

SDH Telecommunications Standard

► Primer

SONET Reference

Transmission standards in the U.S., Canada, Korea, Taiwan, and Hong Kong (ANSI) and the rest of the world (ITU-T) evolved from different basic-rate signals in the non-synchronous hierarchy. ANSI Time Division Multiplexing (TDM) combines twenty four 64 kbit/s channels (DS0) into one 1.544 Mbit/s DS1 signal. ITU TDM multiplexes thirty 64 kbit/s channels (E0) into one 2.048 Mbit/s E1 signal (an extra two channels provide frame alignment and signalling, making 32 total).

An important issue for the ITU-T to resolve was how to efficiently accommodate both the 1.5 Mbit/s and the 2 Mbit/s non-synchronous hierarchies in a single network standard. The agreement reached specified a basic transmission rate of 51 Mbit/s for SONET and a basic rate of 155 Mbit/s for SDH.

Synchronous and non-synchronous line rates and the relationships between each are shown in Tables 13 and 14.

SONET and SDH Hierarchies

SONET and SDH converge at SDH's 155 Mbit/s base level, defined as STM-1 or "Synchronous Transport Module-1." The base level for SONET is STS-1 (or OC-1) and is equivalent to 51.84 Mbit/s. Thus, SDH's STM-1 is equivalent to SONET's STS-3 (3 x 51.84 Mbit/s = 155.52 Mbit/s). Higher SDH rates of STM-4 (622 Mbit/s), STM-16 (2.4 Gbit/s), and STM-64 (10 Gbit/s) have also been defined.

Multiplexing is accomplished by combining – or interleaving – multiple lower-order signals (1.5 Mbit/s, 2 Mbit/s, etc.) into higher-speed circuits (51 Mbit/s, 155 Mbit/s, etc.). By changing the SONET standard from bit-interleaving to byte-interleaving, it became possible for SDH to accommodate both transmission hierarchies. This modification allows an STM-1 signal to carry multiple 1.5 Mbit/s or 2 Mbit/s signals – and multiple STM signals to be aggregated to carry higher orders of SONET or SDH tributaries.

Further Information

Another publication from Tektronix, *SONET Telecommunications Standard Primer* reviews the SONET network standard. Copies can be requested from Tektronix offices, or visit our website at www.tektronix.com.

Table 13. SONET/SDH Digital Hierarchies

| SONET | Bit Rate | SDH | SONET Capacity | SDH Capacity |
|-----------------|-----------------|---------|------------------------|--------------------|
| STS-1, OC-1 | 51.84 Mbit/s | STM-0 | 28 DS1 or 1 DS3 | 21 E1 |
| STS-3, OC-3 | 155.52 Mbit/s | STM-1 | 84 DS1 or 3 DS3 | 63 E1 or 1 E4 |
| STS-12, OC-12 | 622.08 Mbit/s | STM-4 | 336 DS1 or 12 DS3 | 252 E1 or 4 E4 |
| STS-48, OC-48 | 2488.32 Mbit/s | STM-16 | 1344 DS1 or 48 DS3 | 1008 E1 or 16 E4 |
| STS-192, OC-192 | 9953.28 Mbit/s | STM-64 | 5376 DS1 or 192 DS3 | 4032 E1 or 64 E4 |
| STS-768, OC-768 | 39812.12 Mbit/s | STM-256 | 21504 DS1s or 768 DS3s | 16128 E1 or 256 E4 |

Note: Although an SDH STM-1 has the same bit rate as the SONET STS-3, the two signals contain different frame structures.

STM = Synchronous Transport Module (ITU-T)

STS = Synchronous Transport Signal (ANSI)

OC = Optical Carrier (ANSI)

Table 14. Non-Synchronous Digital Hierarchies

| ANSI Rate | | | ITU Rate | | |
|-----------|------------------|----------|----------|------------------|-----------|
| Signal | Digital Bit Rate | Channels | Signal | Digital Bit Rate | Channels |
| DS0 | 64 kbit/s | 1 DS0 | E0 | 64 kbit/s | 64 kbit/s |
| DS1 | 1.544 Mbit/s | 24 DS0 | E1 | 2.048 Mbit/s | 32 E0 |
| DS2 | 6.312 Mbit/s | 96 DS0 | E2 | 8.448 Mbit/s | 128 E0 |
| DS3 | 44.736 Mbit/s | 28 DS1 | E3 | 34.368 Mbit/s | 16 E1 |
| | not defined | | E4 | 139.264 Mbit/s | 64 E1 |