

Course Name: A Level (2nd Sem)

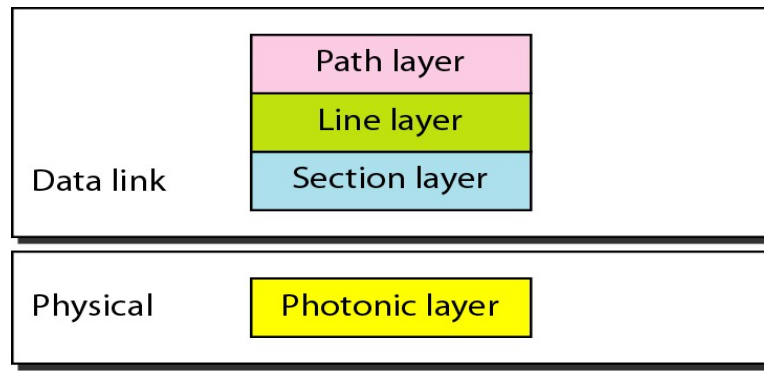
Subject: DCN

Topic: SONET/SDH contd..

Date: 10-06-20

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.



Path Layer:

The path layer is responsible for the movement of a signal from its optical source to its optical destination. At the optical source, the signal is changed from an electronic form into an optical form, multiplexed with other signals, and encapsulated in a frame. At the optical destination, the received frame is demultiplexed, and the individual optical signals are changed back into their electronic forms. Path layer overhead is added at this layer. STS multiplexers provide path layer functions.

Line Layer:

The 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 line layer functions.

Section Layer:

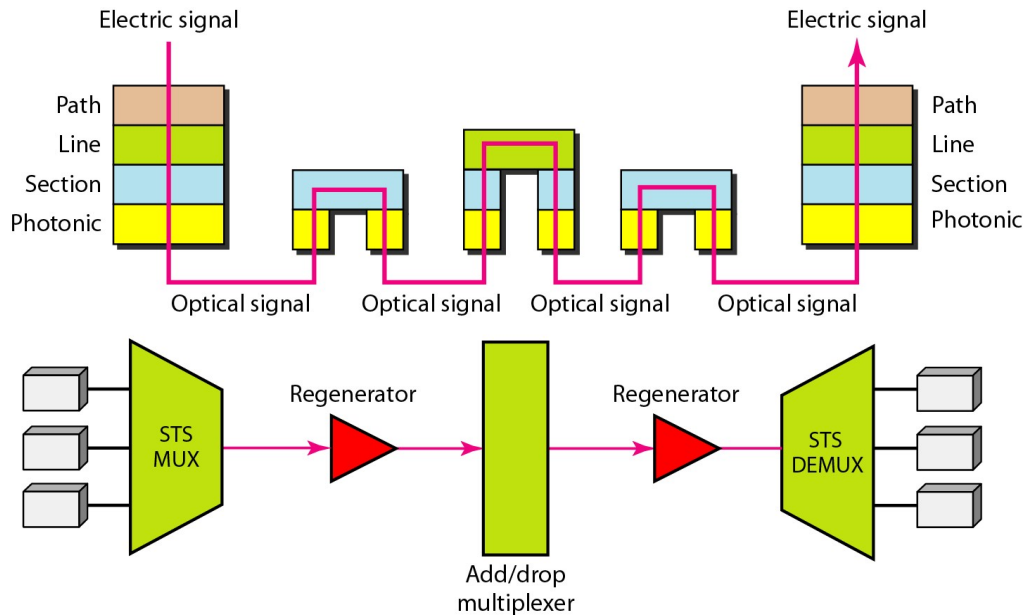
The section layer is responsible for the movement of a signal across a physical section. It handles framing, scrambling, and error control. Section layer overhead is added to the frame at this layer.

Photonic Layer:

The photonic layer corresponds to the physical layer of the OSI model. It includes physical specifications for the optical fiber channel, the sensitivity of the receiver, multiplexing functions, and so on. SONET uses NRZ encoding with the presence of light representing 1 and the absence of light representing 0.

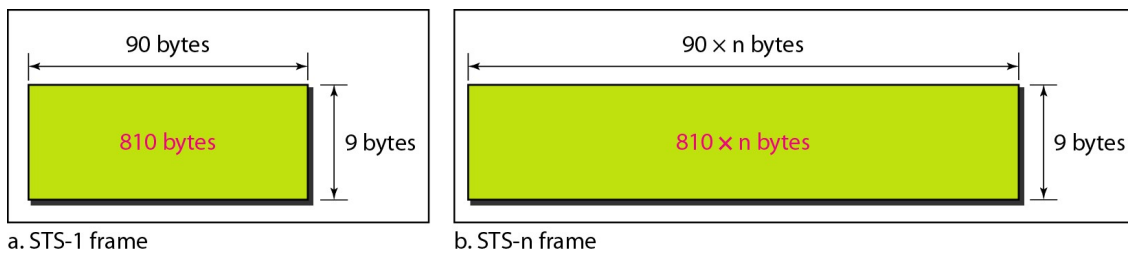
Device-Layer Relationships:

Figure shows the relationship between the devices used in SONET transmission and the four layers of the standard. As you can see, an STS multiplexer is a four-layer device. An add/drop multiplexer is a three-layer device. A regenerator is a two-layer device.



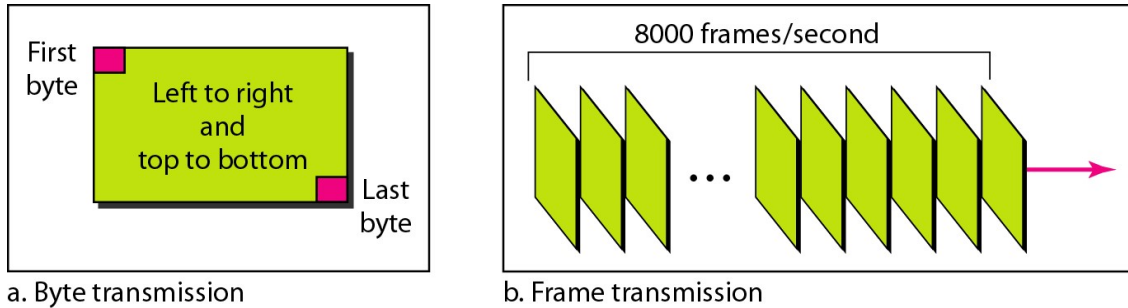
SONET Frames:

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. For example, STS-1 frame is 9 rows by 90 columns (810 bytes), and an STS-3 is 9 rows by 270 columns (2430 bytes). Figure shows the general format of an STS-1 and an STS- n .



Frame, Byte, and Bit Transmission:

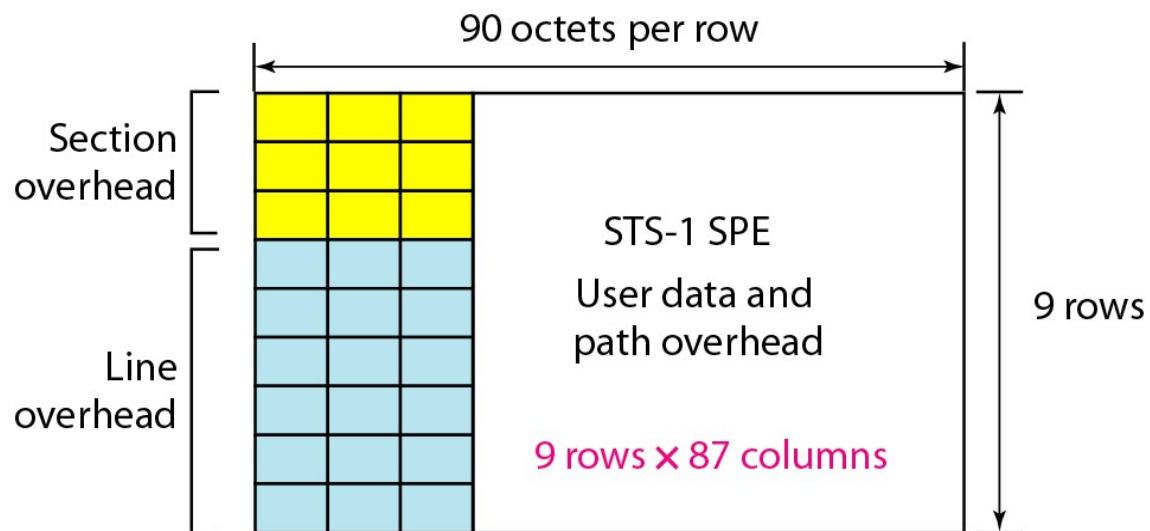
One of the interesting points about SONET is that each STS- n signal is transmitted at a fixed rate of 8000 frames per second. (This is the rate at which voice is digitized.) For each frame the bytes are transmitted from the left to the right, top to the bottom. For each byte, the bits are transmitted from the most significant to the least significant (left to right). Figure shows the order of frame and byte transmission.



If we sample a voice signal and use 8 bits (1 byte) for each sample, we can say that each byte in a SONET frame can carry information from a digitized voice channel. In other words, an STS-1 signal can carry 774 voice channels simultaneously (810 minus required bytes for overhead).

STS-1 Frame Format:

The basic format of an STS-1 frame is shown in Figure. A SONET frame is a matrix of 9 rows of 90 bytes (octets) each, for a total of 810 bytes. The first three columns of the frame are used for section and line overhead. The upper three rows of the first three columns are used for section overhead (SOH). The lower six are line overhead (LOH). The rest of the frame is called the synchronous payload envelope (SPE). It contains user data and path overhead (POH) needed at the user data level.



Q.1. Find the data rate of an STS-1 signal.

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

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

Q.2. Find the data rate of an STS-3 signal.

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

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

Q.3. What is the duration of an STS-1 frame? STS-3 frame? STS-n frame?

In SONET, 8000 frames are sent per second. This means that the duration of an STS-1, STS-3, or STS-n frame is the same and equal to $1/8000$ s, or $125 \mu\text{s}$.

Exercises:

1. What are the four SONET layers? Discuss the functions of each SONET layer.
2. What are the user data rates of STS-3, STS-9, and STS-12?