VLSM Subnetting Explained with Examples

VLSM subnetting allows us to create subnets based on our requirements and network size. It allows us to create subnets with different subnet masks.

There are two types of subnetting: FLSM and VLSM. FLSM is easy but produces subnets having the same number of IP addresses. The same-sized subnets do not scale all networks. Let us take an example. We have an IP subnet having 12 IP addresses. We have two networks. The first network has seven hosts. The second network has three hosts.

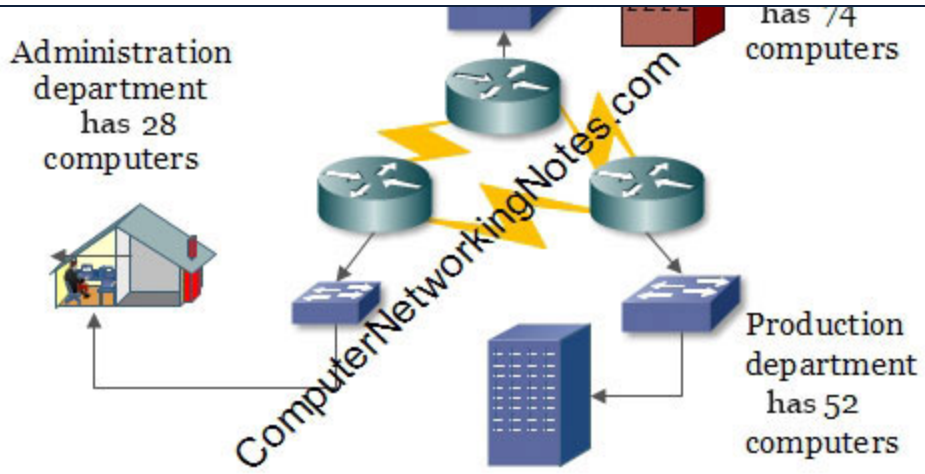
If we use FLSM, we can create the following subnets.

Subnets	Hosts in each subnet
2	6
3	4
4	3

We need seven hosts in the first subnet and three in the second subnet. None of the above-listed combinations fulfill our requirements. If we use VLSM, we can create two subnets. The first will provide eight IP addresses. The second will provide four IP addresses. This example shows how VLSM allows us to utilize IP addresses based on our requirements.

VLSM Subnetting example

The following image shows a network.



The above network has the following requirements.

The development department needs 74 IP addresses.

The production department needs 52 IP addresses.

The administration department needs 28 IP addresses.

Three WAN links connect these departments.

Each WAN link needs two IP addresses.

The given default IP subnet is 192.168.1.0/24.

This tutorial is the ninth chapter of the tutorial series. Other chapters of this series are the following.

VLSM Subnetting step-by-step

In the first step, we calculate and arrange our IP requirements in descending order.

Since each network requires two additional IP addresses, we add two to the total host requirement of each network. After finalizing the host requirement, we find the block size that fulfills the host requirement.

A block size is the block of IP address we get when we convert a host bit into a network bit. The following table lists the block sizes we can have.

Host bit(s)	1	2	3	4	5	6	7	8
Block size	2	4	8	16	32	64	128	256
Host bits	9	10	11	12	13	14	15	16
Block size	512	1024	2048	4096	8192	16384	32768	65536
Host bits	17	18	19	20	21	22	23	24
Block size	131072	262144	524288	1048576	2097152	4194304	8388608	167772

The block size must be greater than or equal to the actual host requirement of the network.

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Actual host requirement = Host requirement + Network address + broadcast address
Block Size >= Actual host requirement
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The following table lists the block sizes that meet our requirements.

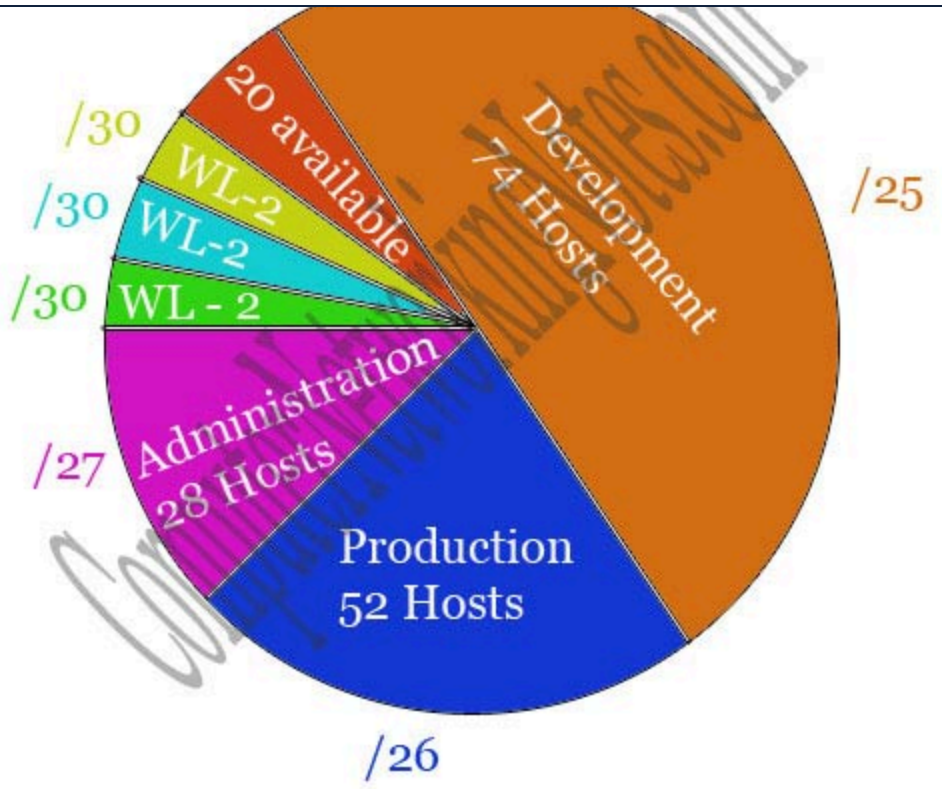
Segment	Host requirement	Actual requirement	Block size
Production	52	54	64

Wan link 1	2	4	4
Wan link 2	2	4	4
Wan link 3	2	4	4

In the next step, we arrange 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

VLSM is an extended version of FLSM. It uses the same steps FLSM uses. In FLSM, we break the default subnet into the same-sized subnets. In VLSM, we further divide the created subnets into small-sized subnets based on our requirements in descending order.



In this example, first, we will perform FLSM from the development segment.

The development segment's block size is 128. The given IP subnet belongs to class C. In class C, the first 24 bits are reserved network bits. We cannot use the reserved network bits. We can use only host bits for subnetting. The default class C IP subnet has 6 (8 - 2 *reserved host bits [30 and 31]*) host bits available for subnetting. Subnetting always goes from left to right without skipping a bit. Hence, the first host bit we can use in subnetting is the 25^{th}. If we convert this host bit (25^{th}) into a network bit, we get two subnets having 128 IP addresses each.

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

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

Our next segment is the production department. Its block size is 64. If we convert the next host bit (26^{th}), we get four subnets having 64 IP addresses each.

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

We cannot use the subnets 1 and 2. They contain the addresses we have already assigned to the development section. We can use the subnet 3 for the production section.

Segment	Production
Requirement	52

Network ID	192.168.1.128
First hosts	192.168.1.129
Last hosts	192.168.1.190
Broadcast ID	192.168.1.191

Our next segment is the administration department. Its block size is 32. If we convert the next host bit (27^{th}), we get eight subnets having 32 IP addresses each.

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

We cannot use the subnets 1, 2, 3, 4, 5, and 6. They contain the addresses we have already assigned to the development and production sections. We can use subnet 7 for the administration section.

Segment	Administration
Requirement	28
CIDR	/27
Subnet mask	255.255.255.224
Network ID	192.168.1.192

Broadcast ID	192.168.1.223

Our remaining segments are WAN links. Their block size is 4. If we convert the next three host bits (28, 29, and 30th), we get sixty-four subnets having 4 IP addresses each.

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

We cannot use the subnets 1 to 56. They contain the addresses we have already assigned to the development, production, and administration sections. We can use subnets 57, 58, and 59 for the 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

Broadcast ID	192.168.1.227

Assign subnet 58 to the WAN link 2.

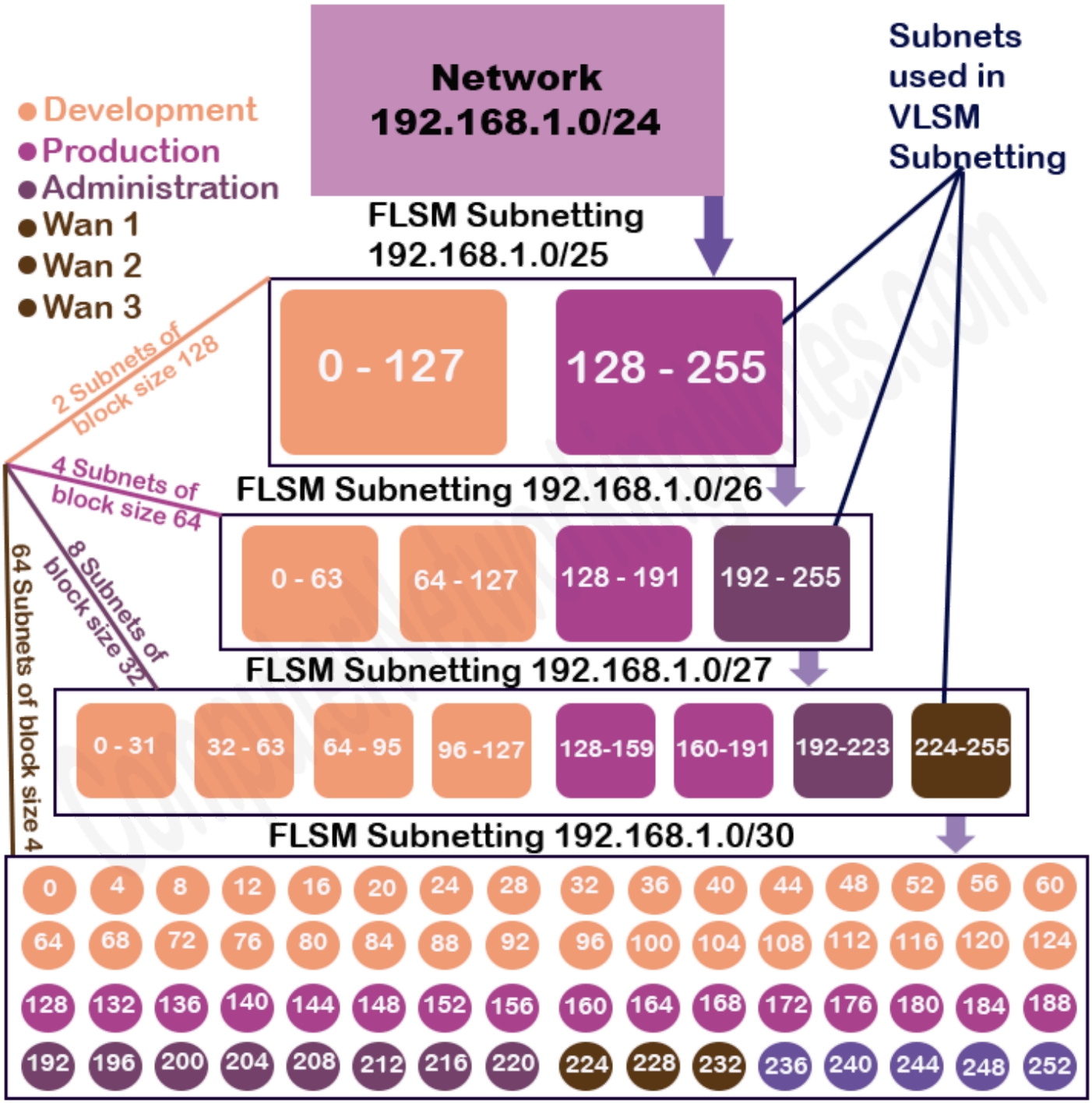
Subnet	Subnet 58
Segments	Wan Link 2
Requirement	2
CIDR	/30
Subnet mask	255.255.255.252
Network ID	192.168.1.228
First hosts	192.168.1.229
Last hosts	192.168.1.230
Broadcast ID	192.168.1.231

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

Last hosts	192.168.1.234
Broadcast ID	192.168.1.235

The following image shows the final allocation of IP addresses.



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Subnetting Tutorial – Subnetting Explained with Examples