The Benefits of SONET

The transport network using SONET provides much more powerful networking capabilities than existing asynchronous systems. The key benefits provided by SONET are as follows.

Pointers, MUX/ DEMUX

As a result of SONET transmission, the network's clocks are referenced to a highly stable reference point. Therefore, the need to align the data streams or synchronize clocks is unnecessary. Therefore, a lower rate signal such as DS1 is accessible, and demultiplexing is not needed to access the bitstreams. Also, the signals can be stacked together without bit stuffing.

For those situations in which reference frequencies may vary, SONET uses pointers to allow the streams to "float" within the payload envelope. Synchronous clocking is the key to pointers. It allows a very flexible allocation and alignment of the payload within the transmission envelope.

Reduced Back-to-Back Multiplexing

Separate M13 multiplexers (DS1 to DS3) and fiber optic transmission system terminals are used to multiplex a DS1 signal to a DS2, DS2 to DS3, and then DS3 to an optical line rate. The next stage is a mechanically integrated fiber/multiplex terminal.

In the existing asynchronous format, care must be taken when routing circuits in order to avoid multiplexing and demultiplexing too many times since electronics (and their associated capital cost) are required every time a DS1 signal is processed. With SONET, DS1s can be multiplexed directly to the OC-N rate. Because of synchronization, an entire optical signal doesn't have to be demultiplexed, only the VT or STS signals that need to be accessed.

Optical Interconnect

Because of different optical formats among vendors' asynchronous products, it's not possible to optically connect one vendor's fiber terminal to another. For example, one manufacturer may use 417 Mb/s line rate, another 565 Mb/s.

A major SONET value is that it allows mid-span meet with multi-vendor compatibility. Today's SONET standards contain definitions for fiber-to-fiber interfaces at the physical level. They determine the optical line rate, wavelength, power levels, pulse shapes, and coding. Current standards also fully define the frame structure, overhead, and payload mappings. Enhancements are being developed to define the messages in the overhead channels to provide increased OAM&P functionality.

SONET allows optical interconnection between network providers regardless of who makes the equipment. The network provider can purchase one vendor's equipment and conveniently interface with other vendors' SONET equipment at either the different carrier locations or customer premises sites. Users may now obtain the OC-N equipment of their choice and meet with their network provider of choice at that OC-N level.

Multipoint Configurations

The difference between point-to-point and multipoint systems was shown previously in Figures 25 and 26. Most existing asynchronous systems are only suitable for point-to-point, whereas SONET supports a multipoint or hub configuration.

A hub is an intermediate site from which traffic is distributed to three or more spurs. The hub allows the four nodes or sites to communicate as a single network instead of three separate systems. Hubbing reduces requirements for back-to-back multiplexing and demultiplexing, and helps realize the benefits of traffic grooming.

Network providers no longer need to own and maintain customer-located equipment. A multi-point implementation permits OC-N interconnects or mid-span meet, allowing network providers and their customers to optimize their shared use of the SONET infrastructure.

Convergence, ATM, IP, Video, and SONET

Convergence is the trend toward delivery of audio, data, images, and video through diverse transmission and switching systems that supply high-speed transportation over any medium to any location. Tektronix is pursuing every opportunity to lead the market providing test and measurement equipment to markets that process or transmit audio, data, image, and video signals over high-speed networks.

With its modular, service-independent architecture, SONET provides vast capabilities in terms of service flexibility. Some broadband services use Asynchronous Transfer Mode (ATM) – a fast packet-switching technique using short, fixed-length packets called cells. Asynchronous Transfer Mode multiplexes the payload into cells that may be generated and routed as necessary. Because of the bandwidth capacity it offers, SONET is a logical carrier for ATM. Also, as local and wide area networks converge, Packet over SONET (PoS) technologies allow the transport of IP packets of SONET rates.

In principle, ATM is quite similar to other packet-switching techniques; however, the detail of ATM operation is somewhat different. Each ATM cell is made up of 53 octets, or bytes (see Figure 29). Of these, 48 octets make up the user-information field and five octets make up the header. The cell header identifies the "virtual path" to be used in routing the cell through the network. The virtual path defines the connections through which the cell is routed to reach its destination.

A Packet-based network is bandwidth-transparent, which allows handling of a dynamically variable mixture of services at different bandwidths. Packet networks also easily accommodate traffic of variable speeds. An example of an application that requires the benefits of variable-rate traffic is that of a video CODEC. The video signals can be packed within ATM or IP cells for transport.

Grooming

Grooming refers to either consolidating or segregating traffic to make more efficient use of the facilities. Consolidation means combining traffic from different locations onto one facility.

Segregation is the separation of traffic. With existing systems, the cumbersome technique of back-hauling might be used to reduce the expense of repeated multiplexing and demultiplexing.

Grooming eliminates inefficient techniques like back-hauling. It's possible to groom traffic on asynchronous systems, however to do so requires expensive back-to-back configurations and manual DSX panels or electronic cross-connects. By contrast, a SONET system can segregate traffic at either an STS-1 or VT level to send it to the appropriate nodes.

Grooming can also provide segregation of services. For example, at an interconnect point, an incoming SONET line may contain different types of traffic, such as switched voice, data, or video. A SONET network can conveniently segregate the switched and non-switched traffic.

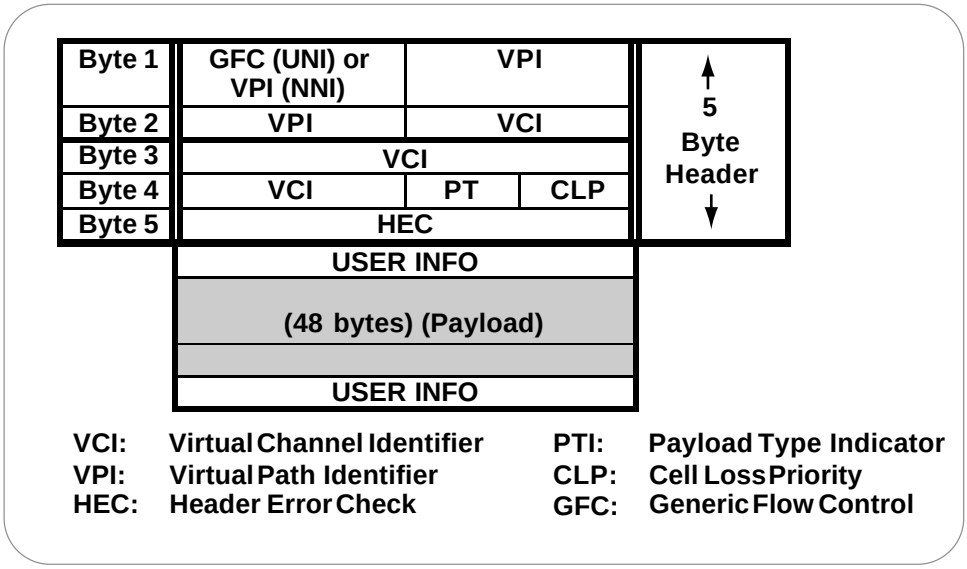
Reduced Cabling and Elimination of DSX Panels

Asynchronous systems are dominated by back-to-back terminals because the asynchronous fiber-optic transmission system architecture is inefficient for other than point-to-point networks. Excessive multiplexing and demultiplexing are used to transport a signal from one end to another, and many bays of DSX-1 cross-connect and DSX-3 panels are required to interconnect the systems. Associated expenses are the panel, bays, cabling, the labor installation, and the inconveniences of increased floor space and congested cable racks.

The corresponding SONET system allows a hub configuration, reducing the need for back-to-back terminals. Grooming is performed electronically so DSX panels are not used except when required to interface with existing asynchronous equipment.

Enhanced OAM&P

SONET allows integrated network OAM&P (also known as OA&M), in accordance with the philosophy of single-ended maintenance. In other words, one connection can reach all network elements (within a given architecture); separate links are not required for each network element. Remote provisioning provides centralized maintenance and reduced travel for maintenance personnel – which translates to expense savings.



► ***Figure 29.*** *ATM cell consists of two parts: a five-byte header and a 48-byte information field.*

Enhanced Performance Monitoring

Substantial overhead information is provided in SONET to allow quicker troubleshooting and detection of failures before they degrade to serious levels.