VLSM

- VLSM is a process of dividing an IP space into the subnets of different sizes without wasting IP addresses. When we perform subnetting, all subnets have the same number of hosts, this is known as FLSM (Fixed length subnet mask).
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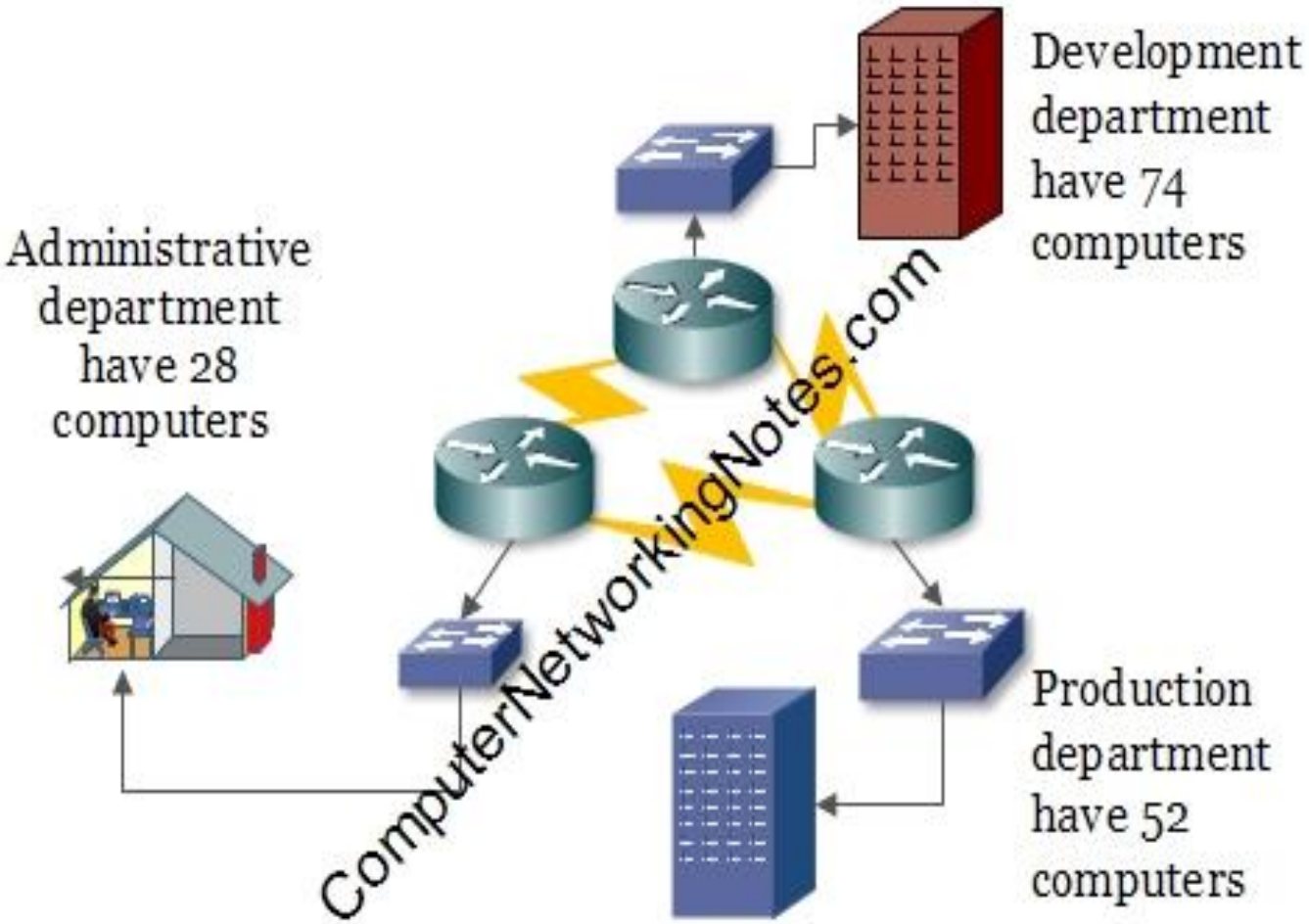
- In FLSM all subnets use same subnet mask, this lead to inefficiencies. In real life scenario, some subnets may require large number of host addresses while other may require only few addresses.

Example

Assume that you are a network administrator at BrainTechnologis. Company have three departments connected with wan links.

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


Development department have 74 computers
Administrative department have 28 computers
Production department have 52 computers
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- **First choice with a example class B address space**
- 172.168.1.0/23
- Subnetting of this address space would give us 128 subnets and 512 hosts in each subnet. Our network requires only 6 subnets and 160 addresses.
- Every IP address add more dollars in company bill. You would have to pay for 65356 addresses while you need only 160 addresses. Would you consider this address space for company?

- **Second choice with two example class C address spaces**
- 192.168.1.0/25
- 192.168.2.0/26
- Subnetting of first address 192.168.1.0/25 would give us 2 subnets and 128 hosts in each subnet.
- Subnetting of second address 192.168.2.0/26 would give us 4 subnets and 64 hosts in each subnet.
- Collectively we are getting 6 subnets and 512 hosts from these two address spaces. We are still wasting more than 300 IP address, and we would have to purchase two address spaces.

Variable Length Subnet Mask

- Variable Length Subnet Mask (VLSM) extends classic subnetting.
- VLSM is a process of breaking down subnets into the smaller subnets, according to the need of individual networks. In above example company have requirement of 6 subnets and 160 host addresses. With VSLM you can fulfill this requirement with single class C address space.
- **VLSM Subnetting**
- In VLSM Subnetting, we do subnetting of subnets according the network requirement.

Steps for VLSM Subnetting

- Find the largest segment. Segment which need largest number of hosts address.
- Do subnetting to fulfill the requirement of largest segment.
- Assign the appropriate subnet mask for the largest segment.
- For second largest segments, take one of these newly created subnets and apply a different, more appropriate, subnet mask to it.
- Assign the appropriate subnet mask for the second largest segment.
- Repeat this process until the last network.

VLSM Example

- Now you know the steps of VLSM Subnetting. Let's understand it with above example. Our company requires 6 subnets and 160 hosts.
- **Step 1 :-** Oder all segments according the hosts requirement (Largest to smallest).

Subnet	Segment	Hosts
1	Development	74
2	Production	52
3	Administrative	28
4	Wan link 1	2
5	Wan link 2	2
6	Wan link 3	2

- **Step 2 :-** Do subnetting for largest segment. Our largest segment needs 74 host addresses. /25 provide us two subnets with 128 hosts in each subnet.
- **192.168.1.0/25**

Subnet	Subnet 1	Subnet 2
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

- **Step 3 :-** Assign subnet mask to the largest segment. As you can see in above table, subnet 1 fulfill our largest segment requirement. Assign it to our 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

- **Step 4 :-** Do subnetting for second largest segment from next available subnet. Next segment requires 52 host addresses. Subnetting of /25 has given us two subnets with 128 hosts in each, from that we have assigned first subnet to development segment. Second segment is available, we would do subnetting of this.
- /26 provide us 4 subnets with 64 hosts in each subnet
- **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

- We cannot use subnet 1 and subnet 2 (address from 0 to 127) as they are already assigned to development department. We can assign subnet 3 to our production department.

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

- **Step 5 :-** Our next segment requires 28 hosts. From above subnetting we have subnet 3 and subnet 4 available. Do subnetting for the requirement of 28 hosts.
- **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
LastHost	30	62	94	126	158	190	222	254
Broadcast ID	31	63	95	127	159	191	223	255

Subnets 1 to 6 [address from 0 to 191] are already occupied by previous segments. We can assign subnet 7 to this segment.

Segment	Administrative
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

- **Step 6 :-** Our last three segments require 2 hosts per subnet. Do subnetting for these.
- **192.168.1.0/30**
- Valid subnets are:-
- 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
- From these subnets, subnet 1 to subnet 56 (Address from 0 - 220) are already assigned to previous segments. We can use 224,228, and 232 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 these subnets to wan links.

Wan Link 1

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

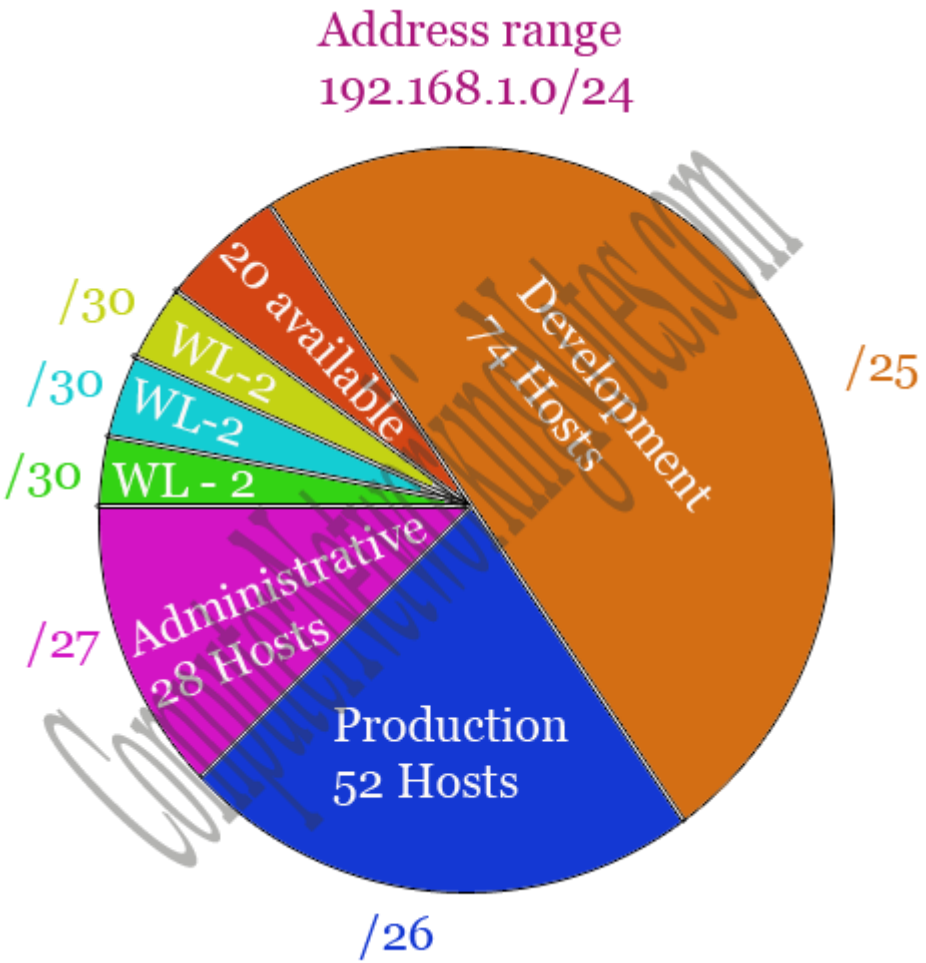
Wan Link 2

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

Wan link 3

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

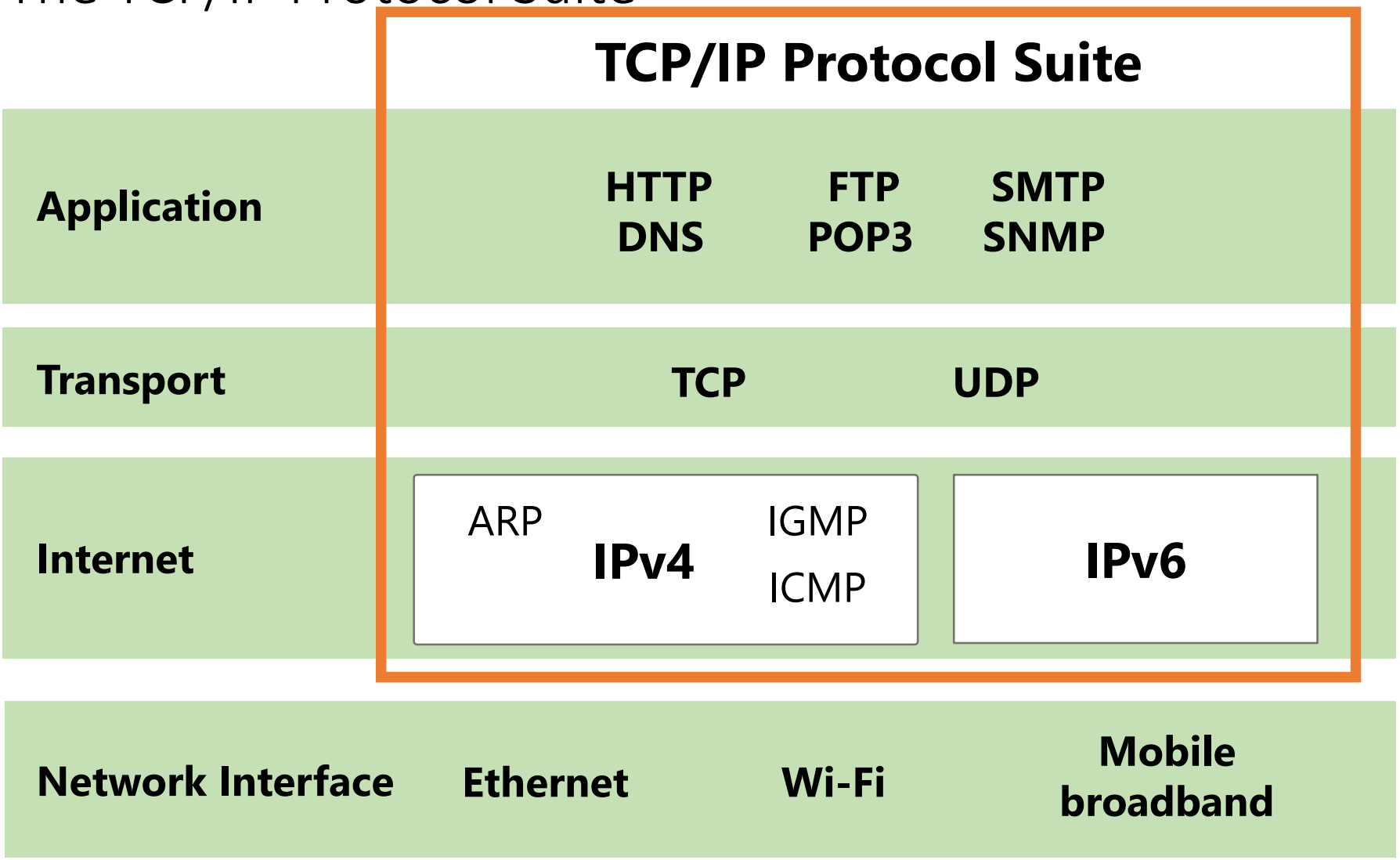
- We have assigned IP addresses to all segments, still we have 20 addresses available. This is the magic of VLSM.



CIDR

- Classless Interdomain Routing
- Improve address space utilization
- Routing scalability in the Internet
- For example, if an ISP owns network 172.16.0.0/16, then the ISP can offer 172.16.1.0/24, 172.16.2.0/24,and so on to customers. Yet, when advertising to other providers, the ISP only needs to advertise 172.16.0.0/16

The TCP/IP Protocol Suite



Protocols in the TCP/IP Suite

OSI	TCP/IP	TCP/IP Protocol Suite		
Application Presentation Session	Application	HTTP	DNS	
		FTP	POP3	
		SMTP	SNMP	
Transport	Transport	TCP	UDP	
Network	Internet	ARP IPv4 IGMP ICMP	IPv6	
Data Link Physical	Network Interface	Ethernet	Wi-Fi	Mobile broadband