

Course ID  
**SONET-SDH**  
Course Duration  
**2 days**

Course Title  
**SONET/SDH: Principles and Design**

**Related Courses**

- DWDM: Dense Wavelength Division Multiplexing Principles and Design (DWDM, 2 days)

**Aimed At**

The standard presentation of this course assumes a bachelor of science in Electrical Engineering, Mathematics, Physics, or a related subject along with an appropriate background in communications.

**Group Size**

5-25

**Prerequisites**

None

**Course in a Nutshell**

Optical networks are a key contributor to the rapid expansion of telecommunications services now underway. Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) have become the worldwide standard for the interface and multiplexing of user information to optical networks. SONET/SDH systems allow much greater network flexibility and management over existing optical systems. The study of SONET/SDH is therefore important for all involved with telecommunication and information technology.

In this course, you will learn both the technology and applications of SONET/SDH. We will review the SONET/SDH system components as well as the end-to-end SONET/SDH network design process. We will also discuss the essentials of SONET/SDH synchronization, control, network management, and practical deployment issues. In short, this course will give you the knowledge and skills you need to understand and deploy this important technology.

**Customize It!**

- *Are you a transmission or network engineer* who would like to “fill in the holes” and catch up with the state-of-the-art of optical systems? Let us know so we can focus on the areas that interest you the most.
- *Are you an optical communications system installer* who would like to learn the concepts and theory that underlie your craft? We can focus on the tools and techniques that will help you become more “tech savvy”.
- *Are you a manager, executive, or sales person* whose work involves optical communication systems? If so, we can emphasize those parts of the course that deal with the markets and applications pertinent to your project or product.

**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

## Course Outline

- 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
- 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)
- 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
- Next Generation Network (NGN)
  - Merging the voice and data worlds
  - Vision of ITU-T NGN
  - Structure of ITU NGN Focus Group (FGNGN)

**How You Will  
Learn**

- A seasoned instructor will present this course in interactive lecture format.
- Along with lecture, we use exercises, case studies, and interesting group activities to enrich the instruction and drive home the essential points.
- If you already know something about the technology, we will build on that. We'll compare and contrast what's familiar with what's new, making new ideas easier to learn as well as more relevant.
- If your background is less technical, we will use meaningful and ingenious examples and analogies to simplify the complex subject matter.
- You will receive a printed Participant Handbook which will help you remember and retain what you learned in class and apply it on your job.

*Revised*

*Oct. 4, 2006*