NUI Galway
OÉ Gaillimh

Semester 1 Examinations 2021-2022

Exam Code(s)	3BCT
Exam(s)	BSc in Computer Science & Information Technology
Module Code(s)	CT3531
Module(s)	Networks and Data Communications 2
Paper No.	1
External Examiner(s)	Dr. R. Trestian
Internal Examiner(s)	Prof. M. Madden *Dr. D. Chambers

Instructions: Answer any 4 questions.
All questions carry equal marks.

Duration	2 hours
No. of Pages	7
Department(s)	School of Computer Science

Requirements:

Release in Exam Venue	Yes	X	No	
MCQ Answersheet	Yes		No	X
Handout	None			
Statistical/ Log Tables	None			
Cambridge Tables	None			
Graph Paper	None			
Log Graph Paper	None			
Other Materials	None			
Graphic material in colour	Yes	X	No	

Question 1

a) Assume that you are working for a large corporation that wants to use the private IP address range starting at 172.16.0.0 for its internal network. The company management wants to be able to provision up to 8 separate sites in Ireland with a subnet for each site, with at least 8000 host IP addresses available per subnet. Ireland has been allocated the first /16 range available i.e. 172.16.0.0/16. You are requested to design the network layout. Answer the following questions and fully explain the logic behind each answer:

(i) What subnet mask will need to be used for the individual subnets in Ireland? Fully explain the logic behind your answer. 5 MARKS

(ii) What are the valid host addresses and the broadcast addresses for the first and second subnets in Ireland? 5 MARKS

(iii) The company has operations in 15 other European countries and each country has been allocated a /16 address range. These individual /16 address ranges are contiguous and Ireland has been allocated the first of these ranges. What route summary or supernet could be used to define a single routing entry for all of the European address ranges? 3 MARKS

b) Write a short essay, approximately 300 words, on one of the following topics. The essay should include a full description of the topic and also discuss its advantages, disadvantages, competitor technologies (if applicable) and its likely evolution:

(i) The Domain Name System (DNS)
(ii) Packet Filtering and Firewalls
(iii) Internet Exchange Points 12 MARKS

Question 2

A company has an office building that has been fitted out with the Local Area Network topology shown in Figure 1 below:

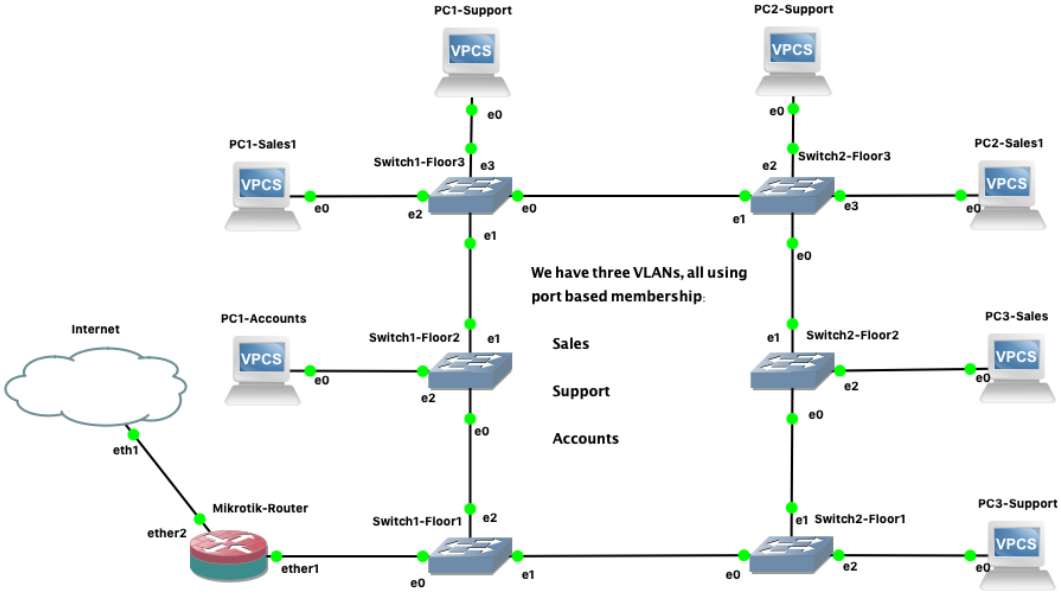

Figure 1 - Local Area Network Topology

The office building has three floors and each floor has two network switches that are used to interconnect with other switches and to connect end user devices e.g. PCs. The company is organised into three departments i.e. Sales, Support and Accounts, each department has its own VLAN. There is also a Mikrotik router connected to one of the switches on the ground floor, this router also provides internet access via an ethernet connection provided by an ISP. Answer the following questions in relation to the design and configuration of this network.

a) What are the advantages of using a VLAN for each Department? Suggest a suitable VLAN id and IP subnet for each VLAN. 5 MARKS

b) What port configuration would be required for Switch2-Floor3? In this context explain the purpose of the 802.1q protocol. 5 MARKS

c) Assume that the router gets a public IP address via DHCP from the ISP connected via ether2. What RouterOS commands are required on the router to ensure that NAT is used for outgoing internet traffic? 5 MARKS

d) What steps and additional configuration would be needed, on the router and the switches, to add another new VLAN to the existing setup? 5 MARKS

e) What mechanism is used to ensure that a broadcast storm does not occur due to the fact that the switches are interconnected in a loop type topology? Explain the basic operation of this mechanism. 5 MARKS

Question 3

a) Explain how traceroute works and what it shows. 5 MARKS

b) State and differentiate the three main means of interconnecting an Autonomous System with another Autonomous System. 3 MARKS

c) Describe briefly each of the following: Border Gateway Protocol, Internet Exchange Point, Asymmetric Route 6 MARKS

d) Describe in your own words what a Route Server is, what function it performs and why it is necessary. 5 MARKS

e) The result of running 'show bgp ipv4 unicast 140.203.0.0/16' on an internet facing BGP router of an ISP in Ireland is shown below. What is the best path from that ISP to the NUI Galway network (140.203.0.0/16)? Explain fully in your answer how the best path is chosen in this case. 6 MARKS

```
rtr01#show bgp ipv4 unicast 140.203.0.0/16

BGP routing table entry for 140.203.0.0/16

Paths: (3 available, best #x)
  174 3356 1213 1213
    154.50.192.49 from 154.50.192.49 (154.26.32.227)
      Localpref 100, valid, external
  1213
    194.88.240.15 from 194.88.240.8 (194.88.240.8)
      Localpref 400, valid, external
  1213
    83.220.203.172 from 83.220.203.172 (83.220.203.170)
      Localpref 300, valid, internal
```

Question 4 Consider the example network shown in Figure 2 below:

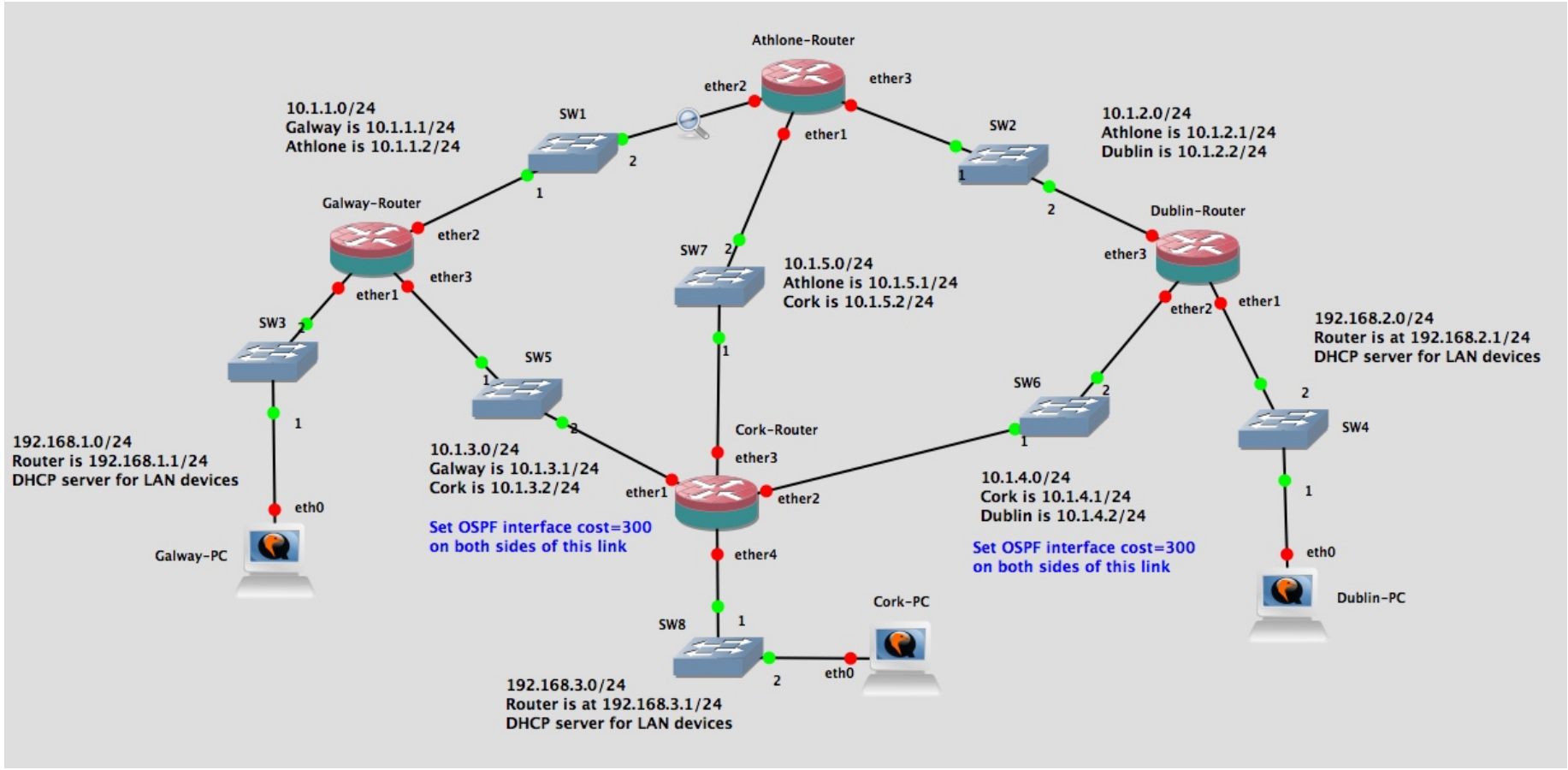

Figure 2 - Example Network

Answer the following questions in relation to this network:

a) Describe the operation and purpose of the OSPF protocol in the network shown. What is the Link State Database and how is Dijkstra's Algorithm used by OSPF in this context? 5 MARKS

b) Describe the format of an OSPF Link State Announcement. Explain how a Link State Announcement from the Galway router would be disseminated throughout the network? 6 MARKS

c) What route will a PC attached to the Cork router normally take to get to the Galway router? What would happen with OSPF if the link between the Galway and Athlone became unavailable for some reason? 5 MARKS

d) Suppose a company was using the RIP dynamic routing protocol on its routers, what reasons would you give to persuade them to change to OSPF instead? In this context explain the difference between Distance Vector and Link State routing. 5 MARKS

e) What is special about the entry **0.0.0.0/0** in an IPv4 routing table? What option needs to be enabled in OSPF to make sure this route is available on other routers within an OSPF network? 4 MARKS

5.a: What types of Sockets are supported in the Java networking package and which type of Socket would you recommend for a VOIP type application and a File Transfer type application? 5 MARKS

b: Write a network Server program in Java where the Server waits for incoming client connections using stream type sockets. Once a Client connects it sends a String object to the server with a simple query – the server then responds with a text based response. The connection is then terminated. The server should use a separate thread of execution for each new client connection and all interaction between the Server and the Client should be done within this thread. The answer only needs to include source code for the server side application. 10 MARKS

c: Write another Java application with the same functionality as outlined above, in part b of this question, but this time using Datagram type sockets. Hint: you can use ByteArrayOutputStream and ByteArrayInputStream to populate and read the array associated with the DatagramPacket object. This application does not need to implement a reliable data transfer protocol or use multiple threads at the server for each new client. The answer only needs to include source code for the server side application. 10 MARKS