

## **BSc in Telecommunications Engineering**

**TEL3214**

### **Computer Communication Networks**

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### **Author**

Diarmuid is a Chartered Engineer (CEng) with over 25 years experience in Telecommunications, Information Networking and Security. He has designed and implemented next-generation networks and information security solutions for major multi-national communications companies as well as serving as Chief Technical Officer for an Irish Internet Service Provider for over 5 years. Since 1999 he has also lectured on Telecommunications and Computing programmes at both the Dublin Institute of Technology (DIT) and the Institute of Technology, Carlow (ITC) in Ireland and more recently at the College of Engineering, Design, Art and Technology (CEDAT) at Makerere University.



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## 1. Module Aims

The aim of this course is to understand the principles, design algorithms behind building blocks of computer networks as well as practices describing how things are done in practice (in the case of Internet and the Web).

## 2. Objectives

- Define the components of a network, devices and topologies.
- What are networking models; the Open Standards Interconnect (OSI) 7 layer model); Department of Defence (DoD) model (Transmission Control Protocol/Internet Protocol (TCP/IP).
- Understand the concept of Local, Metropolitan and Wide Area Networks (LAN/MAN/WAN).
- Describe switching and explore switching concepts; packet switching, circuit switching, Virtual LANs (VLAN).
- Describe the concepts of IP routing, IPv4 and IPv6.
- Describe routing; routing protocols, static routing, distance vector and link state protocols.
- Demonstrate through the building of simple networks the concepts of switching and routing.
- Understand fundamental concepts of networks and their topologies; and understand the concept of network architecture and its hardware components.
- Explore Client-Server applications through the design and building of a simple interactive web-based application.
- Describe the need for network security, the issues involved in the development of a secure network and consolidate through the implementation of a simple firewall.
- Describe the issues for network management arising from a range of security threats, including viruses, worms, Trojan horses, and denial-of-service attack.
- Describe the purpose of encryption, the function of public and private keys, the concept of Transport Layer Security (TLS).
- Describe the main characteristics of mobile IP and explain how differs from IP with regard to mobility management and location management as well as performance.
- Summarise the basic characteristics of sampling and quantisation for digital representation.
- Describe the most appropriate compression techniques for text, audio, image, and video information.

### 3. Course content

#### **Review of Telecommunication networks**

Hardware and software, reference models (Communications Protocol stacks): The OSI Model Vs the TCP/IP Model, transmission media, wireless transmission, the telephone system and the new telecommunication systems.

#### **Brief discussion of the Physical Layer**

Electromagnetic signals “on the wire” Transmission: Modulation, Digitisation, Synchronisation, Transmission Media, Physical Layer Standards : RS-232, CCITT X.21, etc..

#### **Link Layer**

Data transfer between neighbouring network elements including encoding, framing, error correction, access control for shared links (MAC protocols) examples to include Ethernet standards, WiFi, satellite etc..

#### **Network Layer**

Detailed study of routing and addressing. IPv4, IPv6, OSPF.

#### **Transport Layer**

Host-to-host data transport. Detailed study of reliable data transport, congestion control, flow control with examples of TCP and UDP.

#### **Application layer:**

Detailed study of the Network Applications, Client-Server architecture. Popular applications, HTTP, SSH, SFTP.

#### **Firewalls and Network Security**

Study of firewalls, personal firewall, device firewall. Scenario study.

#### **Advanced topics in computer networks**

Multimedia networking, wireless networks, overlay networks; Case studies of emerging network systems/technologies: Software Defined Networking (SDN).

## 4. Teaching and Learning Strategies

Formal lectures, group-based activities, class discussion, case studies and laboratory sessions may be used in the presentation of this module. Typically the lectures will include practical sessions providing students with the immediate opportunity to implement and reinforce the material presented in the lectures.

## 5. Module Lectures

Lecture set 1 – Introduction to Computer Networks

Lecture set 2 – Internetworking Models

Lecture set 3 – Transmission Media: Copper and Fibre

Lecture set 4 – Establishing Network Training Emulation (NTE)

Lecture set 5 – Switching

Lecture set 6 – Internet Protocol

Lecture set 7 – Routing

Lecture set 8 – Wireless LAN

Lecture set 9 – Applications

Lecture set 10 – Network Security

Lecture set 11 – Firewalls

Lecture set 12 – Software Defined Networking

Appendix 01 – Building NTE Virtual Machine

Appendix 02 – Building a SDN Virtual Machine

Appendix 03 – Policy Based Routing example

## 6. Assignments

All assignments will be submitted in both Open Document Format (ODF) and Portable Document Format (PDF). Assignments will be typed in FreeSans or Arial font size 12 single spaced with the text paragraphs justified. The header on each page must include on a single line the title of the assignment in bold type FreeSans or Arial font, size 10.5 while the footer should include the authors name, e-mail address and the page number, all again in font size 10.5 FreeSans or Arial. A coversheet will also be included which will have the assignment title and author's name in font FreeSans or Arial, size 14 bold typeface centred on the page both horizontally and vertically. Header and footer will be separated from the body text by a horizontal line.

Assignments will NOT be accepted after the deadline.

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