VLSM Subnetting

Aim:

To subnet a network using VLSM.

VLSM Example

VLSM is used when more than one subnet mask is used within a single Class A, B or C network. The example below uses a portion of a Class B network. Remember that a Class B network is capable of supporting $\mathbf{2^{16}}$ (65536) hosts and that is far more than we need for our small network.

The natural network prefix for a Class B network is /16. However, our ISP has not provided us with a full Class B network. From the ISPs 169.100.0.0/16 class B network address range we have been allocated the block of addresses 169.100.16.0/22.

Example Network Topology

IP Address Block Allocated: 169.100.16.0/22

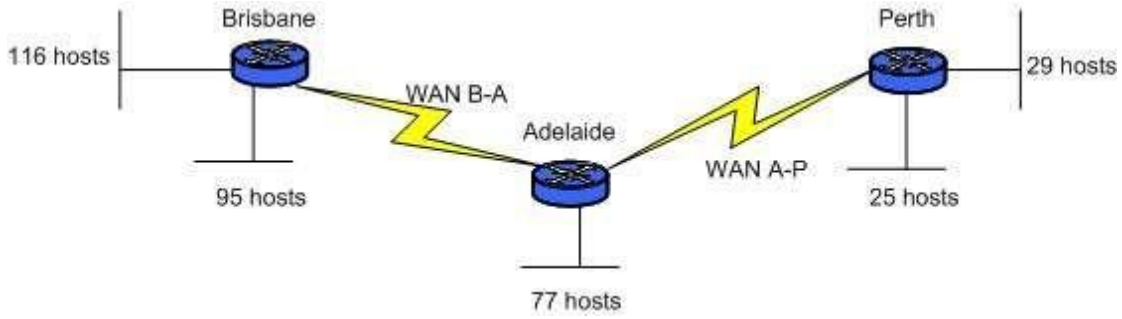


Figure 1

We do not need to use subnets of the same size for each network. We need fewer addresses for the network on the Perth router that has 25 hosts than we need for the network on the Brisbane router that has 116 hosts. If we allocate the same size of address space to each of these networks we will waste addresses. This is especially true when we allocate addresses for the WAN links WAN B-A and WAN A-P.

How many addresses do each of the WAN links require? _____

There are a number of methods used to calculate the subnets using VLSM principles. The method illustrated below uses binary and works for all instances.

Step 1. Organise all resources needed according to the size of the networks from largest to smallest.

LAN	**Number of Hosts per Subnet** (largest to smallest)
Brisbane 1	116 (largest)
Brisbane 2	95
Adelaide	77
Perth 1	29
Perth 2	25 (smallest)

Table 1

Step 2. Determine the number of host bits required for each subnet.

Number of Hosts per Subnet (largest to smallest)	**Subnet Size**	**Number of Host Bits Required**
116 (largest)	128	7
95	128	7
77	128	7
29	32	5
25 (smallest)	32	5

Table 2

The original address allocation we were given is 169.100.16.0/22 which is a subnet of the Class B network 169.100.0.0/16.

We will now subnet this subnet.

Step 3. First we subnet our 169.100.16.0/22 network to accommodate the largest subnet which has 116 hosts. This subnet requires 7 bits for the host portion of the address (table 2). As we have 10 host bits in our original /22 subnet mask (Fig. 2) this means we will have 3 bits for the subnet portion after allocating 7 bits for the host portion (Fig. 3), giving us 8 subnets (total) with 128 hosts (total) per subnet (Fig. 4).

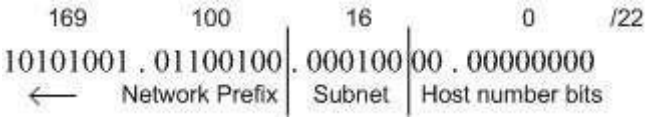


Figure 2

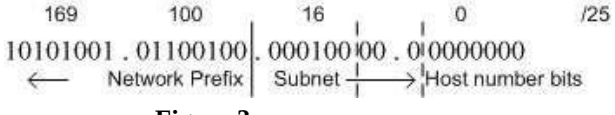


Figure 3

The 8 subnets in binary and decimal format.

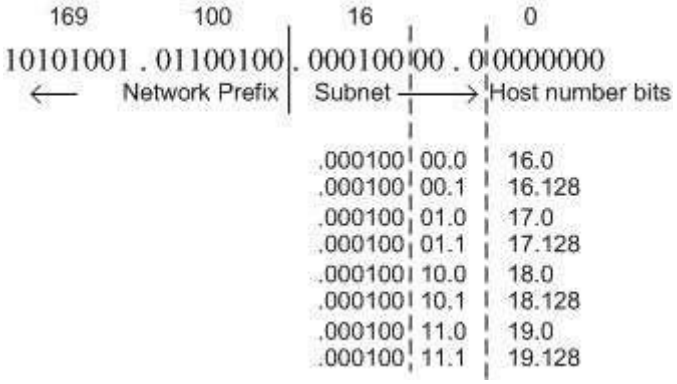


Figure 4

The 8 resultant network addresses (using the /25 subnet mask) are listed below.

Subnet	Used
169.100.16.0 /25	
169.100.16.128 /25	
169.100.17.0 /25	
169.100.17.128 /25	
169.100.18.0 /25	
169.100.18.128 /25	
169.100.19.0 /25	
169.100.19.128 /25	

Table 3

Step 4. Allocate subnets to each of the LANs from table 2 that require 7 host bits. These include the two LANs attached to the Brisbane router and the LAN attached to the Adelaide Router.

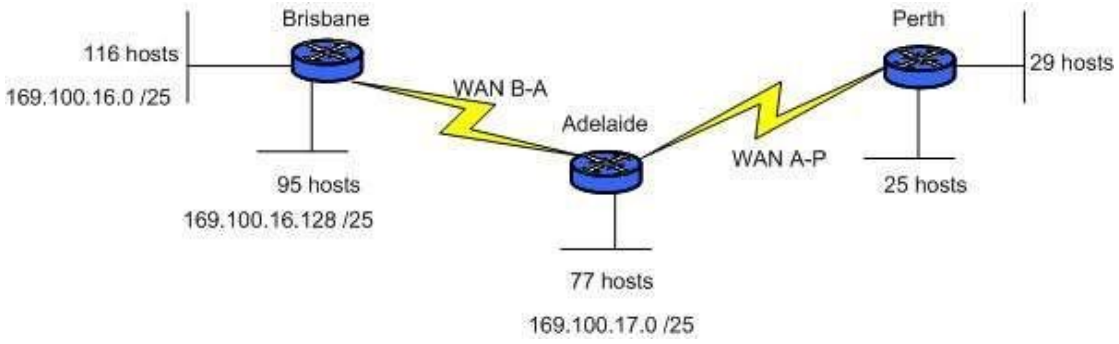


Figure 5

Now tick the subnets that have been used in the table.

/25 Subnets	Used
169.100.16.0 /25	✓
169.100.16.128 /25	✓
169.100.17.0 /25	✓
169.100.17.128 /25	
169.100.18.0 /25	
169.100.18.128 /25	
169.100.19.0 /25	
169.100.19.128 /25	

Table 4

Step 5. Choose the next available subnet, in this case 169.100.17.128 /25, and subnet it for the next smaller set of networks (those requiring 5 bits for host addresses and therefore a /27 network prefix). Since we are subnetting a /25 to a /27 there will be 2 subnet bits, providing 4 subnets (total) with 32 hosts (total) on each subnet as shown below in Fig. 6.

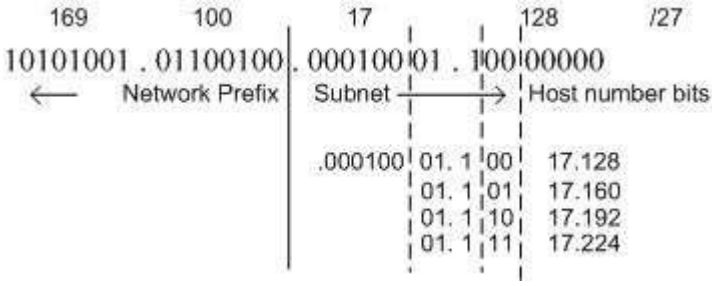


Figure 6

We now have four /27 subnets. The first two will be used for Perth LANs. The first spare /27 subnet will be further subnetted to provide the /30 wan subnets in the next step.

/25 Subnets	Used
169.100.16.0 /25	✓
169.100.16.128 /25	✓
169.100.17.0 /25	✓
169.100.17.128 /25	✓
169.100.18.0 /25	Spare
169.100.18.128 /25	Spare
169.100.19.0 /25	Spare
169.100.19.128 /25	Spare

/27 Subnets	Used
169.100.17.128 /27	✓
169.100.17.160 /27	✓
169.100.17.192 /27 spare	
169.100.17.224 /27	spare

Table 5 and 6

Our network now has all LAN network IP network addresses allocated.

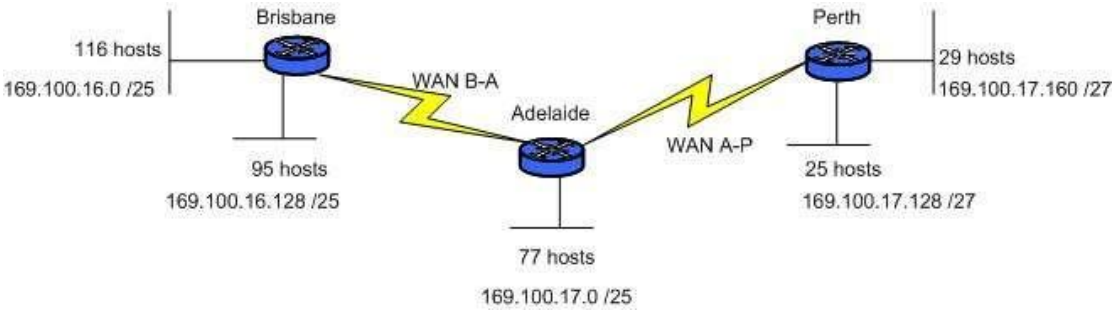


Figure 7

Step 6. In this step we will subnet one of the /27 address ranges to /30s for use with the WAN links. If we use a /30 network prefix we will have 2 useable hosts which is sufficient for the WAN links.

The next unused /27 address is 169.100.17.192. Using two bits for the host portion leaves us with 3 bits for the subnet potion giving us eight /30 subnets (total) as shown below in Fig. 8.

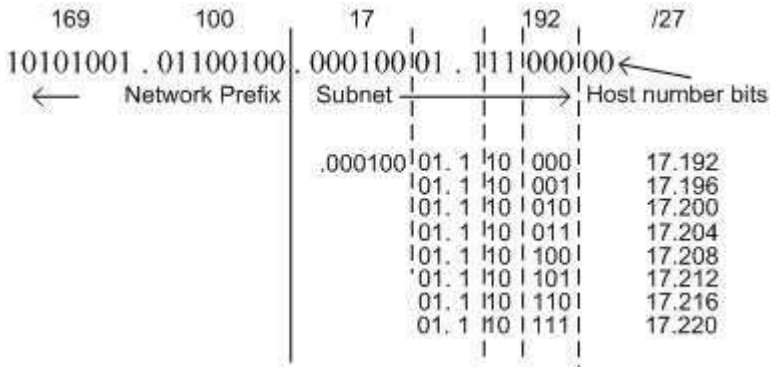


Figure 8

We only need two /30 network addresses for WAN links which leaves 6 spare /30 subnets as shown below.

/30 Subnets	Used
169.100.17.192 /30	✓
169.100.17.196 /30	✓
169.100.17.200 /30	Spare
169.100.17.204 /30	Spare
169.100.17.208 /30	Spare
169.100.17.212 /30	Spare
169.100.17.216 /30	Spare
169.100.17.220 /30	Spare

Table 6

When we allocate the subnet numbers to the WAN links we find that our network has all required addresses assigned as shown in Fig. 9 below.

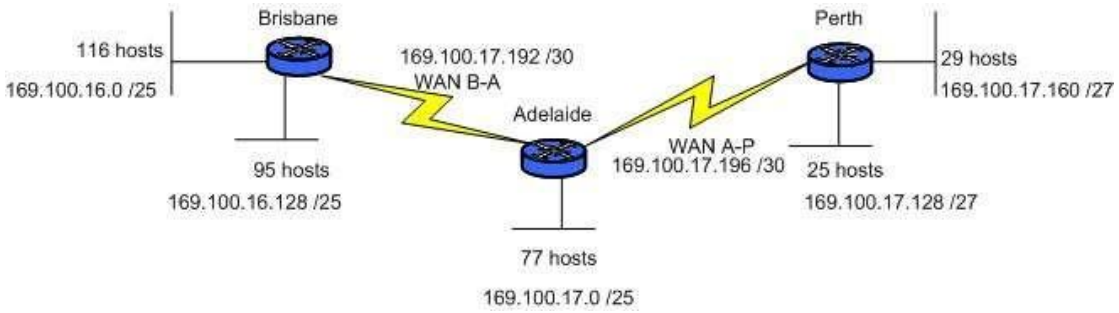


Figure 9

The three tables below summarise the allocated and spare subnets. We see that there are a large considerable number of subnets remaining from the original block of addresses allocated to us.

/25 Subnets	Used
169.100.16.0 /25	✓
169.100.16.128 /25	✓
169.100.17.0 /25	✓
169.100.17.128 /25	✓
169.100.18.0 /25	Spare
169.100.18.128 /25	Spare
169.100.19.0 /25	Spare
169.100.19.128 /25	Spare

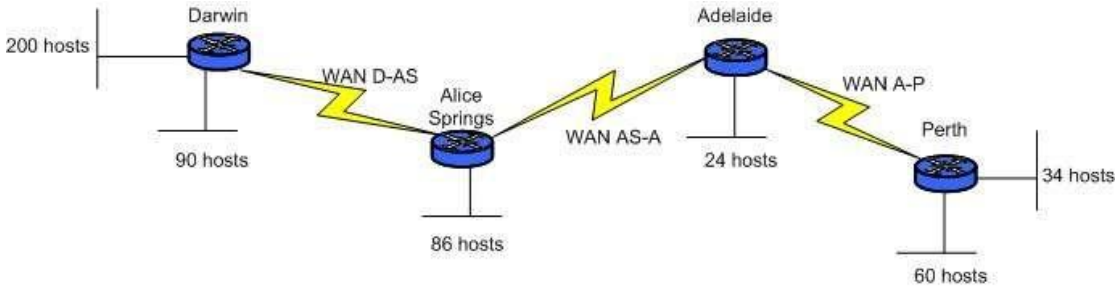
/27 Subnets	Used
169.100.17.128 /27	✓
169.100.17.160 /27	✓
169.100.17.192 /27	✓
169.100.17.224 /27	Spare

/30 Subnets	Used
169.100.17.192 /30	✓
169.100.17.196 /30	✓
169.100.17.200 /30	Spare
169.100.17.204 /30	Spare
169.100.17.208 /30	Spare
169.100.17.212 /30	Spare
169.100.17.216 /30	Spare
169.100.17.220 /30	Spare

Exercise

Using the technique demonstrated above subnet the 150.100.32.0/22 IP address range to provide subnets for the network shown in Fig. 10. Remember, you may need subnets with different sizes than those in the example above. Use table below and the template on the next page to complete your answer.

Address range 150.100.32.0/22



Number of Hosts per Subnet (largest to smallest)	**Subnet Size**	**Number of Host Bits Required**

……..for you to continue on