

Course ID
SONETADV
Course Duration
4 days

Course Title
SONET/SDH - Advanced

Related Courses

SONET/SDH Technology & Design (SONET-SDH, 2 days)
DWDM – Introduction (DWDM101, 2 days)
DWDM – Advanced (DWDM, 2-3 days)
Optical Networking for Managers (OPTNET, 2-3 days)

Aimed At

Those whose job requires an in-depth understanding of the SONET/SDH technology.

Group Size

5-25

Prerequisites

None.

Course in a Nutshell

SONET/SDH technology forms the backbone of most large-scale telecommunications networks. This course covers SONET/SDH in depth in the context of modern telecom systems including the new technologies such as Gigabit Ethernet. It includes enhancements to SONET/SDH including Virtual Tributaries (VT), Optical Transport Network (OTN), and Generic Framing Protocol (GFP). The course also relates SONET/SDH to MPLS and covers protection schemes and related topics.

Customize It!

We will customize this course's content and tech-level to suit your audience. Depending on your need, we can focus the course on SONET, SDH, or both. If you are interested in the technology from a cyber-security perspective, we can include an expanded discussion of the security issues. The course can also be widened to include other optical networking technologies, such as DWDM, if necessary.

Learn How To

- Understand the conceptual and theoretical underpinnings of this field
- Define the important SONET/SDH terms
- Identify applications of SONET/SDH
- Describe the detailed workings of SONET/SDH
- Name the key components of SONET/SDH systems and describe how they fit together
- Design a SONET/SDH system
- Describe the limitations of the SONET/SDH technology
- List the objectives and characteristics of the next generation

SONET/SDH systems

- Describe the vision and structure of the Next Generation Network (NGN) project as it affects SONET/SDH
- Understand how SONET/SDH relates to Ethernet and evolving network demands

**Course
Outline**

Day 1: Overview/Review of Optical Communications Systems

- Basic Physical Theory
 - Brief history of optical communications systems
 - Principles of optics relevant to optical communications systems
 - Key background from physics
- Layered Communications Architectures
 - Why layered architectures
 - OSI Model
 - TCP/IP Model
 - Functionality of each layer and physical implementations
- Optical Fiber
 - Types of optical fiber
 - Operation of optical fiber
 - Limitations of optical fiber and optical communications systems
- Optical Light Sources and Detectors
 - Principles of lasers
 - Solid state lasers
 - Coupling of light into fiber
 - Optical detectors
- Modulation of Light, Optical Receivers
 - Methods of modulating light
 - Practical limitations
 - Formats used to transmit information using light and optics
- Noise and Detection
 - Types of noise and distortion which affects optical signals
 - Methods of reducing effects of noise and distortion
 - Optimal detection methods and devices
- DWDM
 - Basic principles of Wavelength Division Multiplexing (WDM)
 - Dense Wavelength Division Multiplexing (DWDM)

- Architectures used in DWDM
- Components required for WDM networks
- International standards for WDM networks
- Opto-electronic Networks
 - FDDI
 - Fiber channel
 - SONET, SDH
 - Ethernet on optical networks
- MPLS
 - Switching vs routing
 - Label switching
 - Multiprotocol label switching in optical networks

Day 2: SONET/SDH Principles

- SONET Technology and Terminology
 - SONET digital hierarchy
 - Comparison with the Plesiochronous Digital Hierarchy (PDH)
 - SONET equipment types
 - STS-1 frame format
- SONET Headers
 - Section Overhead (SOH)
 - Line Overhead (LOH)
 - Path Overhead (POH)
 - Floating payload: SONET pointers
 - Synchronization and accommodating jitter
- SONET Error Rates, Detection, and Correction
- Virtual Tributaries (Containers)
 - VT groups
 - Virtual tributaries pointers
 - SONET VT multiframe
 - SONET mapping of asynchronous DS-1, byte-synchronous DS-1, asynchronous DS-3, and asynchronous DS-4
- STS-N Frame Format
 - STS-N frame structure
 - Concatenated STS-Nc frame format
 - STS-Nc frame structure
- SDH versus SONET

- SONET vs SDH frame structure
- STM-1 frame
- Overhead bytes and their function
- SDH layers
- Mapping in SDH: C4 mapping and C-3 mapping examples
- Hierarchical multiplexing structure
- SONET/SDH Networking
 - Network survivability architectures
 - Protection topologies: Linear
 - Protection topologies: Ring
 - Protection topologies: Mesh
 - Topologies: Rings, # fibers, directionality
 - SONET: Automatic Protection Switching (APS)
 - SONET linear APS
 - Add-Drop Multiplexing (ADM)
 - Digital Cross-Connects (DCC)

Day 3: SONET/SDH (continued)

- Current Architectures: Ring Protection
 - Unidirectional Path Switched Ring (UPSR)
 - Bidirectional Line Switched Ring (BLSR/2)
 - Bi-directional Line Switched Ring (BLSR/4)
 - Mesh restoration versus ring/linear protection
- IP over SONET
 - IP+SONET vs. IP+ATM+SONET
 - IP over Optical Networks (IPO)
 - Packets over SONET (POS)
 - Point-to-Point Protocol (PPP) - RFC1661
- SONET/SDH Limitations
- Next Generation SONET/SDH
 - Virtual Concatenation: VCAT
 - SONET channelization and concatenation
 - Virtual concatenation group
 - Link Capacity Adjustment Scheme: LCAS
 - LCAS architecture
- Generic Framing Procedure (GFP)
 - GFP client signal adaptation
 - GFP frame format

- Adding GFP on SONET
- Ethernet over SONET
- Virtual concatenation for Ethernet
- Optical Transport Network
 - OTN hierarchical overview
 - Basic transport structure of an OTN
 - OTN transmitter and receiver
 - OTN layer structure
 - OTN interface classes
 - OTN hierarchical overview

Day 4: SONET in the Context of Communications Networks; Advanced Topics

- Network Design Principles and Tradeoffs
- Next Generation Network (NGN)
 - Merging the voice and data worlds
 - Vision of ITU-T NGN
 - Structure of ITU NGN Focus Group (FGNGN)
- SONET vs Ethernet in Future Networks
 - The layer 2 problem
 - Growth of Ethernet and Ubiquity of Ethernet networks
 - Elimination of SONET
- Link Capacity Adjustment (LCAS) and Virtual Concatenation (VCAT)
 - Need for dynamic bandwidth in modern networks
 - LCAS implementation and SONET
 - VCAT supporting variable bit rate data streams
- ASON/GMPLS (include restoration at the FO transport level vs OSPF restoration at the IP layer)
 - Control planes and optical networks
 - Flexible bandwidth and Automatically Switched Optical Network (ASON)
 - Network routing protocols and border gateway protocols
 - GMPLS fundamentals
 - Restoration at FO transport level
- UNI (User Network Interface)
 - Requesting network connection from ASON/GMPLS control plane
- GFP vs HDLC vs PPP (different encapsulation techniques)

- Generic Framing Procedure (GFP) and Ethernet frames
- HDLC service classes and Asynchronous Balanced Mode (ABM)
- Point to Point Protocol (PPP) applications
- Future of SONET/SDH in a Data-driven Ethernet World
 - Expected lifetime of SONET/SDH
 - Replacement technologies for SONET/SDH and timeframes
 - Economic pressures and standards issues
- Wrap-up: Course Recap, Discussion, and Participant Evaluation of the Course

DCN NTDR-Kt-f