Data Communications Essentials

Produced by WebLearning Courseware.

Course duration: 10 hours

Audience: Network managers and newcomers to data communications; builders of wide area networks (WANs); Certified NetWare® Engineer (CNE) candidates

Prerequisites: As this is a foundation-level course, users are not required to have taken any other course; however, some technical background is assumed.

Course aim: To provide a firm foundation in the physics of data communications and in the history of communications and network development

Learning objectives
After taking this course, the user should be able to
• explain the fundamentals of signal theory
• list the modulation techniques and explain how each works
• choose between a frequency and a time division multiplexer
• identify the modes of transmission
• select between fiber, coax, twisted pair and wireless cable systems
• define the term "protocol" and give examples of protocols
• list the network switching technologies
• state which technologies are becoming obsolete

Topics covered
- Electric signals
- Waveforms and frequencies
- Analog v digital
- Noise
- Attenuation
- Digital encoding
- Character codes
- Modulation introduced
- Digital to analog
- Analog to digital
- Channels and bandwidths
- Multiplexing
- Serial and parallel
- Synchronous and asynch.
- Error-checking
- Simplex, half-duplex, duplex
- Data trans. combinations
- DTEs and DCEs
- Modems, codecs and DSUs
- Communications interfaces

| Physical media | Unbounded transmission |
| Unbounded transmission | Satellite transmission |
| Satellite transmission | The PSTN |
| The PSTN | PSTN services |
| PSTN services | Dial-up data links |
| Dial-up data links | Dedicated links |
| Dedicated links | On and off-line computing |
| On and off-line computing | HOST/terminal computing |
| HOST/terminal computing | Distributed processing |
| Distributed processing | Network evolution |
| Network evolution | Client/server computing |
| Client/server computing | LAN topologies |
| LAN topologies | Access methods |
| Access methods | WAN topologies |
| WAN topologies | WAN switching methods |
| WAN switching methods | Introduction to standards |
| Introduction to standards | Standards bodies |
| Standards bodies | The OSI model |

Windows and DOS versions available

Course incorporates: Test
# Protocols and Internetworking

Produced by WebLearning Courseware.

**Course duration:** 15 hours

**Audience:** Network managers and newcomers to data communications builders of wide area networks (WANs); Certified NetWare® Engineer (CNE) candidates

**Prerequisites:** As this is a foundation-level course, users are not required to have taken any other course; however, some technical background is assumed.

**Course aim:** To introduce the topologies, protocols and strategies of networks

**Learning objectives**
After taking this course, the user should be able to
- explain the principles of protocols and set the OSI model in context
- define standards at the physical layer of the OSI reference model and protocols at the data link layer
- define the major 802 standards used in LANs
- describe the functions of the lower and upper OSI layers
- describe the TCP/IP protocols
- describe the NetWare protocol suite
- describe a range of proprietary networking protocol suites
- explain the functions of repeaters, bridges, routers and gateways
- describe digital transmission links with particular reference to ISDN and X.25 networks
- describe the main fast packet technologies

**Topics covered**

<table>
<thead>
<tr>
<th>Introducing protocols</th>
<th>Upper-layer protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>The principle of layering</td>
<td>Introduction to NetWare</td>
</tr>
<tr>
<td>The OSI model</td>
<td>IPX</td>
</tr>
<tr>
<td>Physical layer standards</td>
<td>SPX</td>
</tr>
<tr>
<td>Bit-oriented DL protocols</td>
<td>NetWare services</td>
</tr>
<tr>
<td>SDLC</td>
<td>DNA/DECnet</td>
</tr>
<tr>
<td>HDLC and LAP-B</td>
<td>Introduction to SNA®</td>
</tr>
<tr>
<td>The 802 series</td>
<td>SNA: NAUs (SSCPs, PUs, LUs)</td>
</tr>
<tr>
<td>802.2 (LLC)</td>
<td>AppleTalk</td>
</tr>
<tr>
<td>802.3 (CSMA/CD)</td>
<td>Network scale</td>
</tr>
<tr>
<td>802.5 (Token Ring)</td>
<td>Repeaters</td>
</tr>
<tr>
<td>ARCnet</td>
<td>Bridges</td>
</tr>
<tr>
<td>LocalTalk</td>
<td>Routers</td>
</tr>
<tr>
<td>FDDI</td>
<td>Gateways</td>
</tr>
<tr>
<td>The network layer</td>
<td>Digital transmission</td>
</tr>
<tr>
<td>The transport layer</td>
<td>ISDN development</td>
</tr>
<tr>
<td>The session layer</td>
<td>X.25 networking</td>
</tr>
<tr>
<td>The presentation layer</td>
<td>Frame relay</td>
</tr>
<tr>
<td>The application layer</td>
<td>Cell relay</td>
</tr>
<tr>
<td>The IP layer</td>
<td>ATM switching</td>
</tr>
<tr>
<td>IP addressing</td>
<td>SONET and SDH</td>
</tr>
<tr>
<td>The TCP layer</td>
<td></td>
</tr>
</tbody>
</table>

Windows and DOS versions available

**Course incorporates:** Test
WAN Technologies
Produced by WebLearning Courseware.

Preceding course: Fundamentals of Internetworking
Following course: LAN Fundamentals

Course duration: 4 hours

Audience: Managerial and operational staff

Prerequisites: Some knowledge of data communications, as covered in Data Communications: Signals and Systems, Data Communications: Networks and Standards, Protocol Layers and the OSI Model, Introduction to Common Networking Protocols and Fundamentals of Internetworking

Course aim: To provide the student with a solid foundation in wide area networking technology and operation

Learning objectives
After taking this course, the student should be able to
• compare digital and analog technologies
• compare message, packet, and circuit switching technologies

Topics covered
Link types
Switched and dedicated circuits
Multiplexing
Pulse code modulation
T1 and T3 links
Voice/data integration
Message switching
Packet switching
Circuit switching

Windows® version available
Course incorporates: Test
LAN Fundamentals
Produced by WebLearning Courseware.

Preceding course:      WAN Technologies
Following course:      Network Operating Systems

Course duration:       6 hours

Audience:             Network managers and newcomers to data communications; builders of local area networks

Prerequisites:        Some knowledge of data communications, as covered in Data Communications: Signals and Systems, Data Communications: Networks and Standards, and Protocols Layers and the OSI Model

Course aim:           To provide a firm foundation in LAN technology and access methods

Learning objectives
After taking this course, the student should be able to
• outline the development and use of LANs
• list and briefly describe the media and topologies available
• explain the basic operation of local area networks
• outline the methods of internetworking

Topics covered
   History and development of LANs
   Servers
   Media
   Topologies
   LAN access methods
   CSMA/CD
   Token Bus
   Token Ring
   Wireless LANs
   LAN internetworking

DOS version available, French language version avilable
Course incorporates: Glossary
Network Operating Systems
Produced by WebLearning Courseware.

**Preceding course:**  *LAN Fundamentals*  
**Following course:**  *LAN Media and Components*

**Course duration:**  8 hours  
**Audience:**  Network support, sales support and network management staff  
**Prerequisites:**  Familiarity with the course *LAN Fundamentals* would be useful.  
**Course aim:**  To enable students to choose, manage, and interoperate a network operating system as part of their overall network strategy

**Learning objectives**  
After taking this course, the student should be able to  
- choose the best NOS for their particular network needs  
- outline the key features of network operating systems and list the major NOSes on the market  
- describe the lower and upper layers in the Novell NetWare® protocol suite  
- list the key features of Banyan VINES  
- describe the main features of LAN Manager and its derivatives  
- outline the basic structure of AppleTalk

**Topics covered**  
- NOS functions  
- Global addressing  
- NO Ses in the marketplace  
- NOS interoperability  
- NOS future trends  
- Novell NetWare basics  
- Service advertising protocol  
- NetWare Core Protocol  
- NetWare Loadable Modules  
- Burst mode  
- Directory services  
- Banyan VINES lower, middle and upper layers  
- VINES strengths and weaknesses  
- LAN Manager domains  
- LAN Manager architecture  
- LAN Manager's data link layer  
- LAN Manager derivations  
- AppleTalk architecture  
- Strengths and weaknesses of AppleTalk

**DOS version available**  
**Course incorporates:**  Test
**LAN Media and Components**
Produced by WebLearning Courseware.

**Preceding course:** *Network Operating Systems*  
**Following course:** *LAN Topologies and Techniques*

**Course duration:** 4 hours  
**Audience:** Technical support staff  
**Prerequisites:** A basic understanding of data communications, protocols and LANs as presented in the preceding courses  
**Course aim:** To enable the student to identify the main components of a LAN and the characteristics of LAN media  

**Learning objectives**  
After taking this course, the student should be able to  
- identify each LAN component  
- distinguish between hardware and software components  
- compare the main types of media in terms of expense, interference, susceptibility, reliability, and security

**Topics covered**  
- Servers, workstations and peripherals  
- Network operating systems  
- Network interface cards  
- Analog and digital transmission  
- Transmission media  
- Metallic media  
- UTP, FTP, and STP  
- CAT-5 cable  
- Coaxial cable  
- Installation expense, reliability and security  
- Susceptibility to interference  
- Wireless technology  
- Bridges, routers, and gateways

Windows® version available  
**Course incorporates:** Test
LAN Topologies and Techniques
Produced by WebLearning Courseware.

Preceding course: LAN Media and Components
Following course: IEEE: Introduction and the 802.2 LLC

Course duration: 4 hours

Audience: Technical support staff

Prerequisites: A basic understanding of data communications, protocols, and LANs. The course LAN Media and Components

Course aim: To enable the student to identify the main characteristics of LAN topologies and access techniques

Learning objectives
After taking this course, the student should be able to
• describe the star, mesh, ring, bus, tree, and hybrid topologies
• explain how various access methods work
• describe the process of baseband signaling

Topics covered
Star, mesh, and ring topologies
Bus, tree, and hybrid technologies
Central hub v independent stations
Contingency considerations
Baseband signaling
Manchester coding
Register insertion
Logical v physical topologies
Ring access methods
Token ring/Empty slot/Cambridge ring
Bus access methods
CSMA/CD and CSMA/CA
Peer-to-peer protocols
Medium access control

Windows® version available

Course incorporates: Test
IEEE: Introduction and the 802.2 LLC

Produced by WebLearning Courseware.

Preceding course: LAN Topologies and Techniques
Following course: IEEE: 802.4 Token Bus and High Speed LANs

Course duration: 4 hours

Audience: Technical support staff

Prerequisites: A basic understanding of data communications, protocols, and LANs. The courses LAN Media and Components, and LAN Topologies and Techniques

Course aim: To introduce the IEEE protocols and describe the 802.2 LLC

Learning objectives
After taking this course, the student should be able to
• describe the focus of the IEEE suite of standards
• describe the functions of the IEEE 802.2 logical link control sublayer

Topics covered
The OSI model
LAN standards
Primitives and inter-layer communications
Comparison of OSI and IEEE 802
MAP, TOP, FDDI
802.2 - Logical link control
Connectionless service
Acknowledged connectionless service
Connection-oriented service
LLC frame structure
U-frames, I-frames, S-frames
Normal frame exchanges and recovery from errors

Windows® version available
Course incorporates: Test
IEEE 802.4 Token Bus and High Speed LANs

Produced by WebLearning Courseware.

**Preceding course:** IEEE: Introduction and the 802.2 LLC  
**Following course:** IEEE 802.3 CSMA/CD and 802.5 Token Ring

**Course duration:** 4 hours

**Audience:** Technical support staff

**Prerequisites:** A basic understanding of data communications, protocols and LANs. The course IEEE: Introduction and the 802.2 LLC

**Course aim:** To enable the student to specify the IEEE 802.4 standard and to plan for LANs evolution

**Learning objectives**
After taking this course, the student should be able to
- describe in full detail the IEEE 802.4 Token Bus protocol
- describe the various high-speed LANs that are emerging
- select and implement the appropriate LAN standard for LAN implementation and LAN interconnection

**Topics covered**
- Logical ring
- Network initialization, operation, and recovery
- Network reconfiguration
- Frame structure
- Control frames
- Physical requirements
- Modulation techniques
- High-speed LANs
- Isochronous Ethernet
- 100BaseT
- 100BaseVG
- Switching architectures
- Network evolution
- FDDI
- Primary and secondary rings
- Frame structures
- Early token release
- Timed token-rotation protocol
- Station management
- Physical requirements

Windows® version available

**Course incorporates:** Test
IEEE 802.3 CSMA/CD and IEEE 802.5 Token Ring

Produced by WebLearning Courseware.

**Preceding course:** IEEE: 802.4 Token Bus and High Speed LANs

**Following course:** Management and Security

**Course duration:** 4 hours

**Audience:** Technical support staff

**Prerequisites:** A basic understanding of data communications, protocols and LANs. The courses IEEE: Introduction and the 802.2 LLC and IEEE 802.4 Token Bus and High Speed LANs

**Course aim:** To enable the student to specify the IEEE 802.3 and IEEE 802.5 standards and to configure networks to these standards

**Learning objectives**

After taking this course, the student should be able to

- describe in full detail the IEEE 802.3 CSMA/CD protocol
- describe in full detail the IEEE 802.5 Token Ring protocol

**Topics covered**

- Collision detection and recovery
- Error checking
- Frame structure
- Repeaters
- Frame length
- Notation
- 10Base5, 10Base2, 10BaseT, 10BaseF and 10Base36
- Active control station
- Network initialization and operation
- Frame structure
- Control frames
- Physical requirements

Windows® version available

**Course incorporates:** Test
Management and Security
Produced by WebLearning Courseware.

Preceding course: WAN Technologies
Following course: Managing LANs

Course duration: 4 hours

Audience: Managerial and operational staff

Prerequisites: A basic understanding of data communications, especially wide area networks, is necessary. Familiarity with the course WAN Technologies would be useful.

Course aim: To enable the student to implement security measures on a wide area network

Learning objectives
After taking this course, the student should be able to
• plan, schedule, and manage network availability
• describe network management as it relates to the OSI model
• identify threats to network security and to data in transit
• implement appropriate physical and logical security measures on a wide area network

Topics covered
Introduction to network management
Management and the OSI model
Configuration management
Fault management
Performance management
Security management
Accounting management
Network testing
Network control
Network planning
Change management
Capacity and forecasting
Security threats and risk assessment
Security policy
Access control

Physical security
Security manager
Electronic locks
ID badges, card readers
Audit train of access
Logical security
Database integrity
Message authentication
Transmission security
Data encryption
DES
ECB
CBC
Public key cryptography
Dial-up/dial-back security

Windows® version available, French language course available

Course incorporates: Test
Managing LANs
Produced by WebLearning Courseware.

Preceding course: Management and Security
Following course: Troubleshooting LANs

Course duration: 4 hours

Audience: Managerial and operational staff

Prerequisites: Experience in the administration of LANs

Course aim: To enable the student to implement a management strategy on a local area network

Learning objectives
After taking this course, the student should be able to
• describe the network manager’s role
• list the tools and resources that the manager has to manage the network
• describe the common cabling problems associated with LANs

Topics covered
- Proactive management
- The role of the network manager
- Problem solving
- Performance baselines
- Flow charts
- Libraries and maps
- Tools for testing: Hardware and software
- Protocol analysis
- Potential cabling problems
- Metallic media: twisted-pair and coaxial cables
- Open and short circuits
- Crosstalk
- Optical cables

Windows® version available
Course incorporates: Test
Troubleshooting LANs
Produced by WebLearning Courseware.

Preceding course: Managing LANs
Following course: Several courses possible. See your curriculum planner.

Course duration: 4 hours

Audience: Technical support staff

Prerequisites: Experience in the administration of LANs; a good understanding of LAN standards as provided by the course IEEE 802.3 CSMA/CD and IEEE 802.5 Token Ring

Course aim: To enable the student to troubleshoot Ethernet and Token Ring networks

Learning objectives
After taking this course, the student should be able to
• describe the techniques for server management
• troubleshoot Ethernet networks
• troubleshoot Token Ring networks

Topics covered
Server management
Specific Ethernet problems
Specific Token Ring problems

Windows® version available
Course incorporates: Test
Analog Networks
Produced by WebLearning Courseware.

**Preceding course:** WAN Technologies  
**Following course:** Modem and Interface Testing

**Course duration:** 4 hours  
**Audience:** Operational and technical support staff  
**Pre requisites:** A thorough understanding of the basics of wide area networks, as provided by the course WAN Technologies

**Course aim:** To introduce the student to the operation of analog networks

**Learning objectives**
After taking this course, the student should be able to
- distinguish between point-to-point and multipoint links and between dedicated and dial-up links  
- describe each type of link and choose the appropriate link for a given situation  
- describe the polling of branches on a multipoint link and explain muxing  
- calculate loss (or gain) in decibels  
- use a line analyzer to carry out continuity, noise, amplitude distortion, frequency shift, impulse noise and phase jitter tests  
- suggest appropriate solutions to these problems  
- describe briefly the application of modems and EIA-232 interfaces

**Topics covered**

<table>
<thead>
<tr>
<th>Leased circuits v dial-up links</th>
<th>Phase jitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point-to-point links</td>
<td>Impulse noise</td>
</tr>
<tr>
<td>Multipoint links - main-bearer and spur</td>
<td>Phase and amplitude hits</td>
</tr>
<tr>
<td>Branching/combining unit</td>
<td>Equalization</td>
</tr>
<tr>
<td>Front end processor</td>
<td>Conditioning</td>
</tr>
<tr>
<td>Multiplexing</td>
<td>Line analyzer</td>
</tr>
<tr>
<td>Polling</td>
<td>Testing lines</td>
</tr>
<tr>
<td>Loss</td>
<td>Continuity test</td>
</tr>
<tr>
<td>Noise</td>
<td>Total outage v intermittent problems</td>
</tr>
<tr>
<td>Decibels</td>
<td>Modems</td>
</tr>
<tr>
<td>Amplitude distortion</td>
<td>EIA-232 interface</td>
</tr>
<tr>
<td>Frequency shift</td>
<td></td>
</tr>
</tbody>
</table>

**Windows® version available**
**Course incorporates:** Test
Modem and Interface Testing
Produced by WebLearning Courseware.

Preceding course: Analog Networks
Following course: Several courses possible. See your curriculum planner.

Course duration: 4 hours

Audience: Operational and managerial staff

Prerequisites: The course Analog Networks

Course aim: To enable the student to troubleshoot problems on analog networks

Learning objectives
After taking this course, the student should be able to
• describe the functions and operation of a modem and build an interface, setting up a modem
• test a modem, interpreting the LCD or LED display on the modem
• implement the four loop-back testing mechanisms outlined in CCITT V.54
• use a bit error rate tester
• describe the EIA-232-E interface cable in detail, assigning each pin its function
• use a break-out box to diagnose problems in an EIA-232-E interface
• use a break-out box to build modem-to-modem and terminal-to-terminal interfaces

Topics covered
Functions of modems
Operation of modems
Synchronization
Clocking
Modem facilities
Full duplex operation
Half duplex operation
Modem testing - self-tests and end-to-end test
Line looping and testing
Modem displays
EIA-232-E interface - physical characteristics
EIA-232-E interface - electrical characteristics
Transition region
Pin functions
Operation of the interface
Testing the interface
Using the break-out box
Building interfaces
DTE-DTE connections
DCE-DCE connections

Windows® version available

Course incorporates: Test

16
Internetworking: Essentials
Produced by WebLearning Courseware.

**Preceding course:** Fundamentals of Internetworking
**Following course:** Internetworking: Devices

**Course duration:** 4 hours

**Audience:** Technical support staff

**Prerequisites:** The introductory course Fundamentals of Internetworking

**Course aim:** To introduce the student to internetworking and explain how networks are connected and how differences between them are resolved

**Learning objectives**
After taking this course, the student should be able to
- discuss the reasons for internetworking, explain how networks are connected, and describe the devices used to do it
- outline the types of WAN links and their functions
- describe how networks are connected at different layers in their architectures
- identify ways in which LANs may differ from each other and explain how these differences are resolved

**Topics covered**
- Need for internetworking
- Internetworking LANs
- SO model
- Types of WAN link
- How networks differ
- SODS
- Frame relay
- Bandwidth use
- Access methods
- Frame sizes
- Flow control
- Recovery mechanisms

Windows® version available

**Course incorporates:** Test
Internetworking: Bridges, Routers, and Gateways
Produced by WebLearning Courseware.

Course duration: 8 hours

Audience: Technical support staff

Prerequisites: A good understanding of LAN standards, as covered in the course IEEE LAN Architecture, and some knowledge of internetworking, as provided by the course Internetworking: Essentials

Course aim: To enable the user to implement and manage interconnected networks built to IEEE LAN standards

Learning objectives
After taking this course, the user should be able to
• describe in detail the operations and functions of bridges and how they transfer data from one IEEE network to another
• explain the function of the spanning tree algorithm and give an account of its operation
• discuss source routing
• differentiate between routers and gateways and explain their respective roles
• give an account of the various network layer routing protocols

Topics covered
Bridge types
Local and remote bridging
Passing data through a bridge
Bridges and addressing issues
Passing data on to a network
Services and protocols
Internetworking networks
Physical layer connections
Data link layer connections
Network layer connections
Data transfer between IEEE networks
Routers
Gateways
Routing Information Protocol
OSPF Protocol
Border Gateway Protocol
Spanning tree algorithm
Source routing

Windows version available
Course incorporates: Test, Glossary
Fast Packet Technologies
Produced by WebLearning Courseware.

Preceding course: WAN Technologies
Following course: B-ISDN: Architecture and Channels

Course duration: 4 hours

Audience: Managerial and support staff

Prerequisites: Some knowledge of wide area networking as presented in the course WAN Technologies

Course aim: To overview technologies based on Frame Relay and cell relay and assess their application in networks

Learning objectives
After taking this course, the student should be able to
- discuss the development of fast packet technologies
- describe the Frame Relay network, contrasting it with X.25 and pointing out its advantages
- explain the principle of cell relay and outline some cell relay implementations
- discuss SONET and SDH, describe their unusual frame structure and point out the benefits of multiplexing
- outline the operation of MANs with particular reference to slots and DQDB

Topics covered
Frame Relay
Cell relay
SMDS
Access classes
MANs
DQDB
B-ISDN
ATM
SONET and SDH

Windows® version available
Course incorporates: Test
Broadband-ISDN

Produced by WebLearning Courseware.

Course duration: 8 hours

Audience: Managerial and operational staff

Prerequisites: Some knowledge of wide area networks, as outlined in the course *WAN Fundamentals* and *Fast Packet Technologies*

Course aim: To give to the user an appreciation of the developments in broadband-ISDN

Learning objectives

After taking this course, the user should be able to

- describe ISDN in terms of channels, interfaces, services, standards
- elaborate the motivation behind and evolution towards B-ISDN
- describe B-ISDN building blocks
- describe the B-ISDN network concept
- describe the B-ISDN user-to-network interfaces and protocols
- describe the Signaling System no. 7 (SS7)
- explain how to migrate towards B-ISDN

Topics covered

- ISDN channels
- B-ISDN channels
- Overview of ISDN services
- ATM overview
- Optical transmission - SONET/SDH
- B-ISDN network architecture
  - architecture
  - techniques
  - performance
  - channels
  - OAM
  - traffic control
- B-ISDN, UM and protocols
  - SS-7
    - signaling systems
    - protocol overview
    - services
  - B-ISDN evolution
  - LANs, MANs, IWU
  - Tariffing

Windows version available

Course incorporates: Test
ATM Fundamentals
Produced by WebLearning Courseware.

Course duration: 8 hours

Audience: Managerial and operational staff

Prerequisites: Some knowledge of wide area networks, as outlined in the course WAN Fundamentals; the course Fast Packet Technologies

Course aim: To describe ATM technology and to provide the user with a foundation in ATM operations and applications

Learning objectives
After taking this course, the user should be able to
• outline the new application demands
• describe the principles behind ATM
• distinguish between cell-based and packet-based networks
• describe the ATM network hierarchy
• illustrate the concepts of virtual channels and virtual paths
• illustrate the applications of ATM in LANs and WANs
• illustrate the ATM layered model
• discuss ATM standards and bodies

Topics covered
ATM v STM
Cell v packet-based networks
ATM network
Virtual channels and paths
Cell transmission
ATM and LANs
ATM and WANs
ATM and B-ISDN
ATM and frame relay
ATM and SMDS
ATM layered model
ATM standards and bodies
Barriers to ATM

Windows and DOS versions available
Course incorporates: Test
ATM for Technical Users
Produced by WebLearning Courseware.

Course duration: 8 hours

Audience: Operational and technical staff

Prerequisites: Some knowledge of wide area networks, as outlined in the course WAN Fundamentals, the course Fast Packet Technologies, and the course ATM Fundamentals

Course aim: To describe in detail the ATM reference model and to give an understanding of the techniques used to support the various requirements of the different traffic types

Learning objectives
After taking this course, the user should be able to
• describe ATM switches and multiplexors
• describe how virtual channel and virtual path switching are achieved
• describe in detail the ATM layered model
• describe the process of segmentation and reassembly (SAR)
• describe the ATM adaption layer (AAL) services

Topics covered
Switches for ATM
VC and VP switching
ATM layered model
Physical layer and sublayers
ATM layer
ATM adaption layer (AAL)
Segmentation and reassembly (SAR)
AAL CPCS operation
AAL services
AAL-1
AAL-2
AAL-3
AAL-3/4
ATM cell structure
Cell header
Physical layer and transport
SONET/SDH and ATM

Windows version available
Course incorporates: Test
SMDS, MANs and Fiber Networks
Produced by WebLearning Courseware.

Preceding course: Fast Packet Technologies
Following course: Several courses possible. See your curriculum planner.

Course duration: 4 hours

Audience: Managerial and operational staff

Prerequisites: Some knowledge of wide area networks and local area networks; Fast Packet Technologies provides a good introduction.

Course aim: To give the student an appreciation of developments in the SMDS, FDDI, and SONET/SDH technologies

Learning objectives
After taking this course, the student should be able to
- explain the need for SMDS networks and outline their features
- describe the SMDS interface and how to access the SMDS network
- describe the properties of MANs
- describe the fiber distributed data interface (FDDI) protocol
- describe the operation of SONET and SDH

Topics covered
SMDS operation
The Subscriber network interface (SNI)
SMDS interface
SMDS access classes
MAC sublayer operations
Physical layer operations
Interswitch operations
SMDS PDU
SMDS cells
Metropolitan area networks
IEEE 802.6
ANSI X3T9.5
Distributed queue dual bus - DQDB
Frame generator
Frames and slots
FDDI and FDDI-II
Primary and secondary rings
Class A and B stations
Wiring concentrator
Link failure and recovery
Station failure
SONET and SDH
SONET layers
STS-1
STS-3
STM-1
Synchronous payload envelope
Extracting a data stream
Packet Switching WANs
Produced by WebLearning Courseware.

Preceding course:  WAN Technologies
Following course:  Introduction to X.25 Networking

Course duration:  4 hours

Audience:  Managerial and operational staff

Prerequisites:  The course  WAN Technologies

Course aim:  To provide the student with a solid foundation in wide area packet-switching networking technologies

Learning objectives
After taking this course, the student should be able to
• compare switched and permanent virtual circuits
• describe the operation of logical channels and PADs
• distinguish between adaptive and non-adaptive routing
• compare various network facilities
• implement routing policies

Topics covered
Virtual circuits - SVCs and PVCs
Logical channels
Connection-oriented calls
Call collision
Link recovery
PADs
Non-adaptive routing
Adaptive routing - centralized, isolated, distributed
Closed user groups
Reverse charging
Call hunting
Call redirect

Windows® version available

Course incorporates: Test
Introduction to X.25 Networking
Produced by WebLearning Courseware.

Preceding course: Packet Switching WANs
Following course: X.25 Protocols and Operation

Course duration: 4 hours

Audience: Managerial and operational staff

Prerequisites: Some knowledge of wide area networks, as covered in the course WAN Technologies

Course aim: To enable the student to implement and manage a network using the X.25 interfacing protocol

Learning objectives
After taking this course, the student should be able to
• outline the principles of packet-switched networking
• describe the process of switch and permanent virtual circuits
• name the three layers in the X.25 protocol
• explain why and how PADs are used and name the various protocols associated with them
• identify and interpret the fields of the HDLC LAP-B protocol and describe how HDLC frames are exchanged

Topics covered
Function and operation of packet-switched networks
Packet v circuit switching
X.25 architecture
Dumb terminals and PADs
The triple X protocols
PAD operation
HDLC - response and balanced mode
Flow control
Error checking
Window mechanism

Windows® version available
Course incorporates: Test
X.25 Protocols and Operation
Produced by WebLearning Courseware.

Preceding course: Introduction to X.25 Networking
Following course: Frame Relay: Concepts and Operation

Course duration: 4 hours

Audience: Operational and technical support staff

Prerequisites: Some knowledge of wide area networks, as covered in the course WAN Technologies; the course Introduction to X.25 Networking is required

Course aim: To enable the student to implement and manage a network using the X.25 interfacing protocol

Learning objectives
After taking this course, the student should be able to
- identify and interpret the fields of the X.25 packet header and explain the X.25 addressing method
- give the sequence of X.25 packets exchanged in various situations
- explain the sequencing, error recovery, congestion control, flow control, and rerouting mechanisms used by the X.25 protocol

Topics covered
- Addressing
- Link initialization and synchronization
- Bit stuffing
- Data transparency
- Frames, formats and operation
- Recovery mechanism
- X.25 packet layer protocol
- Virtual calls - switched and permanent
- Logical channels and designation

Windows® version available

Course incorporates: Test
Frame Relay: Concepts and Operation
Produced by WebLearning Courseware.

Preceding course: X.25 Protocols and Operation
Following course: Frame Relay: Protocols and Implementation

Course duration: 4 hours

Audience: Operational and technical support staff

Prerequisites: Some knowledge of wide area networks, as outlined in the course WAN Technologies; Introduction to X.25 Networking, X.25 Protocols and Operation and Fast Packet Technologies would also be useful

Course aim: To enable the student to implement and manage a Frame Relay interface and network

Learning objectives
After taking this course, the student should be able to
• outline the advantages Frame Relay has to offer and explain why the Frame Relay method of handling errors contributes to the speed of the network
• give an example of a commonly used Frame Relay protocol type and outline its operation
• explain how frames are routed on a Frame Relay network
• discuss the concept of CIR
• discuss Frame Relay standards and VPNs

Topics covered
Traditional WANs
High-speed technologies
Advantages of Frame Relay
Error and congestion handling
Header information
DLCI
FECN/BECN
Extended addressing
Committed information rate
PVCs
Routing and sequencing
Frame relay standards: ANSI and CCIT/ITU-T; the Frame Relay Forum
Virtual private networks over Frame Relay networks

Windows® version available

Course incorporates: Test
Frame Relay: Protocols and Implementation
Produced by WebLearning Courseware.

Preceding course: Frame Relay: Concepts and Operation
Following course: Several courses possible. See your curriculum planner.

Course duration: 4 hours

Audience: Operational and technical support staff

Prerequisites: Some knowledge of wide area networks as outlined in the course WAN Technologies; Introduction to X.25 Networking, X.25 Protocols and Operations and Fast Packet Technologies would also be useful. The course Frame relay: Concepts and Operations is essential

Course aim: To enable the student to implement and manage a Frame Relay interface and network

Learning objectives
After taking this course, the student should be able to
- interpret in detail the fields of a Frame Relay frame, explaining the functions and operation of flags, bit-stuffing, the DLCI, EA, BECN, FECN, and DE bits and the FCS operation
- explain the purpose of an LMI and describe the three LMI message types
- discuss issues associated with Frame Relay implementations, LAN bridges and routers, encapsulation, and terminal adapters

Topics covered
Frame Relay frame format
Flags and bit-stuffing
Header: DLCI, BECN, FECN, EA, DE
Information field
FCS
LMIs
Status inquiry
PVC status
LAN bridging and routing
Encapsulation
Terminal adapters

Windows® version available
Course incorporates: Test
WebLearning Network

TCP/IP AND OPEN SYSTEMS COURSES
Open Systems Standards
Produced by WebLearning Courseware.

Preceding course: Several courses possible. See your curriculum planner.
Following course: TCP/IP Architecture and Routing

Course duration: 10 hours

Audience: Managers, sales, and technical staff

Prerequisites: None

Course aim: To enable the student to make better business and technical decisions by defining and putting into context the concepts important to building Open Systems

Learning objectives
After taking this course, the student should be able to
• outline the need for software and hardware standards
• define the term “Open Systems”, with reference to portability and interoperability
• explain the impact of software portability on Open Systems development
• explain the impact of interoperability on building Open Systems
• identify the different standards procedures and standards bodies
• use and interpret Open Systems jargon

Topics covered
Proprietary and Open Systems
Processor technology
Source and binary compatibility
Modern operating systems
User interfaces
POSIX
X/Open
OSF
COSE
Languages and development tools
Client/server systems
The middleware concept
Standards for interoperability

DOS version available

Course incorporates: Test
TCP/IP Architecture and Routing
Produced by WebLearning Courseware.

Preceding course: Open Systems Standards
Following course: TCP/IP Protocols

Course duration: 6 hours

Audience: Operational and technical support staff

Prerequisites: Students should have a basic knowledge of data communications, including Open Systems as covered in the course Open Systems Standards

Course aim: To enable the student to implement and maintain a network conforming to TCP/IP Internet standards

Learning objectives
After taking this course, the student should be able to
• describe the four layers of the TCP/IP model and their role in transferring data
• explain how hosts in the Internet are addressed
• explain how routers are used in routing datagrams and explain the various protocols in operation for updating routing tables

Topics covered
Need for internetworking protocols
DARPA and NSF
Internet community
IAB, ITF and RFC
Comparison with OSI reference model
Internet names and addresses
Address classes and formats
Address masking
Dotted decimal notation
Routing
Core and non-core routers
Direct and indirect routing
Routing protocols: RIP, OSPF, EGP, BGP
Autonomous systems
The PPP

Windows® version available; German language course available
Course incorporates: Test, Glossary
TCP/IP Protocols
Produced by WebLearning Courseware.

Preceding course: TCP/IP Architecture and Routing
Following course: TCP/IP Management: SNMP

Course duration: 6 hours

Audience: Operational and technical support staff

Prerequisites: The courses Open System Standards and TCP/IP Architecture and Routing

Course aim: To enable the student to implement and maintain a network conforming to TCP/IP Internet standards

Learning objectives
After taking this course, the student should be able to
- explain the purpose of the Internet Protocol and describe a connectionless service
- fill in and explain the fields of the IP, ICMP, TCP, and UDP headers
- explain how TCP sets up a connection, manages data transmission, and gracefully closes the connection

Topics covered
- TCP connection-oriented operation
- Fragmentation and assembly
- IP header fields
- Options
- Security
- ICMP operation
- ICMP header fields
- TCP protocol operation
- UDP protocol operation
- Well-known ports
- Passive and active open
- TCP header fields
- Flow control
- Maximum segment size
- Connection open
- Sequencing
- Connection close

Windows® version available; German language course available

Course incorporates: Test, Glossary
TCP/IP Management: SNMP
Produced by WebLearning Courseware.

Preceding course: TCP/IP Protocols
Following course: TCP/IP Applications

Course duration: 6 hours

Audience: Operational and technical support staff

Prerequisites: A thorough understanding of the TCP/IP suite is required. This is provided by the course TCP/IP Architecture and Routing.

Course aim: To enable the student to implement and support the TCP/IP application, SNMP

Learning objectives
After taking this course, the student should be able to
- implement the TCP/IP SNMP protocol
- manage a standardized form of network in accordance with the IAB's plans
- write an MIB object description
- explain the operation of the RMON MIB

Topics covered
- Network management
- Data collection
- Centralized network management
- IAB network management protocols
- NMS
- Network element
- Management agent
- MIB object description
- Registration tree
- Syntax, definition access and status
- MIB object groups
- RMON MIB
- SNMP message structure
- SNMP message and operation
- SNMPv2

Windows® version available; German language course available

Course incorporates: Test, Glossary
TCP/IP Applications
Produced by WebLearning Courseware.

Preceding course: TCP/IP Management: SNMP
Following course: SNA Interconnection

Course duration: 4 hours

Audience: Operational and technical support staff

Prerequisites: A thorough understanding of the TCP/IP suite is required. This is provided by the course TCP/IP Architecture and Routing.

Course aim: To enable the student to implement and support the TCP/IP applications, SMTP, FTP, TELNET, and TFTP

Learning objectives
After taking this course, the student should be able to
- implement TCP/IP applications
- outline the structure of a simple mail transfer protocol message and how it is transmitted, and use SMTP commands and replies
- explain the operation of the file transfer protocol and use common FTP commands and replies
- explain the operation of TELNET and use TELNET commands
- use TFTP commands and other simple applications

Topics covered
- SMTP message structure
- SMTP commands and replies
- SMTP operation
- File transfer, third party transfer
- Protocol interpreter
- FTP file structures
- FTP data types
- FTP transmission modes
- FTP commands and replies
- TELNET options and commands
- NVT
- Option negotiation
- TFTP operation
- TFTP commands and replies
- BOOTP, FINGER, PING, ECHO, WHOIS

Windows® version available; German language course available

Course incorporates: Test, Glossary
SNA® Interconnection
Produced by WebLearning Courseware.

Preceding course: TCP/IP Applications
Following course: Several courses possible. See your curriculum planner.

Course duration: 8 hours

Audience: Network managers

Prerequisites: A knowledge of the appropriate network and protocols

Course aim: To enable students to choose the correct SNA connectivity options for their specific network conditions

Learning objectives
After completing this course the student should be able to
- describe the components of the "new SNA"
- list new SNA connectivity options
- choose the best SNA connectivity for OSI, Novell or TCP/IP networks
- create a migration and interoperability plan for specific network needs

Topics covered
Components of SNA
APPN
The future of APPN
Overview of SNA operation
Data link layer options
Token Ring
SNA and OSI
Internetworking
Multi-protocol transport networks
Connecting to the IP environment
Tunneling
Encapsulation schemes
Data link switching

DOS version available

Course incorporates: Test
TCP/IP for UNIX® Users
Produced by WebLearning Courseware.

Preceding course:  Open Systems Standards
Following course: Several courses possible. See your curriculum planner.

Course duration:  6 hours

Audience: Managerial and operational staff; users who require more detailed TCP/IP training should move straight to TCP/IP Architecture and Routing

Prerequisites: Some experience of UNIX and networking; knowledge of the courses UNIX Awareness and Open Systems Standards would be useful.

Course aim: To study the TCP/IP protocol suite with special reference to internetworking UNIX networks across the Internet

Learning objectives
After taking this course, the student should be able to

• outline the role of LANs in UNIX computing and describe in simple terms two widely used LAN types: Ethernet and Token Ring
• outline some of the issues involved in linking LANs over wide area networks
• describe in brief the TCP/IP protocol suite and outline its architecture
• explain the addressing system used in the Internet, distinguish between physical and IP addresses, and outline the use of address classes
• explain the routing used by TCP/IP, distinguishing between direct and indirect routing and differentiating between core and non core gateways
• describe several applications used in conjunction with TCP/IP

Topics covered
LANs
CSMA/CD
Token ring
Internetworking LANs
Bridges and routers
TCP/IP development
Addressing and classes
Routing and protocols
Applications - SNMP, SMTP, FTP
NFS
RPC and XDR mount and unmount

Windows® and DOS versions available

Course incorporates: Test, Glossary
OSI Fundamentals
Produced by WebLearning Courseware.

Preceding course: Several courses possible. See your curriculum planner.
Following course: Several courses possible. See your curriculum planner.

Course duration: 6 hours
Audience: Managerial and operational staff
Prerequisites: None
Course aim: To give the student a thorough grounding in the OSI reference model and appreciation of the applications using this model

Learning objectives
After taking this course, the student should be able to
- outline the need for internationally accepted and implemented networking standards
- describe the OSI reference model, identify its seven layers and their functions and explain how the model represents the protocols and primitives involved in networking
- describe the OSI application protocols

Topics covered
  Closed v open communities of users
  Reasons for standards
  Standards bodies
  Layered architecture
  OSI reference model
  Responsibilities and services of the layers
  Layer interaction - primitives
  Confirmed v unconfirmed mode
  Service access points - SAPs
  Service data units - SDUs
  Protocol data units - PDUs
  ACSE
  X.400
  X.500
  FTAM
  ROSE

DOS version available; French language course available

Course incorporates: Glossary
OSI Operations
Produced by WebLearning Courseware.

Preceding course: OSI Fundamentals
Following course: Several courses possible. See your curriculum planner.

Course duration: 12 hours

Audience: Operational staff involved with OSI networks. Personnel who require more detailed technical training should move straight to OSI Upper Layers or OSI Network Layers.

Prerequisites: Students should have a good understanding of the principles of OSI and the OSI reference model. This knowledge base is provided by the course OSI Fundamentals.

Course aim: To enable the student to manage and support the day-to-day operations of OSI networks

Learning objectives
After taking this course, the student should be able to
- describe the functions and services of the seven layers of the OSI model
- describe the various types of link and transmission medium that are available
- identify various types of connection, flow control, and addressing system
- identify the types of service and the method of flow control offered by the network layer
- explain the operation of the transport layer
- explain connection and dialog management
- describe synchronization, sync point, activity management and session/transport mapping

Topics covered
Physical layer functions and services
Switched and dedicated links
Analog and digital links
Circuit-switched digital link
LAN media
Baseband and broadband transmission

Data link layer functions and services
Address and control fields
Connectionless operation
Connection-oriented operation
HDLC balanced and unbalanced operation
Flow control
Sequencing
Window mechanism

Network layer functions and services
Set-up and clearing of network layer connections
Connection-oriented operation
Connectionless operation
X.25 packet types
Routing tables
PAD packet assembler/disassembler
Triple X protocols

Transport layer functions and services
Connection-oriented and connectionless operation
Quality of service parameters
Data segmentation and sequencing
Error control
Network types
Transport classes

Session layer functions and services
Connection management
Activity management
Synchronization points
Quality of service
Token management
Quarantine service
Session/transport connection mapping

Presentation layer functions & services
Data representation
Transfer syntax
Abstract syntax
Presentation context
ASN.1 and ASN.1 tag classes: universal, application-specific, context-specific, private

Application layer functions and services
User element
Application entities
Application service elements
Association context
ACSE application control service element
FTAM file transfer, access and management
X.400 message handling systems
ROSE remote operation service element
Client/server model

DOS version available; French language course available
Course incorporates: Test, Glossary
OSI Network Layers
Produced by WebLearning Courseware.

Preceding course:  OSI Fundamentals
Following course:  OSI Upper Layers

Course duration: 14 hours

Audience: Technical support staff

Prerequisites: Students should have a thorough understanding of the principles of OSI, as offered by the course OSI Fundamentals.

Course aim: To enable the student to configure and implement networks conforming to the OSI reference model at the network layers

Learning objectives
After taking this course, the student should be able to
- describe in full detail the functions and services of the three network layers of the OSI model
- weigh up the advantages and disadvantages of each of the available types of link, transmission medium, and topology and choose the appropriate combination for a given situation
- choose the appropriate type of connection, flow control, and addressing system for a given situation
- describe the HDLC in full detail and compare it with the LLC protocol
- identify the types of service and the method of flow control offered by the network layer and suggest ways of dealing with congestion
- explain the operation of the transport layer and compare the TCP and TP4 protocols
- implement the network layers of an OSI network

Topics covered

Physical layer functions and services
Transmission methodologies applications for dedicated and switched lines
Analog/digital links limitations and bandwidths
Errors, interference, throughput
Transmission media
Network topologies
Multiplexing TDM and stat mux
Regeneration of signals

Data link layer functions and services
Connectionless operation
Acknowledged connectionless operation
Connection-oriented operation
Flow and error control
HDLC header, trailer, fields, frame types, error/flow control
Response and balanced mode
Addressing normal and extended
Link initialization and synchronization
Bit-stuffing/ transparency
Sequencing/acknowledgment
Window mechanism
Piggybacking
IEEE LAN sublayers LLC and MAC

Network layer functions and services
Connection-oriented and connectionless operation

X.25 packet layer protocol
Packet types fields, facilities
SVC and PVC
Logical channels designation, call collision
Flow and error control
Sequencing
X.121 addressing
Routing policies and routing tables
Congestion control
Link recovery
X.28 terminal mode
Triple X protocol suite

Transport layer functions and services
Connection-oriented and connectionless operation
Quality of service parameters
Multiplexing users and network connections
Network classification
Transport protocol classes
Flow and error control
Two- and three-way open/close connections
Graceful and abrupt close
Segmentation/reassembly
Sequenced delivery
Normal/expedited delivery
Transport protocol data units
TCP v TP4
OSI Upper Layers
Produced by WebLearning Courseware.

Preceding course: OSI Network Layers
Following course: Several courses possible. See your curriculum planner.

Course duration: 12 hours
Audience: Technical support staff
Prerequisites: Students should have a thorough understanding of the principles of OSI, as provided by the course OSI Fundamentals.

Course aim: To enable the student to implement the upper layers of the OSI reference model, which support the OSI application service elements

Learning objectives
After taking this course, the student should be able to
- describe in full detail the functions and services of the three upper layers of the OSI reference model
- explain connection and dialog management, quarantine service, session transport mapping, sync points and numbers, and full- and half-duplex transmission
- describe synchronization, activity management and exception reporting
- distinguish between abstract and transfer syntax, explain how an agreed syntax is arrived at, and identify the fields of the ASN.1 tag
- give examples of the use of data encryption and compression and illustrate the techniques
- describe the operation and purpose of ACSE and CCR, and identify their primitives, explain VT, FTAM, MHS, and ROSE and illustrate the operation of electronic mail
- explain the operation of the transport layer and compare the TCP and TP4 protocols
- implement the user layers of an OSI network

Topics covered
Session layer functions and services
  Connection management session establishment, agreed/abrupt release
  Dialog management dialog units
  Activity management
  Synchronization major/minor sync points, serial numbers
  Token management
  Quarantine service
  Data types regular, expedited, typed, sync
  Functional units kernel, release, duplex, sync
  Subsets kernel, BCS, BSS, BAS
Presentation layer functions and services
  Transfer syntax
  Abstract syntax
  Presentation context defined context, default context
  Syntax selection and negotiation
  Context management
  ASN.1 class types: universal, application-specific, context-specific, private
  Encryption
  Data compression
Application layer functions and services
  User element
  Application entity
  Application service elements
  Association control primitives
  Commitment, concurrency and recovery
  atomic action and primitives

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Page 42 of 46
EDI and ODA
Produced by WebLearning Courseware.

Preceding course: OSI Fundamentals
Following course: FTAM

Course duration: 6 hours

Audience: Managerial and operational staff

Prerequisites: A basic understanding of data communications, especially the OSI model, is necessary. Familiarity with the course OSI Fundamentals would be useful.

Course aim: To give the student an appreciation of standards related to electronic document handling

Learning objectives
After taking this course, the student should be able to
• outline the requirement in modern business for EDI and ODA
• describe a typical EDI cycle
• propose a solution to the problems that may be involved in switching from paper trading to EDI
• explain how ODA is used to transfer documents between computer systems
• outline the use of SGML in the publication of documents

Topics covered
Value added network
P.EDI
X.435 Interface
Paperless trading
TRADACOMS
ANSI X.12
EDIFACT
Encode/decode
EFT
ISO 8613
CCITT T.610
Logical and layout structure
Document types
ODIF
ISO 8879
SGML
DSSSL
SDIF

DOS version available
Course incorporates: Glossary
FTAM

Produced by WebLearning Courseware.

Preceding course: EDI and ODA
Following course: Several courses possible. See your curriculum planner.

Course duration: 4 hours

Audience: Managerial and operational staff

Prerequisites: A basic understanding of data communications, especially the OSI model, is necessary. Familiarity with the course OSI Fundamentals would be useful.

Course aim: To give the student an appreciation of file transfer access and management (FTAM) standards

Learning objectives
After taking this course, the student should be able to
• describe the components and functions of FTAM
• outline the structure of regimes in FTAM

Topics covered
ISO 8571
File access data units
Data units
FTAM regimes: association, file selection, file open, data transfer
FTAM primitives
Functional units
Virtual filestore
Local filestore
Hierarchical model

DOS version available
Course incorporates: Glossary
MHS Operations
Produced by WebLearning Courseware.

Preceding course: OSI Fundamentals
Following course: X.400 Protocols

Course duration: 8 hours

Audience: Operational and managerial staff

Prerequisites: Students need basic knowledge of data communications, particularly the OSI model. This knowledge base is provided in the course OSI Fundamentals.

Course aim: To give the student an appreciation of the X.400 and X.500 standards

Learning objectives
After taking this course, the student should be able to
- list the components of the message handling system (MHS) and give the functions of each
- draw up a representation of the basic 1984 MHS model and describe the message flow of the MHS system
- describe the additions to the model made in 1988 and show how these changes affect the operation of the model
- relate the four X.400 protocols to the model
- describe the structure of the X.500 directory
- draw up a typical X.500 directory model

Topics covered
UA/MTA configurations
ADMD
PRMD
Distribution list
1984/1988 models
Delivery mode
Directory object classes
RDN
Alias
Dereferencing
Directory user agent
Directory system agent
Chaining, referral, and multicasting

DOS version available
Course incorporates: Test, Glossary