

SONET/SDH



SONET was developed by ANSI; SDH was developed by ITU-T.

SONET : Synchronous Optical Network

SDH: Synchronous Digital Hierarchy

Definition: SONET is a physical layer network technology designed to carry large volumes of traffic over relatively long distances on fiber optic cabling.

The **United States (ANSI)** and **Europe (ITU-T)** have responded by defining standards that, though independent, are fundamentally similar and ultimately compatible.

The ANSI standard is called the Synchronous Optical Network (SONET).
The ITU-T standard is called the Synchronous Digital Hierarchy (SDH).

ARCHITECTURE

Let us first introduce the architecture of a SONET system: signals, devices, and connections.

Topics discussed in this section:

Signals

SONET Devices

Connections

SONET/SDH rates

<i>STS</i>	<i>OC</i>	<i>Rate (Mbps)</i>	<i>STM</i>
STS-1	OC-1	51.840	
STS-3	OC-3	155.520	STM-1
STS-9	OC-9	466.560	STM-3
STS-12	OC-12	622.080	STM-4
STS-18	OC-18	933.120	STM-6
STS-24	OC-24	1244.160	STM-8
STS-36	OC-36	1866.230	STM-12
STS-48	OC-48	2488.320	STM-16
STS-96	OC-96	4976.640	STM-32
STS-192	OC-192	9953.280	STM-64

A simple network using SONET equipment

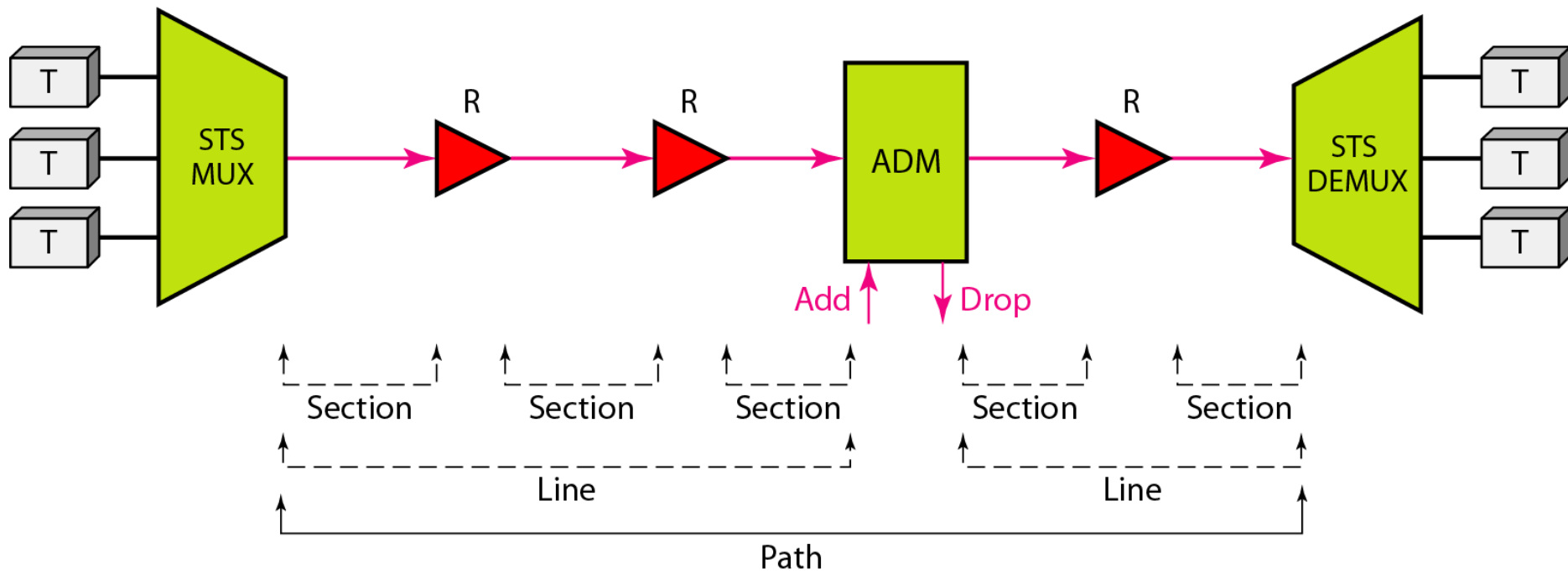
ADM: Add/drop multiplexer

STS MUX: Synchronous transport signal multiplexer

STS DEMUX: Synchronous transport signal demultiplexer

R: Regenerator

T: Terminal



SONET LAYERS

*The SONET standard includes four functional layers: the **photonic**, the **section**, the **line**, and the **path** layer. They correspond to both the physical and the data link layers.*

Topics discussed in this section:

Path Layer

Line Layer

Section Layer

Photonic Layer

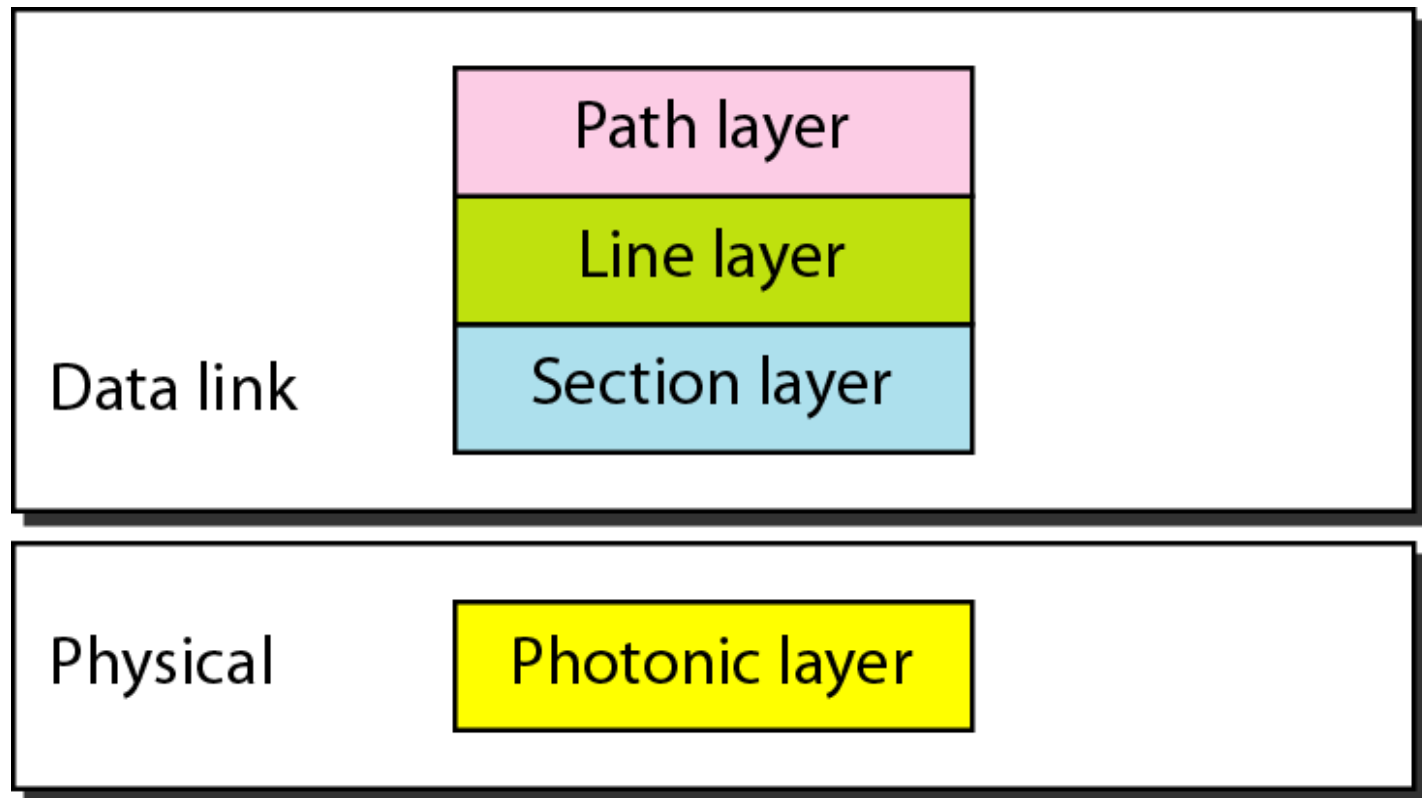
Device–Layer Relationships



Note

**SONET defines four layers:
path, line, section, and photonic.**

Figure 17.2 *SONET layers compared with OSI or the Internet layers*



SONET layers : Path Layer

Path Layer is responsible for the movement of a signal from its optical source to its optical destination.

The signal is change from an electronic form to into optical form.

Multiplexed with other signal.

Encapsulated in a frame.

STS multiplexers provide path layer functions.

SONET layers : Line Layer

Line Layer is responsible for the movement of a signal across a physical line.

Line layer overhead is added to the frame at this layer.

STS multiplexers and add/drop multiplexers provide the line layer function.

SONET layers : Section Layer

Section Layer is responsible for the movement of a signal across a physical line.

It handles framing, scrambling and error control.

Section layer overhead is added to the frame at this layer.

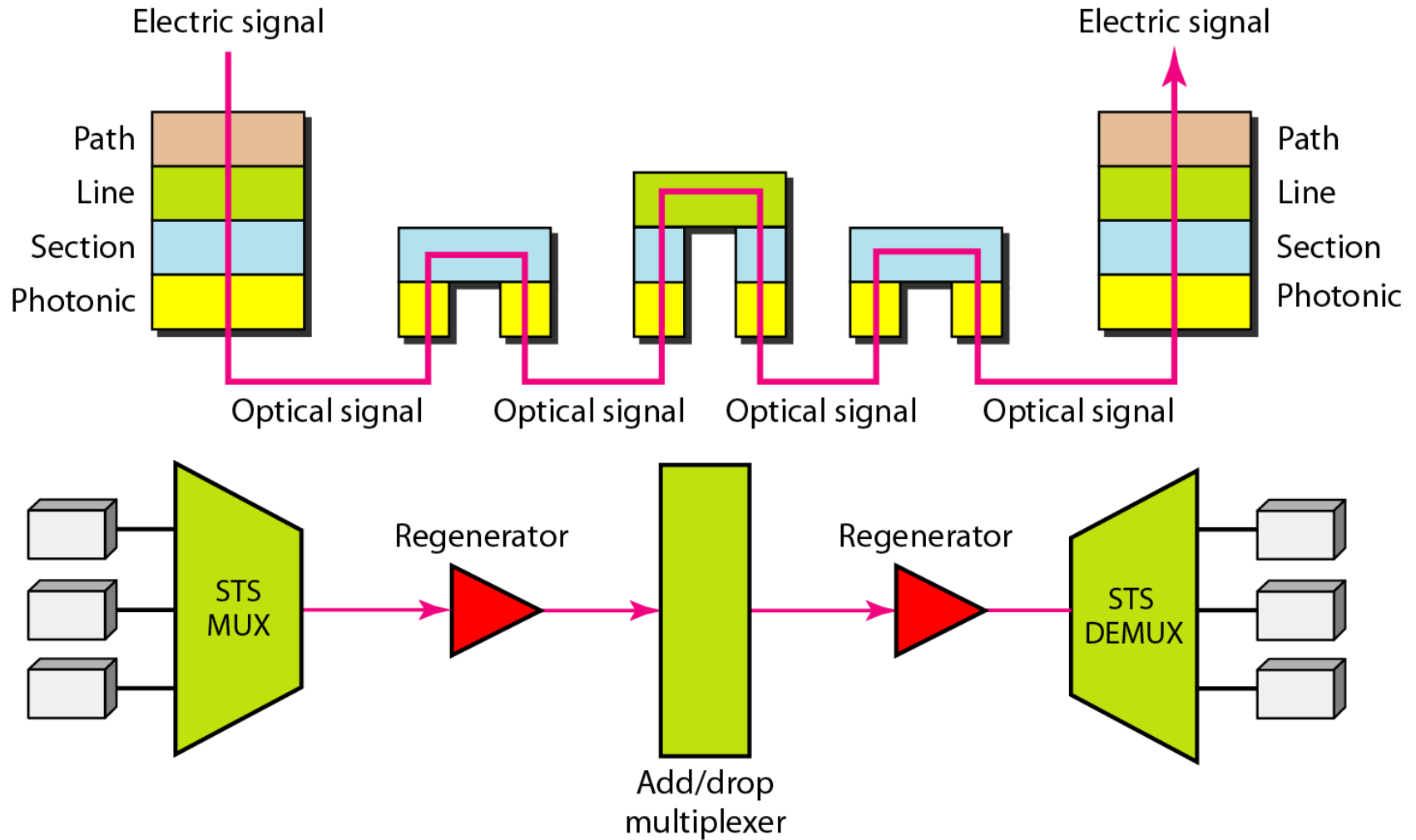
SONET layers : Photonic Layer

Photonic layer corresponds to the physical layer of the OSI model.

It includes physical specification for the optical fiber channel.

SONET uses NRZ encoding.

Figure 17.3 *Device-layer relationship in SONET*

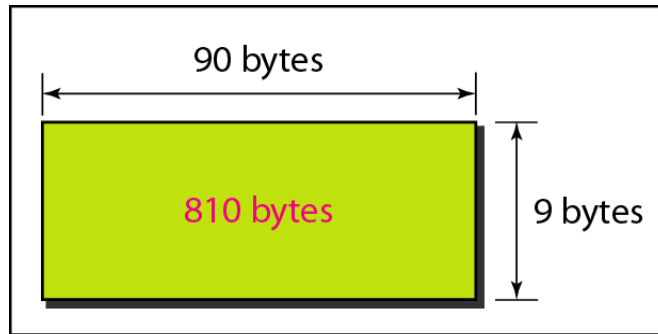


17-3 SONET FRAMES

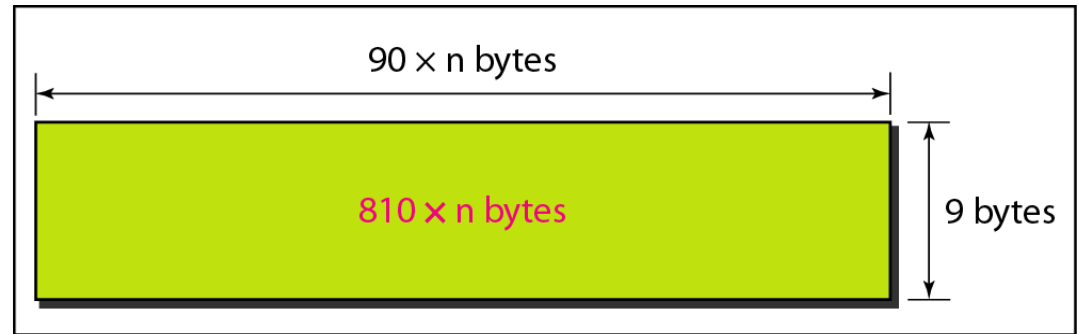
Each synchronous transfer signal STS-n is composed of 8000 frames. Each frame is a two-dimensional matrix of bytes with 9 rows by $90 \times n$ columns.

Frame, Byte, and Bit Transmission
STS-1 Frame Format

Figure 17.4 *An STS-1 and an STS-n frame*

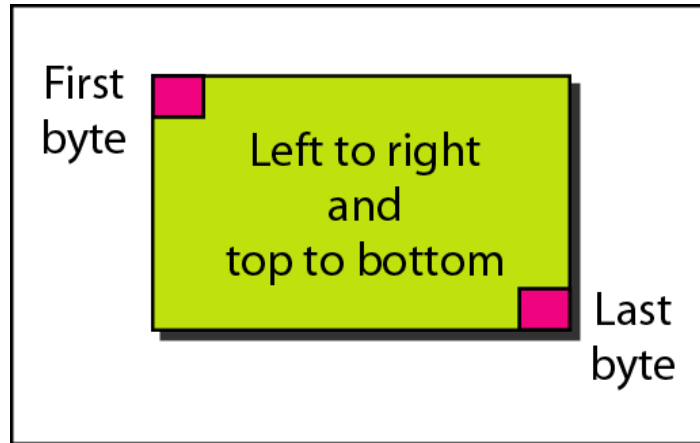


a. STS-1 frame

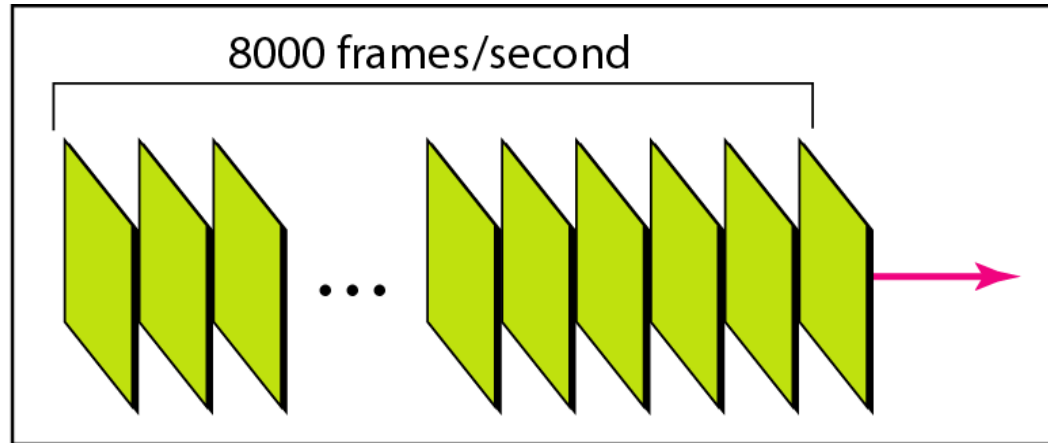


b. STS-n frame

Figure 17.5 *STS-1 frames in transmission*



a. Byte transmission



b. Frame transmission



Note

**A SONET STS-n
signal is transmitted at
8000 frames per second.**

Note

Each byte in a SONET frame can carry a digitized voice channel.

Example

Find the data rate of an STS-1 signal.

Solution:

STS-1, like other STS signals, sends 8000 frames per second. Each STS-1 frame is made of 9 by (1 X 90) bytes. Each byte is made of 8 bits. The data rate is

STS-1 data rate = $8000 \times 9 \times (1 \times 90) \times 8 = 51.840 \text{ Mbps}$

Example

Find the data rate of an STS-3 signal.

Solution

STS-3, like other STS signals, sends 8000 frames per second. Each STS-3 frame is made of 9 by (3 X 90) bytes. Each byte is made of 8 bits. The data rate is

$$\text{STS-3 data rate} = 8000 \times 9 \times (3 \times 90) \times 8 = 155.52 \text{ Mbps}$$

Advantage of SONET

Increased bandwidth over traditional telecomm system

Increased configuration flexibility that supports future applications, with variety of transmission rates

Reduction in equipment requirement

An increase in network reliability

Computer Science & Engineering Assignment

Q:1 *What is Frame Relay? Explain SONET/SDH in detail.*