International Training Courses all over

Understanding the Strategy, Technology, Benefits and Risks of Telecom

London	Miami	LA
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Zagreb	Paris	Panama
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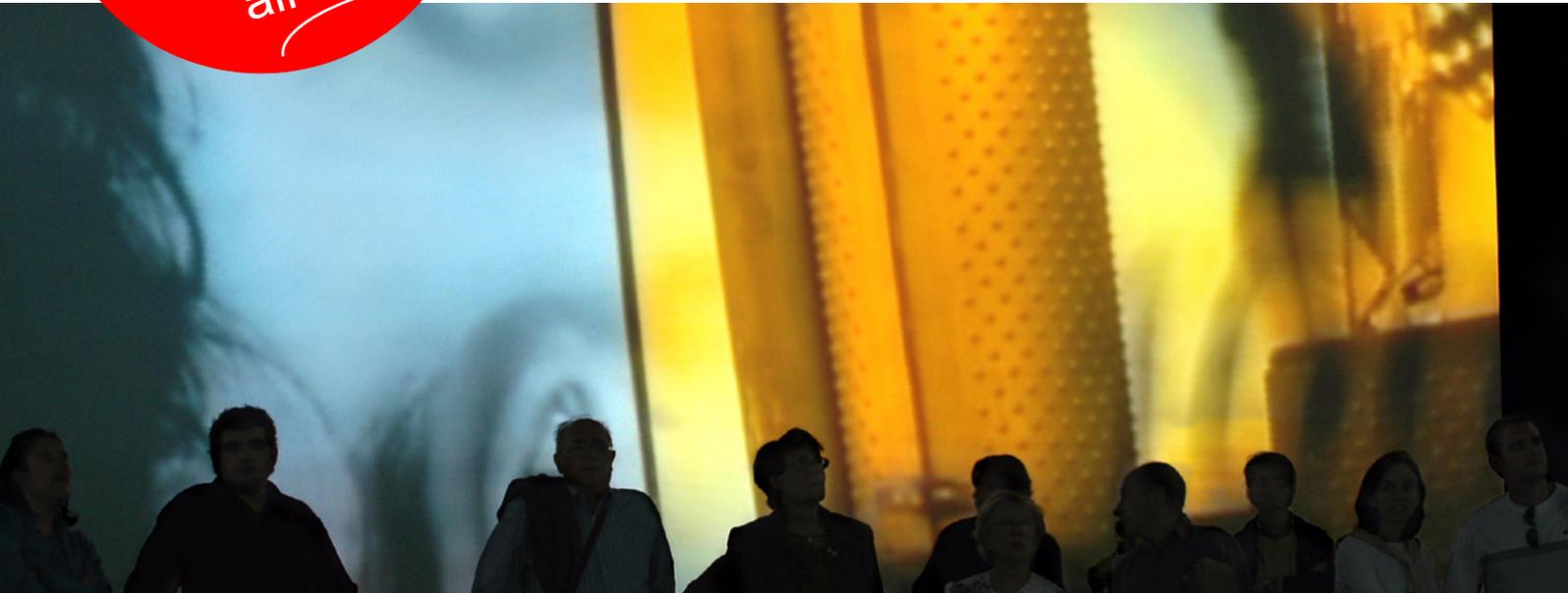
ALBEDO Training Portfolio

– a strategic view from industry experts

Enhance your business prospects, learn about new applications and explore emerging markets for next-generation networks.

Albedo training courses are especially valuable for decision-makers, business developers, sales and marketing professionals, field engineers and those involved in the development of new telecom and datacom networks and services.

We will provide a deep technology analysis and a practical approach to the subjects covered, seeking to answer questions such as:

- *Why* is my company adopting this technology?
- What are its *benefits*?
- What do the changes *mean* for me?
- What *market trends* are there?
- What *challenges* will I face?
- How can I *install* it?
- How can I *test* it?
- How can I *maintain* it?

ALBEDO
Telecom

We are a leading European company in Telecom training. In 15 years of actvities we have taught, with great success, more than 1,600 courses to 24,000 professionals in more than 32 countries.

Experience, quality, full dedication and independence are the characteristics of the company. Leadership in the field of ICT training is the result of intense and sustained effort of our professionals to build knowledge of these complex technologies, and to improve their didactic skills. In the near future we will expand our geographic coverage by offering courses in English and hosting training sessions in Brussels, London and Barcelona. Next to our scheduled training, we can also offer customized training and training on location.

Experience

Our well-known courses are backed by 20 years of experience serving large companies. All the speakers are recognized professionals in the field of datacommunications, with great teaching skills and professional experience between 10 and 32 years, who have developed the courses they teach.

The training is accompanied by valuable and comprehensive documentation, which is carefully revised and updated, providing the attendees with the necessary knowledge to solve real problems they may be faced with.

Quality

Quality is one of the most important aspects of the training. Thorough and constant control of all courses, preparation of the speakers, and adapting the courses to technological reality are prime objectives. Feedback from the attendants, gathered over all the years we've been active, indicates the level of quality offered by the training. Some facts (result from the latest 4,000 surveys):

• Speakers: 8.6 – Case Studies: 8.7 (ratings on a scale of 10)

• Customer retention: 86.3%

• Percentage of attendees who recommend our courses: 99.7%

Full dedication

Our objectives are to provide professionals with the necessary skills to implement and maintain solutions with quality and efficiency. We have the most comprehensive offering of courses in the world market for training in ICT, both in terms of coverage of topics, and with regard to the depth and practical approach with which they are treated.

Independence

The objective of our company is solely to maintain a high level training portfolio; there is no interest in any type of commercial hardware or software, or any other link to commerical goods or services.

The training provided focuses entirely on technology and markets, and is determined by what is drawn from practice and professional experience. This will guarantee that attendees obtain a true and realistic knowledge of these technologies, free from any subjective interference.

Course levels

• 100 – Basic level: Professionals with general knowledge of information technology. Some experience in communications technology is recommended

• 200 – Medium level: Professionals with previous experience in telecommunications

• 300 – High level: Professionals with ample experience in communications technology

• 400 – Advanced level: Experts. Highly specialized training on new technologies

FULL DAY OF INTERACTIVE

"We have had great Pleasure in sharing Knowledge and Experience with Neutral parties" — F. Grogan, UK

"This high level of Support will Help develop our Business" — S. Haouala, Tunisia

"Above all, the Talk was really Captivating" — J. Molina, Spain

"A valuable insight into the concept of Triple Play and related Technologies" — R. Obiodu, France

"This Training Course was far more effective than Consulting Services" — C. Diakonikolaou, Greece

> **Held throughout** in several countries across Europe, Middle East and Far East.

> One-day events divided into two sessions: a technology **training course** and a **hands-on session** using specialised test equipment.

> Why are these training courses **UNIQUE**:

● **Content**: Inside information on new technologies and high-performance networks.

● **Quality**: Industry experts will address and debate the key issues affecting the sector.

● **Opportunity**: This is your opportunity to define a smooth migration path to a network that combines legacy systems with new technologies.

Your Leading Expert

Fran Hens
Marketing Manager at Albedo Telecom.
MS/MA UPC
Francisco as integratior has designed VoIP and IPTV monitoring systems and has also worked as product manager in ICT electronics and Marketing Engineer at Trend. Author of 5 books on SDH, ADSL, Carrier Ethernet, Synchronous Ethernet, VoIP, IPTV and Triple Play networks.

José M. Caballero
General Director Albedo Telecom.
MBA, MS/MA in Communications.
Jose M. has 20 years of experience in IT development, consulting and marketing in IBM, and ICT electronics. Author of articles and six books on telecommunication technologies such as SDH, Carrier Ethernet and Triple Play, he is a frequent speaker in conferences and seminars.

Leo Nederlof
Independent Telecom Consultant
MSc, Delft University
Leo has worked for Alcatel in Belgium and by Corning Inc. in the US. His areas of expertise include communication systems and protocols, network architecture and technology, and modeling of networks and traffic. As an active member of the research community, Leo has authored many papers in magazines and conferences, providing of network design, integration of next generation networks.

aims

+ **LEARN** from business models and case studies
+ **UNDERSTAND** the potential of interoperability with legacy services
+ **EXPERIENCE** specialised test equipment first hand
+ **ASSESS** different solutions for installation and maintenance

1- Ethernet and Access Networks

Fibre optics is the new paradigman in access but copper still remains in the local loop, followed by coaxial and wireless transmission. Digital Subscriber Loop (DSL) technologies, designed for digital transmission over existing copper lines, combine cost-effectiveness with acceptable performance.
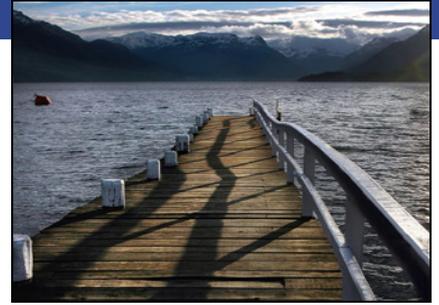
Course Contents

1 Ethernet in Access Networks
- Fiber to the Neighborhood
- Ethernet over Telephone Copper Pairs
- Ethernet in Optical Access Networks
- The Need of an Optical Access Network
- 1Gb/s and 10 Gb/s Ethernet PON
- PON Concepts and Alternatives
- EPON Particularities

1 Broadband Services over Copper
- The Limits of Copper Transmission
- ADSL2
- ADSL2+
- Bonded DSL
- VDSL

2. Passive Optical Network
- Basic Operation, Advantages,
- Broadband PON
- Gigabit PON
- Ethernet PON
- Ethernet in the First Mile
- Ethernet over Copper Pairs
- Ethernet in Optical Access Networks

3. ADSL
- The Origin of DSL technologies
- HDSL
- Modulation Technologies
- Asymmetry
- ADSL Transceivers
- Framing
- Data and Overhead Buffers
- Superframes
- Coding
- Error Protection
- Scrambling
- Interleaving
- DMT Modulation
- Operation and Maintenance Channel
- Initialization

4. Qualification Strategies and Protocols
- Prequalification
- Qualification During Commissioning
- Commissioning Without Qualification

5. Copper Pair
- Attenuation and Distortion
- Return Loss
- Noise
- Longitudinal Conversion Loss
- Crosstalk
- other defects

6. ATM Basics
- ATM Cell Format
- Virtual Channels and Virtual Paths
- ATM Switching

7. ATM Network Architecture
- AAL Layer
- ATM Layer
- Physical Layer

8. ATM Adaptation Layer Structures
- AAL1 Format
- AAL2 Format
- AAL3/4 Format
- AAL5 Format

9. Measurements
- One-End Measurements
- Two-End Measurements
- Bridged Measurements
- Digital Measurements

10. Service Provisioning

Course Profile
- Target groups: network designers, engineers, sales and marketing staff
- Prerequisites: None
- Duration: 10 h - Two sessions
- Evaluation: Test (upon request)
- Languages: English

Course Kit
- First Mile book
- Presentation slides
- 10 x Pocket Guides
- White Papers

2 - n x Giga Ethernet Networks

Ethernet has outlived all other LAN technologies, and nowadays it is used in almost all installations. Although this technology initially had a limited performance, a number of important reasons made Ethernet a winner: low cost, simplicity, flexibility and scalability.

Course Contents

1   Brief History of Ethernet
- ALOHAnet
- Ethernet in Palo Alto

2.   Architecture
- Physical Media
- Multiple Physical Media
- Media-Independent Interfacing Medium Access Control (MAC)
- CSMA/CD
- Collisions
- Jam Signal
- Ethernet Frames
- Formats
- Frame Fields

3.   The Evolution of Ethernet
- From Shared to Dedicated Media
- From Shared to Dedicated Bandwidth
- Frame Bursting in Gigabit Ethernet
- Switched Ethernet Networks
- Full-Duplex Operation
- Flow Control
- Virtual LAN
- Auto-Negotiation

4.   Network Topologies
- The Logical Link Control Layer
- The Network Layer
- The Internet Protocol
- Address Resolution Protocol

5.   1000BASE-X Architecture
- Physical Coding Sublayer
- Physical Medium Attachment
- Physical-Medium Dependent
- 1000BASE-X Auto-Negotiation

6.   1000BASE-T Architecture
- Physical Coding Sublayer
- Physical Medium Attachment
- 1000BASE-T Auto-Negotiation

7.   Installing Gigabit Ethernet
- Migration to Gigabit Ethernet
- Gigabit Interface Converter
- 10 Gigabit Ethernet
- Architecture
- Compatibility with SDH/SONET
- Gigabit and 10 Gigabit Applications
- LAN Applications
- MAN Applications
- WAN Applications

8.   The Future of Ethernet
- Ethernet as a MAN/WAN Service
- Network Architecture
- Virtual Ethernet Connections
- Multiplexing and Bundling
- Generic Service Types
- Connectivity Services

Course Profile

- Target group: Technicians, Engineers, Support, Sales and Marketing staff
- Prerequisites: None
- Duration: 5 h - One sessions
- Evaluation: Test (upon request)
- Price: Request a quotation
- Language: English

Course Kit

- Gigabit Ethernet book
- Presentation slides
- 10 x Pocket Guides
- White Papers

3 - Carrier Ethernet Architectures

Incumbent and competitive operators are now providing Ethernet-based telecommunications services. Ethernet is becoming a real alternative for both traditional data-based applications such as Virtual Private Networks (VPN), and new ones like Triple Play. The Carrier Ethernet training course thoroughly explores all the features that have made Ethernet the standard technology and discusses the latest developments.

Course Contents

1 Brief History of Ethernet
- ALOHAnet, Ethernet in Palo Alto

2. Architecture
- Physical Media
- Multiple Physical Media, Media-Independent Interfacing Medium Access Control (MAC)
- CSMA/CD, Collisions, Jam Signal
- Ethernet Frames
- Formats, Frame Fields

3. The Evolution of Ethernet
- From Shared to Dedicated Media, from Shared to Dedicated Bandwidth, Frame Bursting in Gigabit Ethernet
- Switched Ethernet Networks
- Full-Duplex Operation, Flow Control, Virtual LAN, Auto-Negotiation

4. Network Topologies
- The Logical Link Control Layer
- The Network Layer
- The Internet Protocol, Address Resolution Protocol

5. 1000BASE-X Architecture
- Physical Coding Sublayer, Physical Medium Attachment, Physical-Medium Dependent, 1000BASE-X Auto-Negotiation

6. 1000BASE-T Architecture
- Physical Coding Sublayer, Physical Medium Attachment, 1000BASE-T Auto-Negotiation

7. Installing Gigabit Ethernet
- Migration to Gigabit Ethernet, Gigabit Interface Converter
- 10 Gigabit Ethernet
- Architecture, Compatibility with SDH/SONET
- Gigabit and 10 Gigabit Applications
- LAN Applications, MAN Applications, WAN Applications

8. The Future of Ethernet
- Ethernet as a MAN/WAN Service
- Network Architecture, Virtual Ethernet Connections, Multiplexing and Bundling, Generic Service Types, Connectivity Services

9. End-to-End Ethernet
- Optical Ethernet
- Ethernet over WDM, and SDH

10. Limitations of Bridged Networks
- Scalability
- Protection
- Topologies
- (QoS)

11. Multi-Protocol Label Switching
- Label Distribution and MPLS Forwarding Plane
- Martini Encapsulation
- Pseudowires, Ethernet Pseudowires, PWE3 and NG-SDH, Advantages of MPLS

12. Migration
- Migrating the Architecture, Legacy Services,
- Introduction to NG-SDH + Ethernet, NG-SDH + Virtual Ethernet Services, NG-SDH + MPLS + PWE3 + Ethernet,
- Service Internetworking,
- Ethernet + MPLS – urbi et orbe?

13. QoS in Ethernet Networks
- Traffic Marking, Traffic Conditioning, Congestion Avoidance

14. Application Requirements
- Service Attributes, Bandwidth Profile Parameters
- Service Performance Parameters, Network Service Parameters
- Class-of-Service Labels

15. Gigabit Ethernet Testing
- Approval and Acceptance Tests
- Ethernet Testing Suite
- Performance Testing
- RFC 2544 Test

16. Cable Testing
- Cable Categories, Wiremap,
- Advanced Cable Testing,
- Characteristic Impedance, Insertion Loss or Attenuation,
- Return Loss, Crosstalk, Delay Parameters
- Higher-Layer Testing
- Testing Tools, ICMP Analysis, Sniffers
- Cell Format, Virtual Channels and Virtual Paths, ATM Switching

Course Profile
- Target group: Engineers, Marketing staff
- Prerequisites: None
- Duration: 10 h - Two sessions
- Evaluation: Test (upon request)
- Price: Request a quotation
- Language: English

Course Kit
- Carrier Ethernet book
- Presentation slides
- 10 x Pocket Guides
- White Papers

4 - Carrier Ethernet & MPLS

This course will outline the latest developments of this technology, as well as the solutions for the Aggregation, Transport and Backbone Networks focusing on the evolution of the Ethernet based Network Infrastructures, and the new MPLS technologies based on IP datagrams for high performance networks' interconnection.

Course Contents

1. **ETHERNET IN NEXT-GEN NETWORKS**
   - Looking for the universal services network...
   - What service providers want to offer
   - What standards committees are doing
   - Definition of different types of networks
   - Vision of the NGN (ITU-T)
   - Ethernet and IP Transport
   - Advances services infrastructures
   - Possibilities and realizations with Ethernet

2. **STANDARDIZATION: MEF – ITU – IETf**
   - Ethernet services standardization
   - Metro Ethernet Forum
   - Basic service model based on ETH
   - Ethernet Virtual Connection
   - "Carrier Ethernet": MEF current limitations
   - ITU-T Recommendations: Series G, Q, X, Y
   - IETF – RFCs
   - EFM market anf future

3. **Ethernet based access: efm-GPON**
   - IEEE 802 – 802.1 standards
   - IEEE 802.3ah – EFM
   - EFM: P2P topologies
   - EFMC: EFM-PHY over Copper
   - EFMF (point-to-point Fiber)
   - EFM P2MP (point-to-multipoint) standards
   - FTTX - EPON, GPON, WPON
   - EFM/OAM

4. **MPLS architecture**
   - Evolution of IP backbone networks
   - Emergence of MPLS & GMPLS
   - MPLS switching
   - Architecture:
   - Router types: ingres, LSR, egress
   - Basic functionality
   - Label Switched Path (LSP)
   - Headers
   - Label encapsulation
   - FEC - NHLFE
   - MPLS functions and operations

5. **MPLS signaling protocols**
   - Functions and types
   - Building the MPLS label swapping tables
   - Label distribution and table creation
   - Example of operation

- Protocol description:
- LDP, RSVP-TE, CR-LDP
- Summary and considerations

6. **CARRIER ETHERNET TECHNOLOGIES**
   - Ethernet-based networks
   - 802.1ad
   - Bridging issuesVLANs in 802.1ah
   - Provider Bridging types
   - MAC sublayer organization in 802.1ah
   - Solutions based on Label Swapping
   - PWE3: Architecture
   - VPLS: Architecture
   - T-MPLS: Architecture
   - PBT (Provider Backbone Transport)
   - PBB-TE (PBB-Traffic Engineering)
   - GMPLS Ethernet PBB-TE
   - Overview of Label Swapping solutions
   - Solutions based on SR+DA
   - Source Routing elements in Ethernet
   - Ethernet Administration and Management

Course Profile

- Target group: Engineers, Marketing staff
- Prerequisites: None
- Duration: 10 h - Two sessions
- Evaluation: Test (upon request)
- Price: Request a quotation
- Language: English

Course Kit

- Carrier Ethernet book
- Presentation slides
- 10 x Pocket Guides
- White Papers

5 - Ethernet Mobile Backhaul

This course explains the new Synchronous Ethernet Networks (SyncE) and Precision Time Protocol (PTP) in addtion to the common requirements for the packet switched backhaul network are pretty much the same that for any other carrier network: scalability, QoS, OAM, high resiliency and traffic engineering features. MEF Ethernet service classes (E-Line, E-LAN, E-Tree) are flexible enough for mobile backhaul applications.

Course Contents

1. Gigabit Ethernet Networks
- 1 Gb/sGigabit Ethernet 5
- 1000BASE-X and 1000BASE-T Architecture
- 10 Gb/s Ethernet
- Optical Transmission
- 10 Gb/s Ethernet over Copper
- Compatibility with SDH/SONET
- Higher Speed Ethernet
- Multilane Distribution Procedure
- Physical Media
- 40 Gb/s and 100 Gb/s Ethernet over OTN

2. Switched Ethernet
- From Shared to Dedicated Media
- Ethernet Bridging
- Full-Duplex Operation
- Hands-on: Performance of Ethernet Switches with RFC 2544
- Hands-on: Using TrueSpeed to Test TCP Throughput
- Virtual LANs
- Hands-on: Transparency Tests across VLANs
- The Spanning Tree Protocol Family
- Redundancy and Bridging
- The Classic Spanning Tree Protocol
- Rapid Spanning Tree Protocol
- Multiple Spanning Tree Protocol
- The Network Layer
- The TCP/IP Reference Model
- The Internet Protocol
- Internet Control Message Protocol
- Address Resolution Protocol
- Higher Layers of the TCP/IP Protocol Stack
- Hands-on: Packet Capture and Decode
- Hands-on: J-Mentor Packet Capture Expert

3. Carrier Ethernet in Transport Networks
- Ethernet as a MAN / WAN Service
- Network Architecture
- Ethernet Virtual Connections
- Multiplexing and Bundling
- MEF Generic Service Types
- Connectivity Services
- Ethernet Deployment Alternatives
- Optical Ethernet
- Ethernet over WDM
- Ethernet over SDH or OTN
- Limitations of Bridged Networks
- Quality of Service
- Resiliency and Fault Tolerance

- Multi-Protocol Label Switching
- Labels and MPLS Forwarding Plane
- Martini Encapsulation
- Pseudowires
- Ethernet Pseudowires
- MPLS Transport Profile
- Hands -on: MPLS-TP Traffic Analysis
- Quality of Service
- QoS Control Basics
- QoS In Ethernet Networks
- QoS in IP Networks
- End-to-End Performance Metrics
- Operation, Administration and Maintenance
- Ethernet OAM and MPLS OAM

4. Ethernet Mobile Backhaul Networks
- Towards the "All-IP" Network
- Circuit Emulation Service
- Transmission of Timing Information
- Structure Aware vs. Structure Agnostic CES
- Encapsulations for Structure Agnostic CES
- Encapsulations for Structure Aware CES
- Hands-on: MEF 18 and CES Certification

5. Ethernet Synchronization with IEEE 1588
- Precedents: IP Synchronization with NTP
- PTP Protocol Details
- Protocol Encapsulation
- Synchronous Ethernet
- Ethernet Synchronization Messaging Channel
- Hands-on: Testing Synchronization in Ethernet Applications
- Basic TDM and Packet Test
- Jitter/Wander Tests at Synchronous Ethernet Interface

Course Profile
- Target group: Engineers, Marketing staff
- Prerequisites: None
- Duration: 10 h - Two sessions
- Evaluation: Test (upon request)
- Price: Request a quotation
- Language: English

Course Kit
- MPLS / GMPLS book
- Presentation slides
- 10 x Pocket Guides

6 - PTP & SyncE Synchronization

Accurate frequency distribution through packet switched networks can be understood as an extension of the TDM synchronization network based on a few new building blocks like the Synchronous Ethernet Equipment Clock (EEC) and the Packet-based Equipment Clock (PEC). However, for time and phase distribution applications, where most of the interest resides today, this approach does not work.
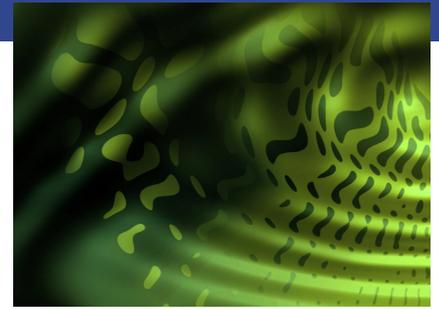
Course Contents

1 Introduction to Communications Systems
- Signals and Information, Transmission Media
- Channel Coding, Multiplexing
- Multiple Access, Pulse Code Modulation

2. From Circuit to Packet

3. Why Synchronization is required?
Synchronization enables many services including assisted navigation, location, and emergency calls. Moreover, synchronization is fundamental to every cellular technology otherwise they would not even work. Base stations must calculate permanently the distance to every single mobile operating in their cell and the neighboring cells.

4. Multiplexing & synchronization
- Multiplexing and Multiple Access
- Time division multiple access (TDMA)
- Code-division multiplexing access (CDMA)
- Polarization division multiple access (PDMA)
- Space division multiple access (SDMA

5. Duplexing
- FDD base stations
- TDD base stations

6. Syntonization and Synchronization
- Syntonization
- Synchronization
- Time of day synchronization

7. Alternatives For Timing
- Syntonization with TDM
- GPS or GLONASS synchronization
- Synchronous Ethernet
- Precision Time Protocol (PTP)

8. Timing Requirements Of Mobile Networks
Mobile operators are moving to a more efficient and higher capacity networks as there is more demand in terms of users and data but the available radio frequencies already are largely allocated, then operators increasingly use new techniques to squeeze more bandwidth from their existing spectrum allocations.
- GSM, 3G
- Long Term Evolution (LTE)

9. PTP in deep
- Protocol Encapsulation
- PTP Synchronization Tests
- Set up a PTP Synchronization Network
- Verify Accurate Time Synchronization
- Generation of impairments to PTP messages
- Analysis of PTP Messages

- Test the Link Quality / Accurate Synchronization

10. PTP clocks
- Ordinary clock
- Master / grandmaster clock
- Boundary clock
- Transparent clock

11. PTP Profiles
A profile may define Path Delay Control, the transport mechanisms required, node types, message exchange rate, unicast or multicast protocol. Profiles facilitate the interoperability between nodes

12. PTP service activation
The first step it the analysis of KPI of the network that has to transport PTP streams in terms of capacity and quality. They may determine the success -or failure- of the implementation. With Ether.Genius executing eSAM can be simulated a PTP service including the generation of background traffic with different traffic profiles

13. From Asynchronous To Synchronous Ethernet
Synchronous Ethernet is an ITU-T standard that provides mechanisms to transfer frequency over the Ethernet physical layer, which can then be made traceable to an external source such as a network clock.
- Ethernet Synchronization Messaging Channel
- Basic TDM and Packet Test
- TDM Jitter / Wander Measurements
- Jitter/Wander measurements
- Verify Network Reference Timing

14. SyncE and PTP testing
- Clock Ref.: recovered; internal, external
- Line Analysis: frequency, offset, drift, Offset Generation:
- Wander MTIE / TDEV
- Decoding ESMC and SSM
- Priority 1-2, Class, Accuracy, Variance, Time source •
- PTP Generation / Analysis / Emulation;
- Sync Inter Arrival Delay (IAD) Avg/Curr; Packet Total Delay (PTD): Std Dev/Range; Packet Delay Variation (PDV)

Course Profile

- Target group: Network designers, Installers, Operators
- Prerequisites: Basic knowledge of transmission
- Duration: 5 h - one sessions
- Language: English

Course Kit

- book
- Presentation slides
- 10 x Pocket Guides
- White Papers

7 - Synchronization Testing

Time and phase synchronization require new synchronization architectures. The challenges to deliver the required accuracy level are especially important in these new scenarios. There is also a renewed interest in synchronization testing related both with network commissioning tasks and troubleshooting

Course Contents

1 PTP standards and profiles
- Time and frequency distribution architectures
- Terminology requirements and thresholds
- Frequency distribution: ITU-T G.8265.1 profile
- Time distribution with full timing support: ITU-T G.8275.1 profile
- Time distribution with partial timing support: ITU-T G.8275.2 profile
- APTS

2. General aspects concerning synchronization T&M
- The local oscillator: TCXOs, OCXOs, Rubidium, Cesium
- Clock references: PRCs, PRTCs, GNSS
- Disciplining the local oscillator
- Tests without an external reference: Closed loop tests, holdover tests

3. Typical test scenarios
- PTP master clock emulation
- The "pseudo-slave" mode
- Monitoring tests

4. Verification of frequency distribution rollouts
- The role of "Synchronous Ethernet"
- MTIE and TDEV
- Floor Delay Population

5. Verification of time distribution rollouts
- The role of the 1 PPS interface
- ToD interfaces
- TE and TIE
- Time error and path asymmetry
- Dynamic and constant TE
- MTIE and TDEV

6. Example and applications
- "Synchronous Ethernet" test
- ITU-T G.8261.1 test in a PTP slave
- MHz synchronization test
- TU-T G.8272 test in a PRTC
- ITU-T G.8271.1 in a PTP slave
- 1 PPS synchronization test
- BC / TC test with GNSS reference
- Self-synchronized BC / TC test
- PTP testing with "Synchronous Ethernet" references

7. Hands-on sessions
- xGenius tester
- Zeus tester
- Clocks

Course Profile

- Target group: Network designers, Installers, Operators
- Prerequisites: Basic knowledge of Timing
- Duration: 10h - including theory and hands on sessions
- Language: English

Course Kit

- Presentation slides
- White paper: PTP Testing Overview

8 - NG - SDH Architectures

The financial and technological cycle of the telecom industry is forcing manufacturers, carriers, operators and standards organizations to move towards a new network that reduces costs while offering new services. Luckily, SDH/SONET has also evolved to more efficiently adapt to statistical multiplexing and traffic based on data packets, especially Ethernet.

Course Contents

1   The Emergence of SDH/SONET Networks
- The limitations of Plesiochronous Networks
- SDH/SONET Challenge

2.   Comparison of SDH and SONET

3.   Functional Architecture
- Network Elements
- Network Topology
- Topology Partitioning
- SDH/SONET Layers

4.   SDH/SONET Formats and Procedures
- SDH/SONET Frame Structure
- Multiplexing Map

5.   SDH Transport Services

6.   Transporting PDH/T-Carrier Tributaries
- Transport on VC-4 or STS-3c SPE
- Transport on VC-3
- Transport of 2-Mbit/s Circuits

7.   Pointers and Timing Compensation
- Payload Synchronisation
- Pointer Formats and Procedures

8.   Overheads
- Path Overhead
- Section Overhead
- SDH/SONET Hierarchy
- Concatenation

9.   Maintenance
- SDH/SONET Events
- Monitoring Events
- Event Tables

10. Performance Monitoring
- Bit Error Checking
- Tandem Connection Monitoring (TCM)
- Forward Error Correction (FEC)

11. SDH Resilience
- Protection Basics
- Multiplex Section or Line Protection

12. Operation, Administration and Maintenance (OAM)
- The TMN Standard
- TMN Benefits

13. Legacy and Next Generation SDH
- Streaming Forces
- Evolution of Transmission Network

14. The Next Generation Challenge
- New Network Elements
- Core Transport Services
- Next-Generation SDH

15. 15. Generic Framing Procedure (GFP)
- Frame–Mapped GFP
- Transparent GFP

16. Concatenation
- Contiguous Concatenation of VC-4
- Virtual Concatenation (VCAT)
- VCAT Setup

17. Link Capacity Adjustment Scheme (LCAS)
- What is LCAS?
- LCAS Applications

18. NG SDH OAM

19. Test and Measurement
- Areas of Application for Test and Measurement
- Interface Testing, Connection Modes in Electrical Interfaces
- Measurements in Electrical Interfaces
- Measurements in Optical Interfaces
- Frequency Measurements
- Bit Error Rate
- Out-of-Service Measurements
- In-Service Measurements
- Synchronisation of NE-Test Set in SDH

Course Profile

- Target group: Network designers, engineers
- Prerequisites: knowledge of SDH transmission
- Duration: 10 h - two sessions
- Evaluation: Test (upon request)
- Language: English

Course Kit

- NG-SDH book
- Presentation slides
- 10 x Pocket Guides
- White Papers

9 - TDM Synchronization

TDM nodes must remain tightly synchronised. In transmission networks, synchronisation failures cause service degradation. In mobile networks, it has been shown that bad synchronisation increases the risk of handover failures.
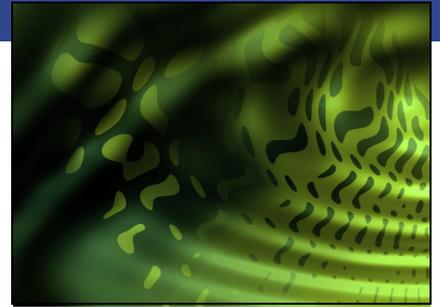
Course Contents

1 Emergence of SDH/SONET Networks
- Limitations of Plesiochronous Networks
- SDH/SONET Challenge

2. Functional Architecture
- Network Elements
- Network Topology
- Topology Partitioning
- SDH/SONET Layers

3. SDH/SONET Formats and Procedures
- SDH/SONET Frame Structure
- Multiplexing Map

4. SDH Transport Services

5. Transporting PDH/T-Carrier Tributaries
- Transport on VC-4 or STS-3c SPE
- Transport of 2-Mbit/s Circuits

6. Pointers and Timing Compensation
- Payload Synchronisation
- Pointer Formats and Procedures

7. Overheads
- Path Overhead
- Section Overhead
- SDH/SONET Hierarchy

8. Concatenation

9. Performance Monitoring
- Bit Error (BER) Checking
- Tandem Connection Monitoring (TCM)
- Forward Error Correction (FEC)

10. SDH Resilience
- Protection Basics, Multiplex Section or Line Protection

11. Synchronisation Networks
- Synchronisation Network Topologies

12. Interconnection of Nodes
- Synchronisation Signals
- Holdover Mode
- Global Positioning System (GPS)

13. Interferences in Synchronisation Signals
- Frequency Offset
- Phase Fluctuation

14. Synchronisation of Transmission Networks
- Synchronisation in SDH/SONET
- Synchronisation Models
- Timing Loops

15. Digital Synchronisation and Switching
- Synchronization Supply Units (SSU) in a Sync. Network
- Functions of SSU

16. Dealing with Jitter
- Phase Fluctuation
- Jitter Metrics and Measurement
- Measuring Jitter in Output Interfaces
- Measuring Jitter Tolerance
- Measuring Jitter Transfer
- Mapping Jitter and Combined Jitter
- Jitter in Leased Lines

17. Dealing with Wander
- Synchronisation of SDH/SONET Networks
- Measuring Relative
- Absolute Wander
- The Metrics of Wander: TIE, MTIE, and TDEV
- Measuring Output Wander
- Measuring Tolerance to Input Wander
- Measuring Wander Transfer
- Response to Phase Transients
- Operating in Holdover Mode

18. Tests on ADMs and Cross-Connects
- Measuring Jitter
- Synchronisation Tests

Course Profile

- Target group: Network designers, engineers
- Prerequisites: Basic knowledge of transmission
- Duration: 7.5 h
- Evaluation: Test (upon request)
- Language: English

Course Kit

- Copper Qualification book
- Presentation slides
- 10 x Pocket Guides
- White Papers

10 - Triple Play Services

The decline of the traditional voice business, together with the ever-increasing competition between companies is pushing the telecommunications industry to provide more services in a more flexible way. This new strategy is based on Triple Play, a bundle of voice, video, and data services for residential customers.

Course Contents

1 Expanding the Business
- Triple Play Market
- Triple Play Applications
- Television and Video Services, Video on Demand (VoD)
- New TV Receivers
- Voice over IP (VoIP) VoIP Roll-out

2. Driving factors of Triple Play
- Re-defining the Business, Competitive Pressure
- New Strategies
- Service Bundling and Network Convergence
- Quadruple Play,
- VoD: the Key Difference, Making a Success Story

3. Real-Time Transport Protocol (RTP)
- Synchronisation Sources and Contributing Sources
- Translators and Mixers, The RTP Packet
- Stream Multiplexing, Security
- Real-Time Control Protocol (RTCP)
- RTCP Packet Types and Formats
- QoS Monitoring, Source Description
- Session Management

4. Session Initiation Protocol (SIP)
- Standardisation, Architectural Entities, Basic SIP Signalling
- Session Description Protocol, Security Issues,
- Service Architecture and Protocol Extensions,
- Firewall Traversal, Internetworking with the PSTN

5. QoS Basics and Provision
- Traffic Differentiation, Congestion Management
- End-to-End Performance Parameters
- One-Way Delay, One-Way Delay Variation
- Packet Loss, Bandwidth
- Marking, Traffic Flows, Traffic Classes, Scheduling
- Congestion Avoidance, Admission Control
- Congestion Control and Recovery
- Bandwidth Profile Characterisation
- Negotiated QoS Parameters
- ATM Service Categories
- SLA in ATM Networks, Resource Management
- The Failure of ATM
- QoS in IP Networks
- The Integrated Services Architecture
- The Reservation Protocol
- The Differentiated Services Architecture

6. IP Multicasting
- IP Multicast Groups and Their Management
- Multicasting in Ethernet Networks
- Multicasting and Internet Group Management Protocol (IGMP)
- Multicast Routing Algorithms

7. Broadband Access
- Services over Copper
- The Limits of Copper Transmission
- ADSL2, ADSL2+, Bonded DSL, VDSL, VDSL2
- Passive Optical Network, Basic Operation, Advantages
- Broadband PON, Gigabit PON, Ethernet PON
- Ethernet in the First Mile, Ethernet over Copper,
- Ethernet in Optical Access Networks
- Ethernet as a MAN/WAN Service
- Network Architecture, Virtual Ethernet Connections
- Multiplexing and Bundling
- Generic Service Types, Connectivity Services

8. End-to-End Ethernet
- Optical Ethernet, Ethernet over WDM, SDH
- Limitations of Bridged Networks
- Scalability, Protection, Topologies, Quality of Service
- Multi-Protocol Label Switching
- Labels, MPLS Forwarding Plane, Label Distribution
- Martini Encapsulation, Pseudowires, Ethernet Pseudowires
- PWE3 and NG-SDH
- Advantages of MPLS

9. Migration
- Migrating the Architecture, Legacy Services
- NG-SDH + MPLS + PWE3 + Ethernet
- Service Internetworking, Ethernet + MPLS – urbi et orbe?

10.The Next-Generation Challenge
- New Network Elements, Core Transport Services
- Next-Generation SDH

Course Profile
- Target group: Network designers, engineers, marketing staff
- Prerequisites: basic TCP/IP
- Duration: 10 h - two sessions
- Evaluation: Test (upon request)
- Price: request a quotation
- Language: English

Course Kit
- Triple Play book
- Presentation slides
- 10 x Pocket Guides
- White Papers

11 - Voice over IP

Although Voice over IP (VoIP) started out as an alternative technology, carriers and service providers are now taking advantage of it to make installation and management tasks easier and more cost-effective, or to integrate fixed and mobile services.

Course Contents

1 Voice Signal Coding
- Network Performance Parameters
- Opinion Quality Rating
- Objective Quality Assessment
- Market Segments

2. The Real-Time Transport Protocol
- Synchronisation Sources
- Contributing Sources
- Translators and Mixers
- RTP Packet
- Stream Multiplexing
- Security

3. The Real-Time Control Protocol
- RTCP Packet Types and Formats
- Quality of Service Monitoring
- Source Description
- Session Management (BYE Packet)

4. The Session Initiation Protocol
- SIP Standardisation
- Architectural Entities
- Basic SIP Signalling Mechanisms
- Session Description Protocol
- Security Issues
- Service Architecture and Protocol Extensions
- Firewall Traversal
- Internetworking with PSTN

5. QoS Basics
- Traffic Differentiation
- Congestion Management

6. End-to-End Performance Parameters
- One-Way Delay
- One-Way Delay Variation
- Packet Loss
- Bandwidth

7. QoS Provision
- Marking
- Traffic Flows
- Traffic Classes
- Scheduling
- Congestion Avoidance
- Admission Control
- Resource Management
- Congestion Control and Recovery

8. QoS in ATM Networks
- Bandwidth Profile Characterisation
- Negotiated QoS Parameters
- ATM Service Categories
- SLA in ATM Networks
- Resource Management
- Failure of ATM

9. QoS In IP Networks
- Integrated Services
- Reservation Protocol
- Differentiated Services

Course Profile

- Target group: Network designers, engineers, sales, marketing and IT staff
- Material included: Book, slides, CD-ROM, pocket guides
- Prerequisites: basic TCP/IP
- Duration: 10 h - two sessions
- Evaluation: Test (upon request)
- Price: request a quotation
- Language: English

Course Kit

- VoIP book
- Presentation slides
- 10 x Pocket Guides
- White Papers

12 - Audiovisual Services over IP

Bundling TV and video with data and voice services is more than just a marketing plan. It is a very ambitious strategy with well-defined targets to reduce churn, gain customer loyalty, minimize costs, gain TV customers, increase profits, grow the brand name and enable network convergence.

Course Contents

1   Business Strategies
- Expanding Telco Businesses
- Digital Television
- The Internet and Television

2. Triple Play Applications
- Television and Video Services
- Video on Demand
- New TV Receivers
- Voice over Internet Protocol
- VoIP Roll-Out

3. Driving Factors of Triple Play
- Business Redefinition
- Competitive Pressure

4. Telcos Strategies
- Service Bundling and Network Convergence
- Quadruple Play
- VoD: the Key Difference
- Making a Success Story
-

5. IPTV Business Models
- Strengths
- Opportunities
- Weaknesses
- Threats

6. Regulatory framework

7. Architectural Design
- Television services Roll-out
- Business Model Definition
- Head-end
- Distribution Network
- Subscriber Site

8. Television and Video Services and Applications
- IPTV Protocols
- Video-on-demand Services
- Personal Video Recording Services
- Converged Telephony

9. Formats and Protocols
- Analogue TV
- Digital TV
- Audio and Video Codecs

10.How a MPEG-2 Works
- MPEG-2 Levels and Profiles

- MPEG Compression
- MPEG Stream Generation Scheme
- The Transport Stream
- Packet Distribution and Delivery

11.Introduction to MPEG-4
- What is MPEG-4?
- Markets and Applications
- Related Standards
- MPEG-4 Levels and Profiles
- Rich Multimedia Framework
- Interoperability

12.Windows Media and VC-1
- VC-1 Profiles and Levels

13.Service Provision
- Quality of Experience
- Service provision

14.Network Impairments
- Service assurance
- Content Faults
- Network impairments
- Transaction Impairments
- Transport impairments
- Media Delivery Index

Course Profile

- Target group: Network designers, engineers, sales, marketing and IT staff
- Material included: Book, slides, CD-ROM, pocket guides
- Prerequisites: basic TCP/IP
- Duration: 10 h - two sessions
- Evaluation: Test (upon request)
- Price: request a quotation
- Language: English

Course Kit

- IPTV and VoD book
- Presentation slides
- 10 x Pocket Guides
- White Papers

13 - Wireless LTE, 5G and IMS

Multimedia conferencing and mobile TV are strategic services for mobile operators, but fixed operators are also looking for mechanisms to add mobility to their services. Residential Internet connections based on Wireless LAN (WLAN), 5G and LTE with WLAN connectivity are good examples of this.

Course Contents

1 Triple and Quadruple Play
- Business redefinition
- Competitive Pressure
- Service Bundling and Network Convergence
- FMS and FMC

2. The Global System for Mobile Communications
- The TDMA/FDMA air interface
- The GSM network reference model
- Data over GSM, CSD, HSCSD, GPRS, EGPRS/EDGE

3. The Universal Mobile Telephone System
- The WCDMA air interface
- High Speed Packet Access, HSDPA, HSUPA
- The UMTS Terrestrial Radio Access Network

4. Long Term Evolution of Wireless Networks
- The HSOPA air interface
- MIMO and other smart antenna technologies
- The E-UTRAN and the AIPN

5. Wireless Local Area Networks
- WLAN applications
- Hotspots, Femtocells
- Wireless mesh networks
- Wi-Fi, radio bands
- FHSS, DSSS and OFDM air interfaces, CSMA/CA
- WLAN integration in mobile networks, GAN/UMA

6. Wireless Metropolitan Area Networks
- WiMAX, allocated radio bands
- OFDM air interface
- MAC layer
- Performance
- WiMAX and 3G network integration
- WiMAX network reference model, I-WLAN

7. The Session Initiation Protocol
- IETF Standardization, MMUSIC and SIP working groups
- User identity, SIP and SIPS URIs
- User agents
- Proxy servers
- Redirect servers
- Regristrars
- SIP Basic Signalling Mechanisms
- Registration
- Call origination
- The Session Description Protocol
- End-to-end security
- Hop-by-hop security

- IPSec, TLS, S/MIME
- Service Architecture and Protocol Extensions
- SIP instant messaging, supplementary services
- Firewall Traversal, types of NAT, UPnP, STUN, TURN, ICE
- Internetworking with the PSTN
- Gateway decomposition, trunking and access MGs

8. The IP Multimedia Subsystem
- IMS advantages
- Unified billing
- Single sign on
- Custom services, FMC
- Standardization
- The Call Session Control Function
- P-CSCF, S-CSCF, I-CSCF
- Main Architectural Entities
- HSS, MRFP, MPRC, MGW, MGCF

9. LTE & 5G Services
- Application Server
- Open Services Architecture
- Voice Call Continuity
- User identities
- IMS private and public identities, GRUUs
- AAA, RADIUS, Diameter, AAA agents
- Policy and Charging Control
- SBLP, FBC
- Off-line and on-line charging
- PCEF and PRCF
- Basic Procedures
- Registration,
- Call origination
- The Next Generation Network
- ITU-T and ETSI TISPAN standardization

Course Profile

- Target group: Network designers, engineers
- Prerequisites: Basic TCP/IP architecture, Wireless networks
- Duration: 10 h - Two sessions
- Evaluation: Test (upon request)
- Price: Request a quotation
- Language: English

Course Kit

- Quadruple Play and IMS book
- Presentation slides
- 10 x Pocket Guides
- White Papers

10 Reasons to Attend

1. *Stay* abreast of the latest technologies
2. *Meet* colleagues facing the same issues
3. *Gain* valuable insight
4. *Carrier Ethernet* is a must for converged networks
5. The *Triple Play market* is growing 250% annually
6. *Evaluate* a key equipment vendor
7. *Learn* from others who already use these technologies
8. *Assess* the financial viability of installing these services
9. *Discuss* your network and needs
10. *Receive* inside information never published befor

Course Kits

Participants will receive an information bag full of documents:
the Course book, a collection of Application Notes, Technology Pocket Guides, and the Course slides.

Worth more than 500 USD

Course Prices / person

- ☐ 1. Ethernet and Access Network .... 150.00 $
- ☐ 2. n x Giga Ethernet networks .... 250.00 $
- ☐ 3. Carrier Ethernet architectures .... 250.00 $
- ☐ 4. Carrier Ethernet and MPLS .... 250.00 $
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- ☐ 6. PTP & SyncE Synchronization ...... 250.00 $
- ☐ 7. Synchronization Testing .... 250.00 $
- ☐ 8. NG SDH architectures .... 400.00 $
- ☐ 9. TDM Synchronization .... 250.00 $
- ☐ 10. Triple Play and QoS .... 400.00 $
- ☐ 11. Voice over IP .... 250.00 $
- ☐ 12. Audiovisual Services over IP .... 250.00 $
- ☐ 13 - Wireless LTE, 5G and IMS......... 250.00 $

(min. 4 persons)

Course Kit

I would like to purchase the following kits:

- ☐ 1. Ethernet and Access Network........150.00 $
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- ☐ 3. Carrier Ethernet architectures........150.00 $
- ☐ 4. Carrier Ethernet and MPLS............150.00 $
- ☐ 5. Ethernet Mobile Backhaul ....150.00 $
- ☐ 6. PTP & SyncE Synchronization.......150.00 $
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- ☐ 11. Voice over IP...............................150.00 $
- ☐ 12. Audiovisual Services over IP ....150.00 $
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