



Course Catalogue

2013



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VoIP with SIP (3 Days)

Course Code VOI12002

This course focuses on theoretical and practical principles of Real-Time Media over Internet Protocol coupled with SIP (Session Initiation Protocol). Although the course is intended to be generic, examples of VoIP networks are highlighted utilising Cisco products and other vendors and hardware.

Prerequisites

A basic understanding of Data Networking and Internet Protocol

Aim:

To provide delegates with a fundamental understanding of how Real-Time Media is delivered using packet switched IP Networks and Initiation Protocol).

Objectives:

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

- Understand how VoIP and it's associated protocols fit in with the existing networking protocol models.
- Be able to explain the reasons for the use of VoIP.
- Describe the potential benefits of VoIP
- Understand voice quality issues associated with VoIP
- State the additional protocols that make VoIP possible
- Understand the differences between H.323 and SIP
- Understand Quality of Service (QoS) and what it means
- Appreciate how IP Multicasting plays a part in Real-time media delivery
- Understand the differences between Circuit Switches and Packet Switched Voice.
- Configure a simple VoIP application on a windows PC and make Phone Calls
- Set up a SIP Server for registration of Client Devices
- Configure a SIP Converter or SIP Phone
- Configure a SIP Server / IP PBX at multiple sites and make calls across a WAN.
- Configure and test basic QoS parameters and Test Voice Quality

Course Content

Introduction to VoIP

- How it Works
- VoIP – Encapsulation
- VoIP – Associated Internet Protocols
- VoIP – Service Providers
- Networks
- Why VoIP?
- What does VoIP Offer?
- The Business Case for VoIP
- Internet Telephony Product Classes
- Today's Voice and Data Networks
- Integration

VoIP Regulatory Bodies

Voice Encoding Schemes

- Waveform Encoding
- Digital Recording and Playback
- PAM – Pulse Amplitude Modulation
- Quantization
- Clipping
- Vocoders
- MOS – Mean Opinion Scores
- Voice Quality Measurement
- Voice Quality Issues
- Latency
- Jitter
- Packet Loss
- Echo Problems in VoIP
- Echo Suppression

Echo Cancellation

Protocols – Network and Transport Layers

- OSI 7 Layer Model
- Internet Protocol
- IP Addressing
- TCP – Transmission Control Protocol
- Ports and Sockets
- Windowing

UDP – User Datagram Protocol

Protocols – Data Link and Physical Layers

- Data Link and Physical Layer in the LAN
- Routed Networks
- Switched Networks
- Networks with VLANs
- What is a VLAN?
- VLAN Membership
- VLAN Tagging
- IEEE 802.1p/q Ethernet Frame Format
- Data and Computer Networking

- Frame-Relay
- xDSL
- Broadband Access
- SONET and SDH
- PPP – Point to Point Protocol
- MTU Size

Fragmentation and Reassembly

VoIP Support Services

- Configuring DHCP to support VoIP
 - Cisco DHCP Configuration Example
 - Option 150 and 66
 - DHCP Relay Agents
 - Cisco Router Relay Agent Configuration
 - NAT – Network Address Translation
 - NTP – Network Time Protocol
 - DNS Support for VoIP
- STUN – Simple Traversal of UDP through NAT

Real Time Protocols

- RTP – Real Time Transport Protocol
- Encapsulation Overhead
- Header Compression
- RTP Translators
- Audio Conferencing (Mixers)
- RTCP – Real Time Transport Control Protocol
- RTCP Bandwidth Control

RTCP Reports

VoIP Security

- Security Implications
- Eavesdropping
- Spoofing
- Interception
- Countermeasures
- Physical and Logical Security

VoIP and Firewalls

VoIP Bandwidth

- Traditional Call Activity
- Trunk Activity
- Erlangs
- Blocking
- Voice Quality Delivery Options

Configuring End-to-End QoS

H.323 Networks

Brief Description for comparison with SIP

SIP – Session Initiation Protocol

- SIP Protocol Stack
- SIP Topology
- SIP Operation
- SIP URLs
- SIP Signalling Messages
- Typical SIP Transaction
- SIP Message Format
- SIP Cseq
- SDP – Session Description Protocol
- SIP Servers
- SIP Registrar
- SIP Proxy
- SIP Redirect

SIP Trunking

- What is VoIP Trunking
- Traditional vs New
- Carrier Class SIP Trunking
- SIP and PSTN Internetworking
- SIP and ISUP
- SIP Telephony and ISUP Tunnelling
- Enhanced Telephony Services
- SIP Example Call Traces

Cisco VoIP Example (Brief)

- Cisco IP Telephony Components
- Cisco CallManager
- SRST – Survivable Remote Site Telephony
- Cisco Unified CallManager

QoS – Quality of Service

- Quality and Delivery Options
- Congestion Control
- Quality of Service Models
- Best Effort
- Integrated Services
- ✦ RSVP
- ✦ Differentiated Services
- ✦ Congestion Management
- FIFO
- Priority Queuing
- Custom Queuing
- Low Latency Queuing
- Weighted Fair Queuing
- Delivering QoS in the core network
- MPLS Overview (Brief)
- CAC – Call Admission Control
- WRED – Weighted Random Early Detection

VoIP Phone / Adapter and IP PBX Configuration

Class Length - 3 Days

Cost: £1200

TCP/IP & LAN Technologies

Course Code TCP11002

This course has been designed to provide delegates with a basic theoretical knowledge of Internetworking and focuses on the use of the TCP/IP protocol suite. Included in the course is a breakdown of the Internet Protocol version 4 address structure and how a network is logically subdivided through the use of subnetting. This course forms part of the prerequisites for further networking courses such as Cisco's Interconnecting Cisco Network Devices (ICND).

Prerequisites

None, although a basic understanding of Datacomms would be beneficial.

Learning Objectives

At the end of this class, participants will be able to:

- Understand the basic history of the Internet.
- Understand the terms WAN, LAN, MAN, Internet and Intranet.
- Determine the functions of the Open Systems Interconnect 7 Layer Model.
- Determine the functions of the Internet Protocol 4 Layer Model.
- Differentiate between different standard Network Topologies.
- Understand the basic functions of a Hub, Switch and Router.
- Comprehend the difference between Distance Vector and Link State Routing Protocols.
- Determine the function of TCP/IP Protocols and at what layer of the Protocol stack they operate.
- Determine the Class of a given IP address.
- Perform subnetting of a given network address with the purpose of building an Internetwork.
-

Who Should Attend

Network technicians, Technical Managers and Support Staff who need an overview of networking technologies relating to the TCP/IP protocol suite.

Course Profile:

- Introduction to TCP/IP
 - Where it all began
 - Arpanet
 - RFCs
 - Internet Architecture Board
 - Internet Development (1960s and 70s)
 - Internet Development (1980s)
 - Internet Development (1990s)
 - Internet Development (2000s)
 - OSI and TCP/IP Models
- Headers and Layers

Local Area Networks and Standards

- Why build Local Area Networks?
- What do we need to communicate?
- Factors to consider?
- Peer to Peer Networking
- Client Server Networking
- What is Ethernet
- Ethernet Standards
- Ethernet Physical Attributes
- Ethernet Framing
- Ethernet Hubs

Layer 2 Devices

- Bridges
- Local and Remote Bridges
- Encapsulating Bridge
- Flow Control in a Bridge
- Address Learning
- Switched Networks
- Full and Half Duplex Operation
- Basic Switch Functions
- Switching Modes
- Store and Forward
- Cut Through
- Fragment Free
- Address Learning and Filtering
- Broadcast and Multicast Flooding
- Redundancy
- Broadcast Storms
- Duplicate Non-Broadcast Frames
- Database Instability
- Spanning Tree Protocol

Virtual Local Area Networks

- Traditional Routed Networks
- Switched Networks
- Understanding VLANs
- VLAN Membership
- VLAN Tags
- IEEE 802.1q
- VTP

Layer 3 Devices

- Routers
- The Routing Process
- Local vs Remote Routing
- Dynamic vs Static Routing
- Static Routes
- Default Routes
- Routing Protocols
- Distance Vector vs Link State Routing Protocols
- Interior Gateway Routing Protocols
- RIP
- OSPF

Layer 3 Protocols

- ICMP
- ARP
- IPv4
- NAT
- DHCP

Internet Protocol Version 6

- IPv6 Header
- IPv6 Address Structure

Layer 4 Protocols

- TCP – Transmission Control Protocol
- Port Numbers
- Sockets
- TCP Header
- Windowing
- TCP 3 Way Handshake
- UDP – User Datagram Protocol
- UDP Header

Applications and Services

- Telnet
- FTP – File Transfer Protocol
- The FTP Model
- TFTP – Trivial File Transfer Protocol
- DNS – Domain Name Service
- SNMP – Simple Network Management Protocol
- SNMP Operation
- SMTP – Simple Mail Transfer Protocol
- POP – Post Office Protocol
- IMAP – Internet Mail Application Protocol

MIME – Multimedia Internet Mail Extensions

IP Addressing and Subnetting

- IP Address Classes
- Binary Fundamentals
- The Logical AND Function
- Subnetting

Class Length - 2 Days

Cost £650

Introduction to Voice over IP

Course Code VOI12001

This course has been designed to provide delegates with knowledge of the fundamental principles of Voice over Internet Protocol. IEEE standard H.323 and the Open Standard Session Initiation Protocol (SIP) are described and compared.

Prerequisites

A basic knowledge of TCP/IP.

Learning Objectives

At the end of this class, participants will be able to:

Understand the reasons for the development of voice over data networks.

Have an appreciation of factors affecting voice quality.

Understand the IETF protocols developed to allow real-time media of data networks.

Determine the function of the real-time protocols and where in the protocol stack they operate.

Understand the elements and function of the ITU-T H.323 umbrella protocol.

Understand the basic functions of the IETF Session Initiation Protocol and compare its operation to that of H.323.

Differentiate between various Quality of Service (QoS) methods employed.

Determine how Layer 3 Multicast addresses are mapped to Layer 2 Multicast addresses.

Who Should Attend

Network technicians, Technical Managers and Support Staff who need an overview of Voice over IP fundamentals.

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
- Vocoders
- MOS – Mean Opinion Score
- Voice Quality Measurement
- Voice Quality Issues
- Latency
- Delay Budget
- 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

H.323 and Network Elements

- H.323 Protocol Stack
 - H.323 Elements
 - H.323 Gateway
 - H.323 Gatekeeper
 - H.323 MCU
 - MGCP – Media Gateway Control Protocol
 - Multipoint Conferencing
 - Call Signalling (Setup, Media Channels, Teardown)
 - Standard Call Model
- FastStart

SIP – Session Initiation Protocol

- 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

Cisco VoIP Example

- Cisco IP Telephony Components
 - Cisco CallManager
 - SRST – Survivable Remote Site Telephony
- Simple Cisco VoIP Network

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
- PIM – Protocol Independent Multicast
- PIM Dense Mode
- PIM Sparse Mode
- Rendezvous Points

Class Length - 2 Days

Cost £725

Broadband Technologies

Course Code TEL13001

The course focuses on theoretical principles of xDSL Technologies, looking at the various implementations of xDSL, the physical architecture needed to deliver xDSL and the equipment and protocols that are needed to service an xDSL environment.

Prerequisites

None

Aim

To provide delegates with a fundamental understanding of xDSL and the protocols and standards associated with it as well as the physical components of xDSL networks.

Objectives:

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

- Understand Basic Telephony.
- Understand Telephone Network Architecture.
- Describe Digital Transmission Technology.
- Understand ISDN Basics.
- Describe DSL Family variations such as HDSL, SDSL, ADSL, VDSL.
- Have an appreciation of alternative Broadband Technologies.
- Describe End User Equipment and Protocols.

Who Should Attend

Network technicians, Technical Managers and Support Staff who need an overview of Broadband Technologies such as DSL, Cable, Wimax and Wireless Technologies.

Recap on Telephone Technology

- How a simple telephone works
- The Analogue Local Loop
- Analogue Telephone Transmission
- The Evolution of Telephone Switching
- The Public Switched Telephone Network
- Multiplexing
- The Street Cabinet
- Dial up Access
- Narrowband ISDN
- Broadband ISDN
- ISDN Architecture
- BRI and PRI
- ISDN Reference Point
- Digital Transmission Technology
- Line Coding
- QAM – Quadrature Amplitude Modulation
- CAP – Carrierless Amplitude with Phase
- DMT – Discrete Multitone
- Error Detection and Correction
- Protocol Adaptation
- Transmission Medium Limitations
- Frequency Response
- Crosstalk
- Bridge Tap Reflections
- Audio Coil Loading

Introduction to xDSL

- Where did it all begin?
- HDSL
- SDSL
- ADSL
- RADSL
- CDSL
- VDSL

Alternative Broadband Technologies

- CATV Systems
- First Generation One Way Modems
- HFC – Hybrid Fibre Coax
- Wireless Cable Systems
- WLL – Wireless Local Loop
- Wimax
- WiFi
- IBSS
- BSS
- ESS
- Wireless Bridges
- WiFi Security
- Fibre Systems

End User DSL Equipment and Protocols

- DSL End User Devices
- Modems
- Microfilter
- Cable Modems
- Residential Gateway / Router
- ADSL Modem / Router Protocols
- ATM – Asynchronous Transfer Mode
- NAT – Network Address Translation
- DHCP – Dynamic Host Configuration Protocol

End User DSL Equipment and Protocols

- Broadband Aggregation Introduction
- CPE – Customer Premises Equipment
- NAP – Network Access Provider
- Subscriber Termination
- SLC Operation
- Aggregation Devices
- Typical ISP Network Topology
- MPLS Overview (Brief)
- NSP – Network Service Provider
- Service Provider Retail Services
- Service Provider Wholesale Services
- ATM Bridging and Routing Methods
- PPP – Point to Point Protocol
- Broadband Access Methods
- PTA – PPP Termination Aggregation
- L2TP – Layer 2 Tunnelling Protocol
- AAA – Authentication, Authorisation and Accounting

Class Length - 2 Days

Cost £745

Networking and Systems

Course Code NET15002

This 2-Day Overview on LAN / WAN Networking and Systems introduces the basic fundamentals of Networking with LANs and WANs and includes information on the key elements in a Modern Networking System. Delegates will be introduced to the function and workings of Modern Networks including an Introduction to Cloud Computing.

The Internet Protocol Suite, commonly known as TCP/IP, forms the basis for the Internet and the next generation of networking and telecommunications services. Not only is it being used for pure data services such as Electronic Mail and Web-Based services but it is now also used as the core for mobile phone networks and Next Generation Services.

It is now important for any staff involved in the transportation of data over networks to understand how the many hardware and software elements in a network interact and compliment each other in order to provide a secure environment for the storage and transportation of data.

Prerequisites:

Delegates are not required to have a formal technical background

Aim:

To understand the fundamentals of modern data networks and architecture.

Objectives

On completion of this course delegates will be able to:

- Explain the function of a Data Network.
- Differentiate between LAN and WAN services.
- Have an appreciation of Secure Wireless Network Technology.
- Understand the fundamentals of Client / Server Operation.
- Understand the terms 'Thick and Thin Clients.
- Have an appreciation of Remote Access Technologies (Risks and Mitigation).
- Explain the purpose and function of a Firewall.
- Have an appreciation Network Security Features.
- Appreciate Hacking and its prevention
- Understand the purpose of Cloud Networks.
- Understand the basic of Storage Media and RAID Systems.
- Describe Virtual Server Technology.
- Explain the Term 'Blade Technology'.
- Describe Backup Power Systems and Data Systems
- Be familiar with some common Monitoring Tools.

Who Should Attend

Network technicians, Technical Managers and Support Staff who need an overview of Basic Network Protocols and Systems.

Course Profile:

Introduction to TCP/IP Networks

- What is LAN?
- Ethernet
- What is a WAN?
- What is a SAN?
- What is a WLAN?
- Common WAN Technologies
- TCP/IP Protocol Architecture (Brief)
- TCP/IP Networking Components

Introduction to Wireless Technologies and Security

- How does a Wireless Network operate.
- What Wireless Standards are commonly in use?
- Wireless Security Standards
- WPA and WPA2
- TKIP and EAP

Client / Server Networking

- Client Server Model
- Comparison with Peer to Peer Networking
- Advantages of a Client Server Network
- Disadvantages of a Client Server Network

Thick and Thin Clients

- Thin Client Definition
- Thick Client Definition
- Advantages and Disadvantages

Remote Access Technologies

- Cable
- DSL
- VPNs
- SSL

Firewalls

- What is the purpose of a Firewall?
- Packet Filters
- Application Layer Firewalls
- Nat Functionality

Network Security Features

- Firewalls
- IDS
- Strong Authentication
- Antivirus
- Physical Security

Cloud Networks

- Overview
- Deployment
- Security

Storage Media and RAID Systems

- Tape Storage
- Disk Storage
- SAN (Storage Area Network)
- Blade Servers
- Virtual Servers
- RAID

Backup Power and Data Systems

- UPS
- Emergency Power Systems
- Live Data Backup

Monitoring Tools

- SNMP (Simple Network Management Protocol)
- HP Network Node Manager (NNMi)
- Cisco Works
- IBM Tivoli

Class Length - 2 Days

Cost £785

Introduction to Telecommunications

Course Code TEL13003

This course focuses on the fundamentals of telecommunications and describes the evolution of telecommunications, advancements in telecommunications technologies and takes a brief look at the future of telecommunications. The invention of the telegraph in support of the railways in the United States heralded the start of telecommunications, and was a revolutionary concept at the time. Alexander Graham Bell couldn't have known how his simple invention would have such a profound impact on the World we live in. The actual basic telecommunications architecture hasn't changed since the early days, with the need for simple endpoints (telephones), a means of local signalling, centralized control and call management and of course a transmission medium. Finally the Cell Phone gave us the mobility and ability to communicate from almost anywhere through the use of wireless technologies.

Prerequisites:

None

Aim:

To provide delegates with an overview and knowledge on basic terms and definitions used in the telecommunications industry. This course is suitable for delegates with no prior knowledge of telecom technologies or the telecoms industry.

Objectives:

By the end of the course you will :

- Understand how technology has driven the telecommunications industry.
- Understand the key technologies deployed within most telecoms networks globally.
- Understand the basic building blocks of telecommunications networks.
- Have an appreciation of how telecommunications networks are evolving to keep pace with customer demand.

Who Should Attend

Network technicians, Technical Managers and Support Staff who need an overview of Telecommunications Systems.

Course Profile

Introduction to Basic Telephony

- Public Telecoms Networks
- The Birth of Telephony
- Strowger
- A Network is?
- Switching and Transmission
- What is a Switch
- Switch Types
- Exchange Services
- Exchanges
- Transmission Lines
- Dedicated and Switched Lines
- Leased Lines
- Signalling
- Switching and Signalling Networks
- Call Reference Model
- Anatomy of a Voice Call
- Cell Sequences
- Evolution of the Market
- Telecoms Standards

Transmission

- Analogue and Digital Lines
- Errors
- Bits, Bytes, Hertz and Wavelength
- Optical and Radio Channels
- Scales and Ranges
- Full and Half Duplex
- Connection Orientated Communications
- Connectionless Communications
- Modems and Codecs
- Voice Characteristics
- Turning Voice into Data
- The Encoding Process
- Analogue to Digital and Digital to Analogue
- Transmission Lines
- Multiplexing
- Primary Rate Multiplexing (PDH)
- Time Division Multiplexing
- European Multiplexing
- PDH – Plesiochronous Digital Hierarchy
- SDH – Synchronous Digital Hierarchy
- SDH Operation
- SDH Frame Format
- So what is SONET?
- Statistical Multiplexing
- Frequency Division Multiplexing
- Why Fibre Optics?
- Fibre Optic Basic Operation
- Single mode vs Multimode Fibre

- Different Frequencies behave differently
- Getting More out of Fibre
- WDM – Wavelength Division Multiplexing
- CWDM – Coarse Wavelength Division Multiplexing
- DWDM—Dense Wavelength Division Multiplexing

Signalling

- Digital Switching
- Signalling
- Signalling Requirements
- Types of Traditional Signalling
- Local Loop Signalling
- Tone Dialling Telephones
- Local Telephone Signalling
- QSIG and DPNSS
- DSS1
- ISDN Signalling is Q.931
- Signalling System 7
- Non-Intelligent Network
- What is an Intelligent Network
- IN Physical Architecture
- Call Centres
- VPNs

Digital Subscriber Line

- ISDN – Integrated Services Digital Network
- The end of the Analogue Core
- ISDN Formats
- Use of ISDN
- Broadband ISDN
- DSL Timelines
- Basic xDSL System
- xDSL Family
- Broadband Aggregation Introduction
- HDSL – High Speed Digital Subscriber Line
- SDSL – Synchronous Digital Subscriber Line
- ADSL
- RADSL
- Service Provider Retail Service
- Service Provider Wholesale Service
- VDSL
- FTTC and FTTH
- DSL Comparison
- Cable Modems
- CATV
- Electricity Cables
- WLL—Wireless Local Loop

NGN and VoIP

- Next Generation Networks
- Why Voice over IP?
- VoIP Patterns of Use

- VoIP Usage Aspects
- VoIP – The Protocols
- Voice Compression
- Standards and Framework
- SIP – Session Initiation Protocol
- SIP Components
- NGN Benefits
- Traditional Telephone Systems
- SoftSwitch Solution
- Multicasting

Telecoms Operators

- UK Carriers
- Telecoms Equipment Vendors
- Systems Integration
- Triple-Play Service Providers

Class Length - 1 Day

Cost £350

Introduction to Next Generation Networks

Course Code TEL13002

The term Next Generation Networks refers to networks being designed to deliver virtually any service including telephony, broadband data and multimedia services over a common infrastructure. For a number of years now telecommunications operators have been switching traditional circuit-switched voice services to IP networks, which are packet switched. In fact Internet Protocol will be the common denominator for all services. Underlying IP, it is proposed that Ethernet will be the data link layer standard, although SDH will play a part for a while yet. IP Core networks will and are being MPLS enabled to provide a Quality of Service link between Ethernet and IP.

Prerequisites

This course is suitable for staff with no prior technical knowledge, but it could be beneficial if delegates had some prior low level knowledge of telecommunications services and / or IP-based communications

Aim:

To provide delegates with a technical overview of the common technologies being used in Next Generation Networks.

Objectives:

By the end of the course you will :

- Be aware of what a multi-service network is designed to deliver
- Understand the common technologies used in the core, distribution and access layers
- Have an appreciation of the architecture required to deliver multiple services over a single architecture.
- Appreciate the benefits for both the provider and customer alike

Who should attend?

Engineers, Technician Managers and Support staff who are likely to be involved in the move from traditional circuit switched voice services to a multiservice IP-based network.

Course Outline:

Introduction to Next Generation Networks

- What is a Next Generation Network?
- A single Architecture
- VoIP and IP Telephony
- What Services will these new networks carry?
- How will the architecture differ?
- Control and Access Protocols

Transmission

- Ethernet Services (10, 100, Gigabit, 10 Gigabit)
- Digital Subscriber Line
- HDSL
- SDSL
- ADSL
- ADSL2
- ADSL2+
- VDSL
- Last Mile / First Mile
- EFM – Ethernet First Mile
- PON – Passive Optical Networks
- EPON—Ethernet over PON

IP Services

- IP Version 4
- IP Addressing
- NAT – Network Address Translation
- ARP – Address Resolution Protocol
- DHCP – Dynamic Host Configuration Protocol
- Multicasting
- TCP – Transmission Control Protocol
- UDP – User Datagram Protocol
- IP Version 6 or IPng

IP Multicasting

- Unicast and Multicast
- Why Multicast?
- Multicast Addressing
- IGMP – Internet Group Management Protocol
- QoS – Quality of Service
- Best Effort
- Integrated Services
- Differentiated Services
- IP Precedence
- Diffserv
- Queuing and Scheduling
- VLANs and IEEE 802.1p/q

MPLS – Multi Protocol Labeled Switching

- What is MPLS
- MPLS Shim Labels
- MPLS Operation

Real Time Media over IP

- Review of traditional voice services
- Codecs
- Quality of Service
- Video over IP
- Voice over IP
- H.323 Overview
- Q.931

SIP - Session Initiation Protocol

- What is SIP?
- SIP URLs
- SIP Registration
- SIP Proxy Server
- SIP Redirect Server
- SDP – Session Description Protocol
- Basic SIP Messages
- SIP Response Codes

IPTV

- What is IPTV?
- IPTV Streams
- IGMP
- Switched Digital Video
- Video on Demand

Signalling and Control Protocols

- H.248
- Megaco
- Media Gateways
- Softswitches

Signalling and IP

- Sigtran
- Sigtran Protocol Architecture
- SCTP – Stream Control Protocol
- SCTP vs TCP
- M2PA
- M2UA
- M3UA

Class Length - 2 Days

Cost £785

Data Networking and Architecture

Course Code NET13003

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).

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
- 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
- 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
- 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
- Data 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 Security

Introduction to Voice over IP

- How does it work?
- Encapsulation
- VoIP Protocols
- VoIP Service Providers
- VoIP Networks

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- 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
- Vocoders
- MOS – Mean Opinion Score
- Voice Quality Measurement
- Voice Quality Issues
- Latency
- Delay Budget
- 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 Networkss
- 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
- 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

- 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

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- 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
 - PIM – Protocol Independent Multicast
 - PIM Dense Mode
 - PIM Sparse Mode
 - Rendezvous Points

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

Class Length - 5 Days

Cost £1785

TCP/IP—A Practical Foundation

Course Code TCP11001

This Hands On TCP/IP training course introduces the basic fundamentals of the Internet Protocols suite and utilises a number of hands-on exercises to allow delegates to develop practical skills. Delegates will be introduced to the function and workings of core TCP/IP suite protocols and will also build a functioning classroom network with hubs, switches routers and server applications.

The Internet Protocol Suite, commonly known as TCP/IP, forms the basis for the Internet and the next generation of telecommunications services. Not only is it being used for pure data services such as Electronic Mail and Web-Based services but it is now also used as the core for mobile phone networks and Next Generation Services. It is now important for engineers and technicians to understand how the core protocols function and interact with each other in order to configure and troubleshoot modern computer networks.

Prerequisites:

Delegates are expected to have a basic understanding of PC principles.

Objectives:

On completion of this course delegates will be able to:

- Use a protocol analyser to identify and troubleshoot the core Internet Protocols.
- Configure IP Addresses and identify IP Address problems
- Troubleshoot IP configuration problems
- Build networks using Hubs, Switches and Routers
- Troubleshoot TCP/IP networks with ICMP, ping and other PC utilities
- Configure and exploit FTP and TELNET
- Perform detailed protocol FTP, TFTP and Telnet sessions
- Understand the management of an Intranet through the use of SNMP

Course Profile:

Introduction to TCP/IP Networking

- What is TCP/IP
- TCP/IP and the Internet
- Request for Comments
- TCP/IP Protocol Suite
- TCP/IP – A Layered Model
- TCP/IP layering and encapsulation
- Network Components and Devices
- Protocol Analysis

The Internet Protocol (IP)

- What is an Internetwork
- What do we Need to Build a Network
- IP addressing and address classes
- IP Protocol Header
- Address Mapping and Resolution
- Address Resolution Protocol
- Automatic Addresses Allocation with BOOTP and DHCP

Building an Intranet

- Providing and Implementing an IP Addressing Scheme
- Lets put our IP Network together
- Global IP Addresses
- The use of Private IP Addresses
- IPv6
- How is IP Implemented on different Physical Networks
- IP on non-Ethernet LANs: SNAP and LLC
- Using IP on WANs
- IP used on Frame Relay AND ATM

Internetworking with IP Routers

- What is a Routed Networks
- What is the Primary Function of a Router
- Interior Gateway Routing Protocols – RIP and OSPF
- Exterior Gateway Routing Protocols - BGP
- Working with Routers and Troubleshooting Issues
- Intranets and the Internet
- Dividing our Network into Logical Sub Networks
- Management of IP with ICMP
- Supernetting
- Classless Inter-Domain Routing (CIDR)
- Network Address Translation (NAT)

The Transport Layer

- TCP/IP Transport Layer Protocols: TCP and UDP
- What is the Function of the Transport Layer
- The role of the transport protocol
- Connection-Orientated vs Connectionless protocols
- Transmission Control Protocol in Detail
- Reliable Data Communications with TCP
- Port Numbers and Sockets
- TCP packet structure and troubleshooting
- TCP performance issues
- User Datagram Protocol in Detail
- Connectionless protocol operation
- Providing reliability at the Application Layer
- Applications and Management Protocols

Applications

- TCP/IP Applications
- What do we mean by the Client/Server Model?
- What do we mean by the Peer-to-peer Model?
- File transfer protocols - FTP
- Trivial File Transfer Protocol - TFTP
- Remote Configuration and Management with Telnet
- The Domain Name Service (DNS)
- SMTP, the basis of Internet mail
- Utilising workstation mail: POP3, IMAP4
- The basics of Voice over Internet Protocol - VoIP
- SIP – Session Initiation Protocol
- TCP/IP for Windows XP, Windows 7 and UNIX
- Exploring Internet Services
- Permanent direct connection
- Dial Services with PPP, PPPoE and PPPoA
- What is a VPN?
- Internet Service tools
- Retrieving files using Anonymous FTP
- Using World Wide Web (WWW) tools

Managing TCP/IP Networks

- What is SNMP?
- Simple Network Management Protocol (SNMP)
- The management database: MIB
- SNMP evolution: MIB I and II, RMON, SNMPv2, SNMPv3
- Community Strings

Hands-on Exercises (over duration of course)

- Analyze TCP/IP Protocols using a Network Protocol Analyzer
- Set up FTP Services
- Use Telnet Services
- Undertake detailed analysis of IP, TCP, FTP, Telnet and other applications
- Configure a PC to use TCP/IP
- Set up a Routed Network with the Correct IP Addressing Scheme
- Configure basic routing services on a Router
- Make and analyze Voice over IP Calls
- Troubleshooting basic network routing problems

Class Length - 4 Days

Cost £1400

SDH Fundamentals

Course Code TRA14002

This course provides an understanding of SDH and how the modern transport network works. The course is tailored for those who require in-depth technical knowledge and an appreciation of SDH equipment and their application in Telecommunications Networks.

Prerequisites:

This course is designed for Telecommunications engineers who already possess knowledge of the fundamentals of Telecommunications.

Learning Objectives

At the end of the course, participants will be able to relate to|:

- SDH Terminology
- SDH Network Structures
- SDH Signals and Framing Structures
- The advantages of SDH, including Pointers and Justifications
- Traffic Protection options

The Synchronisation of SDH Network elements.

Who Should Attend?

- Project managers and team members who require in-depth SDH technical knowledge.
- Technical managers who manage technicians and engineers who work with SDH elements.
- The course is also a suitable prerequisite for subsequent equipment related training.

Course Outline

- Transmission Principles
- Pulse Code Modulation
- To appreciate the limitations of PDH.
- SONET, the origins of SDH?
- To appreciate the improvements and enhancements SDH delivers.
- To understand the SDH multiplexing structure.
- Path Overheads
- Section Overheads
- Concatenation
- Pointers
- Protection options
- Synchronisation
- Examples of manufacturer specific Network Elements.
- Applications and SDH Networks are illustrated throughout the course.

Class Length - 2 Days

Cost £750

SDH Overview

Course Code TRA14003

This course gives an overview of SDH and how the modern transport network works. The course is tailored for those who do not require in-depth technical knowledge, but a basic understanding of SDH.

Prerequisites:

None, this course provides a basic overview of the principles of SDH.

Learning Objectives:

At the end of the course, participants will be able to relate to:

- The evolution of SDH
 - SDH Terminology
 - SDH Network Structures
- SDH Signals and Framing Structures

Who Should Attend?

- Project managers and team members that manage and work on SDH projects.
- Technical managers that manage technicians and engineers who work with SDH.
- Administration or Support staff who work within an SDH based environment.

Course Outline

- To appreciate the limitations of PDH
- SONET, the origins of SDH?
- To appreciate the improvements and enhancements SDH delivers.
- To gain a basic understanding of SDH equipment.
- To understand the SDH multiplexing structure.
- An outline of SDH management.
- Examples of manufacturer specific Network Elements.
- Applications and SDH Networks are illustrated throughout the course.

Class Length - 1 Day

Cost £360

The Evolution of Ethernet

Course Code NET15001

This 4-day course enables delegates to construct a complete service in the classroom using a variety of network equipment. The course contains Hands On labs for implementation, troubleshooting and quality of service.

Ethernet is the most widely-installed LAN technology. Specified in a standard, IEEE 802.3, Ethernet was originally developed by Xerox and then developed further by Xerox, DEC, and Intel. The most commonly installed Ethernet systems are 10BASE-T and provide transmission speeds up to 10 Mbps.

Fast Ethernet or 100BASE-T provides transmission speeds up to 100 megabits per second and is typically used for LAN backbone systems, supporting workstations with 10BASE-T cards. Gigabit Ethernet provides an even higher level of backbone support at 1000 megabits per second.

Prerequisites:

None, but exposure to data networks would be an advantage.

Learning Objectives:

At the end of the course, participants will be able to understand:

- The Origins of Ethernet
 - Ethernet Media Access Control
 - Ethernet Cabling
 - Ethernet Framing
 - From 10Mbps to 100Mbps
 - Designing Ethernet Networks
 - Performance Enhancement
 - Ethernet Bridging
 - Introduction to Ethernet Switching
 - Advanced Spanning-Tree and Trunking Features
 - Introduction to VLANs
- Gigabit and 10 Gigabit Ethernet

Who Should Attend?

Engineers, Technicians and Technical Managers who are working in, or are responsible for Ethernet-based networks.

Course Outline

- In the beginning – Arpanet
- RFC – Request for Comments
- Internetworking Development 1960s & 1970s
- Internetworking Development 1980s
- Internetworking Development 1990s
- Internetworking Development 2000s
- OSI – 7 Layer Reference Model
- DOD Reference – 4 Layer Model (TCP/IP)
- Aloha Radio System
- Original Ethernet
- 10 Mbps Standard
- StarLan
- IEEE 802.3

- CSMA/CD
- Collisions
- Ethernet MAC
- Ethernet Errors
- Ethernet Cabling
- Ethernet Standards (10base2, 10Base5)
- Twisted Pair Cable
- UTP Wiring
- Fibre Optic Cable
- Wireless – IEEE 802.11
- Wireless Modulation and Channels
- WLAN Topologies (IBSS, BSS, ESS)
- CSMA/CA

- Ethernet Framing (Ethernet II and IEEE 802.3)
- Locally Administered MAC Address
- LLC—Logical Link Control

- From 10Mbps to 100Mbps
- 100BaseX
- MII – Media Independent Interface
- 4B5B Encoding (Brief)
- 100BaseTX Physical Layer
- 100BaseT4 Physical Layer
- 100BaseFX Physical Layer
- SC Connectors
- ST Connectors
- MIC Connectors
- Fast Ethernet Development
- EIA/TIA Wiring

- 3 Layer Hierarchical Model
- SME Hierarchical Model
- Switched Hierarchical Model
- Router Hierarchical Model
- Mesh Topologies
- Types of LAN
- Ethernet Diameter
- Repeaters
- Hubs
- Autonegotiation

- Techniques for improving LAN Performance
- Category 5 Cable
- Category 5e Cable
- Category 6 Cable
- 1000BaseX
- Multiple Rate Ethernet Networks
- Link Aggregation
- Network Management
- SNMP—Simple Network Management Protocol

- Ethernet Bridges
- Address Learning
- Local and Remote Bridges
- Flow Control in Bridges

- Switched Networks
- Address Learning
- Broadcast and Multicast Frames
- Redundancy
- Spanning Tree
- Switching Modes
- Duplex and Speed

- Cisco Switch Configuration
- Working with MAC Address Tables
- Port Security
- Fast EtherChannel
- RSTP—Rapid Spanning Tree Protocol

- VLANs
- VLAN Membership
- VLAN Standards
- VLAN Tagging
- VTP
- VLAN Configuration

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- Gigabit Ethernet Overview
 - IEEE 802.3z
 - Gigabit Ethernet Physical Layer
 - 1000BaseT
 - 10 Gigabit Ethernet
 - 10 Gigabit Ethernet in the Metro Network

Class Length - 4 Days

Cost £750

Fundamentals of Fibre Optics

Course Code TRA14001

This course introduces the fundamental principles and techniques underlying fibre optic systems. It covers fibre and laser safety, fibre types and how they operate, connectorisation, fibre cleanliness and the principles of fibre testing. It is a suitable platform for all engineers, technicians and technical managers involved in the design, installation, maintenance and management of modern telecoms networks.

This course is also a suitable pre-requisite for subsequent equipment related training.

Prerequisites

None, this course provides a basic overview of fibre optics.

Learning Objectives

At the end of the course, participants will have covered the following:

- Principles of communications utilising Fibre Optic Cables.
- Safety considerations when working with lasers and fibre optic cables.
- Identification of different types of fibres and relevant roles.
- Identification of different connections and the losses incurred.

Fibre cleanliness

Who Should Attend?

- Project managers and team members that manage and work on fibre projects
- Technical managers that manage technicians and engineers who work with fibre.
- Engineers and Technicians who work with, or come into contact with fibre.
- Administration or support staff who work within a fibre-based environment.

Course Profile:

- What is Fibre?
- The Principles of Light Propagation
- The Light Spectrum
- Different Fibre Types and their roles
- Types of Testing which can be carried out on fibre
- Considerations which should be made when working with Fibre and Optical systems
- The importance of fibre cleanliness in optical systems
- Methods of cleaning fibre connectors and Optical ports
- Example of the use of different fibre connectors and their roles
- The main threats to optical systems

Class Length - 2 Days

Cost £680

Network Systems Training (UK) Ltd have a number of training courses under development, and this Course Catalogue will undergo revisions from time to time. Our next training course to be rolled out is to be a 2 Day practical networking course for beginners, and will appear in the next revision of this catalogue. We will also feature new courses on our [Featured Training Course](#) page on the website.

All of our training courses are offered as Public Scheduled courses at locations around the country including Newcastle-Upon-Tyne, London and Birmingham. We hope to offer other locations in the near future, and will highlight the new locations as soon as they are confirmed.

All of our training courses are available as On-Site training, where we can deliver training on a site of your choice. Contact us at the following email address to discuss On-Site training: enquiries@nstuk.com .

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