for Sales department as follows:

```
192.168.0000|0000.0XXX XXXX (block assigned to previous subnet,i.e., HR department)

=192.168.0000|0000.00XX XXXX (Keept 6 X's and rest X's are replaced with 0)

=192.168.0000|0000.10XX XXXX (Add 1 with binary segment 0000 0 + 1 = 0000 1)
```

So, Sales department will get the block `192.168.0000|0000.10XX XXXX`

Now, consider the third largest department, i.e., Accounting department that requires a block of 6 host bits. We create a block for Accounting as follows:

```
192.168.0000|0000.10XX XXXX (block assigned to previous subnet, Sales department)

=192.168.0000|0000.10XX XXXX (keep 6 X's, and no X to replace with 0)

=192.168.0000|0000.11XX XXXX (Add 1 with binary 0000 10+1=0000 11)
```

So, Accounting department will get the block `192.168.0000|0000.11XX XXXX.`

In this way, the blocks for other departments are shown below:

```
192.168.0000|0000.11XX XXXX

=192.168.0000|0001.000X XXXX (Admin department block)
```

=192.168.0000|0001.0010 00XX (Link1 block)

=192.168.0000|0001.0010 01XX (Link2 block)

=192.168.0000|0001.0010 10XX (Link3 block)

Step 3) Calculate First Host (FH), Last Host (LH), Broadcast (BC), Network (NW), and Subnet Mask (SM) of each block.

Consider the block assigned to HR department 192.168.0000|0000.0XXX XXXX. We calculate the FH, LH, BC, SM for this block.

FH:

=192.168.0000|0000.0XXX XXXX

=192.168.0000|0000.0000 0001 (All 0 and a 1 in host portion)

=192.168.0.1

LH:

=192.168.0000|0000.0XXX XXXX

=192.168.0000|0000.0111 1110 (All 1 and a 0 in host portion)

=192.168.0.254

BC:

=192.168.0000|0000.0XXX XXXX

=192.168.0000|0000.0111 1111 (All 1 in host portion)

=192.168.0.255

NW:

=192.168.0000|0000.0XXX XXXX

=192.168.0000|0000.0000 0000 (All 0 in host portion)

=192.168.0.0

SM:

=1111 1111.1111 1111.1111 1111.1000 0000 (25 1s and 7 0s)

=255.255.255.128

Consider the block assigned to Link1 `192.168.0000|0001.0010 00XX.` We calculate the FH, LH, BC, SM for this block.

FH:

```
 192.168.0000|0001.0010 00XX
=192.168.0000|0001.0010 0001 (All 0 and a 1 in host portion)
=192.168.1.33
```

LH:

```
 192.168.0000|0001.0010 00XX
=192.168.0000|0001.0010 0010 (All 1 and a 0 in host portion)
=192.168.1.34
```

BC:

```
 192.168.0000|0001.0010 00XX
=192.168.0000|0001.0010 0011 (All 1 in host portion)
=192.168.1.35
```

NW:

```
 192.168.0000|0001.0010 00XX
=192.168.0000|0001.0010 0000 (All 0 in host portion)
=192.168.1.32
```

SM:

```
=1111 1111.1111 1111.1111 1111.1111 1100 (30 1s and 2 0s)
=255.255.255.252
```