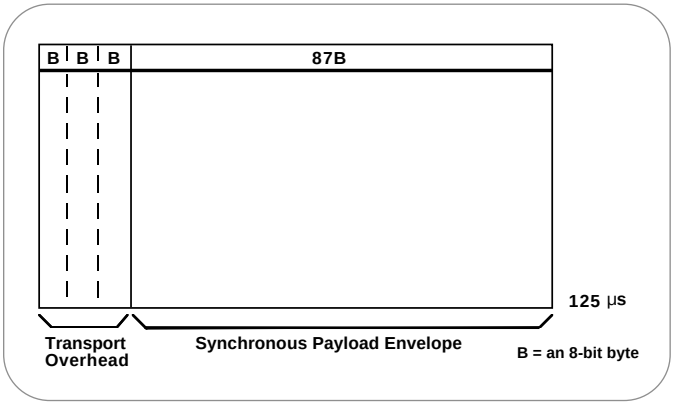
Frame Format Structure

SONET uses a basic transmission rate of STS-1 – equivalent to 51.84 Mb/s. Higher-level signals are integer multiples of the base rate. For example, STS-3 is three times the rate of STS-1 (3 x 51.84 = 155.52 Mb/s). An STS-12 rate would be 12 x 51.84 = 622.08 Mb/s.

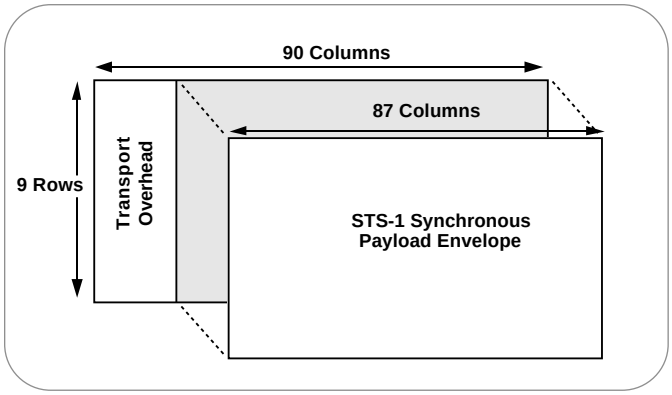
STS-1 Building Block

The frame format of the STS-1 signal is shown in Figure 1. In general, the frame can be divided into two main areas: Transport overhead and the Synchronous Payload Envelope (SPE).

The synchronous payload envelope can also by divided into two parts: STS path overhead and the payload. The payload is the revenue-producing traffic being transported and routed over the SONET network. Once the payload is multiplexed into the synchronous payload envelope, it can be transported and switched through SONET without having to be examined and possibly demultiplexed at intermediate nodes. Thus, SONET is said to be service-independent or transparent.



▶ ***Figure 1.*** *STS-1 frame format.*



▶ ***Figure 2.*** *STS-1 frame elements.*

Transport Overhead is composed of section overhead and line overhead. The STS-1 path overhead is part of the synchronous payload envelope.

The STS-1 payload has the capacity to transport up to:

- 28 DS1s
- 1 DS3
- 21 2.048 Mb/s signals or combinations of the above.

STS-1 Frame Structure

STS-1 is a specific sequence of 810 bytes (6480 bits), which includes various overhead bytes and an envelope capacity for transporting payloads. It can be depicted as a 90 column by 9 row structure. With a frame length of 125 µs (8000 frames per second), STS-1 has a bit rate of 51.840 Mb/s. The order of transmission of bytes is row-by-row from top to bottom, left to right (most significant bit first).

As shown in Figure 1, the first three columns of the STS-1 frame are for the Transport Overhead. The three columns each contain nine bytes. Of these, nine bytes are overhead for the Section layer (for example, Section Overhead), and 18 bytes are overhead for the Line layer (for example, Line Overhead). The remaining 87 columns constitute the STS-1 Envelope Capacity (payload and path overhead).

As stated before, the basic signal of SONET is the Synchronous Transport Signal level 1, or STS-1. The STS frame format is composed of 9 rows of 90 columns of 8-bit bytes, or 810 bytes. The byte transmission order is row-by-row, left to right. At a rate of 8000 frames per second, that works out to a rate of 51.840 Mb/s, as the following equation demonstrates:

9 x 90 bytes/frame x 8 bits/byte x 8000 frames/s = 51,840,000 bits/s = 51.840 Mb/s

This is known as the STS-1 signal rate – the electrical rate used primarily for transport within a specific piece of hardware. The optical equivalent of STS-1 is known as OC-1, and it's used for transmission across the fiber.

The STS-1 frame consists of overhead, plus a Synchronous Payload Envelope (see Figure 2). The first three columns of each STS-1 frame make up the Transport Overhead, and the last 87 columns make up the SPE. SPEs can have any alignment within the frame, and this alignment is indicated by the H1 and H2 pointer bytes in the line overhead.

STS-1 Envelope Capacity and Synchronous Payload Envelope (SPE)

Figure 3 depicts the STS-1 SPE, which occupies the STS-1 Envelope Capacity. The STS-1 SPE consists of 783 bytes, and can be depicted as an 87 column by 9 row structure. Column 1 contains nine bytes, designated as the STS Path Overhead (POH). Two columns (columns 30 and 59) are not used for payload, but are designated as the "fixed stuff" columns. The 756 bytes in the remaining 84 columns are designated as the STS-1 Payload Capacity.

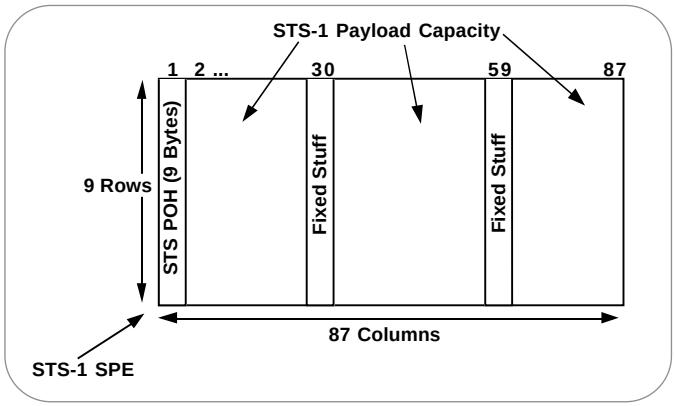
STS-1 SPE in Interior of STS-1 Frames

The STS-1 SPE may begin anywhere in the STS-1 Envelope Capacity (see Figure 4). Typically, it begins in one STS-1 frame and ends in the next. The STS Payload Pointer contained in the Transport Overhead designates the location of the byte where the STS-1 SPE begins.

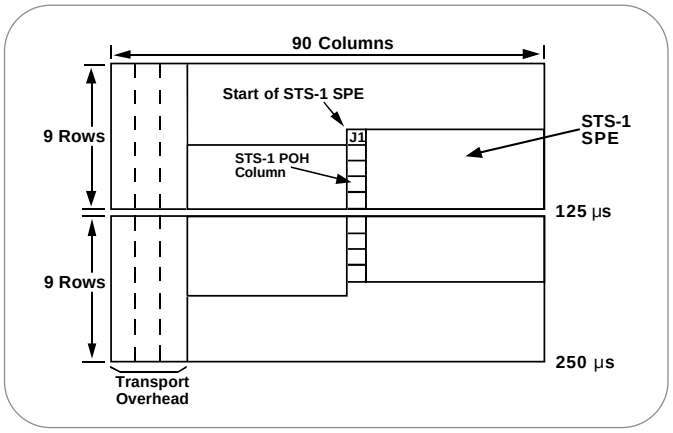
STS POH is associated with each payload and is used to communicate various information from the point where a payload is mapped into the STS-1 SPE to where it's delivered.

STS-N Frame Structure

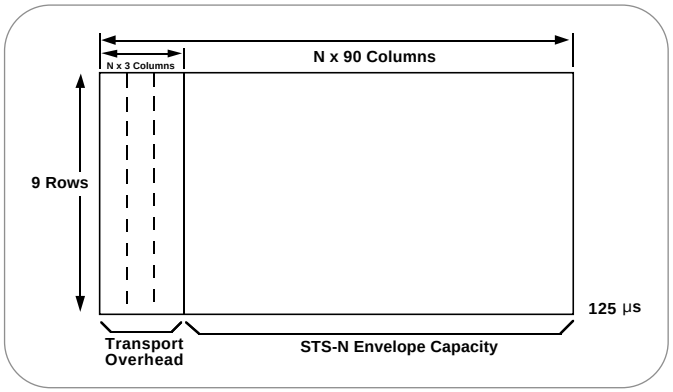
An STS-N is a specific sequence of N x 810 bytes. The STS-N is formed by byte-interleaving STS-1 modules (see Figure 5). The Transport Overhead of the individual STS-1 modules are frame aligned before interleaving, but the associated STS SPEs are not required to be aligned because each STS-1 has a Payload Pointer to indicate the location of the SPE (or to indicate concatenation).



► ***Figure 3.*** *STS-1 SPE example.*



► ***Figure 4.*** *STS-1 SPE position in the STS-1 frame.*



► ***Figure 5.*** *STS-N frame structure.*