Unit 31: Telecommunications Systems

Unit code: Y/602/4639

QCF Level 3: BTEC Specialist

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit will enable learners to develop their knowledge and understanding of the services offered by modern telecommunications systems.

Unit introduction

Just a few years ago most people just had access to a basic telephony service provided over a pair of wires. Data and mobile services were available but, because of cost, their use was restricted mainly to large companies. The capabilities of the data services that were available then were also severely limited.

However, since then the range and capabilities of telecommunications services has increased dramatically while their cost has decreased. Most people now use a mobile phone and increasing numbers have high-speed access to the internet. Even small companies use mobile and fixed line data services.

This unit introduces learners to the facilities and features of conventional telephony services and the data services available to integrated services digital network (ISDN) customers. Many larger businesses need to transfer significant amounts of information, often financially critical, between offices. This unit introduces learners to the principles and characteristics of the various methods of providing reliable, secure data communications services.

The data service that has had most influence on the way we work is, without doubt, that provided by the internet. The administration and operation of this 'network of networks' is therefore, discussed in some detail.

Another telecommunication service that has had a major influence on our way of life in recent years is the mobile telephone service. This unit describes the technologies that allow wireless communications and the services offered by the various types of mobile service.

Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

On completion of this unit a learner should:

Learning outcomes	Assessment criteria
1 Know the facilities and applications of Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) services	1.1 describe the telephony services provided by the PSTN 1.2 describe typical applications of ISDN services
2 Understand the operation, characteristics and applications of Wide Area Network (WAN) services	2.1 explain the principles of the technologies used in a WAN 2.2 describe the capabilities and applications of a modern WAN service
3 Understand the operation, administration, characteristics and capabilities of the internet	3.1 describe the role of the bodies involved in the operation and administration of the internet 3.2 explain the operation of the internet and the role of its functional components
4 Understand the principles and capabilities of modern mobile communication services	4.1 explain the principles and capabilities of radio access technologies 4.2 alternative mobile system

Unit content

1 Know the facilities and applications of Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) services

PSTN service: plain old telephone service (POTS) facilities; error indications eg engaged tone, number unobtainable tone; recorded announcements; progress indicators eg ringing tone, number unobtainable tone; modern PSTN services eg caller display, ring back when free, call waiting, conference call, divert on busy, voice mail; special rate services eg emergency calls, freephone, premium rate; information services eg directory enquiries, time announcement; features and applications of a central office exchange (CENTREX) service

Applications of ISDN services: capabilities of a basic rate access (BRA) in terms of the B and D channels; use of B channels for telephony and data transfer; applications of basic rate ISDN eg telephony, internet access, file transfer, video conferencing; B channel bonding; ISDN standards; primary rate access (PRA) ISDN; n X 64 kbit/s service; applications of PRA ISDN eg high quality video conferencing, connection of a private automatic branch exchange (PABX) to the PSTN

2 Understand the operation, characteristics and applications of Wide Area Network (WAN) services

Principles of WAN technologies: advantages of packet-switched data services; statistical multiplexing gain; causes and effects of congestion; quality of service (QofS) parameters; connection-oriented service; concept of virtual circuits; connectionless service

Capabilities and applications of a WAN service: leased lines; characteristics of modern data services eg asynchronous transfer mode (ATM), X25, frame relay, Ethernet, switched multi-megabit data service (SMDS), digital subscriber line (DSL) services (error correction facilities, QofS and applications); ATM virtual circuits; definition, applications and security aspects of virtual private networks (VPN); integration of voice, video and data services

3 Understand the operation, administration, characteristics and capabilities of the internet

Administration of the internet: roles of internet administrative bodies eg Internet Society (ISOC), Internet Engineering Task Force (IETF), Internet Corporation for Assigned Names and Numbers (ICANN); role of IETF requests for comment (RFC); role of internet service providers (ISP) and network service providers (NSP); the domain name system (DNS); role of DNS registrars

Operation of the internet: role of and relationship between internet protocols with reference to the open systems interconnection reference model (OSIRM) eg internet protocol (IP), user datagram protocol (UDP), transmission control protocol (TCP), hypertext markup language (HTML), file transfer protocol (FTP), simple mail transfer protocol (SMTP), post office protocol (POP); role of routing protocols eg routing information protocol (RIP), open shortest path first (OSPF); role of functional components (network access point (NAP), point of presence (PoP), DNS servers, routers, web servers, email servers); capabilities of methods of internet access eg ADSL, SHDSL, BRA ISDN, dial-up over the PSTN, wireless access

4 Understand the principles and capabilities of modern mobile communication services

Radio access technologies: types, Global System for Mobile (GSM), third generation (3G)

Global system for mobile (GSM) radio access technology: role of European Telecommunications Standards Institute (ETSI); use of time division multiple access (TDMA) and frequency division multiple access (FDMA); concept of cells eg frequency re-use in cells, location areas, GSM cell capacity; short message service (SMS); enhanced message service (EMS); capabilities of standard GSM data services and enhanced GSM data services eg high-speed circuit switched data (HSCSD), general packet radio service (GPRS), enhanced data rates for GSM evolution (EDGE); role of subscriber information module (SIM)

Third generation (3G) radio access technology: role of 3G partnership project (3GPP); principles of wideband code division multiple access (WCDMA); spreading factor; universal mobile telecommunications system (UMTS) cell capacity; relationship between location areas and routing areas; role of universal subscriber identity module (USIM); principles of high-speed downlink packet access (HSDPA); capabilities of modern mobile data services eg GSM, GPRS, UMTS, HSDPA; 3G services including multimedia message service (MMS), video services, location services

Alternative mobile services: eg digital enhanced cordless telecommunications (DECT), Wi-fi, WiMAX, Bluetooth, terrestrial trunk radio (TETRA), near field communications (NFC)

Essential guidance for tutors

Delivery

This unit takes into account the rapid technological changes that are occurring in telecommunications services. It also acknowledges that many countries still rely on conventional telecommunications services. Tutors should ensure that learners appreciate this while they gain an insight into how telecommunications services might evolve.

This unit could be delivered as a stand-alone unit or could be integrated with other telecommunication systems units in order to enhance learning.

It is particularly recommended that *Core Networks* is studied alongside this unit, since it covers aspects of mobile radio systems that complement learning outcome 4. The Core Networks unit also covers parts of the PSTN and ISDN that will aid study of learning outcome 1 and aspects of packet-switched networks that complement learning outcome 3.

Tutors should try to use as wide a range of delivery techniques as possible. For example, lectures, discussions, use of e-learning courses, learner presentations, site visits, research projects and library resources would all be suitable. These techniques can assist in the achievement of all of the learning outcomes.

The internet can be used to give learners access to company-specific websites and other sites that provide explanations of technical and service aspects of telecommunications systems. Many company sites provide technical 'white papers' that can develop learners' understanding of the technologies used in modern telecommunications systems and an appreciation of their capabilities. Descriptions of the types of technology used by a system operator may also be found to ensure learners are exposed to current practice.

The advanced technologies discussed in this unit would probably prevent the use of practical activities within centres. Therefore, learners would benefit from access to businesses involved in operating telecommunications systems, enabling them to put the subjects studied into a relevant context. This could be achieved through the centre's links with their learners' employer(s). However, this might be achieved through work placement opportunities if the course is full time with learners not yet employed . As a minimum, centres should consider supervised visits to industrial sites where learners can see the relevant equipment areas in operation. Areas that would be applicable include network management centres (NMCs), base transceiver stations (BTS), internet PoP, telephone exchanges and distribution (access) nodes. Ideally, the engineer or technician with technical responsibility for the visited area would be available to answer questions.

Where learners are employed or have access to work placements it would be of benefit for them to have supervised access to view, for example the provisioning of virtual connections or faultfinding activities. Learners could also use their workplace or placement as the context for their assessment activities (with permission from the employer/work placement). For example, learners could research and write a report describing the features and capabilities of the telecommunications systems maintained by their employer/work placement. Learners could also assist an engineer or technician in their normal duties, although health and safety issues must be taken into account with suitable training and supervision provided.

The learning outcomes can be delivered in any order, although it is suggested that learning outcome 2 should be studied before learning outcomes 3 and 4 since packet-switching forms the basis of the operation of the internet and aspects of 3G mobile service delivery.

Note that the use of 'eg' in the content is to give an indication and illustration of the breadth and depth of the area or topic. As such, not all content that follows an 'eg' needs to be taught or assessed.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments. The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
Know the facilities and applications of Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) services: • whole-class exercise – tutor presentation on plain old telephone service (POTS) facilities, followed by directed research • whole-class exercise – tutor presentation on capabilities, standards and applications of ISDN basic rate access, followed by directed research • whole-class exercise – tutor presentation on capabilities, standards and applications of ISDN primary rate access, followed by directed research.
Assignment 1 - Which one to use
Understand the operation, characteristics and applications of Wide Area Network (WAN) services: • whole-class exercise – tutor presentation on the principles of WAN technologies, followed by directed research • whole-class exercise – tutor presentation on the capabilities, standards of WAN technologies, followed by directed research • group exercise – directed research into the applications of WAN technologies, followed group reports to the whole class.
Assignment 2 - WAN technologies **Assignment 3** - This is what we offer
Understand the operation, administration, characteristics and capabilities of the internet: • whole-class exercise – tutor presentation on the roles of internet administrative bodies, followed by directed research • whole-class exercise – tutor presentation on the roles of ISPs and NSPs, followed by directed research • group exercise –directed research into the domain name system, structure and administration, followed by group presentations to the whole class.

Topic and suggested assignments/activities and/assessment
Assignment 4 - Keeping up the standard
Understand the principles and capabilities of modern mobile communication services: • whole-class exercise – tutor presentation on GSM networks, standards, types and characteristics, followed by directed research • whole-class exercise – tutor presentation on GSM networks, hardware, followed by directed research • group exercise –directed research into GSM networks, structure and capabilities, followed by group presentations to the whole class • whole-class exercise – tutor presentation on 3G networks, standards, types and characteristics, followed by directed research • whole-class exercise – tutor presentation on 3G network elements, followed by directed research • group exercise –directed research into 3G networks, structure and capabilities, followed by group presentations to the whole class • whole-class exercise – tutor presentation on alternative mobile services, followed by directed research.
Assignment 5 – On the move

Assessment

The assessment strategy for this unit could consist of a mix of report writing and formal, time constrained examinations.

It is suggested that 2.1 is assessed before the criteria 2.2—4.2.

Learners need to be made aware of the integrated nature of the pass criteria in this unit. For example, assessment evidence for pass criteria 1.1 and 1.2 could consist of a learner report that describes the services offered by public circuit-switched networks.

Similarly, assessment of 2.1 and 2.2 could be linked, for example by asking learners to explain the effects of congestion on the performance of a packet-switched data service such as ADSL or Ethernet.

3.1 and 3.2 could also be assessed together, by asking learners to describe the operation and administration of the internet domain name system (DNS).

4.1 could be assessed with a learner report explaining the principles and capabilities of the radio access technologies used in cellular mobile systems.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass criteria in the outcomes and assessment grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment methods
1.1, 1.2	Which one to use	A telecommunications company asks you to produce some training material for their recruiting team. The material should compare and contrast the principles of operation and capabilities of: ISDN base rate ISDN primary rate PSTN. Potential recruits to the company will have good Science and ICT GCSEs but will be unfamiliar with telecommunications equipment.	Web pages. Presentation. Posters. Booklet.
2.1	WAN technologies	The company asks you to produce a presentation on the Principles of WAN Technology. The material should be suitable for displaying to a non-technical audience.	Web pages. Presentation.
2.2	This is what we offer	The company now wants some material for potential customers. The company provides all the normal WAN services and you are asked to produce one section of a presentation that describes these.	Web pages. Presentation.
3.1, 3.2	Keeping up the standard	You supervisor wants you to demonstrate your knowledge of how the Internet is organised. Write a report on how the Internet Engineering Task Force (IETF) uses its Request for Comments (RFC) system to help establish and maintain protocols and standards.	Written report.

Criteria covered	Assignment title	Scenario	Assessment methods
4.1, 4.2	On the move	The company makes use of both GSM and 3G networks. You are asked to produce a simple guide for new employees, describing the differences and commonalities between the two types of. The guide must also include a section on common mobile devices that do not fit under the GSM/3G headings.	Web pages. Posters. Booklet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in IT sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
	Telecommunications Principles	Telecoms Principles
	Telecommunications Technology	Communication Technologies
		Core Network Techniques
		Telephony Voice Systems Operation
		Access Network Techniques and Applications

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 3 National Occupational Standards for IT (ProCom):

4.7   Systems Design

5.1   Systems Development

5.3   IT/Technology Solution Testing.

Essential resources

There are no essential resources for this unit.

Indicative reading for learners

Textbooks

Clark M — Data *Networks, IP and the Internet: Protocols, Design and Operation*
(John Wiley and Sons, 2003) ISBN 0470848561

Freeman R — *Fundamentals of Telecommunications, 2nd Edition*
(John Wiley and Sons, 2005) ISBN 0471710458

Goleniewski L — *Telecommunications Essentials* (Addison Wesley, 2002)
ISBN 0201760320

Griffiths J — *ISDN Explained* (John Wiley and Sons, 1998) ISBN 0471979058

Moore M, Southwick P, Pritsky T and Riggs C — *Telecommunications: A Beginner's Guide*
(McGraw-Hill Education, 2001) ISBN 0072193565

Tomasi W — Introduction *to Data Communications and Networking* (Prentice Hall, 2004)
ISBN 0130138282

Wesolowski K — *Mobile Communication Systems* (John Wiley and Sons, 2001)
ISBN 0471498378

Functional Skills — Level 2

Skill	When learners are …
ICT - Finding and selecting information	
Use appropriate search techniques to locate and select relevant information	describing the role of the bodies involved in the operation and administration of the internet
Select information from a variety of sources to meet requirements of a complex task	explaining the operation of the internet
ICT - Developing, presenting and communicating information	
Combine and present information in ways that are fit for purpose and audience	describing the telephony services provided by the PSTN describing typical applications of ISDN services explaining the principles of the technologies used in WANs describing the capabilities and applications of modern WAN services explaining the principles and capabilities of radio access technologies.