Glossary of Telecommunications Terms

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The following is a list of terms, and their definitions, commonly encountered in the telecommunications industry. Where possible, definitions have been based on the international recommendations of Bellcore, ITU or IEEE. The terms have been sorted into the following categories:

- SIGNAL PROCESSING
- DIGITAL SIGNALS
- PCM MULTIPLEXING
- TIMING
- SIGNALLING
- CODES
- DIGITAL SYSTEMS
- PARAMETERS & UNITS

SIGNAL PROCESSING

Adaptive Differential Pulse Code Modulation (ADPCM)
A form of differential pulse code modulation that uses adaptive quantizing. The predictor may be either fixed (time invariant) or variable. When the predictor is adaptive, the adaptation of its coefficients is made from the quantized difference signal.

A-Law
Companding/encoding law commonly used in Europe (see Companding Law).

A/D (Analog to Digital) Converter
Converts an analog signal sample to a digital representation suitable for digital processing and switching.

Aliasing Noise
A distortion component created when a sampled signal bandwidth is effectively greater than 1/2 the sample rate.

Anti-Aliasing Filter
A filter (normally lowpass) which band limits the input signal before sampling, to less than half the sampling rate, to prevent aliasing noise.

Codec (PCM)
An assembly comprising an encoder and a decoder in the same equipment, usually operating at a sample rate of 8kHz to accommodate a 300Hz to 3.4kHz bandwidth input signal.

Companding
The processes of dynamic range compression of a signal and subsequent expansion in accordance with a given non-linear transfer characteristic (companding law) which is usually logarithmic. In terms of digital transmission this involves a reduction in the number of bits per sample and consequently the transmission bit rate compared to a linear coding law being used.

Companding Law
Mathematically defined non-linear transfer characteristic used for companding. This may be a smooth continuous function or a piecewise (commonly linear) approximation to a continuous function. The two commonly used laws in telecommunications are µ-Law (North America), A-Law (Europe).

Compression
Reduction of a signal's dynamic range in such a way that small signal characteristics are maintained. Usually a logarithmic conversion is used (see Companding).

D/A (Digital to Analog) Converter
Converts a digital word to an analog value.

Decision Value
A reference value defining the boundary between adjacent intervals in quantizing or encoding.

Decoder (PCM Receiver)
A device which performs repeated D/A conversion, expansion and the sample-and-hold function necessary to convert a serial stream of PCM samples to a sample-and-hold equivalent of the originally encoded analog signal (see Codec and Decoding).

Decoding
A process in which one of a set of reconstructed analog samples is generated from the digital character signal representing a sample.

Delta Modulation (Simple)
A single bit per sample iterative coding technique for converting an analog signal to a digital bit stream which can be decoded simply by integrating the digital bit stream and lowpass filtering. To obtain

telephony quality transmission requires a sample rate of approximately 8kHz.

Delta-Sigma Modulation (Simple)
A single bit per sample iterative coding technique for converting an analog signal to a digital bit stream. The resulting bit stream is a pulse density function of the original analog signal which can be recovered simply by low pass filtering the bit stream. To obtain telephony quality transmission requires a sample rate of approximately 8kHz.

Dynamic Range
The dynamic range of a system is a measure of its ability to handle a wide range of input amplitude and is defined as the ratio of the largest resolvable signal to the smallest signal that can be handled.

Echo
A signal derived from a primary signal by reflection at one or more impedance discontinuities and delayed relative to the primary signal.

Echo Canceller
A device that reduces echo on a 4-wire path by cancellation of the returned (echo) signal using digital processing techniques.

Echo Suppressor
A device that detects speech signals transmitted in either direction on a 4-wire circuit and introduces loss in the opposite direction of speech transmission for suppressing echoes.

Encoder (PCM)
A device which performs repeated sampling, compression and A/D conversion to convert an analog signal to a serial stream of PCM samples representing the analog signal (see Codec and Encoding).

Encoding/Coding
The generation of digital character signals to represent quantized analog samples.

Encoding Law (see Companding Law)
The law defining the relative values of the quantum steps used in quantizing and encoding.

Linear Quantizing
Quantizing in which all the intervals are equal, i.e., linear A/D converter.

Non-Linear Quantizing
Quantizing in which the intervals are not all equal. This keeps the quantizing distortion as low as possible.

Pulse Code Modulation (PCM)
A process in which an analog signal is sampled, and the magnitude of each sample with respect to a fixed reference is quantized and converted by coding to a digital signal. This is the prevalent technique for digital transmission in communications systems.

Quantizing
A process in which samples are classified into a number of adjacent intervals (amplitude steps) each interval step being represented by a single value called the quantized value.

Quantizing Distortion
Due to the restriction of a finite number of produced amplitude steps, a difference inevitably occurs between the information which can be transmitted and the original information. This difference is called quantizing distortion.

S&H (Sample and Hold)
A circuit which samples a signal and holds the sample value until the next sample is taken. In A/D conversion, S/H is usually an analog function. In D/A conversion, the S/H may be performed digitally, making continuous use of the D/A convertor or the D/A convertor may be shared by other functions and its output signal held by an analog sample and hold circuit.

Sample
The value of a particular characteristic of a signal at a chosen instant.

Sampled Data System
A system that operates on samples of the analog input signals. Can be either analog (e.g., switched capacitor filter) or digital (speech coding/digital filter) processing or both.

Sampling
The process of taking samples, usually at equal time intervals.

Sampling Rate
The number of samples per unit time.

Segmented Encoding Law
An encoding law which an approximation to a smooth law is obtained by a number of linear segments.

Single Chip Codec
A single integrated circuit capable of performing all codec functions and in some cases providing an auxiliary signalling interface. It may be either single channel or multiplexible.

Smoothing (Decode or Reconstruction) Filter
Usually lowpass. Restores the desired analog signal at the S&H, D/A or decoder output by blocking high frequency components produced by sampling.

Working Range
The permitted range of values of an analogue signal over which a transmission or other processing equipment can operate.

Virtual Decision Value
Two hypothetical decision values, used in quantizing or encoding. Located at the ends of the working range used, and obtained by extrapolation from the real decision values. Effectively specify the maximum input signal amplitude.

μ-Law
Companding/encoding law commonly used in North America (see Companding Law).

DIGITAL SIGNALS

Alternate Digit Inversion (ADI)
Used with A-Law to ensure sufficient 1-0/0-1 transitions for clock extraction (timing recovery) in PCM multiplex transmission equipment.

Asynchronous
A transmission process such that between any two significant instants in the same group, there is always an integral number of unit intervals. Between two significant instants located in different groups, there is not always an integral number of unit intervals.

Binary Digit
A member selected from a binary set, e.g., 1,0; V+, V-; H,L.

Note: Bit is in abbreviation for binary digit.

Character Signal
A set of signal elements representing a character, or in PCM representing the quantizing value of a sample.

Note: In PCM, the term "PCM word" may be used in this sense.

Digit
A member selected from a finite set.

Note 1: In digital transmission, a digit may be represented by a signal element characterized by the dynamic nature, discrete condition and discrete timing of the element, e.g., it may be represented as a pulse of specified amplitude and duration.

Note 2: In equipment used in digital transmission, a digit may be represented by a stored condition characterized by a special physical condition, e.g., it may be represented as a binary magnetic condition of a ferrite core or voltage condition in a semiconductor memory cell.

Note 3: The context of the use of the term should indicate the radix of notation. (The meaning of "digit" in Notes 1, 2, and 3 translates into French as "element numerique".)

Note 4: In telephone subscriber numbering, a digit is any of the numbers 1, 2, 3...9 or 0 forming the elements of a telephone number (Recommendation Q.10). (This meaning of "digit" translates into French as "chiffre".)

Digital Milliwatt
A repetitive transmission of a sequence of codes in a given channel that will be decoded at the receiving terminal as 0-dBm0, 1000Hz signal.

Digital Signal
A signal constrained to have a discontinuous characteristic in time and a set of permitted discrete values.

Intersymbol Interference
Interference in a digital (or any Time Division) transmission system caused by a symbol in one signalling interval being spread out and overlapping the sample time of a symbol in another signal interval.

Isochronous
The time characteristics of an event or signal recurring at known periodic time intervals.

Jitter
Short-term variations of the significant instants of a digital signal from their ideal positions in time.

Regardless of the stability of clocks at both ends of a digital transmission system, certain amounts of instability occur in the received signal because of

external electrical disturbances and changing physical parameters of the transmission link. The resulting instability in the line clock is referred to as “jitter”.

Plesiochronous

Two signals are Plesiochronous if their corresponding significant instants occur at nominally the same rate, any variation in rate being constrained within specific limits.

Regeneration

The process of recognizing and reconstructing a digital signal so that the amplitude, waveform and timing are constrained within stated limits.

Slip (Controlled)

The occurrence at the receiving terminal of a replication or deletion of all the information bits in a frame.

Slip (Uncontrolled)

The loss or gain of one ore more digit positions or a set of consecutive digit positions in a digital signal resulting from an aberration of the timing processes associated with the transmission or switching of the digital signal. The magnitude or the instant of the loss or gain is not controlled.

Synchronous

A mode of transmission in which the sending and receiving terminal equipment are operating continually at the same rate and are maintained in a desired phase relationship by an appropriate means.

Wander

The long term variations of the significant instants of a digital signal from their ideal positions in time. The phase “long term” implies that these variations are of low frequency, less than 10Hz.

PCM MULTIPLEXING

Broadband ISDN (B-ISDN)

A network standard combining voice, data and video services requiring transmission channels capable of supporting rates greater than the primary rate and allowing bandwidth-on-demand allocation of the resources available. Mainly fibre-optic based.

Channel Bank

Terminal equipment for a transmission system used to multiplex individual channels using FDM or TDM techniques.

Digital Multiplex Equipment

Equipment for combining, by time division multiplexing (multiplexer) a defined integral number of digital input signals into a single digital signal at a defined digit rate and also for carrying out the inverse function (demultiplexer).

Digital Signal Cross-Connect (DSX)

A facility for circuit re-arrangements, patching and testing purposes. the DSX is designated DSX-N, where N indicates the hierarchy of the digital network interconnected at that point.

Frame

A set of consecutive digit timeslots in which the position of each digit slot can be identified by reference to a frame alignment. The frame alignment signal does not necessarily occur, in whole or in part, in each frame.

H0 Channel

A channel with a bandwidth of one-quarter that of a T1 trunk or 384kb/s.

H11 Channel

The North American primary rate bandwidth of 1.536Mb/s allocated as a single channel.

H12 Channel

The European primary rate bandwidth of 1.920Mb/s allocated as a single channel.

Highway

A common path or a set of parallel paths over which signals from a number of channels pass with separation achieved by time division.

Justification (Pulse Stuffing)

A process of changing the rate of a digital signal in a controlled manner so that it can accord with a rate different from its own inherent rate, usually without loss of information.

Multiframe

A set of consecutive frames in which the position of each frame can be identified by reference to a multiframe alignment signal. The multiframe signal does not necessarily occur, in whole or in part, in each multiframe.

Multiplexing

The process of combining multiple signals into a single channel for transmission over common facilities.

Narrowband ISDN (N-ISDN)
A network standard combining voice and data services up to 2.048Mb/s and including the Basic Rate (2B+D) and Primary rate (24B or 32B) interfaces supported via copper wire.

PCM Multiplex Equipment
Equipment for deriving a single digital signal at a defined digit rate from two or more analogue channels by a combination of pulse code modulation and time division multiplexing (multiplexer) and also for carrying out the inverse function (demultiplexer). The description should be preceded by the relevant equivalent binary digit rate, e.g., 2048 kbit/s PCM multiplex equipment.

Primary Block
(American: Digroup)
A basic group of PCM channels assembled by time division multiplexing.

Note: The following conventions could be useful:

Primary block µ- a basic group of channels derived from 1544 kbit/s PCM multiplex equipment.

Primary block A- a basic group of PCM channels derived from 2048 kbit/s PCM multiplex equipment.

Time Division Multiplexing
Several information channels are multiplexed (time shared) over a single communication circuit by sampling each channel periodically and allocating each sample an assigned timeslot in the circuit.

T1 Carrier System (North America)
PCM multiplex equipment using 8 digit µ-Law, 24 channels (timeslot).

30 Channel Mux (Europe)
A form of PCM multiplex equipment. 30 speech channels A-Law + 2 eight digit utility channels (32 timeslots in all) for a transmission rate of 2,048 kbit/s.

TIMING

Building Integrated Timing Supply (BITS)
A clock, or a clock with an adjunct in a building that supplies DS1 and/or composite clock timing reference to all other clocks in that building.

Channel
A transmission path between two points. The term channel may refer to a one-way path or, when paths in the two directions of transmission are always associated, a 2-way path. It is usually the smallest subdivision of a transmission system by means of which a single type of communication service is provided, for example, a voice channel or data channel.

Channel Timeslot
A timeslot allocated to a channel for transmission of a character signal and possibly in-slot signalling or other information.

Digital Network
A network consisting of transmission and switching equipment capable of interconnecting digital circuits and requiring timing reference to avoid slip impairment.

Digit Timeslot
A timeslot allocated to a single digit.

Frame Alignment
The state in which the frame of the receiving equipment is correctly phased with respect to that of the received signal.

Frame Alignment Signal
The distinctive signal used to enable frame alignment to be secured.

Frame Alignment Timeslot
A timeslot starting at a particular phase in each frame and allocated to the transmission of a frame alignment signal.

Master Clock
A clock which generates accurate timing signals for the control of other clocks and possibly other equipment.

Signalling Timeslot
A timeslot starting at a particular phase in each frame and allocated to the transmission of signalling.

Timeslot
Any cyclic time interval which can be recognized and defined uniquely.

Timing Recovery
(Timing Extraction)
The derivation of a timing signal from a received signal.

Timing Signal
A cyclic signal used to control the timing of operations.

SIGNALLING

Alarm Indication Signal (AIS)
A signal that replaces the normal traffic signal when a maintenance alarm indication has been activated.

Alerting Signal
Alerting signals (for example, ringing, receiver off-hook) are transmitted over the loop to notify the customer of some activity on the line.

Automatic Number Identification (ANI)
Identification of the calling party's billing number. Provided by the originating switch and used for inter-exchange carrier billing as well as calling party identification to the called party.

Common Channel Interoffice Signalling (CCIS)
A signalling system, developed for use between switching systems with stored-program control, in which all of the signalling information for one or more groups of trunks is transmitted over a dedicated, high-speed data link, rather than on a per-trunk basis.

Common Channel Signalling
A signalling method using a link common to a number of channels for the transmission of signals necessary for the traffic control of these channels.

Custom Local Area Signalling Service (CLASS)
A service which enhances the features available to subscribers within a Local Access Transport Area. Some examples are call trace, call screen, calling name identity and calling party identity on call waiting.

DC Signalling
Refers to a variety of techniques for transmitting signalling information using direct current over metallic circuits, for example, loop reverse battery, loop start or duplex signalling. DC signalling is a subset of out-of-band signalling.

Inband Signalling
Signalling that uses the same path as a message and in which the signalling frequencies are in the same band used for the message.

Off-Hook
The station switch-hook contacts are closed, resulting in line current or whatever supervision condition indicates the in-use or request-for-service use.

On-hook
The station switch-hook contacts are open or whatever supervision condition indicates the equipment-idle state.

Out-of-Band Signalling
A method of signalling that uses the same path as voice-frequency transmission, but in which the signalling band is outside the band used for voice frequencies.

Packet
A group of binary digits which is switched as a whole. Usually assembled into a specified format (such as HDLC).

Protocol
A formal set of conventions governing the format and relative timing of message exchange between to communicating objects. A formal statement of the procedures that are adopted to ensure communication between two or more functions within the same layer of a hierarchy of functions.

Signalling
The exchange of electrical information (other than by speech) specifically concerned with establishment and control of connections, and management, in a communication network. May be transmitted by independent link, designed timeslots, designated bit positions in a timeslot or by "bit stealing" specific speech bit positions in the PCM codeword. In a transmission system signalling may carry equipment status, routing, billing and testing data.

When referred to the line card of a digital switch, signalling includes on-hook/off-hook status, ring trip, applying ringing, dialed digit information, test signals. Where on card timeslot assignment is performed, signalling also includes timeslot identification.

Speech Digit Signalling (sometimes called Bit Stealing or Robbed-bit Signalling)
Signalling in which digit timeslots primarily used for the transmission of encoded speech are periodically used for signalling.

CODES

A-Law/or µ-Law Companded
8 bit PCM Binary code. The codes are used almost universally for PCM digital switching and transmission. When a reference is made to PCM it is these codes which are being referred to (A-Law version in Europe and µ-Law version in North America).

Alternate-Mark Inversion Signal (AMI) (Bipolar Signal)
A pseudo-ternary signal, conveying binary digits, in which successive "marks" are normally of alternate, positive and negative, polarity but equal in amplitude and in which "space" is of zero amplitude.

HDB-3 Code - High Density Bipolar 3 Code
Here two consecutive ones of the same polarity are permitted (interrupting a zero sequence which is too long).These violation bits, moreover, are arranged to form an AMI sequence in itself. (See modified AMI.)

Line Code
A code chosen to suit the transmission medium and giving the equivalence to a set of digits generated in a terminal, or other processing equipment, and the pulses chosen to represent that set of digits for the line transmission.

Modified Alternate Mark Inversion
An AMI signal which does not strictly conform with alternate mark inversion but includes violations in accordance with a defined set of rules.

PCM Binary Code
A pulse code in which the quantized values are identified by binary numbers taken in order.

Note: This term should not be used for line transmission.

Pulse Code
A code giving the equivalence between the quantized value of a sample and the corresponding character signal.

DIGITAL SYSTEMS

'Blocking' System
There are more telephones than connection paths so dynamic channel allocation is needed on a demand basis. If all channels are busy, new calls are blocked from completion or are delayed until a channel comes available.

Connection
The circuits and equipment which together provide a communication path between two subscriber stations.

Digital Switching
A process in which analog signals are converted to digital signals and connections are established by operations on the digital signals. Alternatively, digitally transmitted signals are routed by operating on the digital signals directly without conversion from analog.

End-to-End Transmission
A transmission which proceeds from one end point to the other without being processed at each intermediate node.

Integrated Services Digital Network (ISDN)
An integrated digital network in which the same digital switches and digital paths are used to establish connections for different services, for example, telephony, data.

Layer 1
The physical layer of the OSI Reference model including transmission of signals and activation/ deactivation of the physical connections.

Layer 2
The link layer of the OSI Reference model including synchronization and some level of detection/ correction of errors originating from Layer 1.

Layer 3
The network layer of the OSI Reference model including the routing functions required by a call.

Local Area Network (LAN)
A non-public data network in which serial transmission is used without store and forward techniques for direct data communication among data stations located on the user's premises.

Metropolitan Area Network (MAN)
A network where nodes within the same city or metropolitan area are connected together.

'Non-Blocking' System
Each telephone has a guaranteed through connection when needed. This may be in the form of dedicated channels (fixed channel assignment) which guarantees any phone the same communication channel at any time.

STS Switch
Space Time Space Switch - large switch consisting of a time switch block between two space switch blocks.

Space Division
Use of different physical paths to transmit two or more channels (N.B. 'space division multiplex' is a contradiction in terms).

Space Switch (Abbrev.)
Space Division Switch
Multiport switch in which ports are interconnected by use of different physical paths.

TST Switch
Time Space Time Switch - large switch consisting of a space block between two time switch blocks.

Time Switch (Abbrev.)
Time Division Multiplex Switch
Multiport switch in which all ports have access to the same physical path on which transmitted data from individual ports are allocated unique timeslots. Send and receive paths are connected by both accessing the same timeslot. The path may be a serial data or parallel data highway.

Wide Area Network (WAN)
A network where nodes covering a large geographic area (larger than a city or metropolitan area) are interconnected.

PARAMETERS & UNITS

Bit Error Rate (BER)
A ratio of the number of digital errors received in a specified period to the total number of bits received in the same period. Usually expressed as a negative exponent, i.e.;

10^{-6}; means one bit error in 10^6 bits of transmission, or one in a million.

Concatenation
The combination of several, usually lower speed, channels into one, usually higher speed, channel.

dB
Decibel - unit of measure of relative power level defined as $10\log_{10}(P_1/P_2)$ assuming R1=R2 where P_1 and P_2 are the power levels.

dBm
Power in dB relative to 1 mW.

dBm0
dBm referred to or measured at a point of zero transmission level.

dBmp
dBm psophometrically weighed. Unit of power in dBm measured with psophometric weighting. Conversion is as follows:

dBmp = 10 $\log_{10}$pWp-90
=dBa- 84
=dBm - 2.5 (for flat noise 300-3400 Hz)

dBm0p
Circuit noise in dBm0 measured on a line with a noise measuring set having psophometric weighting.

dBr
dB relative to point of zero transmission level.

dBrn
(decibels above reference noise). Weighted circuit noise power in dB referred to 1 picowatt (-90 dBm) which is defined as 0dBrn. Type of weighting is indicated by next letter (see dBrnc).

Note: With 'C' message weighting, a 1mW 1 kHz tone will read +90 dBrn, but the same power with the noise randomly distributed over a 3 kHz band (300-3400 cps) will read +88dBrn.

dBrnc
Weighted circuit noise power in dBrn, measured on a line by noise measuring set with 'C' message weighting.

dBrnc0
Noise measured in dBrnc referred to zero transmission level point (0 TLP).

$dBrnc0 = dBrnc - 20 \log_{10} R_{LOAD}/600$

Gain Tracking Error (N.A)
Gain Level Linearity (U.K.)
A measurement of the dependence of a device gain on signal level. The output signal is compared to the input signal (assuming unity gain) over a range of input signals. The variation of gain from a constant gain (determined at 0dBm input level) is the gain tracking error.

Idle Channel Noise
The total signal energy measured at the output of the device when the input of the device is grounded. Unless otherwise specified, this is a wideband noise measurement.

Load Capacity
(Overload Point)
In PCM, the level expressed in dBm0, of a sinusoidal signal the positive and negative peaks of which coincide with the positive and negative virtual decision values of the encoder.

Peak Limiting
In PCM, the effect caused by the application to an encoder of an input signal whose value exceeds the virtual decision values of the encoder.

Quantizing Distortion
The distortion resulting from the process of quantizing.

Quantizing Distortion Power
The power of the distortion component of the output signal resulting from the process of quantizing.

Signal to Distortion Ratio (S/D)
The ratio between the input signal level, and the level of all components that are present when the input signal (usually a 1.020 kHz sinusoid) is eliminated from the output signal (by filtering for example).

Transmission Level Point (TLP)
A point in a transmission system evaluated by the ratio (in decibels) of the power of the test signal at that point to the power of the test signal at a reference point. A 0 TLP is an arbitrarily established point in a communications circuit to which all relative levels at other points in the circuit are referred.

Weighting Filters
Several different filters have been used to represent the transmission passband characteristics of different communication networks. The two most frequently used are C-message (N.A) and Psophometric (Europe) weighting filters.

Notes: