

Unit 12: Telecommunications Technology

Unit code:	K/601/3290
QCF Level 2:	BTEC Specialist
Credit value:	10
Guided learning hours:	60

Aim and purpose

To enable learners to know how telecommunication systems are linked and understand multiplexing and data transmission in order to connect telecommunications in a local system.

Unit introduction

Telecommunications have developed rapidly from a simple circuit switched network into the current 21st century broadband network capable of carrying a wide range of multimedia applications. Technological innovations in fibre optics have led to the construction of vast networks at a lower cost to the user. The use of cellular and wireless technologies (3G) along with the development Asymmetric Digital Subscriber Line (ADSL) techniques has resulted in the majority of people being able to access the new networks from their own homes. This unit introduces learners to the concepts, terminology and methodologies of telecommunications systems and networks.

The aim of this unit is to provide a clear introduction to the concepts and technology involved in telecommunications networks. The majority of the content is based upon the use of digital techniques and signals that continue to supplement or replace analogue techniques. Switching and transmission systems and sub-systems are addressed, together with typical characteristics of the type of signals carried over current networks. Practical work will be used to reinforce learners' understanding of concepts and theory. Learners will use and become familiar with, a range of cabling tools and techniques as well as preparing and terminating several types of telecommunications links and cables.

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 how telecommunication systems are linked	1.1 describe different types of telecommunications links
2 Understand how analogue and digital signals carry data	2.1 compare how analogue and digital signals carry data
3 Understand multiplexing in telecommunications networks	3.1 explain multiplexing in telecommunication networks
4 Be able to connect telecommunications for a local system	4.1 connect telecommunications for a local connection 4.2 test cables on a local telecommunications connection

Unit content

1 Know how telecommunication systems are linked

Copper links: types eg 2-wire, 4-wire, multi-core cable, colour coding, physical connectors, pin-outs, shielding, co-axial, RJ45 network cabling

Optical links: optical fibre; multi-mode fibres; single mode fibres

Radio links: microwave, satellites, GPRS, 3G, wireless internet access

Characteristics: potential problems eg loss, impairments, attenuation, interference, noise, distortion, truncation

2 Know how analogue and digital signals carry data

Analogue: signals eg analogue periodic signals, amplitude, period time, wavelength, frequency, wave equation, speech signals, sampling, modulation

Digital: signals eg two-state signals, binary, bits, pulse amplitude modulation, digitisation, pulse code modulation, encoding/decoding, synchronisation

3 Understand multiplexing in telecommunications networks

Multiplexing in telecommunication networks: the plain old telephone service (POTS) eg distribution, switching, manual exchanges, operator patching, electro-mechanical exchanges, digital switching private branch exchanges (PBX); mesh connections; multiplexing/de-multiplexing eg space, frequency, time division hierarchies; analogue and digital networks eg dial-up, leased line services, contention based, mobile

Pulse code modulation: analogue to digital signal conversion eg filtering, sampling, quantisation coding; advantages of digital

Digital data: digital subscriber line (DSL) techniques eg ADSL; mobile eg 3G, 4G

Multiplexing equipment: equipment eg 30 channel system, PCM, sampling rate, data rates, multiplexing techniques

Line equipment: eg amplifiers, isolators, transformers, primary and secondary cross-connect points, street cabinets, local exchange multiplexers and de-multiplexers

Data communication equipment and interfaces: eg modems, ADSL routers, regenerators

4 Be able to connect telecommunications for a local system

Telecommunications: telephone sub-systems eg dialling, alerting, signalling, speech circuitry, pulse dialling, tone dialling, handset digit frequencies; line equipment eg amplifiers, isolators, transformers, primary cross-connect points, secondary cross-connect points, street cabinets, local exchange, multiplexers, demultiplexers; data eg modems, ADSL routers, regeneration, 3G, 4G

Local system: architecture of access networks eg local exchange to customer network topologies, POTS networks, DSL, 3G, 4G

Terminating cables: copper links eg multi-core SCART, printer cable, co-axial radio frequency cable, RJ45, RJ11

Testing cables: checks eg testing for continuity, short circuits, near, far end cross-talk

Essential guidance for tutors

Delivery

This unit is designed to develop the underpinning knowledge and skills of learners in the fields of telecommunications systems and computer networking. The focus of learning outcome 1 will be the investigation of existing practical telecommunications networks.

Tutors should provide support in the form of guided discussion and presentations on the topics listed in the first section of the content. Initially, tutors should cover the properties of the infrastructure of the analogue local loop, the need for switching and the use of modems to convey digital data. The requirement for multiplexing voice and data signals on high capacity broadband networks should be covered with the emphasis on Pulse Code Modulation and Time Division Multiplexing. The applications of radio and wireless links, the use of optical fibres in high capacity long distance networks and fibre to the curb in the local loop should also be covered. Tutors also need cover the range of services offered and the types of traffic carried over telecommunications networks.

Learning outcome 2 lends itself to a range of practical activities. Tutors are encouraged to prepare a series of demonstrations and/or practical experiments involving signal and pulse generators, oscilloscopes and other measuring instruments in order to allow learners to investigate the nature of analogue and digital signals.

Learning outcome 3 may be best delivered by a combination of practical activities and tutor-led presentations. If possible, a site visit to a local telephone exchange should be arranged.

Finally, learning outcome 4 lends itself to a range of practical activities in the construction, terminating/establishment and testing of communications links. Tutors should cover the relative characteristics of copper, optical fibre and radio links together with the causes of attenuation and distortion in each case.

Note that the use of examples 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 example 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
<p>Current developments in telecommunications networks:</p> <ul style="list-style-type: none"> • whole-class exercise – tutor presentation on multiplexing • whole-class exercise – tutor presentation on understanding pulse code modulation • individual exercise – how is digital data transmitted.
Assignment 1 - State of the Art
<p>Telecommunications links and connectivity:</p> <ul style="list-style-type: none"> • whole-class exercise – tutor presentation on characteristics of transmission links • individual exercise – tutor presentation on understanding copper links • individual exercise – understanding optical links • individual exercise – understanding radio links • whole-class exercise – tutor presentation on terminating cables • whole-class exercise – testing telecommunication cables.
<p>Connect local systems involved in telecommunications networks:</p> <ul style="list-style-type: none"> • whole-class exercise – tutor presentation on how to configure communication between two callers • whole-class exercise – tutor presentation on understanding local exchanges • whole-class exercise – tutor presentation on how does line equipment work? • individual exercise – data communication equipment and interfaces.
Assignment 2 - Data and Voice Transmission
<p>Signals and data carried via telecommunications systems:</p> <ul style="list-style-type: none"> • individual exercise – learn about analogue signals • individual exercise – how do digital signals work?
Assignment 3 - Make the Connection

Assessment

It is suggested that this unit is assessed using three assignments as summarised in the *Programme of suggested assignments* table.

Assessment for the unit as a whole may be achieved through a portfolio of evidence produced in response to set tasks. Assignments and case studies should be employed as a suitable method of enabling learners to gather and structure evidence. The summative assessment of learners for this unit will be on an individual basis. However, group working and the sharing of tools and equipment is reasonable for the practical exercises and should be encouraged as it adds to the learning experience and the acquisition of knowledge.

A proportion of the assessment for this unit will be through tutor observation and questioning. To support this assessment approach learners should provide supporting evidence, for example, the use of a logbook that is maintained by learners. The log could contain a description of the task undertaken, the instructions provided (annotated to record progress or difficulties), a list of tools and equipment provided and their condition, relevant photographs that have been annotated to explain procedures and problems encountered, etc. Such supporting activity evidence would then validate the tutor or witness observation/oral questioning records and vice versa. The use of witness testimonies to confirm that learners have met the relevant assessment criteria should be encouraged.

1.1 is a theoretical criterion, where learners must describe the different forms of physical transmission media. For each transmission type, learners must give a clear and logical outline of its characteristics, using graphics as appropriate. A presentation is suggested in the programme of suggested assignments table.

For 2.1, learners must compare the characteristics of analogue and digital signals. Any form of evidence can be used. It may be appropriate to include this in a presentation and use graphical illustrations to support the theory.

For 3.1, learners must be able to explain the basics of multiplexing. In order to pass this criterion, learners need to provide an explanation of what multiplexing is, and also a basic explanation of how it works.

Learners could show their understanding in any form of written work, eg a report or a leaflet, or as part of a presentation.

For 4.1, learners can move from theory to practice, connecting telecommunications for a local exchange. While learners must complete the task successfully to pass the criterion, emphasis should be placed on making it relatively simple to do.

4.2 is about testing the cable connections of the network they connect for 4.1. Tutor observation and a witness statement are likely to be the best means of providing evidence.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the assessment criteria in the assessment and grading 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 method
1.1, 2.1	State of the Art	A firm has asked for a short paper on current developments in telecoms.	Written report.
3.1, 4.1	Data and Voice Transmission	The firm has now asked you to give a talk on signals and transmission technology.	Presentation.
4.2	Make the Connection	Create a telecommunications connection for a local firm.	Tutor observation. Documentation.

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 Technology	Communication Technologies
	An Introduction to Communication Technologies	Telecommunication Systems

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 2 National Occupational Standards for IT (ProCom):

4.6 Human Computer Interaction/Interface (HCI) Design.

Essential resources

Learners will need access to practical resources and suitable technology, they can also use simulators or multimedia tools to gain prior experience before handling 'live resources'.

Employer engagement and vocational contexts

Visits to a local ISP or using the centre telecommunications network would put the unit in a vocational context.

There is a range of organisations that may be able help centres to engage and involve local employers in the delivery of this unit, for example:

- Learning and Skills Network – www.vocationallearning.org.uk
- Local, regional business links – www.businesslink.gov.uk
- National Education and Business Partnership Network – www.nebpn.org
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm
- Work experience/workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei

Indicative reading for learners

Textbooks

Dodd A – *The Essential Guide to Telecommunications* (Prentice Hall, 2005)

ISBN 0131487256

Goleniewski L – *Telecommunications Essentials* (Addison Wesley, 2002)

ISBN 0201760320

Plevyak T, Sahin V – *Next Generation Telecommunications Networks, Services, and Management* (IEEE Press Series on Network Management) (WileyBlackwell, 2010)

ISBN 047057528X

Functional Skills – Level 2

Skill	When learners are ...
ICT - Using ICT	
Select, interact with and use ICT systems safely and securely for a complex task in non-routine and unfamiliar contexts	when connecting and terminating local telecommunication connections.
Mathematics - Representing	
Identify the situation or problems and identify the mathematical methods needed to solve them	setting up, configuring and testing a mobile communications device to meet a defined need
English - Writing	
Write a range of texts, including extended written documents, communicating information, ideas and opinions, effectively and persuasively	creating written reports for the assignment.