

# Synchronous Digital Hierarchy Networks, Alarms, Protection

SDH has belonged to the main transmission technologies for many years now. It is characterized by excellent network protection and high-performance network management. The course topics comprise planning, operation, coupling, and protection of SDH networks, as well as Ethernet and IP over SDH. Next Generation SDH opens up completely new dimensions for network operators and their customers. Participants will acquire a profound and practice-related knowledge which is imperative for the management of SDH networks and permits a deeper understanding of optical transport networks.

#### Course Contents

- Setup of the Transport Modules
- Tasks of the Overhead and of the Pointers
- Setup and Application of the Network Elements
- Internetworking
- Clock Generation in SDH Networks
- Network Protection Concepts
- Network Management
- Measuring Technologies
- Implementation of Leased Line Connections
- SDH in Interaction with ATM, IP, and DWDM
- Packet over SONET/SDH (POS)
- SDH Next Generation: Virtual Concatenation and Link Capacity Adjustment Scheme

In this course of the ExperTeach Networking series, each student will receive the comprehensive ExperTeach course documentation.

#### Target Group

The course is customized for employees of network operators, vendors, ISPs, and large-scale customers. Moreover, it is designed for employees of companies which use site interconnections or long-distance traffic connections with high bit rates.

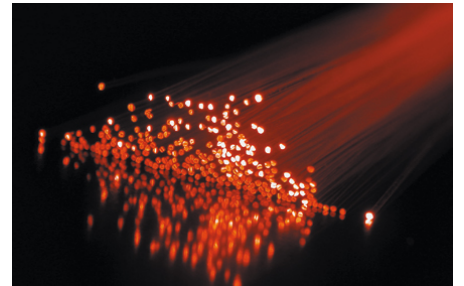
#### Knowledge Prerequisites

The course requires no special know-how. Interest in the topic and the active participation in the discussion ensure an optimum learning success.

#### Reservation and Registration

We will be glad to make a free and non-binding course reservation for you for the duration of two weeks. On [www.experteach-benelux.com](http://www.experteach-benelux.com) under *Registration*, you can conveniently make course reservations, registrations, and hotel reservations. Alternatively, call us under +31 (0)76 52 32 950.

For closed groups of participants, we can modify the course contents according to your requirements. Do not hesitate to contact us!



**3 days** €1,545 exclusive of V.A.T.

#### Course date (dd.mm.yy)/Location

Course dates available on request

Up-to-date information: [www.experteach-benelux.com](http://www.experteach-benelux.com) SPDH



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<p><b>1 Digital Transmission Technologies</b></p> <p><b>1.1</b> Plesiochronous Digital Hierarchy—Technology with Fluctuations</p> <p><b>1.1.1</b> PDH Transmission Rates</p> <p><b>1.1.2</b> 2 Mbps—Structured or Transparent?</p> <p><b>1.1.3</b> Multiplexing—A Bit, Please</p> <p><b>1.2</b> Synchronous Digital Hierarchy—Simple and Brilliant</p> <p><b>1.2.1</b> SDH Transmission Rates</p> <p><b>1.2.2</b> Why SDH? —PDH and SDH in Comparison</p> <p><b>1.2.3</b> SDH Networks in an Overview</p> <p><b>1.2.4</b> Important Standards in the SDH Environment</p> <p><b>1.3</b> Synchronous Optical Network—The American SDH Variant</p> <p><b>2 The Basics of SDH</b></p> <p><b>2.1</b> Basic Rate—STM-1</p> <p><b>2.1.1</b> STM-1 Overhead</p> <p><b>2.1.2</b> Multiplexing Overview</p> <p><b>2.2</b> Transport Units</p> <p><b>2.2.1</b> Containers and Virtual Containers</p> <p><b>2.2.2</b> Tributary Units and Tributary Unit Groups</p> <p><b>2.2.3</b> Administrative Units</p> <p><b>2.2.4</b> Administrative Unit Group (SONET)</p> <p><b>2.2.5</b> Generation of a Higher Order Container</p> <p><b>2.3</b> Highest Bit Rates—From STM-4 to STM-256</p> <p><b>2.3.1</b> STM-4 Multiplexing</p> <p><b>2.3.2</b> Concatenation—STM-4c</p> <p><b>3 SDH in Practical Application</b></p> <p><b>3.1</b> Implementation of Different Leased Line Connections</p> <p><b>3.1.1</b> Mapping E4 in VC-4</p> <p><b>3.1.2</b> Mapping E3 in VC-3</p> <p><b>3.1.3</b> Mapping E1 in VC-12</p> <p><b>3.2</b> ATM over SDH</p> <p><b>3.2.1</b> An Insight into ATM</p> <p><b>3.2.2</b> Come Together—ATM over SDH</p> <p><b>3.2.3</b> Mapping ATM Cells</p> <p><b>3.3</b> Ethernet over SDH</p> <p><b>3.3.1</b> An Insight into Ethernet</p> <p><b>3.3.2</b> Mapping via GFP</p> <p><b>3.3.3</b> Ethernet and Virtual Concatenation (VCAT)</p> <p><b>3.3.4</b> Dynamic Bandwidth Allocation with LCAS</p> <p><b>3.4</b> IP over SDH—Packet over SONET</p> <p><b>3.4.1</b> An Insight into the IP World</p> <p><b>3.4.2</b> Mapping of IP Packets</p> <p><b>3.5</b> WDM—Wavelengths Ahead</p> <p><b>3.5.1</b> Advantages of WDM</p> <p><b>3.5.2</b> SDH and WDM</p> <p><b>3.6</b> Overhead—Basis for Network Monitoring</p> <p><b>3.6.1</b> Section Overhead—Bytes and Meaning</p>	<p><b>3.6.2</b> Path Overhead—Tasks and Function</p> <p><b>4 SDH Technology</b></p> <p><b>4.1</b> Pointers—Synchronization of the Payload</p> <p><b>4.1.1</b> Structure of a Pointer</p> <p><b>4.1.2</b> Tasks of a Pointer</p> <p><b>4.1.3</b> Pointer Changes</p> <p><b>4.1.4</b> AU Pointers</p> <p><b>4.1.5</b> TU Pointers</p> <p><b>4.2</b> Functioning and Application of the Network Elements</p> <p><b>4.2.1</b> Functional Blocks in SDH Devices</p> <p><b>4.2.2</b> Terminal Multiplexers</p> <p><b>4.2.3</b> Add/Drop Multiplexers</p> <p><b>4.2.4</b> Cross-Connect Systems</p> <p><b>4.2.5</b> Preview: Optical Network Elements</p> <p><b>4.3</b> Measurement Technology Instead of Witchcraft</p> <p><b>4.3.1</b> Transport Test</p> <p><b>4.3.2</b> Jitter Tests</p> <p><b>4.3.3</b> Pointer Tests</p> <p><b>5 Design and Management of SDH Networks</b></p> <p><b>5.1</b> Network Design</p> <p><b>5.1.1</b> The SDH Network Model</p> <p><b>5.1.2</b> Rings or Mesh</p> <p><b>5.2</b> Clock Generation—For Whom the Bell Tolls</p> <p><b>5.2.1</b> Clock Sources—There Can Be Only One</p> <p><b>5.2.2</b> Rules for Clock Distribution</p> <p><b>5.2.3</b> Configuration Examples</p> <p><b>5.3</b> Network Protection—Self-Healing Rings</p> <p><b>5.3.1</b> Unidirectional and Bidirectional Rings</p> <p><b>5.3.2</b> Path Protection</p> <p><b>5.3.3</b> Line Protection</p> <p><b>5.3.4</b> MS Shared Protection Rings</p> <p><b>5.3.5</b> Ring Interconnection</p> <p><b>5.3.6</b> Hardware Protection and Node Failure</p> <p><b>5.4</b> Network Management</p> <p><b>5.4.1</b> The SDH Information Model</p> <p><b>5.4.2</b> Monitoring Functions</p> <p><b>5.4.3</b> Alarms and Error Sources</p> <p><b>6 Exercises on the Synchronous Digital Hierarchy (SDH)</b></p> <p><b>6.1</b> Link Allocation of STM-1</p> <p><b>6.2</b> Overhead Tasks</p> <p><b>6.3</b> Equivalent Circuits in the Case of Errors</p> <p><b>6.3.1</b> Path and Line Protection</p> <p><b>6.3.2</b> MS-SPRing</p> <p><b>6.3.3</b> Node Failure</p> <p><b>6.3.4</b> Failure of Nodes and Trunks in Meshed Networks</p>	<p><b>A Standards of the CCITT/ITU-T</b></p>
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