Differences between FLSM Subnetting and VLSM Subnetting

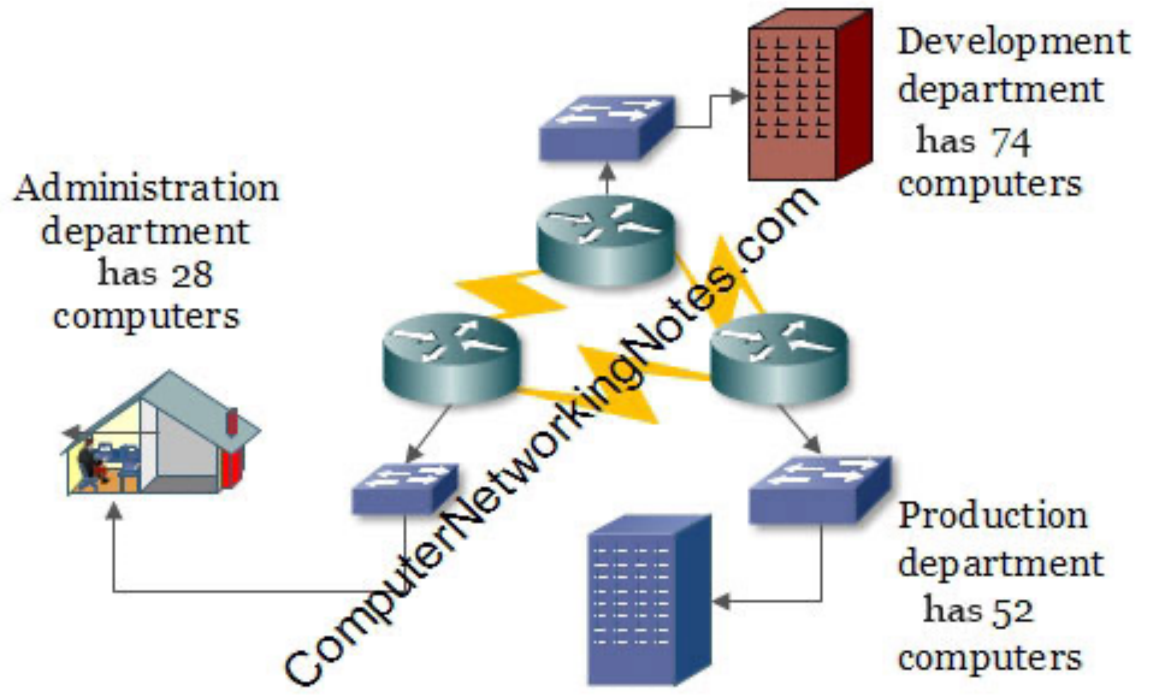
FLSM (Fixed Length Subnet Masks) Subnetting	VLSM (Variable Length Subnet Masks) Subnetting
All subnets are equal in size.	Subnets are variable in size.
All subnets have equal number of hosts.	Subnets have variable number of hosts.
All subnets use same subnet mask.	Subnets use different subnet masks.
It is easy in configuration and administration.	It is complex in configuration and administration.
It wastes a lot of IP addresses.	It wastes minimum IP addresses.
It is also known as classfull Subnetting.	It is also known as classless Subnetting.
It supports both classfull and classless routing protocols.	It supports only classless routing protocols.

VLSM Subnetting

The biggest advantage of VLSM Subnetting is that, instead of forcing us to use a fixed size for all segments, it allows us to choose the individual size for each segment. This flexibility reduces the IP wastage. We can choose the size of subnet which closely matches with our requirement. Let’s understand it with an example.

VLSM Example

Do the VLSM Subnetting of following network.



In this network: -

- Development department has 74 computers.
- Production department has 52 computers.
- Administration department has 28 computers.
- All departments are connected with each other via wan links.
- Each wan link requires two IP addresses.

- The given address space is 192.168.1.0/24.

Before we perform VLSM Subnetting for this network, let's understand how VLSM Subnetting actually works.

Basic concepts of VLSM Subnetting

VLSM Subnetting is the extended version of FLSM Subnetting. If you know how FLSM Subnetting works and how it is done, you already know the 90% of VLSM Subnetting. In FLSM, all subnets use same block size, thus Subnetting is required only one time. In VLSM, subnets use block size based on requirement, thus Subnetting is required multiple times.

The concept of VLSM Subnetting is relatively simple.

- Select block size for each segment. Block size must be greater than or equal to the actual requirement. Actual requirement is the sum of host addresses, network address and broadcast address.
- Based on block size arrange all segments in descending order.
- Do FLSM Subnetting for the block size of the first segment.
- Assign first subnet from subnetted subnets to the first segment.
- If next segment has similar block size, assign next subnet to it.
- If next segment has lower block size, do FLSM Subnetting again for the block size of this segment.
- From subnetted subnets exclude the occupied subnets. Occupied subnets are the subnets which provide the addresses which are already assigned.
- From available subnets, assign the first available subnet to this segment.
- Repeat above steps till the last segment of the network.

Let's implement above steps in our example network.

Step by step VLSM Subnetting

The first step of VLSM Subnetting is selecting the appropriate block size for each segment. Following table lists all available block sizes.

2	4	8	16	32	64	128	256
512	1024	2048	4096	8192	16384	32768	65536
131072	262144	524288	1048576	2097152	4194304	8388608	16777216

To learn how block size is calculated, please see the third part of this tutorial.

While selecting appropriate block size for a given segment, always select a size which is adequate for host addresses plus two additional addresses; network address and broadcast address.

Identity of a subnet and certain networking services depend on network address and broadcast address. In each subnet, the first address and the last address are always reserved for network address and broadcast address respectively.

Regardless the information about these two addresses is provided or not in question; always add these addresses in requirement while selecting the block size for a segment.

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Actual requirement = Host requirement + Network address + broadcast address
Block Size >= Actual requirement
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Following table shows the selection of block size in our example.

Segment	Host requirement	Actual requirement	Block size
Production	52	54	64
Wan link 1	2	4	4
Development	74	76	128
Wan link 2	2	4	4
Administration	28	30	32

Wan link 3	2	4	4

The next step of VLSM Subnetting is arranging segments in descending order. Based on block size, following table arranges all segments in descending order.

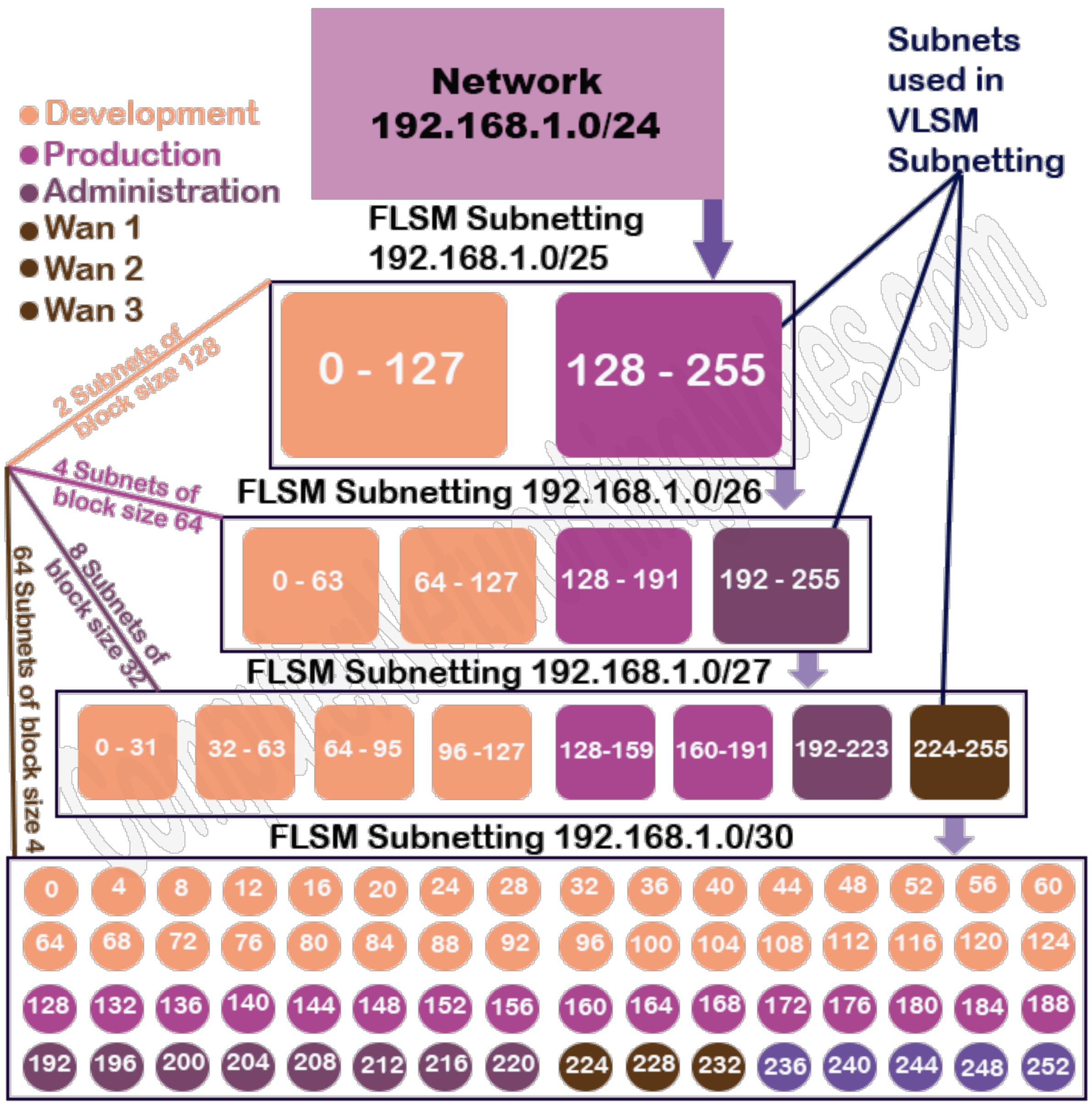
Segment	Block size	Descending order
Development	128	1
Production	64	2
Administration	32	3
Wan link 1	4	4
Wan link 2	4	5
Wan link 3	4	6

The next step of VLSM Subnetting is doing FLSM Subnetting and selecting appropriate subnets for segments from the subnetted subnets.

A single FLSM Subnetting provides a single block size for all of its subnets. If different block size is required, we have to perform the FLSM Subnetting again for that block size. How many times we have to perform the FLSM Subnetting is depend on how many unique block sizes we need. For instance, our example network requires four unique block sizes 128, 64, 32 and 4. For four block sizes, we have to perform FLSM Subnetting four times.

FLSM Subnetting is always performed in descending order. For ordering, block size is used. In our example, first we have to perform FLSM Subnetting for block size 128 then for block size 64 then for block size 32 and finally for block size 4.

Following figure shows the FLSM Subnetting for all four block sizes and selected subnets for segments from each FLSM Subnetting.



Development
Production
Administration
Wan 1
Wan 2
Wan 3
Network
192.168.1.0/24
Subnets
used in
VLSM
Subnetting
FLSM Subnetting
192.168.1.0/25
2 Subnets of
block size 128
0 - 127
128 - 255
4 Subnets of
block size 64
FLSM Subnetting 192.168.1.0/26
0 - 63
64 - 127
128 - 191
192 - 255
8 Subnets of
block size 32
FLSM Subnetting 192.168.1.0/27
0 - 31
32 - 63
64 - 95
96 -127
128-159
160-191
192-223
224-255
64 Subnets of block size 4
FLSM Subnetting 192.168.1.0/30
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60
64 68 72 76 80 84 88 92 96 100 104 108 112 116 120 124
128 132 136 140 144 148 152 156 160 164 168 172 176 180 184 188
192 196 200 204 208 212 216 220 224 228 232 236 240 244 248 252

Let’s understand above process in more detail.

First largest segment (Block size 128)
Our first segment needs a block size of 128. The FLSM Subnetting of /25 provides us two subnets with the block size 128.

FLSM Subnetting of 192.168.1.0/25

Subnet	Subnet1	Subnet2
Network ID	192.168.1.0	192.168.1.128
First host address	192.168.1.1	192.168.1.129
Last host address	192.168.1.126	192.168.1.254
Broadcast ID	192.168.1.127	192.168.1.255

From Subnetted subnets assign first subnet to this segment.

Segment	Development
Requirement	74
CIDR	/25
Subnet mask	255.255.255.128
Network ID	192.168.1.0
First hosts	192.168.1.1
Last hosts	192.168.1.126
Broadcast ID	192.168.1.127

Since our second segment (Production) needs different block size (64), instead of using second subnet (Subnet2) for it, let’s do Subnetting again.

Second largest segment (Block size 64)
The Subnetting of /26 provide us 4 subnets with block size 64.

Subnetting of 192.168.1.0/26

Subnet	Subnet 1	Subnet 2	Subnet 3	Subnet 4
Network ID	0	64	128	192
First address	1	65	129	193
Last address	62	126	190	254
Broadcast ID	63	127	191	255

From this Subnetting, we cannot use subnet 1 and subnet 2 as they are already occupied.

Subnet 1 and Subnet 2 provide addresses from 0 to 127 which are already assigned in the development department.

We can use subnet 3 for this segment (production).

Segment	Production
Requirement	52
CIDR	/26
Subnet mask	255.255.255.192
Network ID	192.168.1.128
First hosts	192.168.1.129
Last hosts	192.168.1.190
Broadcast ID	192.168.1.191

Third largest segment (block size 32)

The Subnetting of /27 provides us 8 network and 32 hosts.

Subnetting of 192.168.1.0/27

Subnet	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Sub 7	Sub 8

Net ID	0	32	64	96	128	160	192	224
First Host	1	33	65	95	129	161	193	225
Last Host	30	62	94	126	158	190	222	254
Broadcast ID	31	63	95	127	159	191	223	255

Exclude the already occupied subnets (Sub1 to Sub6) and assign the first available subnet (Sub7) to this segment.

Segment	Administration
Requirement	28
CIDR	/27
Subnet mask	255.255.255.224
Network ID	192.168.1.192
First hosts	192.168.1.193
Last hosts	192.168.1.222
Broadcast ID	192.168.1.223

WAN Links (Block Size 4)

Last three segments require the block size of 4. The Subnetting of /30 gives us 64 subnets of block size 4.

Subnets of /30 Subnetting:-

0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, 92, 96, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144, 148, 152, 156, 160, 164, 168, 172, 176, 180, 184, 188, 192, 196, 200, 204, 208, 212, 216, 220, 224, 228, 232, 236, 240, 244, 248, 252, 256

Exclude already occupied subnets (0-56) and use first three available subnets 57, 58 and 59 for WAN links.

Subnet	Subnet 57	Subnet 58	Subnet 59
Network ID	224	228	232

First host	225	229	233
Last host	226	230	234
Broadcast ID	227	231	235

Assign subnet 57 to the WAN link 1.

Subnet	Subnet 57
Segments	Wan Link 1
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.224
First hosts	192.168.1.225
Last hosts	192.168.1.226
Broadcast ID	192.168.1.227

Assign subnet 58 to the WAN link 2.

Subnet	Subnet 58
Segments	Wan Link 2
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.228
First hosts	192.168.1.229
Last hosts	192.168.1.230
Broadcast ID	192.168.1.231

Assign subnet 59 to the WAN link 3.

Subnet	Subnet 59
Segments	Wan Link 3
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.232
First hosts	192.168.1.233
Last hosts	192.168.1.234
Broadcast ID	192.168.1.235

We have assigned IP addresses to all segments. The subnets 60, 61, 62, 63 and 64 are still available for further use.

Following figure shows a summarize allocation of all addresses in given network.

Address range
192.168.1.0/24