learntelecoms

e-learning courses for telecoms manufacturers, operators, end-users and students from **PTT**

learntelecoms interactive e-learning suite of courses:

TransNet v6— Wide Area Networks

TransNet

- is a suite of interactive, multimedia e-learning courses designed to run under Windows™ 98, 2000 Professional or XP**.**
- provides training in the technical aspects of Wide Area Networks and data services.
- consists of eight separate but integrated courses:

A	Principles of Wide Area Networks
B	X25 data services
C	Frame Relay data services
D	Principles of ATM
E	ATM networks
F	IP networks
G	Advanced IP networks inc. voice over IP
H	DSL services

Each TransNet course:

- provides several hours of in-depth, authoritative technical training
- employs interactive simulations, hypertext links and question sessions to fully involve the trainee in the learning experience.
- provides personalised training with each trainee able to make his/her on notes and place bookmarks. A record of progress and level of achievement is recorded for each trainee.
- provides a structured assessed course and can also be used to browse for revision or reference.
- can be studied in isolation or as an integrated suite; each chapter of a course includes revision links to relevant subjects covered in the other **TransNet** courses.

Target audience:

TransNet is designed for:

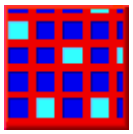
- Those studying for a career in telecommunications and who require a detailed knowledge of modern Wide Area Networks and data services.
- Technical staff involved in the operation, design or maintenance of Wide Area Networks.

learntelecoms e-learning courses from **PTT** - Providers of Telecoms Training - the experts in the provision of interactive telecoms training for network operators, manufacturers, end-users and students.

Tel: +44 (0) 1736 810610 **Fax:** +44 (0) 1736 810160

Email: support@ptt.co.uk **Web site:** www.learntelecoms.com

Course A - Introduction to Wide Area Networks



Course aim: This course provides an introduction to the fundamental concepts that underpin the operation of modern Wide Area Networks.

Pre-requisites: Secondary (high) school education in Physics; In the UK appropriate pre-requisite qualifications are General Certificate of Secondary Education (GCSE) in Physics or BTEC National Vocational Qualification (NVQ) at level 2 in Electronics.

Course content:

Asynchronous and synchronous transmission: Principles and comparison; transport of asynchronously generated packets over synchronous networks.

TDM and time switching: Principles of Time Division Multiplexing (TDM); function of a primary multiplexer; 2 Mbit/s frame structure; SDH aggregate bit rates and payload capabilities; principles of time switching; concept and use of time slot interchange.

Packet switching: Principles of packet switching and address multiplexing; statistical multiplexing gain; congestion and its causes; avoiding congestion; advantages of address multiplexing over TDM.

OSI protocol layers: Role and structure of OSI Reference Model; peer to peer protocol communications; interaction between different protocol layers; signalling and management plane of OSIRM.

Connection types: Features and applications of leased lines; features and applications of circuit-switched connections; introduction to signalling; principles of connection oriented packet switching; features of permanent and switched virtual circuits; role and basic types of flow control; principles of connectionless packet switching.

Route discovery: The role of addressing, route discovery and signalling; hierarchical addressing; network areas; the role of routing tables; introduction to distance vector and link state route discovery.

Multimedia traffic: Multimedia traffic sources; requirements for a broadband multimedia WAN; the causes and effects of network impairments including delay, delay variation and errors.

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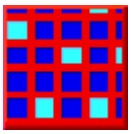
Course B – X25 data services



Course aim: This course provides an introduction to the principles, operation and features of data services conforming to the ITU X25 recommendations.

Pre-requisites: Understanding of the basic principles of packet switching. It is recommended that TransNet course A – Principles of Wide Area Networks – is studied before attempting this course.

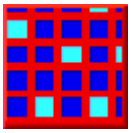
Course content:

Introduction to X25: Features and applications of an X25 data service; functions of the equipment required to access an X25 data service; introduction to the protocols involved in X25 data transfer; provision of virtual circuits; significance of Logical Channel Numbers (LCN).

X25 error checking and flow control: Introduction to the mechanisms used at both the X25 data link layer and the network layer to ensure the reliable, in-sequence delivery of packets; concept of window size; significance of Send Sequence Numbers (SSN) and Receive Sequence Numbers (RSN).

X25 packets and frames: Description of the function of the fields of a of data link layer LAPB frame and a network layer PLP packet; role of the different types of PLP control packet; demonstration of the use of control packets in setting up a switched virtual circuit.

Course C – Frame Relay data services



Course aim: This course provides an introduction to the principles, operation and features of data services conforming to the Frame Relay specifications.

Pre-requisites: Understanding of the basic principles of packet switching. It is recommended that TransNet course A – Principles of Wide Area Networks – is studied before attempting this course.

Course content:

Introduction to Frame Relay: Basic components of a Wide Area Network (WAN) employing Frame Relay access; introduction to the protocols involved in the provision of a Frame Relay network; significance of the virtual circuit parameters CIR and DLCI; facilities and benefits of a Frame Relay data service.

Congestion control: Causes and effects of congestion; significance of congestion collapse; function of the fields of the frame header; explicit and implicit congestion notification; congestion control measures including the function of the DE, FECN and BECN bits.

Local Management Interface (LMI): The facilities provided by the link management facilities of the LMI extensions to the Frame Relay specification; implementation of global addressing with LMI; use of the Inverse Address Resolution Protocol (InARP) in conjunction with global addressing; LMI multicasting; function of the fields in an LMI frame.

Voice over Frame Relay: Introduction to the techniques used to overcome the limitations of a Frame Relay connection to provide a telephony service over a Frame Relay virtual circuit; the use and benefits of frame fragmentation, voice compression and silence suppression; use of sub-frames to transport several voice and data channels over a single Permanent Virtual Circuit (PVC).

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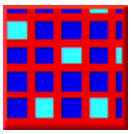
Course D – Principles of ATM



Course aim: This course provides an introduction to the fundamental concepts and protocols underlying data networks employing the Asynchronous Transfer Mode (ATM).

Pre-requisites: Understanding of the basic principles of packet switching and the concepts of virtual channels and the OSI Reference Model (OSIRM). It is recommended that TransNet course A – Principles of Wide Area Networks – is studied before attempting this course.

Course content:

Introducing ATM: Overview and capabilities of ATM networks; transport of multimedia traffic over existing transmission networks.

ATM cell structure: Benefits of small, fixed sized cells; ATM cell structure: function of information fields in UNI and NNI cell headers.

Virtual paths and channels: Concepts of virtual path and virtual channel connections; relationship between ATM virtual paths and channels and SDH transmission paths; functions of ATM switches and cross-connects; features of Permanent Virtual Circuits (PVCs) and Switched Virtual Circuits (SVCs).

ATM protocol layers: Physical, ATM and AAL layers of the Broadband ISDN (B-ISDN) protocol stack and their relationship to the OSI Reference Model (OSIRM); roles of the different ATM Adaptation Layer (AAL) protocols; sending timing information over a Virtual Channel Connection (VCC) using the AAL 1 protocol; functions of the Segmentation and Re-assembly (SAR) sub-layer and the Convergence Sub-layer (CS) of the AAL protocol.

Providing a quality of service: Role and content of a traffic contract; definitions of traffic parameters including Peak Cell Rate (PCR) and Sustainable Cell Rate (SCR); definition of quality of service (QofS) parameters including Cell Loss Ratio (CLR) and Cell Transfer Delay (CTD); features of the QofS classes.

Traffic Control: Functions of traffic shaping and policing; principles and use of the "leaky bucket" algorithm; concepts of the User Network Interface (UNI) and the Network Network Interface (NNI); role of the Usage Parameter Control (UPC) and Connection Admission Control (CAC) functions.

Congestion Control: Recommended methods of avoiding congestion; operation and use of rate based and credit based flow control; use of the Explicit Forward Congestion Indication (EFCI); methods of recovering from congestion.

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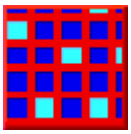
Course E – ATM Networks



Course aim: This course describes the structure, operation and features of data networks employing the Asynchronous Transfer Mode (ATM). It is recommended that the “Principles of ATM” course in the TransNet suite is studied before attempting this course.

Pre-requisites: Understanding of the basic principles of the Asynchronous Transfer Mode (ATM). It is recommended that TransNet course D – Principles of ATM – is studied before attempting this course.

Course content:

Virtual networks and interworking: Interconnecting LANS using ATM Permanent Virtual Connections (PVCs); interworking between Frame Relay and ATM; use of a Data Exchange Interface (DXI) to connect existing equipment such as routers to an ATM network.

ATM networks: Functional description of ATM switches and cross-connects; components of an end-user's network and an ATM public network; comparison of B-ICI, DXI, FUNI, UNI, NNI and PNNI interfaces; ATM signalling inc. DSS2 and B-ISUP.

ATM addressing schemes: Hierarchical global addressing; the different ATM private and public address structures; choice of public network address scheme.

Private Network Node Interface (PNNI): Signalling, addressing and route discovery aspects of the PNNI; significance of peer groups; the role of a Peer Group Leader (PGL); the building of a topological database; the role of a Logical Group Node (LGN); description of source routing in a PNNI network; requesting a quality of service using PNNI signaling; operation of connection admission control; structure of a PNNI address.

Voice over ATM: Reducing the effects of cell fill delay; interworking with a circuit-switched network with particular reference to signalling and synchronisation issues; operation and features of unstructured and structured AAL 1 Circuit Emulation Services; benefits and operation of an AAL 2 VBR voice trunking.

IP over ATM networks: Comparison of IP and ATM networks; the use and limitations of “Classical IP over ATM”; benefits of the use of “cut through” ATM virtual channel connections compared with the use of IP routing; using the Next Hop Resolution Protocol (NHRP) to provide “cut through” connections; integrating the quality of service techniques of IP networks with those of ATM networks.

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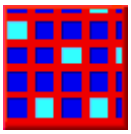
Course F - IP networks and the Internet



Course aim: This course describes the features, facilities, structure and basic operation of networks using the Internet suite of protocols.

Pre-requisites: Understanding of the basic principles of packet switching and connectionless operation. It is recommended that TransNet course A – Principles of Wide Area Networks – is studied before attempting this course.

Course content:

Introducing the Internet: Topology of the Internet; roles of Internet administrative bodies; role of network and service providers; facilities offered by Internet Service Providers (ISPs).

IP addressing: IPv4 address classes; addressable subnets; subnet masks; IPv6 address format.

Domain Name System (DNS): use and structure of Uniform Resource Locators (URLs); hierarchical structure of domain names; name allocation administration; the use of name servers.

The Internet Protocol (IP): Review of the Internet suite of protocols and the relationship of IP to the OSI Reference Model; connectionless operation of IP; function of the various IPv4 and IPv6 packet header fields; advantages of IPv6.

RIP route discovery: Principles of routing over a connectionless network; operation of the distance vector, route discovery Routing Information Protocol (RIP); building a routing table; causes and effects of "counting to infinity".

OSPF route discovery: Advantages of the dynamic route discovery protocol, OSPF, over a distance vector protocol such as RIP; building a topological database and a routing table using OSPF; benefits of dividing a network into areas.

BGP and EGP route discovery: Operation and role of the Exterior Gateway Protocol (EGP); operation and role of the Border Gateway Protocol (BGP); advantages of BGP over EGP.

Other Internet protocols: The use of the Point to Point Protocol (PPP) on serial links, role of the Transmission Control Protocol (TCP); setting up a TCP session; demonstration of TCP flow control, relevance and use of TCP port numbers; use of the User Datagram Protocol (UDP); review of application layer protocols including FTP and SMTP.

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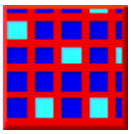
Course G – Advanced IP networks



Course aim: This course describes the methods used to provide differentiated multimedia services over an IP network with particular emphasis on IP telephony.

Pre-requisites: Understanding of the use and operation of the TCP/IP protocols and principles of route discovery in a network operating in the connectionless mode. It is recommended that the "IP networks and the Internet" course in the TransNet suite is studied before attempting this course.
An appreciation of voice encoding techniques and the principles of voice transmission would also be beneficial. The study of the StarTel course "Principles of voice encoding and transmission" is, therefore, recommended.

Course content:

RSVP resource reservation: Reserving network resources; role and operation of the Resource Reservation Protocol; function of the flowspec and filterspec.

Label switching: Benefits of integrating IP routing with high speed switching; operation of Multi Protocol Label Switching (MPLS) in an ATM network; function of Label Edge Routers (LERs) and Label Switch Routers (LSRs); significance of Forward Equivalence Class (FEC); role of label distribution protocols including LDP and CR-LDP; employing MPLS in other types of network such as Frame Relay and Ethernet.

Providing a quality of service with an IP network: Operation of a Differentiated service (DiffServ); features of typical classes of service; provisioning an IP network using Diffserv; comparison of the features of Diffserv and the Resource Reservation Protocol (RSVP); interworking between RSVP, DiffServ and Multi Protocol Label Switching (MPLS).

Transporting voice over IP: Comparison of circuit-switched telephony with a voice service provided by an IP network; limitations of an IP network; role of speech processing techniques including echo cancellation and silence suppression; features of typical voice compression techniques; features and operation of the Real-time Transport Protocol (RTP) and the session control protocol, RTCP.

Voice over IP call set up protocols: Operation and features of the call set-up protocols SIP and H.323; demonstration of the functions of SIP proxy, registrar and redirect servers; interworking with the Public Switched Telephone Network (PSTN): functions of a VoIP gateway and a location server; components of a system based on the H.323 suite of protocols; basic structure of a Megaco based system; comparison of the benefits of SIP and H.323.

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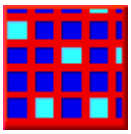
Course H – DSL Services



Course aim: This course describes the theory, operation, components and features of systems providing ADSL and SDSL services.

Pre-requisites: Understanding of basic datacoms principles and the use and operation of the Internet Protocol (IP). It is recommended that PTT's "Ethernet networks" e-learning course and the "IP networks and the Internet" course in the TransNet suite are studied before attempting this course.

Course content:

Digital access over the last mile: Exploiting the existing telephone local access network to provide broadband Internet access; structure and components of the local access network; using different frequency bands for voice and data; summary of the different types of DSL service.

Loop impairments: Source and effects of the various impairments on the last mile that limit the performance of DSL services including loss, crosstalk, external interference, bridged taps and loading coils.

Signal processing: Principles of the signal processing techniques used by DSL services including 2B1Q and PAM-16 line codes, PSK and QAM modulation, and error correction.

ADSL principles and services: Principles of DMT as employed in ADSL systems; simultaneous provision of a telephone service and an ADSL service over a single pair; basic functions of an ADSL Termination Unit (ATU-R); differences between a full rate ADSL service and an ADSL Lite service; enhanced features of ADSL2 and ADSL2 Plus.

ADSL connections: Role of DSLAM and B-RAS equipment in an access network; review of the features and benefits of an ATM network; use of virtual channel connections; role of the PPP protocol and authentication servers; allocation of IP addresses to customers' equipment; operation of a simple bridged Ethernet ADSL connection; principles and benefits of PPPoE and PPPoA connections.

ADSL customer's equipment: Overview of various types of customers' equipment including ADSL modems, ADSL enabled routers, wireless routers; use and comparison of splitters and microfilters; review of security aspects of an ADSL service.

Symmetrical DSL service: Operation and the features of a Single pair High speed DSL (SHDSL) service; benefits of the use of TC-PAM modulation and error correction; format and payload capability of an SHDSL frame; use of an Integrated Access Device for the simultaneous transmission of voice and data.

Testing DSL connections: Tests discussed include AC and DC line tests, Time Domain Reflectometer tests; insertion loss and noise measurement, ATM and IP end-to-end tests.

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