

Unit T6: Data Communication and Sensor Networks

Unit code:	A/503/7342
QCF level:	6
Credit value:	15

Aim

This unit aims to develop an understanding of data communication concepts and networks. It gives learners the skills needed to design packet switched networks for specific computer and network applications.

Unit abstract

Data communication networks allow information to be transported in a digital format, irrespective of the source or distance. The use of a layered model of communication networks allows the communication between heterogeneous elements using a range of possible communications media.

This unit focuses on key concepts of information and data communications networks and explores the operation of data communication and sensor networks through application of the OSI (open systems interconnection) model, developing an understanding of the operation of network components which exist at the media and transport layers of the model.

Learning outcomes

On successful completion of this unit a learner will:

- 1 understand key data communication concepts
- 2 understand the operation of data communication network components
- 3 understand the special requirements of wireless sensor networks
- 4 be able to design packet switched networks for specific applications.

Unit content

1 Understand key data communication concepts

Information and communication: information content (entropy, bits, symbols); Shannon-weaver model of communication; synchronous transmission; asynchronous transmission

Data communication networks: network topologies (mesh, bus, star); control of access in shared media, eg carrier sense multiple access/collision detection (CSMA/CD); open systems interconnection (OSI) model

Transmission media: properties of common physical media standards (unshielded twisted pair [UTP], co-axial, optical fibre); data representation and line coding, eg 4B5B, Manchester; common physical media standards, eg 100 BASE TX, ProfiBus; wireless communication standards

2 Understand the operation of data communication networks

Network components: network interface cards; switches and bridges; routers and gateways

Local area networks: data framing; data frame formats (Ethernet/802.3); physical addresses (media access control (MAC)); host-to-host communication; resolving physical addresses, eg address resolution protocol; collision domains; broadcast domains

Layer 2 network devices: switches and bridges; structure of a switch; operation (learning, forwarding); types of switch (store and forward, cut through)

3 Understand the special requirements of wireless sensor network components

Sensor network characteristics: sensor network applications; node distribution; effect of intermittent communication; node characteristics (size, power constraints, reliability)

Sensor network communication: standards for wireless sensor networks, eg zigbee, IEEE 1451; routing protocols; ad-hoc routing protocols, eg AODV (ad-hoc on-demand distance vector)

4 Be able to design packet switched networks for specific applications

IP (internet protocol): IP packets format; logical addresses; IPv4 addresses (IPv4, IPv6, network addresses, host addresses, subnetting)

Routing: router operation; routing protocols (distance vector, link state); path finding algorithms (Dijkstra's, distributed Bellman-Ford)

Transport protocols: port numbers; unreliable (user datagram protocol (UDP)); connection oriented (transmission control protocol (TCP), TCP handshake, TCP flow control)

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand key data communication concepts	1.1 Analyse information content in relation to data communication networks 1.2 Critically evaluate the characteristics of data communications networks 1.3 Critically appraise common transmission media
LO2 Understand the operation of data communication network components	2.1 Critically evaluate the role of data communication network components 2.2 Critically evaluate the structure of data frames 2.3 Explain the roles of physical addresses in local area networks 2.4 Describe the process by which data is transferred between network hosts, including the resolution of physical addresses 2.5 Critically appraise the operation of layer two network devices
LO3 Understand the special requirements of wireless sensor networks	3.1 Critically appraise the constraints placed on sensor network communication in relation to specific sensor network applications. 3.2 Critically evaluate routing protocols for wireless sensor networks 3.3 Critically evaluate wireless communication standards employed on sensor networks
LO4 Be able to design packet switched networks for specific applications	4.1 Critically evaluate internet protocol packet formats 4.2 Design an appropriate logical addressing scheme 4.3 Select through evaluation suitable routing protocols 4.4 Select through evaluation transport protocols used on IP networks

Guidance

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

The content of this unit has been designed and mapped against the Engineering Council's current Learning Outcomes for IEng Accreditation. The completion of the learning outcomes for this unit will contribute knowledge, understanding and skills towards the evidence requirements for IEng Registration.

See *Annexe B* for summary of mapping information for IEng Accreditation.

Essential requirements

Where specific industrial networks are being covered, learners must have access to appropriate hardware and the physical media. Alternatively, computer networking equipment will be sufficient.

Assessment

Paper-based practical assignments can be used for learning outcomes 3 and 4 where learners can demonstrate synthesis of new solutions.

Resources

Books

Cisco Systems – *Internetworking Technologies Handbook*, 4th Edition (Cisco Press, 2003) ISBN 978-1587051197

White C – *Data Communications and Computer Networks: A Business Users' Approach*, 6th Edition (Thomson Course Technology, 2011) ISBN 978-0538452618

Stallings W – *Data and Computer Communications: International Version*, 9th Edition, Pearson, 2011) ISBN 978-0132172172

Tanenbaum A and Wetherall D – *Computer Networks*, 5th Edition (Pearson, 2010) ISBN 978-0132553179