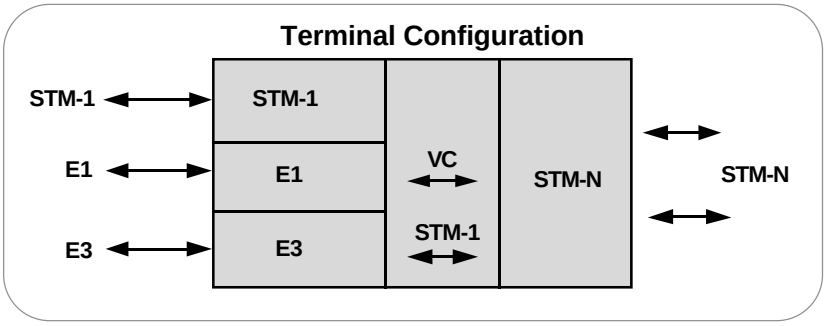
SDH Network Elements

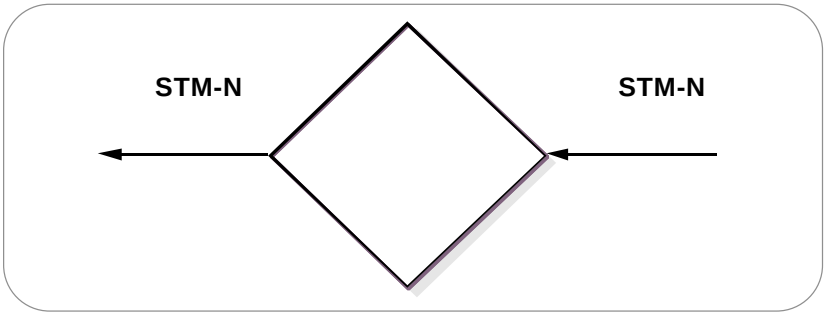
Terminal Multiplexer

The path terminating element (PTE) acts as a concentrator of E1s as well as other tributary signals (see Figure 19).

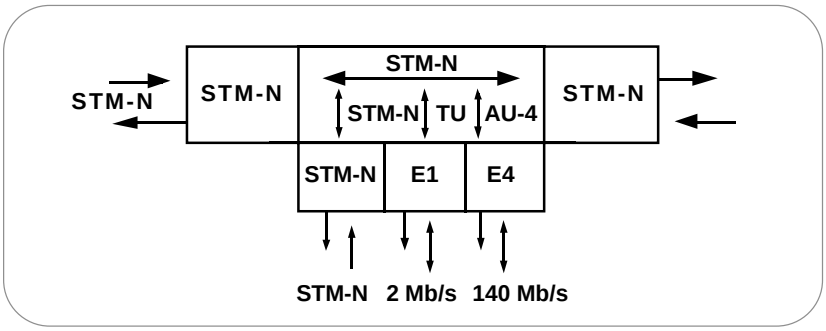
Its simplest deployment would involve two terminal multiplexers linked by fibre with or without a regenerator in the link. This implementation represents the simplest SDH link (Regenerator Section, Multiplex Section, and Path, all in one link).



▶ ***Figure 19.*** *Terminal multiplexer example.*



▶ ***Figure 20.*** *Regenerator.*



▶ ***Figure 21.*** *Add/Drop multiplexer example.*

One of the main benefits of SDH as seen by the network operator is the network simplification brought about through the use of synchronous equipment. A single synchronous node can perform the function of an entire plesiochronous "multiplexing by steps", leading to significant reductions in the amount of equipment used and consequently space and energy savings.

Regenerator

A regenerator (see Figure 20) is needed when, due to the long distance between multiplexers, the signal level in the fibre becomes too low.

The regenerator recovers timing from the received signal and replaces the Regenerator Section overhead bytes before re-transmitting the signal; the Multiplex Section overhead, path overhead, and payload are not altered.

Add/Drop Multiplexer

One of the major advantages of SDH is its ability to Add and Drop tributaries directly from higher-order aggregate bit streams.

Although network elements (NEs) are compatible at the STM-N level, they may differ in features from vendor to vendor. SDH does not restrict manufacturers from providing a single type of product, nor require them to provide all types. For example, one vendor might offer an add/drop multiplexer with access at E1 only, whereas another might offer simultaneous access at E1 and E4 rates (see Figure 21).

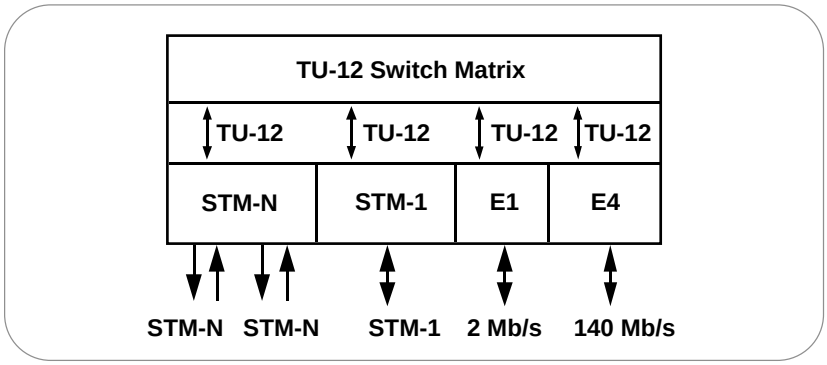
A single-stage multiplexer/demultiplexer can multiplex various inputs into an STM-N signal. At an add/drop site, only those signals that need to be accessed are dropped or inserted. The remaining traffic continues through the network element without requiring special pass-through units or other signal processing.

In rural applications, an ADM can be deployed at a terminal site or any intermediate location for consolidating traffic from widely separated locations. Several ADMs can also be configured as a survivable ring.

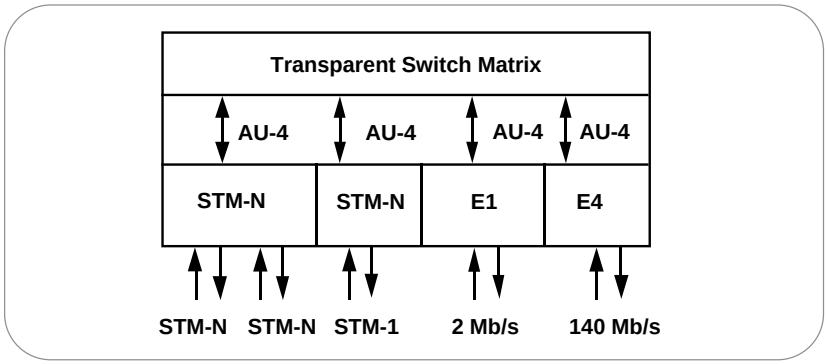
SDH enables drop-and-continue, a key capability in both telephony and cable TV applications. With drop-and-continue, a signal terminates at one node, is duplicated, and is then sent to the next node and to subsequent nodes.

In ring-survivability applications, drop-and-continue provides alternate routing for traffic passing through interconnecting rings in a "matched-nodes" configuration. If the connection cannot be made through one of the nodes, the signal is repeated and passed along an alternate route to the destination node.

In multi-node distribution applications, one transport channel can efficiently carry traffic between multiple distribution nodes. When transporting video, for example, each programming channel is delivered (dropped) at the node and repeated for delivery to the next and subsequent nodes. Not all bandwidth (program channels) need be terminated at all the nodes. Channels not terminating at a node can be passed through without physical intervention to other nodes.



▶ ***Figure 22.*** *Wideband digital cross-connect example.*



▶ ***Figure 23.*** *Broadband digital cross-connect example.*

Wideband Digital Cross-connect

An SDH cross-connect accepts various SDH rates, accesses the STM-1 signals, and connects payloads, for example, at a TU-12 level (see Figure 22). One major difference between a cross-connect and an add-drop multiplexer is that a cross-connect may be used to interconnect a much larger number of STM-1s. The cross-connect can be used for grooming (consolidating or segregating) of STM-1s or for broadband traffic management. For example, it may be used to segregate high-bandwidth from low-bandwidth traffic and send them separately to the high-bandwidth (for example video) switch and a low-bandwidth (voice) switch. It supports hubbed network architectures.

This type of cross-connect is similar to the broadband cross-connect except that the switching is done at TU-12 level. It is suitable for E1 level grooming applications at cross-connect locations. One major advantage of wideband digital cross-connects is that less demultiplexing and multiplexing is required because only the required tributaries are accessed and switched.

Broadband Digital Cross-connect

The Broadband Digital Cross-connect interfaces SDH signals and possibly high-rate tributaries (see Figure 23). It accesses the STM-N signals, and typically switches at an AU-4 level.

It's best used as an SDH cross-connect, where it can be used for grooming STM-1s, for broadband restoration purposes, or for routing traffic.

Flexible Multiplexer

The Flexible Multiplexer (see Figure 24) may be considered a concentrator of low-speed services before they are brought into the local exchange for distribution. If this concentration were not done, the number of subscribers (or lines) that an exchange could serve would be limited by the number of lines served by the exchange. The Flexible Multiplexer itself is actually a system of multiplexers and switches designed to perform some traffic concentration and limited switching at a remote location.

SDH Network Configurations

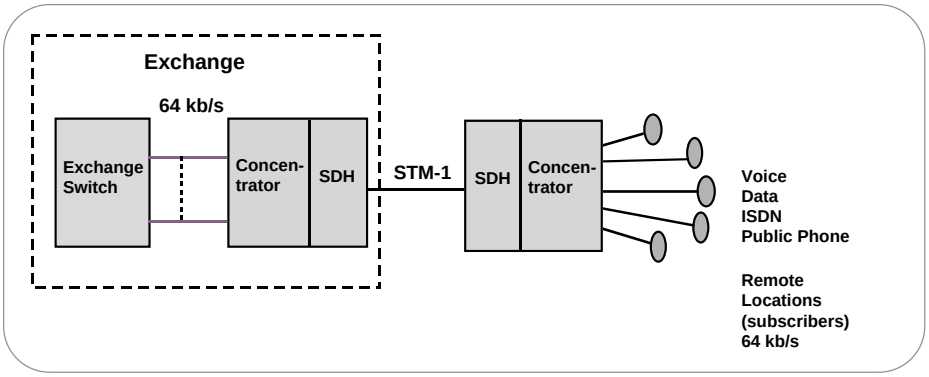
Point-to-Point

The simplest network configuration involves two terminal multiplexers linked by fibre with or without a regenerator in the link (see Figure 25).

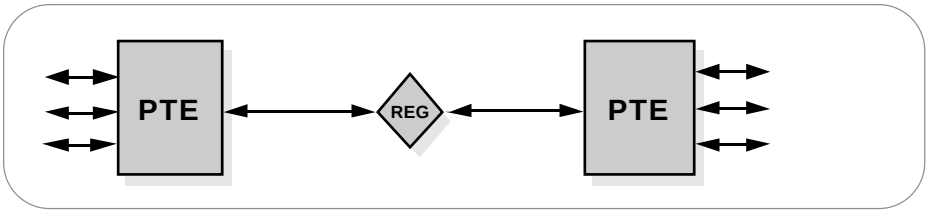
In this configuration, the SDH path and the Service path (for example, E1 or E3 links end-to-end) are identical and this synchronous island can exist within an asynchronous network world. In the future, point-to-point service path connections will span across the whole network and will always originate and terminate in a multiplexer.

Point-to-Multipoint

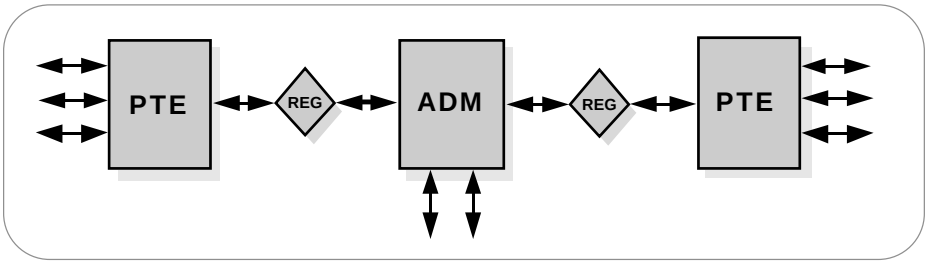
A point-to-multipoint (linear add/drop) architecture includes adding and dropping circuits along the way (see Figure 26). The SDH ADM (add/drop multiplexer) is a unique network element specifically designed for this task. It avoids the current cumbersome network architecture of demultiplexing, cross-connecting, adding and dropping channels, and then re-multiplexing. The ADM typically is placed in an SDH link to facilitate adding and dropping tributary channels at intermediate points in the network.



▶ ***Figure 24.*** *Flexible multiplexer example.*



▶ ***Figure 25.*** *Point-to-point.*



▶ ***Figure 26.*** *Point-to-multipoint.*