

## **Diploma in Business Information Systems – Part 2**

### **Networks and Distributed Systems**

This course unit offers an insight into Enterprise Networks with an emphasis on their technological basis and corporate applications.

#### **Aims**

1. Build on the concepts introduced in Computer Fundamentals.
2. Provide an overview of the principles of telecommunications.
3. Examine the underlying technology to communications systems, especially those concerned with PC LANs and WANs, including the Internet.
4. Introduce the issues involved in the building and use of Open Systems and applications.

#### **Programme Content and Learning Objectives**

**After completing the programme, the student should be able to:**

1. Understand and apply basic data communications principles and concepts
2. Understand the importance of structured models such the OSI - ISO model
3. Identify different LAN technologies and understand their various differences, similarities, advantages and disadvantages
4. Describe distributed applications such as EDI, E-mail and understand their various differences, similarities, advantages and disadvantages
5. Understand the emerging role of client-server operation
6. Map TCP/IP onto the OSI model and apply to enterprise network architectures
7. Contrast de Jure, de Facto & Proprietary standards and understand their importance to business in making decisions about communications networks

## **Syllabus Content**

### **Standards**

Standards Bodies: De Jure, De Facto & Proprietary Standards Bodies & Regulators. Technology development and standards creation. An Introduction to layered models for business data communications, the ISO OSI 7-layer functional model.

### **Data Communication Concepts**

End-to-End data communication. Simplex, Duplex, Synchronous, Asynchronous, Digital, Analogue, Serial & Parallel transmissions. Media, characteristics of signals; bandwidth. Modulation and demodulation principles using amplitude and frequency. Modems. Protocol basics. An introduction to character encoding (EBCDIC vs. ASCII) and data compression (lossless vs. lossy)

### **Local Area Networks(LANs)**

Characteristics of network used in local area networks. Their topologies, transmission media and access techniques, and their associated IEEE 802 standards, including both wired & wireless LANs. Mapping various network models onto the ISO reference model. An introduction to high speed LANs & MANs. An introduction to structured wiring. LAN operating systems.

### **Wide Area Networks(WANs)**

Characteristics of network topologies used in wide networks. Mapping various network models onto the ISO reference model, including TCP/IP. Appreciation of circuit and packet switching and network routing with reference to public and networks, ISDN and X.25. Connectionless and Connection-oriented operation.

### **Interconnection & Internetworking**

Interconnection methods. Bridges, routers, brouters, gateways. Modems. Security : firewalls, encryption.

### **Applications**

ISO & non ISO application protocols, such as X.400, X.500, FTP, SMPT and their use in e-mail, EDI etc., Client-server models. TCP/IP Enterprise networks such Intranets and Extranets. Meeting the needs of Businesses. The Internet.

### **Method of Assessment**

By written examination. The pass mark 40%. Time allowed 3 hours.

### **The question paper contains:**

**Seven** questions of which **five** must be answered. All questions carry 20 marks.

It is expected that candidates will have done some practical work which would involve access to the Internet using a browser and the use of message handling systems such as e-mail, as this helps to set the context for this unit of study, but this work will not be directly assessed by the ABE.

## Reading List:

### Essential Reading

Applied Data Communications: A Business-Oriented Approach	James E. Goldman	2nd Ed., Wiley. ISBN 0-471-17067-4
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### Additional Reading

Business Data Communications and Networking	Jerry Fitzgerald & Alan Dennis	5th Ed., Wiley. ISBN 0-471-12365-X
Data Communications Computer Networks and Open Systems	Fed Halsall	4th Ed., Addison-Wesley ISBN 0-201-56506-4
Essentials of Data Communications	David Stamper & the Saratoga Group	Benjamin Cummings ISBN 0-8053-7736-0
Business Data Communications	David Stamper	Benjamin Cummings ISBN 0-8053-7715-8

## Computer & Software Access

### Recommended

Internet Access either via a commercial Internet Service Provider (ISP) home service or from a workplace desktop facility (or CyberCafe/InternetCafe facility) so that students may become experienced in the use of Browser software and search engines. Use of electronic mail (e-mail) to include the use of Internet addresses, using enclosures, encoding and compression facilities.

### Guidance Notes for Tutors

### Weighting of Topics and Sections

This syllabus is comprised of 6 sections. With the exception of the section on Interconnection & Internetworking it is divided into more or less equal parts, with that for Interconnection & Internetworking being approximately half the work of any other section. If students are offered the recommended 36 hours tuition over say 10 weeks then one would expect to spend about 2 weeks per section.

I am assuming that Goldman's book will be used. The text has some very useful case study material that could be used by tutors to direct the students work outside the formal taught sessions. I understand that an Instructor's Resource Guide is available and it includes a CD-ROM of the book's diagrams and illustrations. Although I have neither used nor seen the guide and as such can't comment on its direct applicability I would recommend that tutors acquire it and modify it to support the course. In these notes I shall indicate sections within Goldman which do NOT form part of the course. Needless to say candidates may study these sections for interest at their leisure! In my opinion, the best information on the functional layers of the OSI model in Halsall's book. This book is at too a technical level for this course to use as the main text, but I would hope that tutors would find it particularly useful as a backup on technical issues for them, for in my view it is still one of the most clearly written books on data communications.

It is particularly important to get across the idea that networks and distributed systems exist to meet the needs of business and not for the good of technical support staff. Networks and distributed systems provision is expensive and needs to be cost effective to support business functions. Encourage students to look the newspaper business pages or the on-line services of the (London) Financial Times, (London) Times or New York Times, etc. In any of these publications there are regularly reports about the telecomms industry.

## **Standards**

*See Goldman chapter 1*

As part of this section students should acquire a perspective of the Data Communications Industry. Goldman's fig 1.1 is an excellent mechanism to understand the components , forces and interactions concerned.

In addition it would be useful background to understand the position of the local national PTT(s). Goldman uses the breakup of Bell as a case study, but a good exercise for the students would be to write a short report about their local "players". For example is the local PTT a state monopoly? what sort of services are provided? Who are the ISPs? etc.

The standards process : without going into how the ISO works, the students should be able to distinguish between de Jure, de facto & proprietary standards and how proprietary become de facto and in turn de facto become de Jure. The effect of this in terms of open systems standards.

Layered models : Goldman's Top-Down model makes a good introduction to the concept of logical functional layers which have clearly defined boundaries. The OSI models need only be used for functional mapping purposes. For example e-mail may be supported by either wired or wireless LANs and across WANs. Halsall (see section 1.4 for the ISO reference model) has a particularly useful section on the functions and shows the mapping to various services (see figure 1.10, Protocol Layer Summary). The ISO reference model is a useful vehicle to discuss most of the rest of the curriculum. Halsall section 1.5 on Open Systems Standards provides figures which give example mappings for international standards.

## **Data Communication Concepts**

*See Goldman chapter 2 and chapter 3.*

It is important to be able to distinguish between the various types and modes of communication. I find it useful to describe the various ways of dividing the "communications cake" as some students seem to think that Simplex, Duplex (full + half), Synchronous, Asynchronous, Digital, Analogue, Serial & Parallel are just 8 states rather than 4 different views each with 2 states.

If you follow Goldman, figure 2.1 provides a useful perspective of end-to-end modem based communication.

Only a basic comparison between EBCDIC and ASCII will be necessary, i.e., no need to know the ASCII table, but they need to know that there are both graphical characters & control characters. Similarly they should know the difference between serial and parallel transmission, but will not need to know the technical details of the standards for the RS232, instead they will need to know that it exists and where it might be used.

Modem principles :I suggest that tutors use the I-P-O model in Goldman to introduce the concept of modulation. They should understand the general differences between frequency and amplitude modulation without studying the maths behind the principles. No need to cover phase modulation, QAM, Nyquist etc.. Table 2.23 is useful to provide the context.

Modem + data compression: Part of Goldman chapter 3 up to & including table 3.5

No need to know the details of modem standards or compression standards instead to know the difference between "lossless & lossy" for the latter. The section on Communications Software Functionality -Top-down approach to communications software analysis - at the end of chapter 3 should be included.

## **Local Area Networks(LANs)**

See Goldman chapter 5. This provides a fairly full coverage of the material. Use the OSI - ISO reference model to show the mapping for LANs. As you'll see, figure 5-4 is very useful and provides help with the course sections on WANs and Applications. Students should appreciate that IEEE 802.n and ISO 8802.n are essentially the same. This provides a nice link for the section on standards bodies so the students understand the role of standards makers in de Jure process. Describe the IEEE 802.n architecture including the latter part of the chapter on the introduction to high speed LANs.

See Goldman chapter 6 for background information on structured cabling. Students should know why there are different standards/categories and when it is appropriate the use them rather than the precise technical details.

## **Wide Area Networks(WANs)**

See *Goldman chapter 8*. This gives a good basis for this section. The student should be able to contrast circuit-switched operation and packet-switched operation

Connectionless and Connection-oriented operation : students should be able to compare datagrams and virtual circuit operation

No need to include Broadband transmission architectures, Digital Service Hierarchy, SONET, the technical details of ISDN i.e. go as far as the information in figure 8.13. The introductory sections of X25 should be included as far error detection & correction which can be left for students to read for interest only. ATM is not included. Use the section on Internet Suite of Protocols Model in Goldman chapter 1 to discuss TCP/IP together with the section in Goldman chapter 7. There is no need to cover TCP/IP encapsulation.

## **Interconnection & Internetworking**

See *Goldman chapter 9 & chapter 13*

Interconnection methods: It is important not to get bogged down in the details. The students need to understand that repeaters are (OSI reference model) level 1 devices, bridges are level 2 devices, routers are level 3 devices etc.. Chapter 9 as far as "routing protocols" provides most of the material. No need to include specific examples of commercial products. The tables of Repeaters & Bridges Technical Analysis provide a useful background, but would not be examined.

Security : see chapter 13. I suggest you use this chapter as far as the section on firewall functionality together with the section on encryption. i.e. "Authentication & Access Control " and "Applied Security Scenarios" are not required other than for background.

## **Applications**

See *Goldman chapter 11*

ISO & non ISO application protocols: specific technical details are not required. The idea is for students to understand the principles of message handling systems and its importance to businesses e.g., their use in e-mail, EDI, electronic commerce. The start of Goldman chapter 11 as far as and including "Overall Enterprise Network Architecture" is useful. The sections on "Enterprise Network Logical Design" and "Enterprise Network Physical Design" are not required.

The Internet :Goldman chapter 11 sections on "The Internet as an Enterprise Network backbone" to the end but omitting product specific information, other than for background. Intranets and Extranets as TCP/IP Enterprise networks . Distinguish between Intranet & Extranet.

Client-server models: Simple definitions & models in terms of use in distributed systems. Goldman chapter 7 – details of operating systems are not examined.