Glossary & ITU T Standards

CT850 Test Set SDH/PDH, Jitter/Wander

Included in this section along with the glossary of terms is a listing of ITU T standards for SDH and PDH.

Three sets of terms are arranged at the beginning of this section because it is important to see that they are not equivalent terms, which is how they get used in normal discussions. They are:

Add/ Drop

The process where a part of the information carried in a transmission system is extracted (dropped) at an intermediate point and different information is inserted (added) for subsequent transmission. The remaining traffic passes straight through the multiplexer without additional processing.

Map/ Demap

A term for multiplexing, implying more visibility inside the resultant multiplexed bit stream than available with conventional asynchronous techniques.

Multiplex/ Demultiplex

Multiplex (MUX) To transmit two or more signals over a single channel. Demultiplex (DEMUX) To separate two or more signals previously combined by compatible multiplexing equipment. Demultiplexing A process applied to a multiplex signal for recovering signals combined within it and for restoring the distinct individual channels of the signals.

An alphabetical list of glossary terms follows.

Add/Drop Multiplexer (ADM)
A multiplexer capable of extracting and inserting lower rate signals from a higher rate multiplexed signal without completely demultiplexing the signal.

Administrative Unit (AU)
An Administrative Unit is the information structure which provides adaptation between the higher order path layer and the Multiplex Section layer. The Virtual Container (VC) plus the pointers (H1, H2, H3 bytes) is called the Administrative Unit (AU).

AIS (Alarm Indicating Signal)
A code sent downstream indicating an upstream failure has occurred.

AMI
Alternate Mark Inversion. The line coding format in transmission systems where successive ones (marks) are alternatively inverted (sent with polarity opposite that of the preceding mark).

Analog Jitter Out
A signal that contains the demodulated jitter from a line or clock input.

ANSI
American National Standards Institute. A standards setting, non government organization, which develops and publishes standards for ”voluntary” use in the United States.

Asynchronous
A network where transmission system payloads are not synchronized and each network terminal runs on its own clock.

Asynchronous Transfer Mode (ATM)
A multiplexing/switching technique in which information is organized into fixed length cells with each cell consisting of an identification header field and an information field. The transfer mode is asynchronous in the sense that the use of the cells depends on the required or instantaneous bit rate.

Attenuation
Reduction of signal magnitude or signal loss, usually expressed in decibels.

AU-4
Virtual Container (VC) plus the Transport Overhead pointers.

AU N
Administrative Unit N; a discrete unit of the SDH payload carrying one or more VC N

Automatic Protection Switching (APS)
The ability of a network element to detect a failed working line and switch the service to a spare (protection) line. 1+1 APS pairs a protection line with each working line. 1:N APS provides one protection line for every N working lines.

Backhauling
Cumbersome traffic management technique used to reduce the expense of multiplexing/demultiplexing.

Bandwidth
Information carrying capacity of a communication channel. Analog bandwidth is the range of signal frequencies that can be transmitted by a communication channel or network.

Bidirectional
Operating in both directions. Bi directional APS allows protection switching to be initiated by either end of the line.

Binary N Zero Suppression (BNZS)
Line coding system that replaces N number of zeros with a special code to maintain pulse density required for clock recovery. N is typically 3, 6, or 8.

BIP 8 (Bit Interleaved Parity 8)
A method of error checking in SDH which allows in service performance monitoring. For example, a BIP 8 creates eight bit (one byte) groups, then does a parity check for each of the eight bit positions in the byte.

B ISDN (Broadband Integrated Services Digital Network)
A single ISDN network which can handle voice, data, and eventually video services.

Bit
One binary digit; a pulse of data.

Bit Error vs. Block Error

Error rate statistics play a key role in measuring the performance of a network. As errors increase, user payload (especially data) must be re transmitted, or lost entirely.

Bit Error Rate (BER) The number of bit errors detected in a unit of time, usually one second. Bit Error rate (BER) is calculated with this formula:

BER = errored bits received/ total bits sent.

Block Error Rate (BLER) One of the underlying concepts of error performance is the notion of Errored Blocks, i.e., blocks in which one or more bits are in error. A block is a set of consecutive bits associated with the path or section monitored by means of an Error Detection Code (EDC), such as Bit Interleaved Parity (BIP). Block Error rate (BLER) is calculated with this formula:

BLER = errored blocks received/ total blocks sent.

Bit Interleaved Parity (BIP)
A parity check that groups all the bits in a block into units (such as byte), then performs a parity check for each bit position in the group.

Bit Stuffing
In asynchronous systems, a technique used to synchronize asynchronous signals to a common rate before multiplexing.

Bits per second (bit/s)
The number of bits passing a point every second. The transmission rate for digital information.

Broadband
Services requiring over 2 Mbit/s transport capacity.

CCITT
See ITU.

Channel
The smallest subdivision of a circuit that provides a type of communication service; usually a path with only one direction.

Circuit
A communications path or network; usually a pair of channels providing bi directional communication.

Circuit Switching
Basic switching process whereby a circuit between two users is opened on demand and maintained for their exclusive use for the duration of the transmission.

Coding Violation (CV)
A transmission error detected by the difference between the transmitted line code and that expected at the receive end by the logical coding rules.

Concatenation
The linking together of various data structures, for example two channels joined to form a single channel. In SDH, a number (M) of TUs can be linked together to produce a concatenated container, M times the size of the TU. An example of this is the concatenation of five TU 2s to carry a 32 Mbit/s video signal, known as VC 2 5c. Once assembled, any concatenated VC structure is multiplexed, switched and transported through the network as a single entity.

Conformance Tests
Conformance Tests (also know as Standards Conformance Tests) are predefined tests that measure the impact of jitter or wander on networks or network elements. They are defined in the ITU-T Recommendations.

Cyclic Redundancy Check (CRC)
A technique for using overhead bits to detect transmission errors.

Data Communications Channel (DCC)
Data channels in SDH that enable OAM communications between intelligent controllers and individual network nodes as well as inter node communications.

dB
The symbol for decibels.

dBm
The symbol for power level in decibels relative to 1 mW.

Defect
A limited interruption in the ability of an item to perform a required function. Persistence of a defect can cause a failure.

Digital Cross connect (DCS)
An electronic cross connect which has access to lower rate channels in higher rate multiplexed signals and can electronically rearrange (cross connect) those channels.

Digital Signal
An electrical or optical signal that varies in discrete steps. Electrical signals are coded as voltages, optical signals are coded as pulses of light.

E1, E2, E3, E4
Alternative names for the ITU T 2 Mb/s, 8 Mb/s, 32 Mb/s, and 140 Mb/s tributary signals.

ES
Errored Second; measure of network or equipment performance

ETSI (European Telecommunications Standards Institute)
Organization responsible for defining and maintaining European standards, including SDH.

Failure
A termination of the ability of an item to perform a required function. A failure is caused by the persistence of a defect.

FEBE (Far End Block Error)
See Remote Error Indication (REI).

FERF (Far End Receive Failure)
See Remote Defect Indication (RDI).

FIFO
First In First Out; a type of data buffer

Fixed Stuff
A bit or byte whose function is reserved. Fixed stuff locations, sometimes called reserved locations, do not carry overhead or payload.

Floating mode
A virtual tributary mode that allows the VC synchronous payload envelope to begin anywhere in the VC.

Framing
Method of distinguishing digital channels that have been multiplexed together.

Frequency
The number of cycles of periodic activity that occur in a discrete amount of time.

Frequency Drift Rate
The rate of change of a line or clock frequency, measured in ppm/sec. A new measure of tining quality.

Fullband
A jitter filter range that includes the wideband range but extends the low-frequency cutoff to 10 Hz or below. This filter is useful when analyzing video timing quality.

Grooming
Consolidating or segregating traffic for efficiency.

HDB3
High Density Bipolar 3. A bipolar coding method that does not allow more than three consecutive zeros.

Highband
A jitter filter range that measures high-frequency jitter. The band pass filters are defined in ITU-T standards (where they are sometimes referred to as HP2 LP1).

Highpass
The lower 3 dB corner frequency of a filter. The filter passes frequencies higher than this frequency.

HP PLM
High order path, payload label mismatch (or path label mismatch). This measurement is classifed as a defect. Disable or Enable this choice at the RX Analysis Configuration, *Trace Mismatch Detection* menu.

HP UNEQ
High order path, unequipped. This measurement is classifed as a defect. Disable or Enable this choice at the RX Analysis Configuration, *Trace Mismatch Detection* menu.

Interleave
The ability of SDH to mix together and transport different types of input signals in an efficient manner, thus allowing higher transmission rates.

ITU (International Telecommunications Union)
An agency of the United Nations responsible for the regulation, standardization, co ordination and development of international telecommunications as well as the harmonization of national policies. It functions through international committees of telecommunications administrations, operators, manufacturers and scientific/industrial organizations.

Jitter
The short term variations of the significant instants of a timing signal from their ideal positions in time (where short term implies that these variations are of frequency greater than or equal to 10 Hz).

Jitter Hit
When peak-to-peak jitter crosses a predetermined threshold.

Jitter Tolerance
A conformance test that measures the susceptability of a network element input to incoming jitter.

Jitter Transfer
A conformance test that measures the transfer of jitter from the input to the output of a network element.

Jitter Transfer Function
A graph that shows jitter gain as a function of jitter frequency.

Line Alarm Indication Signal (AIS)
A Line AIS is generated by Section Terminating Equipment upon Loss of Signal or Loss of Frame.

Line Coding Violation (LCV)
The sum of the BIP errors detected at the Line layer. Line CVs are collected using the BIP codes in the B2 bytes of the Line Overhead.

Line Errored Second (ES)
A second during which at least one Line CV occurred, or a second during which the line was in the Line AIS state.

Line Overhead (LOH)
Controls the payload information using the section layer and provides alarm indications, error monitoring, and message signalling between two LTEs.

Line Severely Errored Second (SES)
A second with N or more Line CVs, or a second during which the line was in the Line AIS state. The value of N varies with the transmit rate, but corresponds to a 2×10^{-7} BER.

Locked Mode
A virtual tributary mode that fixes the starting location of the VC. Locked mode has less pointer processing than floating mode.

LOF
An acronym for Loss of Frame.

LOP
An acronym for Loss of Pointer.

LOS
An acronym for Loss of Signal.

Low Frequency Jitter
Jitter that crosses the wander threshold (approximately 0.1 Hz to 500 Hz). Low frequency jitter is often the result of pointer movement.

Lowpass
The upper 3 dB corner frequency of a filter. The filter passes frequencies lower than this frequency.

LP PLM
Low order path, payload label mismatch (or path label mismatch). This measurement is classifed as a defect. Disable or Enable this choice at the RX Analysis Configuration, *Trace Mismatch Detection* menu.

LP RFI
Low order path, remote failure indication. This measurement is classifed as a defect. Disable or Enable this choice at the RX Analysis Configuration, *Trace Mismatch Detection* menu.

LP UNEQ
Low order path, unequipped. This measurement is classifed as a defect. Disable or Enable this choice at the RX Analysis Configuration, *Trace Mismatch Detection* menu.

LTE
An acronym for Line Terminating Equipment.

Mapping
The process of associating each bit transmitted by a service into the SDH payload structure that carries the service. For example, mapping a E1 service into a SDH VC 12 associates each bit of the E1 with a location in the VC 12.

MTIE
Maximum Time Interval Error Related to Peak to Peak Wander.

Multiframe
Any structure made of multiple frames. SDH has facilities to recognize multiframes at the E1 level and at the VC n level.

Multiplex Section Alarm Indication Signal (MS AIS)
MS AIS is generated by Section Terminating Equipment (STE) upon the detection of a Loss of Signal or Loss of Frame defect, on an equipment failure. MS AIS maintains operation of the downstream regenerators, and therefore prevents generation of unnecessary alarms. At the same time, data and orderwire communication is retained with the downstream Line Terminating Equipment (LTE).

Multiplex Section Remote Defect Indication (MS RDI)
A signal returned to the transmitting Line Terminating Equipment (LTE) upon detecting a Loss of Signal, Loss of Frame, or MS AIS defect. MS RDI was previously known as Multiplex Section FERF.

Multiplex Section Overhead (MSOH)
18 bytes of overhead accessed, generated, and processed by MS terminating equipment. This overhead supports functions such as locating the payload in the frame, multiplexing or concatenating signals, performance monitoring, automatic protection switching and line maintenance.

Multiplexer
A device for combining several channels to be carried by a single physical channel.

Narrowband
Services requiring up to 2 Mbit/s transport capacity.

Network Element (NE) In SDH, the five basic network elements are:
add/drop multiplexer;
broadband digital cross connect;
wideband digital cross connect;
flexible multiplexer; and,
regenerator.

Any device which is part of a SDH transmission path and serves one or more of the section, line and path terminating functions.

OAM
Operations, Administration, and Maintenance. Also called OAM&P.

OAM&P (Operations, Administration, Maintenance, and Provisioning)
Provides the facilities and personnel required to manage a network.

Orderwire
A dedicated voice channel used by installers to expedite the provisioning of lines.

OOF
An acronym for Out of Frame.

OS (Operations System)
Sophisticated applications software that manages operation of the entire network.

OSI Seven layer Model
A standard architecture for data communications. Layers define hardware and software required for multi vendor information processing equipment to be mutually compatible. The seven layers from lowest to highest are: physical, link, network, transport, session, presentation, and application.

Output Jitter
A compliance test the measures the output jitter of a network or network element.

Overhead
Extra bits in a digital stream used to carry information besides traffic signals. Orderwire, for example, would be considered overhead information.

Packet Switching
An efficient method for breaking down and handling high volume traffic in a network. A transmission technique that segments and routes information into discrete units. Packet switching allows for efficient sharing of network resources as packets from different sources can all be sent over the same channel in the same bitstream.

Parity check
An error checking scheme which examines the number of transmitted bits in a block which hold the value of ”one”. For even parity, an overhead parity bit is set to either one or zero to make the total number of transmitted ones in the data block plus parity bit an even number. For odd parity, the parity bit is set to make the total number of ones in the block an odd number.

Path
A logical connection between a point where a service in a VC is multiplexed to the point where it is demultiplexed.

Path Overhead (POH)
Overhead accessed, generated, and processed by path terminating equipment.

Path Terminating Equipment (PTE)
Network elements such as fibre optic terminating systems which can access, generate, and process Path Overhead.

Payload
The portion of the SDH signal available to carry service signals such as E1 and E3. The contents of a VC.

Payload Pointer
Indicates the beginning of a Virtual Container.

Payload capacity
The number of bytes the payload of a single frame can carry.

Plesiochronous
A network with nodes timed by separate clock sources with almost the same timing.

PLL
Phase Locked Loop; method of timing recovery

Pointer
A part of the SDH overhead that locates a floating payload structure. AU n pointers locate the payload. TU m Pointers locate floating mode virtual tributaries. All SDH frames use AU pointers; only floating mode virtual containers use TU pointers.

Pointer Hit

When the line or clock frequency drift crosses a predetermined threshold.

Pointer Jitter

A measure of the jitter output of a network when specified pointer test sequences are applied to its input.

ppTIE

Peak to PeakTime Interval Error , a measure of wander

PRC (Primary Reference Clock)

In a synchronous network, all the clocks are traceable to one highly stable reference supply, the Primary Reference Clock (PRC). The accuracy of the PRC is better than ±1 in 10^{11} and is derived from a cesium atomic standard.

Remote Alarm Indication (RAI)

A code sent upstream in a E *n* network as a notification that a failure condition has been declared downstream. (RAI signals were previously referred to as Yellow signals.)

Remote Defect Indication (RDI)

A signal returned to the transmitting Terminating Equipment when the receiving Terminating Equipment detects a Loss of Signal, Loss of Frame, or AIS defect. RDI was previously known as FERF.

Remote Error Indication (REI)

An indication returned to a transmitting node (source) that an errored block has been detected at the receiving node (sink). This indication was formerly known as Far End Block Error (FEBE).

Remote Failure Indication (RFI)

A failure is a defect that persists beyond the maximum time allocated to the transmission system protection mechanisms. When this situation occurs, an RFI is sent to the far end and will initiate a protection switch if this function has been enabled.

Regenerator
Device that restores a degraded digital signal for continued transmission; also called a repeater.

rms
Root Mean Square; calculation often applied to power and noise measurements

SDH (Synchronous Digital Hierarchy)
The ITU defined international networking standard whose base transmission level is 155 Mbit/s (STM 1). SDH standards were first published in 1989 to address interworking between the ITU and ANSI transmission hierarchies.

SEC (Synchronous Equipment Clock)
G.813 slave clock contained within a SDH network element.

Section
The span between two SDH network elements capable of accessing, generating, and processing only SDH Section overhead.

Section Overhead
Nine columns of overhead accessed, generated, and processed by section terminating equipment. This overhead supports functions such as framing the signal and performance monitoring.

Section Terminating Equipment (STE)
Equipment that terminates the SDH Section layer. STE interprets and modifies or creates the Section Overhead.

SES
Severely Errored Second; measure of network performance

Slip
An overflow (deletion) or underflow (repetition) of one frame of a signal in a receiving buffer.

SONET (Synchronous Optical Network)
A standard for optical transport in the United, States, Canada, Japan, Korea and Hong Kong that defines optical carrier levels and their electrically equivalent synchronous transport signals. SONET allows for a multi vendor environment and positions the network for transport of new services, synchronous networking, and enhanced OAM&P.

SSM (Synchronisation Status Message)
Bits 5 to 8 of SDH overhead byte S1 are allocated for Synchronisation Status Messages. See further details on the assignment of bit patterns for byte S1 in the section of this primer on Multiplex Section Overhead.

Stuffing
see bit stuffing

Synchronous
A network where transmission system payloads are synchronized to a master (network) clock and traced to a reference clock. A network where all clocks have the same long term accuracy under normal operating conditions.

Synchronous Equipment Timing Source (SETS)
A network equipment clock.

Synchronous Transport Module (STM)
A structure in the SDH transmission hierarchy. STM 1 is SDH's base level transmission rate equal to 155 Mbit/s. Higher rates of STM 4, STM 16, and STM 64 are also defined.

TDEV
Time Deviation; a measure of wander

Through Mode
The ability to retransmit the incoming signal and manipulate its contents.

TIE
Time Interval Error is the time difference in nanoseconds between the nominal value of a line or clock period and the actual received period.

Tributary
The lower rate signal that is input to a multiplexer for combination (multiplexing) with other low rate signals to form a higher rate signal.

Tributary Unit (TU)
A Tributary Unit is an information structure which provides adaptation between the lower order path layer and the higher order path layer. It contains the Virtual Container (VC) plus a tributary unit pointer.

Tributary Unit Group (TUG)
Contains several Tributary Units.

UI
Unit Interval; a measure of jitter

UIpp
Unit Interval Peak to Peak;a common measure of jitter

UIrms
Unit Interval rms; a measure of jitter in line systems

Virtual Container (VC)
A signal designed for transport and switching of sub SDH payloads.

Wander
The long term variations of the significant instants of a digital signal from their ideal position in time (where long term implies that these variations are of frequency less than 10 Hz).

Wideband
A jitter filter range that measures jitter over a wide range. The band pass filters are defined in ITU-T standards (where they are sometimes referred to as HP1 LP1).

Yellow Signal
See Remote Alarm Indication (RAI).

SDH & PDH Standards for ITU T

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Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704

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G.742
PDH Frame Structure for 8 Mb/s

G.751
PDH Frame Structure for 34 Mb/s, 140 Mb/s

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PDH Framing Structure for 45 Mb/s (M23 positive justification)

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PDH Monitor Mode Levels Protected monitoring points provided on digital transmission systems

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