



OLLSCOIL NA GAILLIMHE
UNIVERSITY OF GALWAY

Autumn Examinations 2022-2023

Course Instance 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 6
Department(s) School of Computer Science
Course Co-ordinator(s) Dr Colm O’Riordan

Requirements:

Release in Exam Venue	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
MCQ Answersheet	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
Handout	None			
Statistical/ Log Tables	None			
Cambridge Tables	None			
Graph Paper	None			
Log Graph Paper	None			
Other Materials	None			
Graphic material in colour	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>

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 16 separate sites in Ireland with a subnet for each site, with at least 4000 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. 4 MARKS
 - (ii) What are the valid host addresses and the broadcast addresses for the first and second subnets in Ireland? 4 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) Virtual LANs
 - (ii) Packet Filtering and Firewalls
 - (iii) Dynamic Routing Protocols 14 MARKS

Question 3

- a) Explain how traceroute works and what it shows using an appropriate example. 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 the command `/ip route print` on a Mikrotik router is shown below. The router is running OSPF with other routers in the same Autonomous System:

```
[admin@10.10.10.1] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
```

#	DST-ADDRESS	PREF-SRC	GATEWAY	DISTANCE
0	ADo 0.0.0.0/0		10.1.1.2	110
1	ADC 10.1.1.0/24	10.1.1.1	ether1	0
2	ADo 10.1.4.0/24		10.1.1.2	110
3	ADC 10.10.10.1/32	10.10.10.1	loopback	0
4	ADo 10.10.10.2/32		10.1.1.2	110
5	ADo 10.10.10.4/32		10.1.1.2	110
6	ADC 172.21.1.0/30	172.21.1.2	ether2	0
7	ADC 192.168.10.0/24	192.168.10.1	ether3	0
8	ADo 192.168.11.0/24		10.1.1.2	110
9	ADo 192.168.12.0/24		10.1.1.2	110
10	ADo 192.168.81.0/24		10.1.1.2	110
11	ADC 192.168.182.0/24	192.168.182.138	ether4	0

Answer the following questions in relation to this routing table.

- What does the route entry for destination 0.0.0.0/0 mean and why is this route entry particularly important? 2 MARKS
- Is the destination IP range 192.168.10.0/24 on the same router or a different router? How can you tell? 2 MARKS
- What is the meaning of the GATEWAY value shown and how might this affect a routing decision? 2 MARKS

Question 4

Assume that an Internet Service Provider has built a routed network in Co Galway as shown in Figure 2 below:

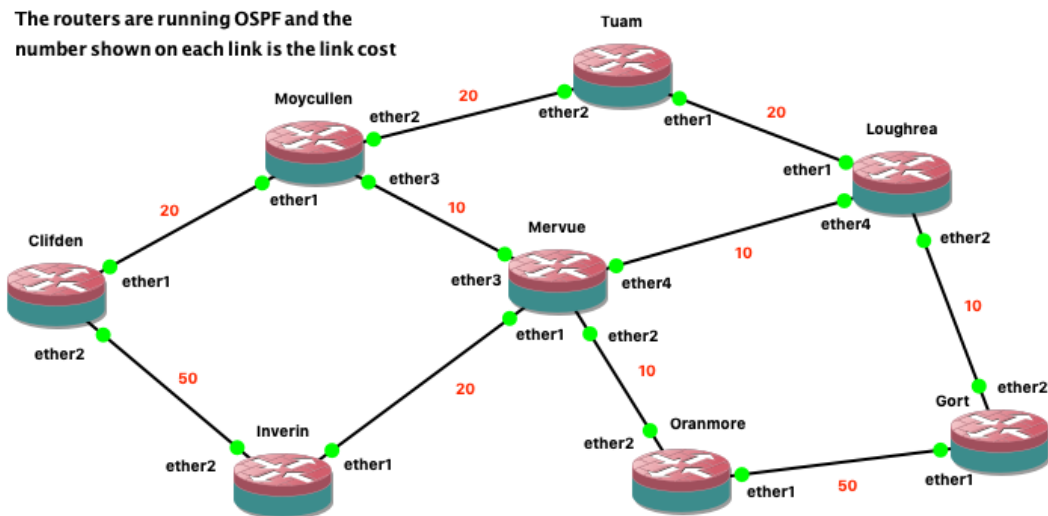


Figure 2 - ISP Regional Network

The routers are all Mikrotik routers running the RouterOS operating system. Answer the following questions in relation to the operation and configuration of this network. Please note that you do not need to build the network shown in the GNS3 simulator to answer these questions.

- Describe the operation and purpose of the OSPF protocol in the network shown. How is Dijkstra's Algorithm used by OSPF in this context and what would the sink tree look like from the Loughrea router?
5 MARKS
- Describe the format of an OSPF Link State Announcement. Explain how a Link State Announcement from the Loughrea router would be disseminated throughout the network and how can this be done reliably.
5 MARKS
- Suggest suitable IP subnets for the links connected to the Loughrea router. What RouterOS commands are required to assign appropriate IP addresses and to also fully enable OSPF on the Loughrea router?
5 MARKS
- What route would a PC attached to the Inverin router normally take to get to the Gort router? What exactly would happen with OSPF if the link between Inverin and Mervue became unavailable for some reason?
5 MARKS
- Assume that the Clifden router needs to have an additional local area network, attached to ether3, for some end user devices e.g. PCs. Suggest a suitable IP subnet for this new local area network. What RouterOS commands would be required on the Clifden router to assign an appropriate IP address for this additional local area network and to ensure that the new IP range is reachable from the other routers in the network?
5 MARKS

Question 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 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