Unit 159: Digital Subscriber Line Broadband Technologies

Unit code: M/615/4149

QCF level: 5

Credit value: 15

● Aim

The aim of this unit is to develop an understanding of the configuration, operation and commercial aspects of the family of Digital Subscriber Line technologies (xDSL), used for residential broadband services.

● Unit abstract

The unit explores the different communication features offered by members of the xDSL family. It focuses on Asymmetric Digital Subscriber Line (ADSL) and its successors, ADSL2 and ADSL2+ in order to develop learners' awareness of the method of operation and how the technology copes with transmission constraints of the Access Network. The unit raises awareness of the commercial factors associated with competing technologies.

● Learning outcomes

On successful completion of this unit a learner will:

1   Understand the key members of the (xDSL) family

2   Understand the operation of an Asymmetric Digital Subscriber Line

3   Understand the transmission constraints of standard analogue copper wire PSTN access

4   Be able to evaluate the commercial factors of ADSL against main competing technologies.

Unit content

1 **Understand the key members of the (xDSL) family**

Family: Rate Adaptive Digital Subscriber Line (RDSL); High-Speed Digital Subscriber Line (HDSL and HDSL2); Asymmetrical Digital Subscriber Line (ADSL and ASDL2 and ASDL2+); Single-pair high-speed digital subscriber line (G.SHDSL); Very-high-bit-rate digital subscriber line (VDSL and VDSL2)

Communication differences: typical transmission distances; typical bit rates (upstream and downstream)

Types of communications: broadcast; video on demand; voice; video conferencing; computers; streaming; games and entertainment; interactive and multimedia

2 **Understand the operation of an Asymmetric Digital Subscriber Line**

Configuration: use of an ADSL router (sometimes referred to as an ADSL modem); detailing of physical connections, eg CPE, RJ 45, RJ 11, USB, Firewire, at premises and use of splitter to isolate voice; Local Digital Exchange equipment, eg Digital Subscriber Line Access Multiplexer (DSLAM); subscribers premises ADSL equipment; twisted pair metallic cable; typical distances

Signal processing methods: Carrierless Amplitude Phase-modulation (CAP); Discrete Multi-Tone modulation (DMT)/Orthogonal frequency-division; multiplexing (OFDM); use of routers (sometimes referred to as ADSL modems); frequencies utilised; typical bit rates upstream and downstream; channels available; maximum distances for both upstream and downstream connections; use of Frequency Division Multiplexing (FDM) to split the frequency spectrum; frequency spectrum division of upstream downstream and voice

Main protocols: Internet Protocol (IP); Asynchronous Transfer Mode (ATM)

3 **Understand the transmission constraints of standard analogue copper wire PSTN access**

Purpose: how the access network has evolved

Transmission constraints: distance from customer premises to local exchange; gauge of wire; attenuation due to Leakance, Induction, Resistance, Capacitance; effect of loading coils

How ADSL adapts: data rates (passband) restricted by access line; filters; signal to noise; quantisation when encoded/decoded; modulation methods

4   **Be able to evaluate the commercial factors of ADSL against main competing technologies**

Advantages of ADSL technology: home usage, eg fast, services offered, always-on, simultaneous phone calls, improved webcam, cost effective; asymmetric against symmetrical

Commercial benefits: ADSL compared against competition, eg ISDN, cable modem, conventional modem technologies such as V.90, WiFi, fibre optic; ease of installation at subscriber premises

Competing technologies: ISDN; cable modem; satellite broadband; conventional modem connections; WiFi/cellular; fibre optic

Service providers: eg Energis, BT, NTL, Sri Lanka Telecom.

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 the key members of the (xDSL) family	1.1 compare the key members of the residential (xDSL) family 1.2 evaluate the differences in communication features of the residential broadband (xDSL) family 1.3 assess the types of communications best suited to each member of the xDSL family
LO2 Understand the operation of an Asymmetric Digital Subscriber Line	2.1 describe and explain the configuration of an ADSL/ADSL2/ADSL2+ connection from premises equipment to local exchange equipment 2.2 explain signal processing methods 2.3 evaluate the main protocols carried by ADSL/ADSL2/ADSL2+
LO3 Understand the transmission constraints of standard analogue copper wire PSTN access	1.1 discuss the original purpose of the access network and bandwidth specification 1.2 explain the transmission constraints of the access network 1.3 explain how ADSL/ADSL2/ADSL2+ adapts to the transmission constraints of the Access Network
LO4 Be able to evaluate the commercial factors of ADSL against main competing technologies	4.1 report on the advantages offered to customers utilising ADSL/ADSL2/ADSL2+ technologies for home use 4.2 discuss the commercial benefits offered to customers by ADSL/ADSL2/ADSL2+ against competing technologies 4.3 investigate the national ADSL service providers and analyse cost/benefit differences with various ADSL/ADSL2/ADSL2+ connection packages.

Information for tutors

Essential requirements

Access to the internet is essential for investigative and analysis assignments.

Delivery guidance

This unit may be delivered as a stand-alone package or integrated with other appropriate programme units. If delivered in an integrated way, care must be taken to provide tracking of evidence for the outcomes of learning. Wherever possible, a practical approach should be adopted. A visit to a Local Digital Exchange equipped with an ADSL multiplexer rack would be of great benefit to learners.

Learning and assessment can be across units, at unit level or at individual outcome level. Effort should be made to identify the relevance of the principles covered to engineering applications and system design.

Assessment guidance

Evidence of outcomes can be generated from assignments, reports of practical activities, computer printouts, solutions to applied problems or the result of tests/examinations. Evidence can be accumulated by learners compiling a portfolio of evidence derived from their centre-based or work-based activities, or through a tutor-led combination of tests and assignments.