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

17.3

SONET/SDH rates

STS	OC	Rate (Mbps)	STM
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   R: Regenerator

STS MUX: Synchronous transport signal multiplexer   T: Terminal

STS DEMUX: Synchronous transport signal demultiplexer
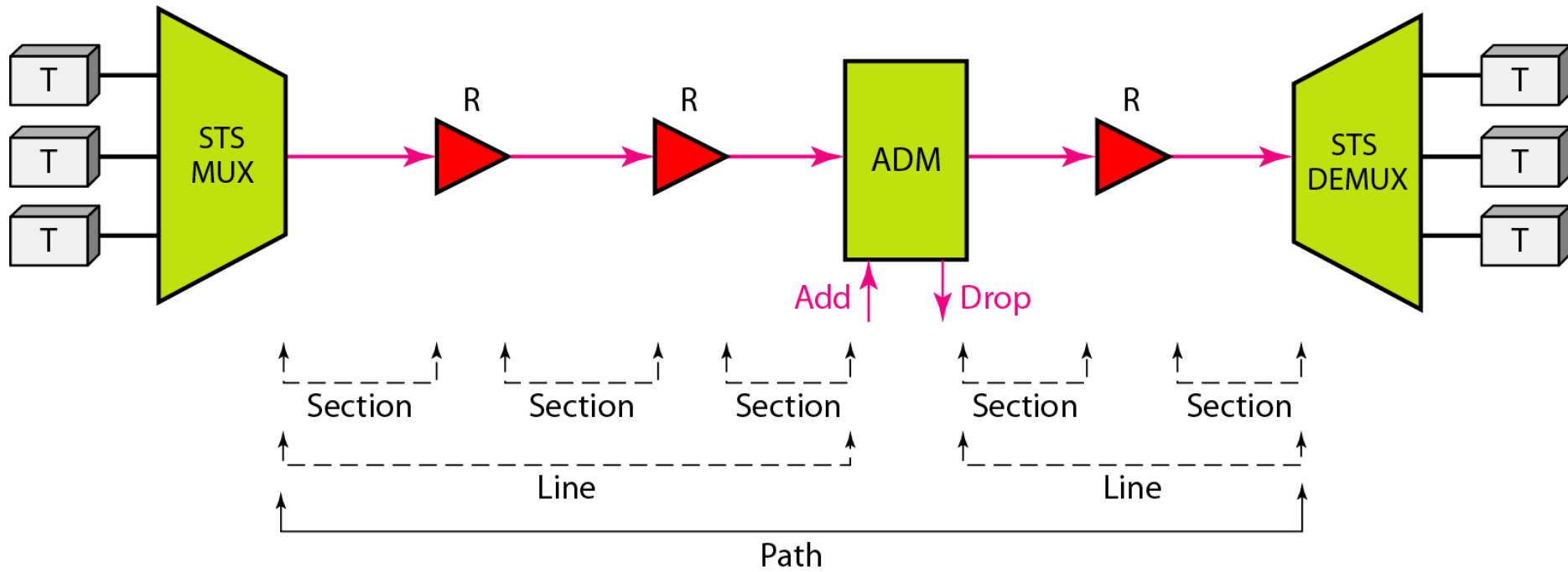
SONET LAYERS

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.

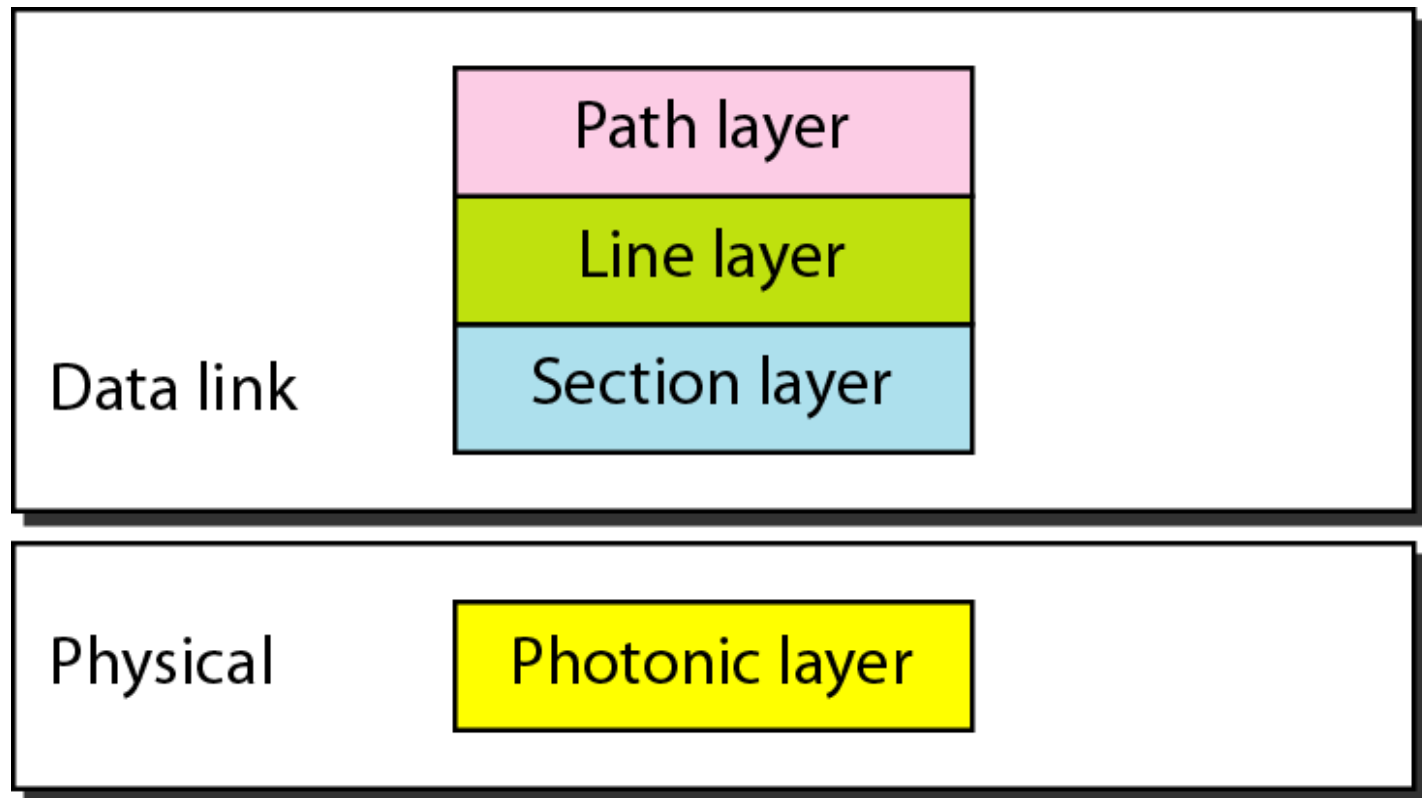**Note**

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.
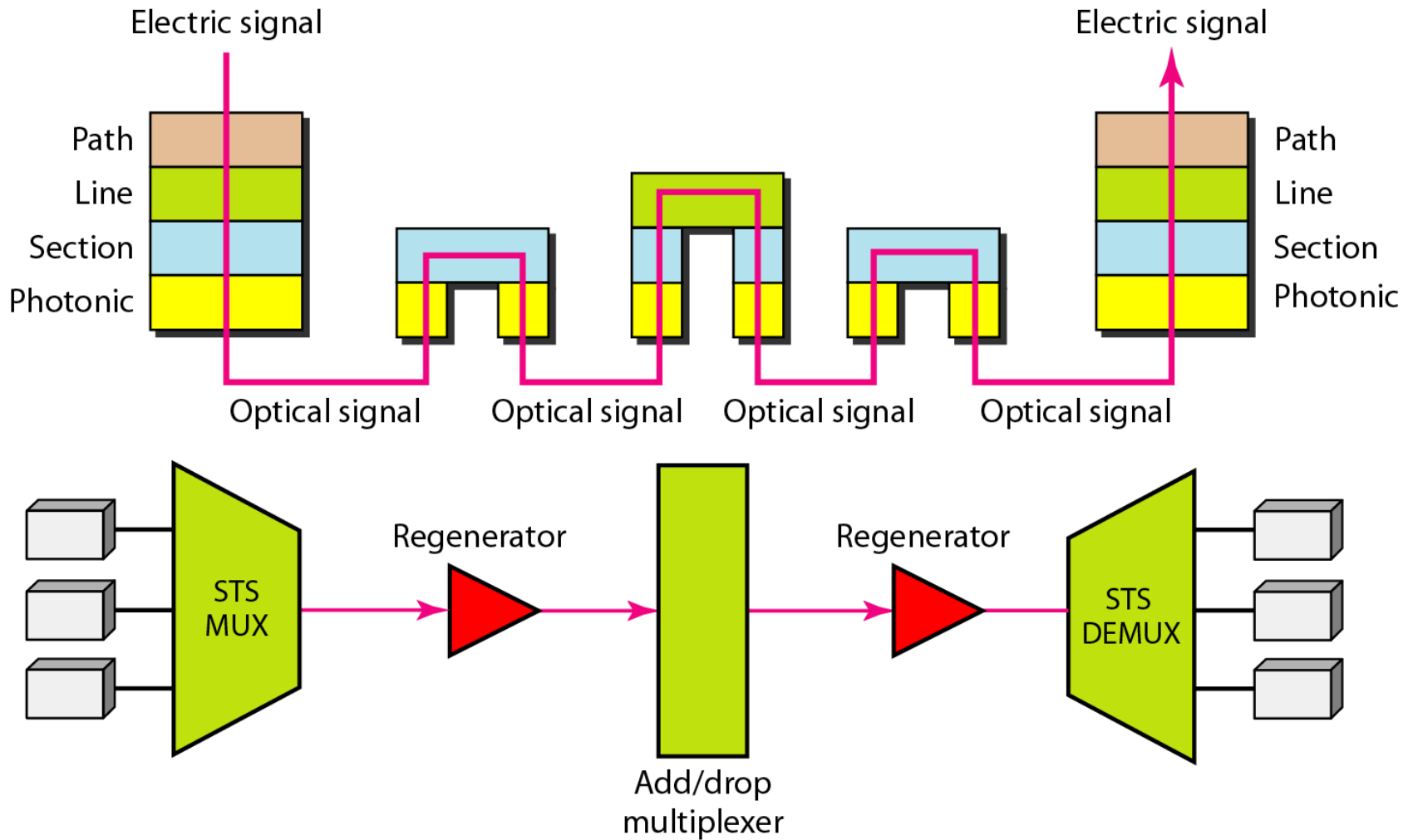
SONET layers : Photonic Layer

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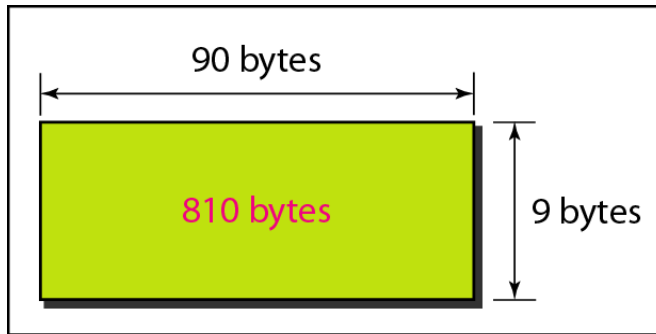
Each synchronous transfer signal STS-n is composed of 8000 frames. Each frame is a two-dimensional matrix of bytes with 9 rows by 90 × n columns.

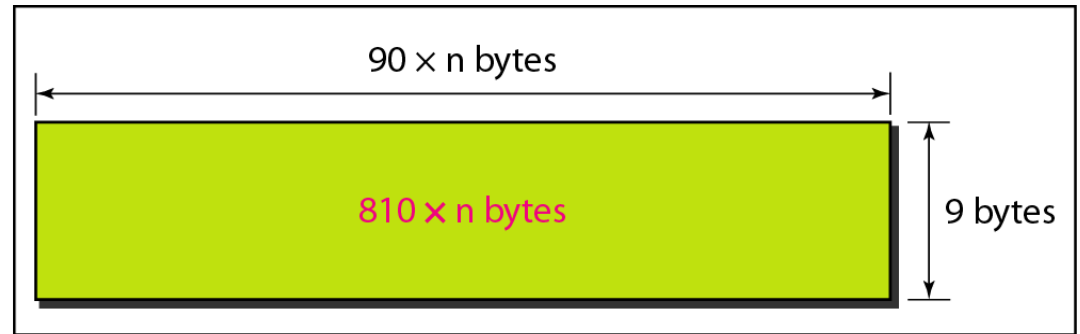**Frame, Byte, and Bit Transmission**
STS-1 Frame Format

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

90 bytes

810 bytes

9 bytes
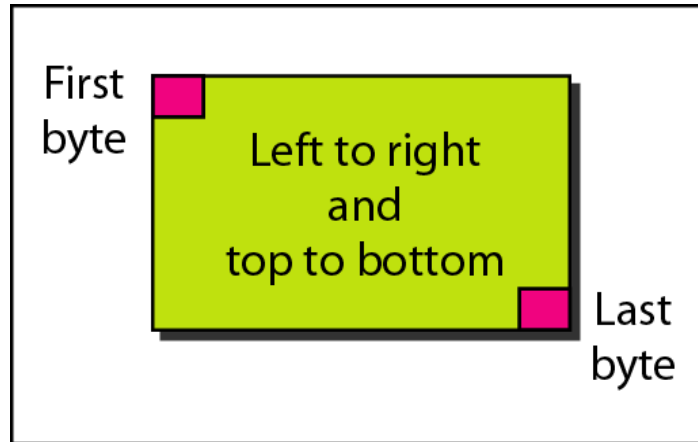
a. STS-1 frame

$90 \times n$ bytes

$810 \times n$ bytes

9 bytes

b. STS-n frame

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Figure 17.5 *STS-1 frames in transmission*

First byte

Left to right and top to bottom

Last byte

a. Byte transmission
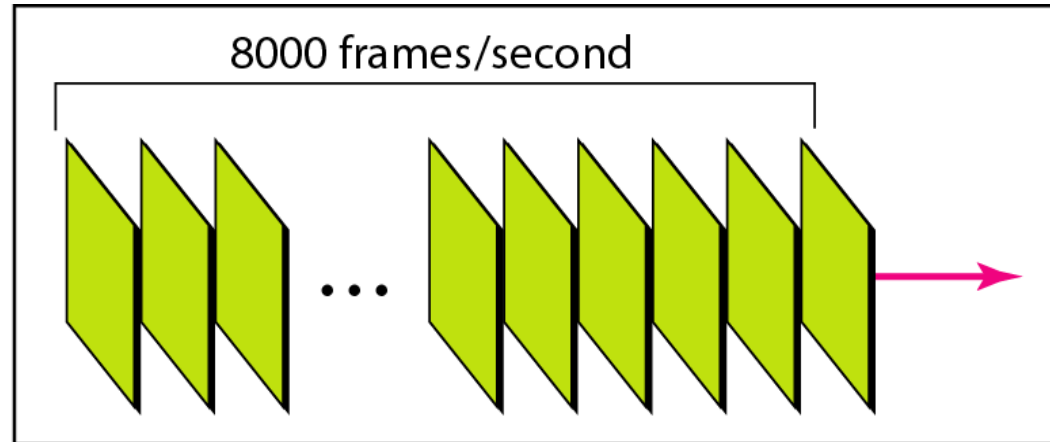
8000 frames/second

b. Frame transmission

**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-I signal.

Solution:

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

STS-1 data rate = 8000 X 9 X (1 X 90) x8= 51.840 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

STS-3 data rate= 8000 x 9 x (3 X 90) x 8 =155.52 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

DRONACHARYA COLLEGE OF ENGINEERING, GURGAON
Computer Science & Engineering
Assignment

Semester- VI (I & II)   **Branch: CSE**
Subject with Code: Computer Networks (IT-305-F)

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