

Data Networking and Architecture

The course focuses on theoretical principles and practical implementation of selected Data Networking protocols and standards. Physical network architecture is described as well as some of the configuration techniques used to achieve the goals. Some of the Core Network Protocols in this course are aimed at those working in a Service Provider or Carrier environment.

Prerequisites:

Delegates should have some basic knowledge of Internet Protocol and Data Networking principles.

Aim:

To provide delegates with a fundamental understanding of selected Data Network standards, protocols and implementation.

Objectives:

By the end of the course you will be able to.

Understand Ethernet Technologies and Concepts.

Describe Layer 2 and Layer 3 switching.

Describe the basic function of Routing with Interior Gateway Routing Protocols, OSPF and IS-IS.

Describe the basic function and operation of BGP.

Describe a VLAN and its purpose and function.

Understand the Technologies behind VPNs.

Describe VPLS (Virtual Private LAN Service) and VPWS (Virtual Private Wire Service).

Describe the purpose and function of an Emulated LAN

Describe the function of LACP (Link Aggregation Control Protocol)

Understand the principles of MPLS (Multi Protocol Labelled Switching)

Describe TMPLS and the use of Pseudowires.

Compare and contrast TMPLS with PBB-TE (Provider Backbone Bridging-Traffic Engineering).

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Course Code – NET15003

Understand IP Multicast

Describe the function and purpose of DHCP (Dynamic Host Configuration Protocol).

Describe the use of VoIP (Voice over Internet Protocol), the drivers behind it and the numerous protocols associated with it.

Course Profile:

Understanding Ethernet Technologies

- Introducing Ethernet
- LAN Components
- Practical Considerations when building LANs
- Ethernet Evolution
- LAN Standards
- Ethernet Frame Structure
- LLC – Logical Link Control
- CSMA/CD
- LAN Communications
- Media Access Control
- Multicast Ethernet Mapping
- Enhanced Ethernet Standards
- Gigabit and 10 Gigabit Ethernet

Layer 2 Bridging and Switching

- Switched Networks
- Functions of a Switch
- Address Learning (Switch)
- Address Learning (Bridge0)
- Flooding of Broadcast and Multicast Frames
- Redundancy
- Broadcast Storms
- Duplicate non-broadcast frames
- Database Instability
- STP - Spanning Tree Protocol

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- STP – Root Bridge Election
- STP – States
- STP – Port Path Cost
- STP – Operation
- STP – PortFast
- Switching Modes
 - Store and Forward
 - Cut Through
 - Fragment Free
- Duplex Operation
- Speed Settings
- CRC Errors and Late Collisions
- MAC Address Tables
- Configuring a Static MAC Address
- Configuring a Secure MAC Address
- Port Security

Virtual Local Area Networks

- Routed Networks
- Switched Networks
- Network with VLANs
- What is a VLAN
- VLAN Membership
- VLAN Tagging with ISL and IEEE 802.1q
- VTP – VLAN Trunking Protocol
- VTP Pruning
- VLAN Configuration
- VLAN Trunking
- Creating and Assigning VLANs

Routing Principles and Interior Gateway Routing Protocols

- The Routing Process

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- Advertising Networks
- Discovering Routes
- Autonomous Systems
- Distance Vector Routing Protocols
- RIP – Routing Information Protocol
 - RIP – Configuration and Verification
- IP Classless
- Administrative Distance
- Static Routes
- Default Routes
- OSPF – Open Shortest Path First
 - OSPF – Forming Neighbour Relationships
 - OSPF – Discovering Routes
 - Configuring and Verifying OSPF Operation
- Introduction to IS-IS
 - IS-IS Terminology
 - IS-IS Routing
 - OSI Addressing
 - LSP – Link State Packet
 - DIS – Designated Intermediate System
 - Level 1 Routers
 - Level 2 Routers
 - Level 1/2 Routers
 - IS-IS Backbone Formation
 - Integrated IS-IS
 - IS-IS Configuration
 - Basic IS-IS Troubleshooting Commands
- BGP Overview
 - BGP Topology
 - BGP Characteristics
 - BGP Peers
 - IBGP – Internal BGP
 - BGP Policy-Based Routing

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- BGP Attributes
- AS Path Attribute
- Next Hop Attribute
- Local Preference Attribute
- Configuring Basic BGP
- MPLS Overview
 - Source Routing
 - Label Switching
 - MPLS Labels
 - MPLS History
 - Scalability
 - Functionality
 - MPLS Terms
 - MPLS Control and Forwarding
 - MPLS Bindings
 - MPLS Label Distribution
 - MPLS Operation
 - MPLS Traffic Engineering
 - Loop Detection and Prevention
 - Constraint-Based Fast Re-Route
 - ATM Label Stacking
- DHCP Operation
 - Dynamic DHCP
 - DHCP Relay Agents
- Understanding VPNs
 - Benefits of VPNs
 - Site to Site VPNs
 - Remote Access VPNs
 - VPN Appliances
 - VPN Clients
 - IPSEC
 - Encryption
 - Diffie-Hellman Key Exchange

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- Date Integrity
- Authentication
- Protocols
- IPSEC Framework
- LACP – Link Aggregation Control Protocol
 - Benefits
 - Switch to Switch Connections
 - Switch to Server Connections
 - Station to Station Connections
 - LACP Frames
 - Example LACP Configuration
 - LACP Modes
 - LACP Failover
 - LACP Hot Standby Ports
 - LACP System and Port Priority

Introduction to Voice over IP

- How does it work?
- Encapsulation
- VoIP Protocols
- VoIP Service Providers
- VoIP Networks
- Why VoIP
- What does VoIP have to offer?
- Internet Telephony Product Classes
- VoIP Regulatory Bodies

Voice Encoding Schemes

- Waveform Encoding
- Recording and Playback
- PAM – Pulse Amplitude Modulation
- Quantization
- Vcoders
- MOS – Mean Opinion Score
- Voice Quality Measurement
- Voice Quality Issues
 - Latency
 - Delay Budget

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- Codec Latency
- Serialisation Latency
- Network Latency
- Jitter
- Silence Suppression
- Packet Loss
- Echo Problems in VoIP
 - Acoustic Echo
 - Hybrid Echo
 - Echo Suppression
 - Echo Cancellation

Protocols Network and Transport Layer

- OSI – 7 Layer Network Model
- TCP/IP Suite
- Internet Protocol
- Transmission Control Protocol
 - Ports and Sockets
- User Datagram Protocol

Routing Protocols

- The Routing Process
 - Advertising Networks
 - Discovering Routes
 - Interior Gateway Routing Protocols
 - Exterior Gateway Routing Protocols
 - Autonomous Systems
 - Distance Vector Routing Protocols - RIP
 - Hybrid Routing Protocols - EIGRP
 - Link State Routing Protocols – OSPF

Real Time Protocols

- ITU-T H.323 Protocol Stack
- RTP
- Encapsulation Overhead
 - Header Compression
 - Multi Payload
- RTP Translators
- Audio Conferencing (Mixers)
- RTCP
 - RTCP Bandwidth Control
 - RTCP Sender Report
 - RTCP Receiver Report
 - RTCP Session Description
 - RTCP Bye Packets

SIP – Session Initiation Protocol

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- SIP Protocol Stack
- SIP Topology
- SIP Operation
- SIP URL
- SIP Signalling Messages
- SDP – Session Description Protocol
- SIP Header Formats
- SIP Servers
 - SIP Registrar
 - SIP Proxy
 - SIP Redirect

QoS – Quality of Service

- Congestion Control
- Quality of Service Models
 - Best Effort
 - Integrated Services
 - RSVP
 - Differentiated Services
- Congestion Management
 - FiFo
 - Priority Queuing
 - Custom Queuing
 - Weighted Fair Queuing
 - Low Latency Queuing
- MPLS – Multi Protocol Labelled Switching

Multicasting

- Multicast Enabled Components
- Review of Address Types
- Multicast Applications
- Mbone
- Distribution Protocols
- Broadcast vs Multicast
- Multicast Hardware Addressing
- Multicast IP Addressing
- Multicast Mapping
- IGMPv1
- IGMPv2
- IGMP Snooping
- CGMP – Cisco Group Management Protocol
- Multicast Forwarding Algorithms
- Flooding
- Reverse Path Broadcast
- Reverse Path Multicast
- Truncated Reverse Path Multicast

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- PIM – Protocol Independent Multicast
 - PIM Dense Mode
 - PIM Sparse Mode
 - Rendezvous Points
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- **UNDERSTANDING T-MPLS, PB, PBB AND PBB-TE**
- Transport Systems using L2TP
- L2TPv3
- T-MPLS
- IETF PPVPN Working Group
- Labels and Control Word
- Control Word – Frame Relay Example
- Layer 2 Transport over MPLS (ATM)
- PseudoWires
- Properties of PWE3 for Ethernet
- Advantages of Ethernet over MPLS
- VPWS – Virtual Private Wire Service
 - VPWS Signalling
- VPLS – Virtual Private LAN Service
 - VPLS Operation
- Provider Bridge and Provider Backbone Bridge
 - Provider Backbone Bridging
 - Provider Bridging Evolution
 - PBB-TE