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BANGLADESH UNIVERSITY OF BUSINESS AND TECHNOLOGY

Assignment-2

Course Code: CSE 319

Course Title: Computer Networks

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VLSM Problem Solutions

Problem-1

Solution:

Class C network

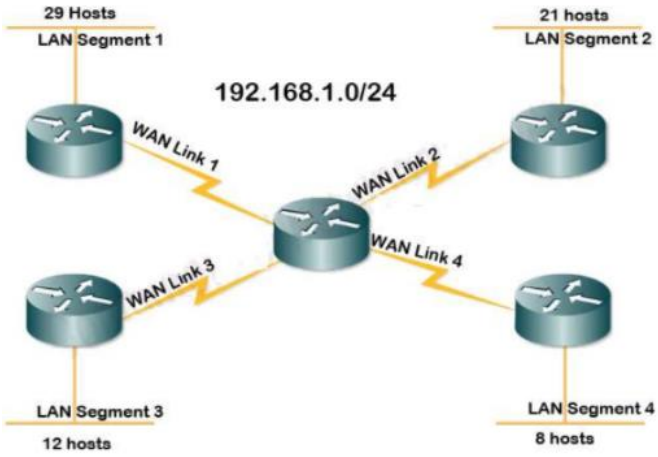

Figure 1: VLSM (class C network)

As the name implies, subnetting is the process of dividing a single large network into multiple small networks known as subnets. The primary purpose of subnetting is to help relieve network congestion and improve efficiency in the utilization of the relatively small network address space available especially in IPv4. Though there are five IP address classes: A, B, C, D and E. But subnetting can be done only in first three classes: A, B and C. And VLSM stands for Variable Length Subnet Mask where the subnet design uses more than one mask in the same network which means more than one mask is used for different subnets of a single class A, B, C or a network. For this problem we have to do it for Class C.

Based on hosts' requirement, arranged all segments in descending order and selects appropriate block size for each segment.

Step by step VLSM calculation:

No.	Segment	Host requirement	Nearest block size	Valid hosts in block
1	LAN Segment1	29	32	30 (32 -2)
2	LAN Segment 2	21	32	30 (32 -2)
3	LAN Segment 3	12	16	14 (16-2)
4	LAN Segment 4	8	16	14 (16-2)
5	WAN Link 1	2	4	2 (4-2)
6	WAN Link 2	2	4	2 (4-2)
7	WAN Link 3	2	4	2 (4-2)
8	WAN Link 4	2	4	2 (4-2)

While selecting the nearest block size, I compare the host requirement with valid host instead of the block size itself. For example, LAN segment 4 needs 8 hosts, but we can't use the block size 8 for it. As block size 8 offers only 6 valid hosts (8 -2) while we need 8 valid hosts for this segment. For this segment, we have to use the block size which provides 8 or more valid hosts such as block size 16. Same way for WAN links which need 2 hosts, we have to use the block size 4.

Once segments are arranged based on hosts' requirement and host requirements are converted in nearest block size, we can use the following steps for further solution:

- Do Subnetting for the largest segment. From subnetted subnets, assign first subnet to it.
- If next segment has similar block size, assign next subnet to it.
- Repeat this process till the requirements are same.
- If next segment requires different block size, do Subnetting again for the block size of that segment and pick the subnet which comes after the occupied subnets. Occupied subnets are the subnets which provide the IP addresses which are already used.

- Just like above step, if next segment requires similar block size, use next subnet for it otherwise do Subnetting again.
- Repeat same steps till the last segment of the network.

Let's implement above steps in our examples:

The first largest segment (LAN Segment1) requires the block size 32. For 32 block size, we use the Subnetting of /27.

In class C, Subnetting of /27 provides us 8 networks (subnets) of block size 32.

0-31, 32-63, 64-95, 96-127, 128-159, 160-191, 192-223, 224-255

Let's use the first subnet **0-31** for it.

Since second segment (LAN Segment2) also has the similar requirement, use the second subnet **32-63** for it.

Third segment (LAN Segment3) requires the block size 16 which is different from the second segment, so instead of using the subnet which provides block size 32, we will do the Subnetting again and use the subnet which provides block size 16.

In class C, Subnetting of /28 provides 16 networks of block size 16.

0-15, 16-31, 32-47, 48-63, 64-79, 80-95, 96-111, 112-127, 128-143, 144-159, 160-175, 176-191, 192-207, 208-223, 224-239, 240-255

If we exclude the occupied subnets, we will get the available subnets for this segment and next segments.

The subnets which provide the addresses which are already assigned are known as occupied subnets. In this Subnetting the occupied subnets are 0-15, 16-31, 32-47 and 48-63. These subnets provide the addresses (0 to 63) which are already assigned in previous segments.

Let’s use the first available subnet **64-79** from this Subnetting for the third segment (LAN Segment3).

Forth segment (LAN Segment4) also has the similar requirement. Let’s assign next available subnet **80-95** to it.

Next segments are WAN links. WAN links require only 2 addresses. For 2 valid addresses we need the block size of 4.

In class C, Subnetting of /30 provides us 64 networks of block size 4.

0-3, 4-7, 8-11, 12-15, 16-19, 20-23, 24-27, 28-31, 32-35, 36-39, 40-43, 44-47, 48-51, 52-55, 56-59, 60-63, 64-67, 68-71, 72-75, 76-79, 80-83, 84-87, 88-91, 92-95, 96-99, 100-103, 104-107, 108-111, 112-115, 116-119, 120-123, 124-127, 128-131, 132-135, 136-139, 140-143, 144-147, 148-151, 152-155, 156-159, 160-163, 164-167, 168-171, 172-175, 176-179, 180-183, 184-187, 188-191, 192-195, 196-199, 200-203, 204-207, 208-211, 212-215, 216-219, 220-223, 224-227, 228-231, 232-235, 236-239, 240-243, 244-247, 248-251, 252-255

Exclude the occupied subnets and use first four available subnets 96-99, 100-103, 104-107 and 108-111 for WAN links.

Following figure explains above steps and Subnetting.

Subnetting table for problem-1:

Segment	CIDR	Subnet Mask	Network Address	Broad cast Address	Valid host addresses
LAN Segment1	/27	255.255.255.224	192.168.1.0	192.168.1.31	192.168.1.1 to 192.168.1.30
LAN Segment 2	/27	255.255.255.224	192.168.1.32	192.168.1.63	192.168.1.33 to 192.168.1.62
LAN Segment 3	/28	255.255.255.240	192.168.1.64	192.168.1.79	192.168.1.65 to 192.168.1.78
LAN Segment 4	/28	255.255.255.240	192.168.1.80	192.168.1.95	192.168.1.81 to 192.168.1.94
WAN Link 1	/30	255.255.255.252	192.168.1.96	192.168.1.99	192.168.1.97 to 192.168.1.98
WAN Link 2	/30	255.255.255.252	192.168.1.100	192.168.1.103	192.168.1.101 to 192.168.1.102
WAN Link 3	/30	255.255.255.252	192.168.1.104	192.168.1.107	192.168.1.105 to 192.168.1.106
WAN Link 4	/30	255.255.255.252	192.168.1.108	192.168.1.111	192.168.1.107 to 192.168.1.108

Problem-2

Solution:

Class B network

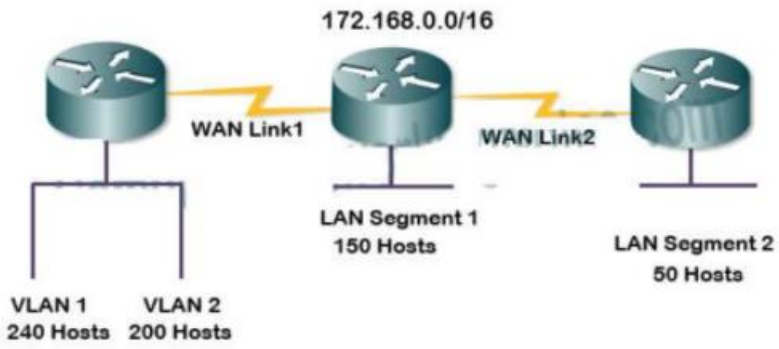

Figure 2: VLSM (class B network)

No.	Segment	Host requirement	Nearest block size	Valid hosts in block
1	VLAN1	240	256	254
2	VLAN2	200	256	254
3	LAN Segment 1	150	256	254
4	LAN Segment 2	50	64	62
5	WAN Link 1	2	4	2
6	WAN Link 2	2	4	2

In this example, first segment (VLAN1) requires the block size of 256.

In class B, Subnetting of /24 provides us 256 subnets and 256 hosts in each subnet.

0.0, 1.0, 2.0, 3.0, 4.0, 5.0 …….. 252.0, 253.0, 254.0, 255.0

Let’s assign first subnet **0.0** to this segment.

Since second segment (VLAN2) and third segment (LAN Segment1) also have the similar requirement, instead of doing Subnetting again, let's use the next available subnets from already subnetted subnets for these segments.

Assign second subnet **1.0** and third subnet **2.0** to the second segment (VLAN2) and third segment (LAN Segment1) respectively.

Fourth segment (LAN Segment2) requires the block size of 64 which is different and lower from current block size. Instead of using current subnets, let's do Subnetting again for this segment.

In class B, Subnetting of /26 provides 1024 subnets with block size of 64.

0.0, 0.64, 0.128, 0.192, 1.0, 1.64, 1.128, 1.192, 2.0, 2.64, 2.128, 2.192, 3.0, 3.64, 3.128, 3.192, 4.0, 4.64, 4.128, 4.192…….. 254.0, 254.64, 254.128, 254.192, 254.0, 254.64, 254.128, 254.192

Exclude already occupied subnets and use first available subnet **3.0** for this segment (LAN segment2).

Next two segments are WAN links. For WAN links we use the Subnetting of /30.

In class B, Subnetting of /30 provides 16384 networks with the block size of 4.

0.4, 0.8, 0.12, ……. 3.0, 3.4, ……. 3.56, 3.60, .64, 3.68, 3.72, 3.78, …… 255.248, 255.252

Just like we did above, exclude occupied subnets and assign first two available subnets **3.64** and **3.68** to the WAN Link1 and WAN Link2 respectively.

Subnetting table for problem-2:

Segment	CIDR	Subnet Mask	Network Address	Broad cast Address	Valid host addresses
VLAN1	/24	255.255.255.0	172.168.0.0	172.168.0.255	172.168.0.1 to 172.168.0.254
VLAN2	/24	255.255.255.0	172.168.1.0	172.168.1.255	172.168.1.1 to 172.168.1.254
LAN Segment 1	/24	255.255.255.0	172.168.2.0	172.168.2.255	172.168.2.1 to 172.168.2.254
LAN Segment 2	/26	255.255.255.192	172.168.3.0	172.168.3.63	172.168.3.1 to 172.168.3.62
WAN Link 1	/30	255.255.255.252	172.168.3.64	172.168.3.67	172.168.3.65 to 172.168.3.66
WAN Link 2	/30	255.255.255.252	172.168.3.68	172.168.3.71	172.168.3.69 to 172.168.3.70

Problem-3

Solution:

Class A network

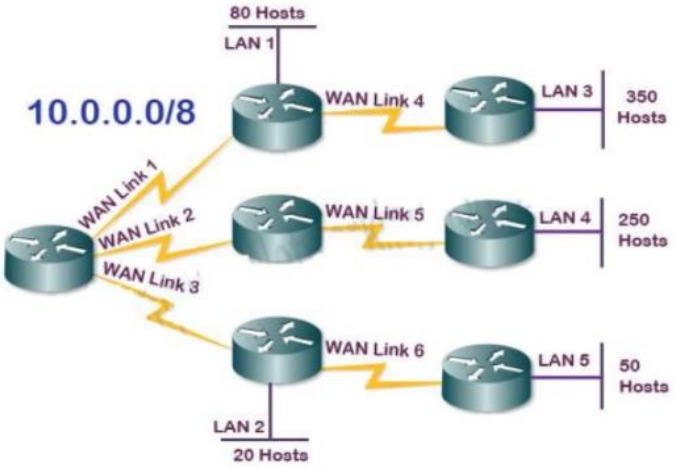

Figure 2: VLSM (class A network)

No.	Segment	Host requirement	Nearest block size	Valid hosts
1	LAN Segment 3	350	512	510
2	LAN Segment 4	250	256	254
3	LAN Segment 1	80	128	126
4	LAN Segment 5	50	64	62
5	LAN Segment 2	20	32	30
6	WAN Link1	2	4	2
7	WAN Link2	2	4	2
8	WAN Link3	2	4	2
9	WAN Link4	2	4	2
10	WAN Link5	2	4	2
11	WAN Link6	2	4	2

The largest segment (LAN Segment 3) requires the block size 512.

In class A, Subnetting of /23 provides 32768 networks with the block size of 512.

0.0.0, 0.2.0, 0.4.0, …… 0.252.0, 0.254.0

Assign first subnet **0.0.0** to this segment.

The second largest segment (LAN Segment 4) requires the block size of 256.

In class A, Subnetting of /24 provides 65536 networks with the block size of 256.

0.0.0, 0.1.0, 0.2.0, 0.3.0, 0.4.0, 0.5.0, …… 0.252.0, 0.253.0, 0.254.0

Exclude the occupied subnets and assign first available subnet **0.2.0** to it.

The third largest segment (LAN Segment 1) requires the block size of 128.

In class A, Subnetting of /25 provides 131072 networks with the block size of 128.

0.0.0, 0.0.128, 0.1.0, 0.1.128, 0.2.0, 0.2.128, 0.3.0, 0.3.128, 0.4.0, 0.4.128 …… 0.254.0, 0.254.128 , 0.255.0 , 0.255.128

Assign first available subnet **0.3.0** to this segment.

The fourth largest segment (LAN Segment 5) requires the block size of 64.

In class A, Subnetting of /26 provides 262144 networks with the block size of 64.

0.0.64, 0.0.128, 0.0.192, 0.0.255, 0.1.64, …… 0.2.192, 0.2.255, 0.3.64, 0.3.128, 0.3.192, 0.3.255, 0.4.64 …… , 0.254.0 , 0.254.64 , 0.254.128 , 0.254.255

In this Subnetting, the first subnet with available addresses is **0.3.128**. Assign it to this segment.

The fifth largest segment (LAN Segment2) requires the block size of 32.

In class A, Subnetting of /27 provides 524288 networks with the block size of 32.

0.0.32, 0.0.64, 0.0.96, 0.0.128 ……. 0.3.0, 0.3.32, 0.3.64, 0.3.96, 0.3.128, 0.3.160, 0.3.192, 0.3.224, 0.3.255, …… , 0.255.0, 0.255.32, 0.255.64, 0.255.92, 0.255.128, 0.255.224, 0.255.255

The first available subnet of this Subnetting is **0.3.192**. Let’s assign it to this segment.

Next six segments are WAN links. For WAN links use the Subnetting of /30.

In class A, Subnetting of /30 provides 4194304 networks with the block size of 4.

0.0.0, 0.0.4, 0.0.8 …….…….. 0.3.208, 0.3.212, 0.3.216, 0.3.220, 0.3.224, 0.3.228, 0.3.232, 0.3.236, 0.3.240, 0.3.248, 0.3.252, 0.4.0, 0.4.8, …….. 0.255.240, 0.255.244, 0.255.248, 0.255.252

Assign subnets 0.3.224, 0.3.228, 0.3.232, 0.3.236, 0.3.240 and 0.3.248 to WAN links respectively.

Subnetting table for problem-3:

Segment	CIDR	Subnet Mask	Network Address	Broad cast Address	Valid host addresses
LAN Segment 3	/23	255.255.254.0	10.0.0.0	10.0.1.255	10.0.0.1 to 10.0.1.254
LAN Segment 4	/24	255.255.255.0	10.0.2.0	10.0.2.255	10.0.2.1 to 10.0.2.254
LAN Segment 1	/25	255.255.255.128	10.0.3.0	10.0.3.127	10.0.3.1 to 10.0.3.126
LAN Segment 5	/26	255.255.255.192	10.0.3.128	10.0.3.191	10.0.3.129 to 10.0.3.190
LAN Segment 2	/27	255.255.255.224	10.0.3.192	10.0.3.223	10.0.3.193 to 10.0.3.222
WAN Link1	/30	255.255.255.252	10.0.3.224	10.0.3.227	10.0.3.225 to 10.0.3.226
WAN Link2	/30	255.255.255.252	10.0.3.228	10.0.3.231	10.0.3.229 to 10.0.3.230
WAN Link3	/30	255.255.255.252	10.0.3.232	10.0.3.235	10.0.3.233 to 10.0.3.234
WAN Link4	/30	255.255.255.252	10.0.3.236	10.0.3.239	10.0.3.237 to 10.0.3.238
WAN Link5	/30	255.255.255.252	10.0.3.240	10.0.3.243	10.0.3.241 to 10.0.3.242
WAN Link6	/30	255.255.255.252	10.0.3.244	10.0.3.247	10.0.3.245 to 10.0.3.246