Network Layer Exercises

1 IP Addressing

1 This exercise refers to the network in Figure 1. You should assume throughout that you are the lead network designer for the network and that you have been allocated the network address `212.10.10.0` to satisfy all of the addressing requirements of the network. The number of hosts shown in the figure for each subnet should be regarded as the *maximum* number of hosts that need be supported by the subnet.

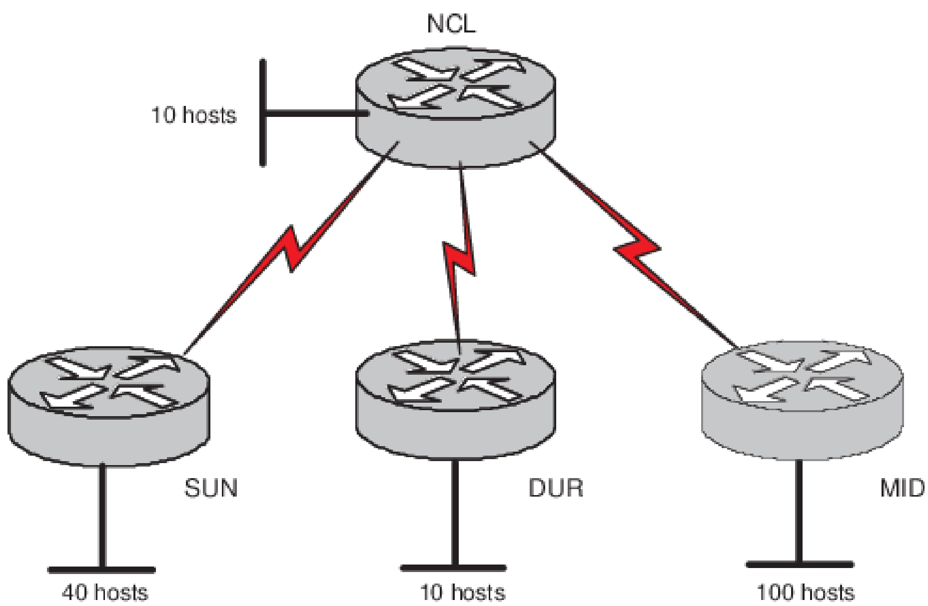

Figure 1: Network addressing

(a) What *class* of network address is `212.10.10.0`? What can be deduced about the number of octets in the network and host portions of this address from knowledge of the class of address? Explain the distinction between *classful* and *classless* addressing. What is the maximum number of hosts that can be supported by this address in a *classful* addressing scheme?

(b) Design a VLSM addressing scheme for the network in Figure 1. You may assume throughout that subnet 0 is a usable subnet. You should be guided by the requirement to make the most efficient use of the address space, i.e. minimise the allocation of host addresses on each subnet. For each router and point-to-point link, show the network address, the broadcast address, the first usable host address and the last usable host address.

2 This question refers to the network in Figure 2. You should assume throughout that you are the lead network designer for the network and answer the following questions accordingly.

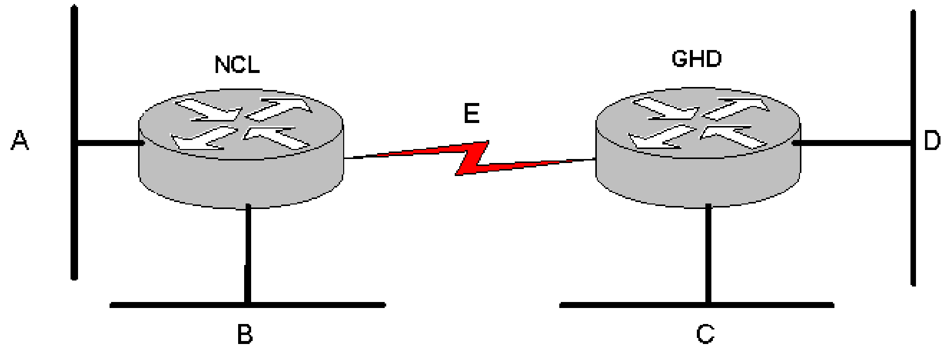

Figure 2: Network addressing

(a) Assume that you are given the *classful* IP address `192.168.7.0` to use as the basis of an addressing scheme for this network. What *class* of network address is `192.168.7.0`? What can be deduced about the number of octets in the network and host portions of this address from knowledge of the class of address? What is the maximum number of hosts that can be supported by this address in a classful addressing scheme?

(b) Given the address `192.168.7.0/24` as the basis, design a VLSM addressing scheme for the network in Figure 2. You may assume throughout that subnet 0 is a usable subnet. The maximum number of hosts required to be supported by each subnet has been determined as shown by the following table:

Subnet	Max Hosts
A	14
B	118
C	5
D	60
E	2

You should be guided by the requirement to make the most efficient use of the address space, i.e. minimise the allocation of host addresses on each subnet. Present your design in a table, showing for each subnet its network address, broadcast address, first usable host address and last usable host address.

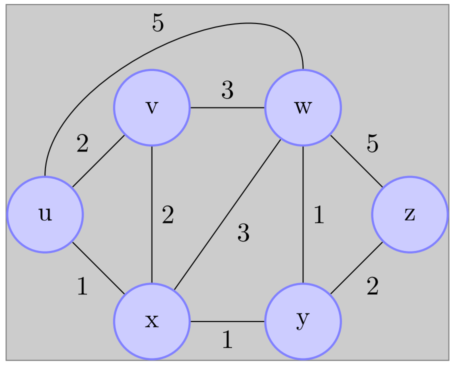

Figure 3: Network scenario

2 Link-state routing – Dijkstra's algorithm

2.1 Example

Consider the network scenario in Figure 3.

The table below shows the execution sequence of Dijkstra's algorithm at node u.

Step	N'	$D(v), p(v)$	$D(w), p(w)$	$D(x), p(x)$	$D(y), p(y)$	$D(z), p(z)$
0	u	2,u	5,u	1,u	∞	∞
1	ux	2,u	4,x		2,x	∞
2	uxy	2,u	3,y			4,y
3	uxyv		3,y			4,y
4	uxyvw					4,y
5	uxyvwz					

and the resulting routing table is as follows:

Destination	Next Hop	Cost
v	v	2
w	x	3
x	x	1
y	x	2
z	x	4

2.2 Exercises

1. Show the execution sequences and the resulting routing tables for each of the other nodes: v, w, x, y and z.
2. Imagine now that the link between x and y fails and that each node recalculates its routing table using Dijkstra's algorithm. Show the execution sequence and resulting routing table for nodes u and z.
3. Now consider the network scenario of Figure 4 and calculate the execution sequence and routing tables from the point of view of nodes u and z.
4. Imagine now that the link between u and w fails and that each node recalculates its routing table using Dijkstra's algorithm. Show the execution sequence and resulting routing table for nodes u and z.

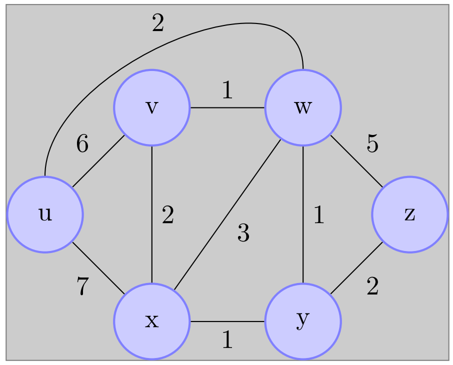

Figure 4: Network scenario

3 Distance Vector Routing – Applying Bellman-Ford equation

3.1 Example

Consider the network scenario in Figure 5.

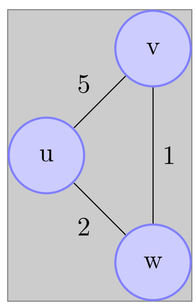

Figure 5: Network scenario

Refer to the slides in lecture 09-2 to refresh your memory about how to apply the Bellman-Ford equation in distance vector routing.

3.2 Exercises

1. Show the routing tables at each node as distance vector routing is used in the scenario above. Stop when all nodes agree on the routing tables (i.e. when the algorithm has *converged*). To shorten the number of iterations, assume that nodes receive updates from their neighbours at the same time before recalculating their distance vectors.

2. Now assume that the link from v to w changes its cost from 1 to 6. Repeat the calculation of the routing tables as above until the algorithm converges.