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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 65 TRANSMISSION

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Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 65 TRANSMISSION

0. FOREWORD

0.1 This Indian Standard (Part 65/Sec 1 to 5) was adopted by the Bureau of Indian Standards on 23 February 1988, after the draft finalized by the Basic Standards on Electronics and Telecommunication in consultation with the Radio Communications Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 A series of standards has been brought out with a view to bringing together the terms relating to radio communications covering different aspects, such as circuits, sound and television broadcasting, transmitting and receiving equipment, radio telegraphy and mobile radio, etc.

0.2.1 This standard deals with terms relating to information transmission as applied to radio communications.

0.3 The terminology on transmission has been covered in the following five sections:

Sec 1 General aspects of transmission

Sec 2 Analogue transmission

Sec 3 Time division multiplexing

Sec 4 Digital transmission

Sec 5 Pulse code modulation

0.4 This standard is based on IEC Doc: 1 (IEV 704) (Central Office) 1241 'International electrotechnical vocabulary Chapter 704 of IEV: Transmission', issued by the International Electrotechnical Commission (IEC).

Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 65 TRANSMISSION

Section 1 General Aspects of Transmission

1. SCOPE

1.1 This standard (Part 65/Sec 1) covers definitions of terms relating to general aspects of information transmission.

2. TERMINOLOGY

2.1 Basic Terms in Transmission

2.1.1 *Information* — Intelligence or knowledge capable of being represented in forms suitable for communication, storage or processing.

NOTE — Information may be represented for example by signs, symbols, pictures or sounds.

2.1.2 *Signal* — A physical phenomenon one or more of whose characteristics may vary to represent information.

NOTE — The physical phenomenon may be, for instance, an electromagnetic wave or an acoustic wave, and the characteristic may be an electric field, a voltage, or a sound pressure.

2.1.3 *Analogue Signal* — A signal in which the characteristic quantity representing information may assume, at any instant, any value in a continuous interval.

NOTE — For example, an analogue signal may continuously follow the values of another physical quantity representing information.

2.1.4 *Discretely-Timed Signal* — A signal composed of successive elements in time, each element having one or more characteristic quantities which can convey information, for example, its duration, its position in time, its waveform, its amplitude.

2.1.5 *Digital Signal* — A discretely-timed signal in which information is represented by a number of well defined discrete values that one of its characteristic quantities may take in time.

2.1.6 *Transmission* — The transfer of information from one point to another point or to multipoint by means of signals.

NOTE 1 — Transmission can be effected directly, or indirectly with or without intermediate storage.

NOTE 2 — The use of the word 'transmission' in the sense of 'emission' in the radio communication is deprecated.

Associated term : To transmit

2.1.7 *Analogue Transmission* — The transmission of an analogue signal.

2.1.8 *Digital Transmission* — The transmission of a digital signal.

2.1.9 *Unidirectional* — Pertaining to a link where the transfer of users' information is possible in one pre-assigned direction only.

NOTE — This term should not be used to describe the direction of call set-ups.

2.1.10 *Bidirectional* — Pertaining to a link where the transfer of users' information is possible in both directions between two points.

NOTE 1 — The transmission channel capacities or digit rates are not necessarily the same in both directions.

NOTE 2 — This term shall not be used to describe the direction of call set-ups.

2.1.11 *One-Way* — Pertaining to an operational mode in which the call set-ups always occur in one direction.

NOTE — This term shall not be used to describe the direction of transfer of users' information.

2.1.12 *Both-Way ; Two-Way* — Pertaining to an operational mode in which the call set-ups occur in both directions.

NOTE 1 — The amount of traffic flowing is not necessarily the same in both directions.

NOTE 2 — These terms shall not be used to describe the direction of transfer of users' information.

2.1.13 *Simplex Operation* — Operating method in which transmission is made possible alternately in each direction of a telecommunication channel, for example, by means of manual control.

2.1.14 *Duplex Operation* — Operating method in which transmission is possible simultaneously in both directions of a telecommunication channel.

2.1.15 *Data* — Information represented in a manner suitable for automatic processing.

2.1.16 *Data Communication; Data Transmission* (deprecated in this sense) — A form of telecommunication intended for transfer of information between data processing equipments.

2.1.17 *Data Transmission* — The conveying of data from one place to another by telecommunication.

NOTE — The term 'data transmission' is deprecated in the sense of 'data communication'.

2.2 Transmission Media

2.2.1 *Transmission Medium* — A natural medium or manufactured structure through or over which a signal is conveyed.

2.2.2 *Transmission Line* — A manufactured transmission medium used to convey electromagnetic energy between two points with a minimum of radiation.

2.2.3 *Earth Return* — An electrically conducting path provided through the earth or the sea between two points.

2.2.4 *Symmetric Pair* — A transmission line consisting of two metallic conductors of the same type, symmetrically arranged in relation to each other, to earth, and to other circuits.

2.2.5 *Coaxial Pair* — A transmission line consisting of two coaxial cylindrical conductors.

2.2.6 *Waveguide* — A transmission line consisting of a system of material boundaries or structure for guiding electromagnetic waves.

NOTE — The most common form of waveguide is a metallic tube, other forms are a dielectric rod, for a mixed structure of conducting and dielectric materials.

2.2.7 *Optical Fibre* — A filament-shaped optical waveguide made of dielectric materials, capable of guiding optical power.

2.2.8 *Space* — A transmission medium in which manufactured structures are not used for guiding electromagnetic energy.

2.3 Physical Transmission Circuits

2.3.1 *Metallic Circuit* — A circuit composed of a pair of metallic conductors between two points.

2.3.2 *Balanced Metallic Circuit; Balanced Transmission Line* (deprecated) — A circuit, between two points, composed of a pair of metallic conductors and associated terminations, with the whole ideally having equal impedances from each conductor to earth and to other circuits.

2.3.3 *Unbalanced Metallic Circuit; Unbalanced Transmission Line* (deprecated) — A circuit, between two points, composed of a pair of metallic conductors and associated terminations, with the whole having different impedances from each conductor to earth and to other circuits.

2.3.4 *Earth-Return Circuit* — A circuit, between two points, obtained by using a single metallic conductor, or a number of metallic conductors in parallel, with return through the earth or the sea between these points.

2.3.5 *Superposed Circuit* — An additional circuit obtained from one or more conductors provided for other circuits, and arranged so that all the circuits may be used simultaneously.

NOTE — An example of a superposed circuit is a phantom circuit.

2.3.6 *Side Circuit* — One of the metallic circuits from which a superposed circuit is derived.

2.3.7 *Earth Phantom Circuit* — A superposed circuit derived from the conductors of a metallic circuit, with these two conductors effectively being used in parallel, and with return through the earth or the sea between the end points.

2.3.8 *Phantom Circuit* — A superposed circuit derived from the conductors of two metallic circuits, with the two conductors of each metallic circuit effectively being used in parallel.

2.3.9 *Double Phantom Circuit* — A superposed circuit derived from the conductors of two phantom circuits, with the four conductors of each phantom circuit effectively being used in parallel.

2.4 Transmission Networks

2.4.1 *Transmission Path* — The course taken by a signal during its transmission between two points.

2.4.2 (*Transmission*) *Channel* — A means of transmission of signals in one direction between two points.

NOTE 1 — Several channels may share a common path, for example, where each channel is allocated a particular frequency band or a particular time-slot.

NOTE 2 — The usage of the term 'communication channel' or its abbreviation 'channel' to mean 'telecommunication circuit', for example, to encompass the two directions of transmission, is deprecated.

NOTE 3 — A transmission channel may be qualified by the nature of transmitted signals, or its bandwidth, or its digit rate, for example, telephone channel, telegraph channel, data channel, 10 MHz channel, 34 Mbit/s channel.

2.4.3 (*Telecommunication*) *Circuit* — A combination of two transmission channels permitting transmission in both directions between two points.

NOTE 1 — If the telecommunication is by nature unidirectional, for example, long distance television transmission, the term 'circuit' is sometimes used to designate the single transmission channel providing the facility but this usage is deprecated.

NOTE 2 — A telecommunication circuit may be qualified by the nature or characteristics of the transmitted signals, for example, telephone circuit, telegraph circuit, data circuit, digital circuit.

NOTE 3 — Characteristics of the transmission channels, such as bandwidth or digit rate may be different in the two directions of transmission.

NOTE 4 — In telephony, usage of the term 'telephone circuit' is generally limited to a telecommunication circuit directly connecting two switching centres.

2.4.4 *Go Channel* (*Return Channel*) — One of a pair of channels used to provide a telecommunication circuit, normally handing signals which leave (arrive at) a given point.

NOTE — The qualifications 'go' and 'return' are usually highly localized. A channel referred to as a go channel at one point in a network may be referred to as a return channel at another point, and *vice-versa*.

2.4.5 *Distribution Frame* — A structure providing flexibility of semi-permanent interconnection of channels and circuits, by terminating them and providing means for connecting them together in any required order.

NOTE 1 — A distribution frame permits any semi-permanent inter-connection of subscribers' lines and line terminal multiplex, switching, signalling and other equipment. The semi-permanent interconnections may be changed as required from time to time.

NOTE 2 — Examples of the technology used for semi-permanent interconnections are wires, U-links, and plugs and sockets, all of which are set up and rearranged manually, and electromagnetic or electronic switches which can be operated locally or remotely.

2.4.6 (*Transmission*) *Link* — A means of telecommunication with specified characteristics between two points.

NOTE — The type of transmission path or the capacity is normally indicated, for example, line link, radio link, broadband link.

2.4.7 *Line Link* — A transmission link provided by a manufactured transmission medium.

NOTE — Examples of a line link are a symmetric pair line link, a coaxial line link, a waveguide line link, and optical fibre line link.

2.4.8 *Radio Link* — A transmission link provided by means of radio waves.

NOTE — Examples of a radio link are a radio-relay link, a satellite link, direct wireless link, troposcatter link, etc.

2.4.9 *Transmission System*

2.4.9.1 The organized set of principles defining a particular method of transmission.

2.4.9.2 The whole of the means of transmission between two points, comprising of:

a) Transmission medium,

b) Terminal equipments,

c) Any necessary intermediate equipments, and

d) Any equipment provided for such ancillary purposes as power feeding, supervision, testing.

2.4.10 *Transmitted Source Signal* — A signal applied to an input port of the transmitting terminal equipment of a transmission system.

NOTE — A transmitted source signal of one transmission system may be a received source signal of another transmission system.

2.4.11 *Received Source Signal* — A signal emitted from an output port of the receiving terminal equipment of a transmission system.

NOTE 1 — Ideally, a received source signal shall be an undistorted version of the corresponding transmitted source signal.

NOTE 2 — A received source signal of one transmission system may be a transmitted source signal of another transmission system.

2.4.12 *Line Signal* — The signal actually transmitted over a transmission channel.

NOTE — Where the line signal needs to have a different form from that of the signal applied to the input port of the terminal equipment, this terminal equipment carries out the required reversible processing, such as modulation, multiplexing, and coding.

2.4.13 *Two-Wire Transmission; 2-Wire Transmission* — A method of transmission in which the go and return channels use the same path and the same frequency band at the same time.

2.4.14 *Four-Wire Transmission; 4-Wire Transmission* — A method of transmission in which the go and return channels use separate paths, or separate frequently bands, or separate time intervals, or other means of separation throughout.

2.4.15 *Two-Wire Circuit; 2-Wire Circuit* — A telecommunication circuit that provides two-wire transmission.

NOTE 1 — An example of a two-wire circuit is one formed from a pair of metallic conductors.

NOTE 2 — Certain types of two-wire circuit were formerly known as two-wire type circuits. The term 'two-wire type circuit' is deprecated.

2.4.16 *Four-Wire Circuit; 4-Wire Circuit* — A telecommunication circuit that provides four-wire transmission.

NOTE 1 — An example of a four-wire circuit is one formed from two pairs of metallic conductors arranged as two channels, one in each direction.

NOTE 2 — Certain types of four-wire circuit were formerly known as four-wire type circuits. The term 'four-wire type circuit' is deprecated.

2.4.17 (*Four-Wire*) *Terminating Set; 4-Wire Terminating Set; 4 W/2W Terminating Set* — An assembly of apparatus used to terminate the go and return channels of a four-wire circuit, and to provide connections between these channels and a two-wire circuit.

2.5 Repeaters

2.5.1 *Repeater* — An equipment, essentially including one or several amplifiers and/or regenerators and associated devices, inserted at a point in a transmission medium.

NOTE — A repeater may operate in one or both directions of transmission.

2.5.2 *Analogue Repeater* — A repeater for amplifying analogue signals or digital signals, but not capable of regenerating digital signals.

2.5.3 *Regenerative Repeater* — A repeater for regenerating digital signals.

NOTE — A regenerative repeater is sometimes referred to as a 'regenerator'.

2.5.4 *Two-Wire Repeater; 2-Wire Repeater* — A repeater for use at a point in a two-wire circuit and which provides gain for both directions of transmission.

2.5.5 *Four-Wire Repeater* ; *4-Wire Repeater* — A repeater for use at a point in a four-wire circuit and which provides gain for both directions of transmission.

2.5.6 *Section Termination* — A conventional interface selected to be the boundary between the physical transmission medium and its assoicated equipment, such as repeaters.

NOTE — The location of the section termination in relation to the accessories, such as splices, connectors and flexible connecting cables, may differ for different transmission systems, different manufacturers and different administrations.

2.5.7 *Elementary Cable Section* — The whole of the physical transmission medium and accessories, such as splices, connectors, flexible connecting cables, included between two consecutive section terminations.

NOTE — The main transmission medium usually consists of several factory lengths of cable connected together.

2.5.8 *Elementary Repeater Section; Elementary Repeatered Section* — In a given direction of transmission, and elementary cable section together with the immediately following regenerative repeater, all included between two section terminations.

2.5.9 *Elementary Regenerator Section; Elementary Regenerated Section* — In a given direction of transmission, and elementary cable section together with the immediately following analogue repeater, all included between two section terminations.

2.6 Repeater Stations

2.6.1 *Repeater Station* — An aggregate of transmission equipment at one location, usually including repeaters and other equipment for such functions as signalling, modulating, multiplexing, monitoring, and power feeding.

2.6.2 *Locally-Controlled (Repeater) Station* — A repeater station with means for adjusting the characteristics of repeaters under manual control or automatically under the control of locally derived signals.

2.6.3 *Controlling (Repeater) Station* — A repeater station which originates signals for remotely controlling the characteristics of repeaters in other repeater stations.

2.6.4 *Remotely-Controlled (Repeater) Station* — A repeater station with means for adjusting the characteristics of repeaters under the control of signals received from a controlling repeater station.

2.6.5 *Directly-Powered (Repeater) Station* — A repeater station which receives its electric energy directly from the local mains or from a local generator.

2.6.6 *Power-Feeding (Repeater) Station* — A directly-powered repeater station which supplies electric energy to other repeater stations.

2.6.7 *Dependent (Repeater) Station* — A repeater station which receives its electric energy from a power-feeding repeater station.

NOTE — Electric energy may be conveyed to a dependent repeater station by the physical transmission medium itself, or by conductors in the same cable sheath, or by another exterior cable.

2.7 Echo Control

2.7.1 *Echo* — An electric, acoustic or electromagnetic wave which arrives at a given point, after reflection, or indirect propagation, with sufficient magnitude and delay for it to be distinguishable from the direct wave.

2.7.2 *Echo Control* — The intentional reduction of unwanted echoes arising in a telecommunication circuit.

NOTE — The reduction may be effected, for example, by techniques of impedance balancing, inserting loss, or cancelling.

2.7.3 *Echo Suppression* — A method of echo control in which the reduction of echoes is effected by the insertion of loss in the transmission path(s) under the control of the voice signals being transmitted.

2.7.4 *Echo Suppressor* — A device placed in the 4-wire part of a telecommunication circuit for effecting echo suppression.

NOTE — An echo suppressor may operate on a multiplex signal.

2.7.5 *Full Echo Suppressor* — An echo suppressor in which voice signals in one transmission path control the insertion of a large loss in the other transmission path, and *vice-versa*.

2.7.6 *Half Echo Suppressor; Split Echo Suppressor* — An echo suppressor in which the voice signals in one transmission path control the insertion of a large loss in the other transmission path, but not *vice-versa*.

NOTE — These echo suppressors are normally used in pairs in telecommunication circuits.

2.7.7 *Unoperated State (of an Echo Suppressor)* — The state of an echo suppressor in which it does not insert loss in either direction of transmission.

NOTE — This state may result from the application of a disabling signal.

2.7.8 *Suppression State (of an Echo Suppressor)* — The state of an echo suppressor in which one transmission path is carrying voice signals and the echo suppressor has inserted a large loss in the other transmission path.

2.7.9 *Break-in State (of an Echo Suppressor)* — The state of an echo suppressor which results from the simultaneous presence of voice signals in both transmission paths and the large loss required for the suppression state is not inserted.

NOTE — A small loss is normally inserted in at least one of the transmission paths.

2.7.10 *Echo Cancellation* — A method of echo control in which the reduction of echoes is effected by subtracting an estimated echo from each circuit echo.

2.7.11 *Echo Cancellor* — A device placed in the 4-wire part of a telecommunication circuit for effecting echo cancellation.

NOTE — An echo cancellor may operate on a multiplex signal.

2.7.12 *Disabling (in Echo Control)* — The action of preventing an echo control device from carrying out its echo control functions.

Associated term : To disable

2.7.13 *Enabling (in Echo Control)* — The action of permitting an echo control device to resume its echo control functions after being disabled.

Associated term : To enable

2.8 Multiplexing

2.8.1 *Multiplexing* — A reversible process for assembling signals from several separate sources into a single composite signal for transmission over a common transmission channel; this process is equivalent to dividing the common channel into distinct channels for transmitting independent signals in the same direction.

Associated terms : To multiplex, multiplex, multiplexed

2.8.2 *Multiplex Signal; Multiplexed Signal* — The composite signal produced by multiplexing several signals.

2.8.3 *Demultiplexing* — A process applied to a composite signal, formed by multiplexing, for recovering the original independent signals, or groups of these signals.

NOTE — Demultiplexing may be partial, for example, for extracting a primary group from a secondary group.

Associated terms : To demultiplex, demultiplexed

2.8.4 *Derived Channel* — Any of the separate channels provided by multiplexing.

2.8.5 *Frequency Division Multiplexing; (FDM)* — Multiplexing in which several independent signals are allocated separate frequency bands for transmission over a common channel.

Associated term : Frequency-derived channel

2.8.6 *Wavelength Division Multiplexing (WDM)* — Multiplexing in which several independent signals are allotted separate wavelengths for transmission over a common optical transmission medium.

NOTE — Wavelength division multiplexing is a form of frequency division multiplexing. The use of a special term avoids confusion with the possible use of frequency division multiplexing in assembling the baseband signal which has to be carried over the optical link by one wavelenth.

Associated term : Wavelength-derived channel

2.8.7 *Time Division Multiplexing (TDM)* — Multiplexing in which several independent signals are allotted separate periodic time intervals for transmission over a common channel.

Associated term : Time-derived channel

2.8.8 *Code Division Multiplexing (CDM)* — Multiplexing in which several independent signals are allotted orthogonal signals for transmission over a common channel.

NOTE — In code division multiplexing, the signal elements allotted to distinguish the channels are so shaped that they can be easily distinguished and separated by using an appropriate operation although they may overlap in time and frequency when transmitted over a common channel.

Associated term : Code-derived channel

2.8.9 *Multiplex Transmission; Multiplexed Transmission* — A method of transmission employing multiplexing at the input terminal of a transmission path and complementary demultiplexing at the output terminal.

Associated term : Multiplex system

2.8.10 *Carrier Transmission* — A form of transmission in which the transmitted signal is the result of the modulation of one or more carriers by one or more signals.

NOTE — This term is usually qualified by the method of modulation, for example, single sideband (carrier) transmission.

Associated term : Carrier system

2.8.11 *Multichannel Carrier Transmission; Multichannel FDM Transmission; Analogue Carrier Transmission* — A form of carrier transmission on a common path provided for several independent signals by a combination of single or double sideband transmission and frequency division multiplexing.

NOTE 1 — In multichannel carrier transmission, the carriers may be transmitted or suppressed.

NOTE 2 — CCITT normally uses the term 'analogue carrier transmission'.

Associated terms :

Multichannel carrier system, multichannel FDM system, analogue carrier system

2.8.12 *Multichannel PCM Transmission* — A form of transmission on a common path provided for several independent signals by a combination of pulse code modulation and time division multiplexing.

Associated term : Multichannel PCM system

2.8.13 *Multiplexer* — An equipment for effecting multiplexing.

2.8.14 *Demultiplexer* — An equipment for effecting demultiplexing.

2.8.15 *Muldex : Muldem* — An assembly of a multiplexer and a demultiplexer operating in opposite directions of transmission in the same equipment.

NOTE — When used to describe an equipment, the function of that equipment shall qualify the title, for example, PCM muldex, data muldex, digital muldex.

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PART 65 TRANSMISSION

Section 2 Analogue Transmission

1. SCOPE

1.1 This standard (Part 65/Sec 2) covers definitions and terms relating to analogue transmission.

2. TERMINOLOGY

2.1 Basic Terms in Analogue Transmission

2.1.1 *Frequency Spectrum* — The continuum of frequencies that can be used for transmission of signals in telecommunications.

2.1.2 *Frequency Band* — A portion of the frequency spectrum lying between two specified limiting frequencies.

NOTE — *See* Note 2 under 2.1.3.1.

2.1.3 *Bandwidth* — The numerical difference between the frequencies at the extremities of a portion of the frequency spectrum.

2.1.3.1 *X* dB *bandwidth* — The width of a frequency band such that beyond its lower and upper limits, any discrete spectrum component or continuous spectral power density is at least *X* dB lower than a predetermined 0 dB reference level.

NOTE 1 — This term is usually associated with a qualification, for example, baseband bandwidth, necessary bandwidth, bandwidth of an amplifier or a device.

NOTE 2 — A clear distinction must be drawn between:

a) The frequency band which occupies a clearly defined position in the frequency spectrum, and which is characterized by two values, namely, its lower and upper limits, or by any equivalent means; and

b) The bandwidth which is expressed by only a single value. This value is the difference between the limits of a frequency band but these limits may have any position in the spectrum with a constant difference.

2.1.4 *Baseband*—By convention, that frequency band occupied by one signal or by a number of multiplexed signals, at specified input and output points of a transmission system.

NOTE 1 — In the case of a radiocommunication, the baseband is that frequency band which is occupied by the signal modulating the transmitter.

NOTE 2 — Where the transmission involves multiple modulation, it is generally considered that the baseband is that frequency band occupied by the signal which is applied to the first modulation stage, and not by an intermediate modulated signal.

2.1.5 *Baseband Transmission* —The transmission of signals in their original frequency band.

2.1.6 *Voice-Frequency Channel; VF Channel* — A channel that provides the frequency band required for transmission of telephone quality speech, and that operates at the original audio frequencies.

NOTE 1 — A voice-frequency channel normally has a standardized frequency band of 300-3 400 Hz.

NOTE 2 — Signals, other than speech signals, having appropriate specified characteristics may occupy the whole or a part of a voice-frequency channel.

NOTE 3 — The use of this term to denote a wider band channel, such as the one suitable for high quality sound signals, is deprecated.

2.1.7 *Sound Programme Channel*—A channel that provides the frequency band required for the transmission of high quality sound signals.

2.1.8 *Repeater Distribution Frame; RDF* — A distribution frame in a repeater station for interconnecting voice-frequency and signalling channels and circuits, with or without repeaters.

2.2 Frequency Division Multiplexing

2.2.1 *Frequency Translation* — The transfer en block of the spectral components of a signal from one position in the frequency spectrum to another in such a way that the absolute value of the frequency difference between any pair of components is preserved, as well as the relative amplitude and phase of each component.

NOTE 1 — Frequency translation may be accompanied by frequency inversion, in which case the sign of the frequency difference between any pair of component is reversed.

NOTE 2—A composite signal produced by frequency division multiplexing may itself be subjected to further frequency translation.

2.2.2 *Carrier* — An oscillation or wave, usually periodic, some characteristic of which is intended to be constrained by modulation to follow the values of a signal or another oscillation.

2.2.3 *Carrier Frequency (in Multichannel Carrier Transmission)* — The specified frequencies of the carriers used for effecting modulation and demodulation in frequency translating equipments.

2.2.4 *Channel (Group) (...) Carrier Frequencies* — A specified set of carrier frequencies used by channel (group) (...) translating equipment for the frequency translation of channels (groups) (...).

Associated terms:

a) Group carrier frequencies;

b) Supergroup carrier frequencies;

c) Mastergroup carrier frequencies;

d) Supermaster group carrier frequencies; and

e) 15 supergroup assembly carrier frequencies; hypergroup carrier frequencies.

2.2.5 *Guard Band* — A frequency band left between the limits specified for two adjacent channels in multichannel carrier transmission, with a width chosen to reduce mutual interference.

2.2.6 (*FDM Telephone*) *Channel* — A channel that has a standardized bandwidth suitable for the transmission of telephone quality speech in multichannel carrier transmission, and that occupies one of a number of specified positions in the frequency spectrum.

NOTE 1 —An FDM telephone channel normally has a standardized bandwidth of 4 kHz, this being sufficient for a signal occupying a frequency band of 300-3 400 Hz, for outband signalling, and for the required guard bands.

NOTE 2 —Signals, other than speech signals, having appropriate specified characteristics may occupy the whole or a part of an FDM telephone channel.

2.2.7 *Channel Translating Equipment*; *Channel Bank* — Equipment used for frequency translation of a specified number of voice-frequency channels and their assembly into a specified frequency band normally 12 voice-frequency channels into a basic group, and for performing the complementary process.

2.2.8 *Group*

a) The assembly, obtained by frequency division multiplexing of a specified number of FDM telephone channels, normally 12, in adjacent positions in a frequency band of specified width constituting the first level in the standardized frequency division multiplex hierarchy.

b) A frequency band of standardized width, 48 kHz, in a multichannel carrier system and occupying one of a number of specified positions in the spectrum.

NOTE 1 — A group is normally an assembly of 12 FDM telephone channels, each of 4 kHz bandwidth. But in some systems, for example, those systems used over submarine cables, a group is an assembly of 16 FDM telephone channels, each of 3 kHz bandwidth.

NOTE 2 — Signals other than those derived from FDM telephone channels, may occupy the whole or a part of the frequency band normally assigned to a group.

2.2.9 *Group A* (obsolete term), *Basic Group A* (deprecated) — A group occupying the frequency band 12-60 kHz.

2.2.10 *Basic Group*; *Basic Group B* (deprecated); *Group B* (obsolete term) — A group occupying the frequeney bond 60-108 kHz.

2.2.11 *Sub-Group* — An assembly, obtained by frequency division multiplexing, of a specified number of FDM telephone channels in adjacent positions in a frequency band of specified width, and normally used as an intermediate stage in the formation of a group. The number of channels in a sub-group is a sub-multiple of the number of channels in a group.

NOTE — A subgroup may sometimes be transmitted without subsequent formation into a complete group.

2.2.12 *Group Modulating Equipment* — Equipment used for frequency translation of one basic group into a specified frequency band, for example, into the band 12-60 kHz, and for performing the complementary process.

2.2.13 *Group Translating Equipment*; *Group Bank* — Equipment used for frequency translation of a specified number of basic groups and their assembly into a specified frequency band, normally 5 basic groups into a basic supergroup, and for performing the complementary process.

2.2.14 *Supergroup*

a) An assembly, obtained by frequency division multiplexing of a specified number of groups, normally 5, in adjacent positions in a frequency band of specified width.

b) A frequency band of standardized width, 240 kHz, in a multichannel carrier system and occupying one of a number of specified positions in the spectrum.

NOTE 1 — A subgroup is normally an assembly of 60 FDM telephone channels.

NOTE 2 — Signals, other than those derived from an assembly of groups but having specified characteristics, may occupy the whole or a part of frequency band assigned to a supergroup.

2.2.15 *Basic Supergroup* —A supergroup occupying the standardized frequency band 312-552 kHz.

2.2.16 *Supergroup Modulating Equipment* — Equipment used for frequency translation of one basic supergroup into a specified frequency band, for example, into the band 12-252 kHz, and for performing the complementary process.

2.2.17 *Supergroup Translating Equipment*; *Supergroup Bank* — Equipment used for frequency translation of a specified number of basic supergroups and their assembly into a specified frequency band, normally 5 or 10 basic supergroups into a basic supermaster group or 15 basic supergroups into a basic 15-super group assembly, and for performing the complementary process.

2.2.18 *Mastergroup*

a) An assembly, obtained by frequency division multiplexing of a specified number of supergroups, normally 5, in adjacent positions in a frequency band of specified width with guardbands between adjacent supergroups.

b) A frequency band of standardized width, 1 232 kHz, in a multichannel carrier system and occupying one of a number of specified positions in the spectrum.

NOTE 1 — A mastergroup is normally an assembly of 300 FDM telephone channels.

NOTE 2 — Signals, other than those derived from an assembly of supergroups but having specified characteristics, may occupy the whole or a part of a frequency band normally assigned to a mastergroup.

2.2.19 *Basic Mastergroup; Mastergroup A* (obsolete term) — A mastergroup occupying the standardized frequency band 812-2 044 kHz.

2.2.20 *Mastergroup B* (obsolete term) — A mastergroup occupying the frequency band 2 796-4 028 kHz.

2.2.21 *Mastergroup Modulating Equipment*—Equipment used for frequency translation of one basic mastergroup into a specified frequency band, for example, into the band 2 796-4 028 kHz, and for performing the complementary process.

2.2.22 *Mastergroup Translating Equipment* — Equipment used for frequency translation of a specified number of basic mastergroups and their assembly into a specified frequency band, normally 3 basic mastergroups into a basic supermastergroup, and for performing the complementary process.

2.2.23 *Supermastergroup*

a) An assembly, obtained by frequency division multiplexing, of a specified number of mastergroups, normally 3, in adjacent positions in a frequency band of specified width with guardbands between adjacent mastergroups.

b) A frequency band of standardized width, 3 872 kHz, in a multichannel carrier system and occupying one of a number of specified positions in the spectrum.

NOTE 1 — A supermastergroup is normally an assembly of 900 FDM telephone channels

NOTE 2 — Signals, other than those derived from an assembly of mastergroups but having specified characteristics, may occupy the whole or a part of a frequency band normally assigned to a supermastergroup.

2.2.24 *Basic Supermastergroup* — A supermastergroup occupying the standardized frequency band 8 516-12 388 kHz.

2.2.25 *Supermastergroup Translating Equipment* — Equipment used for the frequency translation of a specified number of basic supermastergroups and their assembly into a specified frequency band, and for performing the complementary process.

2.2.26 *15-Supergroup Assembly; (15-Supergroup) Hypergroup*

a) An assembly, obtained by frequency division multiplexing, of 15 supergroups in adjacent positions in a frequency band of specified width, with guardbands between adjacent supergroups.

b) A frequency band of standardized width, 3 716 kHz, in a multichannel carrier system and occupying one of a number of specified positions in the spectrum.

NOTE 1 — '15-supergroup assembly' is the only term in use by the CCITT.

NOTE 2 — The English word 'hypergroup' is sometimes used for a supergroup assembly different from that standardized by CCITT. Accordingly, this term should be qualified by the number of supergroups used in each application.

NOTE 3 — A 15-supergroup assembly is normally an assembly of 900 FDM telephone channels.

NOTE 4 — Signals, other than those derived from an assembly of supergroups but having specified characteristics, may occupy the whole or a part of a frequency band assigned to a 15-supergroup assembly.

2.2.27 *Basic 15-Supergroup Assembly; Basic (15-Supergroup) Hypergroup* — A 15-supergroup assembly occupying the standardized frequency band 312-4 028 kHz.

2.2.28 *15-Supergroup Assembly Modulating Equipment; Hypergroup Modulating Equipment*—Equipment used for frequency translation of one basic 15-supergroup assembly into a specified frequency band, for example, into the band 8 620-12 336 kHz which is inside the basic supermastergroup, and for performing the complementary process.

2.2.29 *15-Supergroup Assembly Translating Equipment; Hypergroup Translating Equipment*—Equipment used for frequency translation of a specified number of basic 15-supergroup assemblies and their assembly into a specified fraquency band, and for performing the complementary process.

2.3 Analogue Carrier Transmission

2.3.1 *High-Frequency Repeater Distribution Frame; HFRDF* — A distribution frame in a repeater station for channels and circuits carrying basic groups, basic supergroups, etc.

NOTE — Wherever possible, the use of the appropriate special term is recommended.

2.3.2 *Group (Supergroup) (...) Distribution Frame* — A distribution frame for channels and circuits carrying basic groups (basic supergroups) (...).

Associated terms:

a) Supergroup distribution frame;

b) Mastergroup distribution frame;

c) Supermastergroup distribution frame; and

d) 15-Supergroup assembly distribution frame; hypergroup distribution frame.

2.3.3 *Separation Point (in FDM Transmission)* — A defined point at the end of a transmission system where standard defined conditions exist such that interconnection with another transmission system may be achieved.

NOTE — Separation points permit interconnection with other equipment such as direct through-connection filters, translating equipment, etc.

2.3.4 *FDM Link*; *Line Link* (deprecated in this sense) — The basic entity of frequency division multiplex transmission, for transmitted source signals occupying a specified frequency band, comprising the whole of the means of transmission over a given transmission medium, between two consecutive separation points at this frequency band.

NOTE 1 — An FDM link provides transmission in both directions unless otherwise specified.

NOTE 2 — An FDM link never includes a direct through-connection filter.

NOTE 3 — In such cases as optical fibre transmission, radio-relay transmission, etc, the appropriate terminal equipment is included within the 'FDM link'.

2.3.5 *Group (Supergroup) (...) Section*—The whole of the means of transmission including one or more FDM links, for signals occupying a standardized frequency band of a group (supergroup) (...) between two consecutive group (supergroup) (...) distribution frames, or equivalent points.

NOTE —A group (supergroup) (..) section provides transmission in both directions unless otherwise specified.

Associated terms:

a) Supergroup section;

b) Mastergroup section;

c) Supermastergroup section; and

d) 15-Supergroup assembly section; hypergroup section.

2.3.6 *Group (Supergroup) (...) Link* — A group (supergroup) (...) section or a number of tandem connected group (supergroup) (...) sections between two group (supergroup) (...) distribution frames, or equivalent points, where the group (supergroup) (...) originates or terminates.

NOTE 1 — A group (supergroup) (...) link provides transmission in both directions unless otherwise specified.

NOTE 2 — Examples of where a group (supergroup) (...) may originate or terminate are multiplex equipments or wideband modems.

Associated terms:

a) Supergroup link;

b) Mastergroup link;

c) Supermastergroup link; and

d) 15-Supergroup assembly link; hypergroup link.

2.3.7 *Direct Through-Connection Filter*; *Direct Line Filter*; *Direct Transfer Filter* — A bandpass filter for the interconnection of two FDM links providing transmission for transmitted source signals occupying the same frequency band.

NOTE — A direct through-connection filter may be used to interconnect two FDM links inside the same group section, the same supergroup section, etc.

2.3.8 *Direct Through-Connection Point* — A point at which a direct through-connection filter is used for the interconnection of two FDM links.

2.3.9 *Through-Group (Through-Supergroup) (...) Filter* — A bandpass filter whose pass band is the standardized frequency band of a basic group (basic supergroup) (...).

NOTE — A through-group (through-supergroup) (...) filter may be used to interconnect two consecutive group (supergroup) (...) sections, where appropriate.

Associated terms:

a) Through-supergroup filter;

b) Through-mastergroup filter;

c) Through-supermastergroup filter; and

d) Through 15-supergroup assembly filter; through-hypergroup filter.

2.3.10 *Through-Group (Through-Supergroup) (...) Connection Point* —A point in a group (supergroup) (...) link at which two consecutive group (supergroup) (...) sections are connected in tandem, via a through-group (through-supergroup) (...) filter, where appropriate.

Associated terms:

a) Through-supergroup connection point;

b) Through-mastergroup connection point;

c) Through-supermastergroup connection point; and

d) Through 15-supergroup assembly connection point; through hypergroup connection point.

2.4 Pilot Signals

2.4.1 *Pilot Signal* — A signal, usually a single frequency, transmitted in telecommunication network for measurement, supervision, or control purposes.

2.4.2 *Reference Pilot* — A pilot signal used to facilitate the maintenance and adjustment of a multichannel carrier system.

2.4.3 *Group (Supergroup) (...) Reference Pilot* — A reference pilot applied where a group (supergroup) (...) is assembled and which accompanies the group (supergroup) (...) over the system up to the point where it is broken down into its constituent elements.

NOTE 1 — Various frequencies have been standardized by the CCITT for group (supergroup) (...) reference pilots within the frequency band of a basic group (basic supergroup) (..).

NOTE 2 — In certain cases, two reference pilots may be applied where a basic group (basic supergroup) (..) is assembled.

Associated terms:

a) Supergroup reference pilot;

b) Mastergroup reference pilot;

c) Supermastergroup reference pilot; and

d) 15-Supergroup assembly reference pilot; hypergroup reference pilot.

2.4.4 *Regulating Pilot* — A reference pilot used to maintain the level of the line signal of the multichannel carrier system at the prescribed value, and to ensure that the attenuation-equalization is continuously satisfactory.

2.4.5 *Frequency Comparison Pilot*; *Synchronizing Pilot* (obsolete term) — A reference pilot used either for comparing the frequencies, and possibly the phases, of the carriers generated at the sending and receiving terminals in one direction of transmission of a multichannel carrier system, or for maintaining the synchronism of these carriers.

2.4.6 *Switching Control Pilot*; *Switching Pilot* — A reference pilot used to control a maintenance switching function at a distant point.

NOTE — Examples of such switching functions are, to busy the channels of a multichannel carrier system, or to replace a normal repeater by a standby repeater in the case of a fault.

2.4.7 *Regulated Line Section* — A succession of tandem-connected elementary repeater sections over which the line signal and one or more regulating pilots are transmitted from end to end, with this signal and the pilots passing through the same amplitude regulating devices at intermediate points.

NOTE — At the end of a regulated line section, the initial pilot signals are removed, or reconstituted, or replaced by new pilot signals sent at the reference level.

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PART 65 TRANSMISSION

Section 3 Time Division Multiplexing

1. SCOPE

1.1 This standard (Part 65/Sec 3) covers definition of terms relating to time division multiplexing.

2. TERMINOLOGY

2.1 Timing

2.1.1 *Time-Scale* — A succession of continguous pre-determined time intervals.

NOTE — The time intervals in a time-scale need not all have the same duration.

2.1.2 *Cyclic Time-Scale* — A time-scale consisting of periodic repetition of a succession of time intervals.

NOTE — The individual time intervals comprising a single cycle need not all have the same duration, but, ideally, all the cycles are identical, any variations being constrained within the specified limits.

2.1.3 *Significant Instant (in Transmission)* — An instant at which a time interval commences in a time-scale or a signal element commences in a discretely-timed signal.

2.1.4 *Phase Relationship (in or between Cyclic Time-Scales)* — The difference in time between two significant instants in a cyclic time-scale or between corresponding significant instants in two cyclic time-scales at the same place.

NOTE — The phase relationship may be expressed in units of time, or as a proportion or percentage of the cycle duration.

2.1.5 *Timing Signal* — A signal used to determine the instants at which the operations are initiated.

2.1.6 *Cyclic Timing Signal* — A cyclic signal used to determine the instants at which operations are initiated.

2.1.7 *Cyclic Control Signal* — A cyclic signal used to control the frequency at which operations occur.

2.1.8 *Time-Slot (TS)* — Any cyclic time interval that can be recognized and defined uniquely.

2.1.9 *Clock* — Equipment that provides a cyclic timing signal.

NOTE — Where replicated sources are used for reliability reasons, the assembly of these is regarded as a single clock.

2.1.10 *Reference Clock* — A clock of very high stability, accuracy and reliability which is used as the single reference standard for the clocks in a synchronized network.

2.1.11 *Master Clock* — A clock used to control the frequency of other clocks.

2.1.12 *Isochronous* — Qualifying a time-varying phenomenon, a time-scale, or a signal characterized by consecutive significant instants which are separated by time intervals which all have the same nominal duration or have nominal durations equal to integral multiples of a unit duration.

NOTE — In practice, any variations of the time intervals are constrained between the specified limits.

2.1.13 *Burst Isochronous* — Qualifying a time-varying phenomenon, a time-scale, or a signal in which there are bursts of isochronous activity.

2.1.14 *Anisochronous* — Qualifying a time-varying phenomenon, a time-scale, or a signal characterized by consecutive significant instants which are separated by time intervals which are not constrained to have the same nominal duration or to have nominal durations equal to integral multiples of a unit duration.

2.1.15 *Synchronous* — Qualifying two time-varying phenomena, time-scales, or signals characterized by corresponding significant instants which are separated by time intervals of a nominally constant duration at two designated places, one for each phenomenon, time-scale or signal.

NOTE 1 — In practice, any variations of the time intervals are constrained within the specified limits.

NOTE 2 — Two anisochronous phenomena, time-scales, or signals may be synchrouous.

Associated term:

Synchronism

2.1.16 *Synchronization* — The process of adjusting clocks to achieve synchronism of two time-varying phenomena, time-scales, or signals.

Associated term:

To synchronize

2.1.17 *Plesichronous* — Qualifying two time-varying phenomena, time-scales, or signals in which corresponding significant instants occur at nomially the same rate, any variations in rate being constrained within the specified limits.

NOTE — Corresponding significant instants are separated by time intervals having durations which may vary without limit at two designated places, one for each phenomenon, time-scale or signal.

2.1.18 *Non-Synchronous*: *Asynchrono s*(deprecated in this sense)—Qualifying two time-varying phenomena, time-scales, or signals characterized by corresponding significant instants which are separated by time intervals that do not have a nominally constant duration at two designated places, one for each phenomenon, time-scale or signal.

2.2 Frames and Channels

2.2.1 *Frame* — A repetitive set of consecutive time-slots constituting a complete cycle of a signal, a process, etc, in which the relative position of each time-slot in the cycle can be identified.

2.2.2 *Frame Start* — An instant, always occupying the same relative position in every frame, used as the datum for timing other events in the frame.

2.2.3 *Frame Alignment* — The state in which the frame generated by the receiving equipment has a desired constant phase relationship with the frame of the received signal so that the individual time-slots in each frame can be uniquely identified.

2.2.4 *Frame Alignment Signal* — A distinctive signal inserted in every frame or once in every frame, always occupying the same relative position within the frame, and used to establish and maintain frame alignment.

2.2.5 *Bunched Frame Alignment Signal* — A frame alignment signal whose signal elements occupy consecutive digit time-slots.

2.2.6 *Distributed Frame Alignment Signal* — A frame alignment signal whose signal elements occupy non-consecutive digit time-slots.

2.2.7 *Frame Alignment Time-Slot* — A time-slot occuyping the same relative position in every frame, used to transmit the frame alignment signal.

NOTE 1 — The frame alignment time-slot may be used permanently or periodically for transmitting the frame alignment signal; when it is not occupied by this signal, it may be used for the transmission of other information.

NOTE 2 — In digital TDM systems, the frame alignment time-slot consists of one or more digit time-slots.

2.2.8 *Frame Alignment Recovery Time* — The time that elapses between a valid frame alignment signal available at the receive terminal equipment and frame alignment being established.

NOTE — The frame alignment recovery time includes the time required for replicated verification of the validity of frame alignment signal.

2.2.9 *Out-of-Frame-Alignment Time* — The time during which frame alignment is effectively lost.

NOTE — The out-of-frame-alignment time includes both the time taken to detect loss of frame alignment and the frame alignment recovery time.

2.2.10 *Channel Time-Slot* — A time-slot occupying a specific position in a frame and permanently allocated to a particular time-derived channel.

NOTE 1 — A channel time-slot may be qualified by its usage, for example, telephone channel time-slot.

NOTE 2 — In digital TDM systems, a channel time-slot, in addition to its main functions, may also be used for in-slot signalling or for transmitting other information.

2.2.11 *Signalling Time-Slot* — A time-slot occupying a specific position in a frame and permanently allocated for the transmission of signalling.

2.2.12 *Highway*: *Bus* — A common path within an apparatus or station over which signals from a number of channels pass with separation achieved by time division multiplexing.

2.2.13 *Channel Gate* — A device for connecting a time-derived channel to a highway, or a highway to a time-derived channel, at specified times.

2.2.14 *Sub-Frame* — A fixed number of non-contiguous channel time-slots within a frame that together provide a digital channel having a specified digit rate higher than that of a single channel time-slot.

2.2.15 *Multiframe* — A repetitive set of consecutive frames in which the relative position of each frame in the set can be identified.

2.2.16 *Multiframe Alignment* — The state in which the multiframe generated by the receiving equipment has a desired constant phase relationship with the multiframe of the received signal so that the individual frames in each multiframe can be uniquely identified.

2.2.17 *Multiframe Alignment Signal* — A distinctive signal inserted in every multiframe or once in every n multiframes, always occupying the same relative position within the multiframe, and used to establish and maintain multiframe alignment.

2.3 Synchronized Networks

2.3.1 *Synchronized Network*; *Synchronous Network* — A network in which clocks at designated nodes are adjusted to establish and maintain signals in synchronism.

2.3.2 *Non-Synchronized Network*; *Non-Synchronous Network*; *Asynchronous Network* (deprecated in this sense) — A network not designed to maintain synchronism between signals.

2.3.3 *Plesichronous Network* — A non-synchronized network in which clocks are designed to have high accuracy and stability such that the signals are plesichronous.

NOTE — The network effectively operates for long periods as if it were a synchronized network.

2.3.4 *Mutually Synchronized Network*

a) In theory, a synchronized network in which each clock exerts direct control on all the other clocks.

b) In practice, a synchronized network in which each clock exerts direct control on a few other clocks, and indirectly influences the remaining clocks.

2.3.5 *Democratic Mutually Synchronized Network*

a) In theory, a mutually synchronized network in which all the clocks are of equal status and directly exert equal amounts of control on all the other clocks.

b) In practice, a mutually synchronized network in which all the clocks are of equal status and in which each clock directly exerts equal amount of control on a few other clocks.

NOTE — In the theoretical case, the network operating frequency or digit rate is the mean of the natural frequencies of all the clocks.

2.3.6 *Hierarchic Synchronized Network* — A synchronized network in which each clock is assigned a status in a hierarchy which permits it to exert control only over clocks of equal or lower status.

2.3.7 *Hierarchic Mutually Synchronized Network* — A hierarchic synchronized network in which some of the status levels are themselves democratic mutually synchronized networks.

2.3.8 *Synchronization Signal* — A signal which indicates the phase relationship between two cyclic time-scales or a significant variation of this relationship.

2.3.9 *Timing Information (in a Synchronized Network)* — Information pertaining to the timing relationship of several series of events and which is conveyed by and/or derived from synchronization signals, timing signals, or time-scales embodied in digital signals.

2.3.10 *Synchronization Node* — A point in a synchronized network at which timing information is derived, sent, or received and processed for the purpose of synchronization.

2.3.11 *Synchronization Link* — A link, between two synchronization nodes, over which timing information is transmitted in one or both directions.

2.3.12 *Synchronization Network* — An arrangement of synchronization nodes and synchronization links provided in a synchronized network to synchronize the clocks in or connected to these nodes.

NOTE — A synchronization network is usually an important constituent of a synchronized network.

2.3.13 *Locally-Derived Synchronization Signal* — A synchronization signal derived at a synchronization node from the phase relationship between the cyclic time-scale generated by the local clock and the cyclic time-scale of a digital signal received over a synchronization link from a particular distant synchronization node.

2.3.14 *Remotely-Derived Synchronization Signal* — A synchronization signal received at a synchronization node over a synchronization link from a particular distant node, this signal having been derived at the distant node, as a locally-derived synchronization signal, from the phase relationship between the cyclic time-scale generated by its own clock and the cyclic time-scale of a digital signal received from the node to which the synchronization signal is sent.

2.3.15 *Single-Ended Synchronization* — A method of synchronizing clocks at a synchronization node with respect to a distant synchronization node solely by means of locally-derived synchronization signals relating to that particular distant node.

2.3.16 *Double-Ended Synchronization* — A method of synchronizing clocks at a synchronization node with respect to a distant synchronization node by means of both locally derived synchronization signals and remotely derived synchronization signals relating to that particular distant node.

2.3.17 *Unilateral Control* — Control between two synchronization nodes such that the frequency of the clock of only one of these nodes is influenced by timing information derived from the clock of the other node.

2.3.18 *Bilateral Control* — Control between two synchronization nodes such that the frequency of the clock of each of these nodes is influenced by timing information derived from the clock of the other node.

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PART 65 TRANSMISSION

Section 4 Digital Transmission

1. SCOPE

1.1 This standard (Part 65/Sec 4) covers definitions of terms relating to digital transmission.

2. TERMINOLOGY

2.1 Basic Terms in Digital Transmission

2.1.1 *Signal Element (in Digital Transmission)* — A part of a digital signal, characterized by its discrete timing and its discrete value, and used to represent a digit.

2.1.2 *Digit Time-Slot* — A time-slot allocated to signal element of a digital signal.

2.1.3 *Binary (Ternary) (N-ary) (Digital) Signal* — A digital signal in which each signal element has one of two (three) (N) permitted discrete values.

2.1.4 *Digit Rate* — The number of digits transferred per second.

NOTE 1 — The term digit rate may be qualified, for example, ternary digit rate.

NOTE 2 — The term digit rate should not be used to express the transmission rate of a line signal for which the appropriate term is 'line digit rate'.

2.1.5 *Binary (Ternary) (N-ary) Digit Rate : Bit Rate* — The number of binary (Ternary) (N-ary) digits transferred per second.

NOTE — The term 'binary digit rate' may be abbreviated to 'bit rate'.

2.1.6 *Effective Digit Rate (of a Time-Slot)* — The number of digits per second provided by a time-slot and numerically equal to the product of the number of digits per time-slot and the number of repetitions of that time-slot per second.

NOTE — The term may be qualified, for example, 'effective bit rate'.

2.1.7 *Decision Instant (for a Digital Signal)* — The instant at which a decision is taken as to the probable value of a signal element of a received digital signal.

2.1.8 *Decision Circuit (for a Digital Signal)* — A circuit that decides the probable value of a signal element of a received digital signal.

2.1.9 *Jitter (in Digital Transmission)* — Short-term variations in the significant instants of a digital signal from their ideal positions in time.

2.1.10 *Wander (in Digital Transmission)* — Long-term variations in the significant instants of a digital signal from their ideal positions in time.

2.1.11 *Time Interval Error* — The cumulative drift of the significant instants of a digital signal from their ideal positions in time, measured over a specified period.

2.1.12 *Timing Recovery* — The derivation of a cyclic timing signal from a received digital signal, based on the periodicity of the digit time-slots.

2.1.13 *Retiming* — Adjustment of the intervals between the significant instants of a digital signal by reference to a cyclic timing signal.

2.1.14 *Regeneration (of a Digital Signal)* — The process of receiving a digital signal and reconstructing it in a form in which the timing, waveforms, and amplitudes of the signal elements are constrained within the specified limits.

2.1.15 *Regenerator* — A device which performs regeneration of a digital signal.

2.1.16 *Byte (in Digital Transmission)* — A specified number of binary digits, or signal elements representing binary digits, operated on as an entity.

NOTE — The term 'byte' is often used as a synonym for 'octet' but this usage is not recommended.

2.1.17 *Octet (in Digital Transmission)* — A group of eight binary digits, or eight signal elements representing binary digits, operated on as an entity.

2.1.18 *Digit Position* — The position in time or space into which a representation of a digit may be placed.

2.1.19 *Digital Filling* — The addition of a constant number of signal elements at regular intervals to a digital signal to increase the digit rate from its original value to a predetermined multiple.

NOTE 1 — The added signal elements are not normally used to transmit information.

NOTE 2 — The multiple need not be an integer but must be a rational number, for example, 64/62.

2.1.20 *Re-iteration* — The repetition of the signal elements of a given digital signal to change the digit rate from its original value to a value which is an integral multiple of the original digit rate.

Associated term:

To re-iterate

2.1.21 *De-iteration* — The process applied to a re-iterated signal for restoring the original signal.

2.1.22 *Service Digits; Housekeeping Digits; Overhead Digits* (*USA*) — Ancillary signal elements, normally added at regular intervals to a digital signal at the sending end and removed at the receiving end of a transmission path, mainly used to ensure that when the sending equipment carries out a process on the digital signal, particularly an aperiodic process, the receiving equipment carries out the corresponding complementary process.

2.1.23 *Serial (Digital) Transmission* — The successive transmission of signal elements over a single path between two points.

2.1.24 *Parallel (Digital) Transmission* — The simultaneous transmission of a group of signal elements over the appropriate number of parallel paths between two points.

2.1.25 *Serial-to-Parallel Converter: Deserializer: Staticizer* (deprecated) — A device for converting a sequence of consecutive signal elements into a corresponding group of signal elements which are all presented simultaneously.

2.1.26 *Parallel-to-Serial Converter; Serializer; Dynamicizer* (deprecated) — A device for converting a group of signal elements, which are all presented simultaneouely, into a corresponding sequence of consecutive signal elements.

2.2 Line Codes

2.2.1 *Line Code* — A code, chosen to suit the characteristics of a transmission channel, defining the equivalence between a set of digits, represented by the signal elements of the transmitted source signal, and the sequence of signal elements in the corresponding line signal.

2.2.2 *Line Encoding* — The process of applying the rules of a particular line code to a given set of digits to derive the sequence of signal elements of the line signal.

2.2.3 *Line Digit Rate; Modulation Rate* (deprecated in this context); *Symbol Rate* (deprecated) — In digital transmission, the number of signal elements of the line signal transmitted per second, expressed in bauds.

NOTE — The term 'modulation rate' is used in telegraphy and data communication; it is the reciprocal of the duration of unit interval or of the shortest signal element.

2.2.4 *Equivalent Binary Content* — The minimum number of binary digits strictly necessary to convey the same information as a defined number of consecutive signal elements in a given digital signal.

2.2.5 *Equivalent Bit Rate* — The minimum value of the bit rate strictly necessary to convey the same information in the same time as a given digital signal at a given digit rate.

2.2.6 (*Uniform*) *Multivalue Digital Signal* — A digital signal whose nominal permitted discrete values form a set in which adjacent values differ by the same constant amount.

NOTE — A multivalue digital signal is usually used as a line signal.

2.2.7 *Notional Value (of a Uniform Multivalue Digital Signal)* — The value of signal element of a uniform multivalue digital signal, with the unit of value being so chosen that adjacent values differ by one unit according to the following rules:

a) For unbalanced signals, the lowest notional value is zero;

b) For balanced signals having an even number of permitted discrete values, the notional values are symmetrical about, but omit zero; and

c) For balanced signals having an odd number of permitted discrete values, the notional values are symmetrical about and include zero.

NOTE — Examples of notional values of uniform multivalue digital signals are as follows:

Unbalanced signals

Binary	0	1			
Ternary	0	1	2		
Quaternary	0	1	2	3	
Quinary	0	1	2	3	4

Balanced signals

Binary	$-\frac{1}{2}$	$+\frac{1}{2}$				
Ternary	-1	0	$+1$			
Quaternary	$-\frac{3}{2}$	$-\frac{1}{2}$	$+\frac{1}{2}$	$+\frac{3}{2}$		
Quinary	-2	-1	0	$+1$	$+2$	

2.2.8 *Digital Sum* — The algebraic sum of the notional values of a sequence of consecutive signal elements.

2.2.9 *Disparity* — The digital sum of one or more consecutive signal elements forming a defined group.

2.2.10 *Digital Sum Variation (of a Line Code)* — The difference between the theoretical maximum possible digital sum and the theoretical minimum possible digital sum of consecutive signal elements of a uniform multivalue digital signal produced by encoding, in accordance with a given line code, all permitted sequences of signal elements in the original signal.

2.2.11 *Balanced Code* — A line code producing an encoded signal which has a finite digital sum variation and which has no discrete zero-frequency component in its power spectrum.

2.2.12 *Paired-Disparity Code* — A line code in which the sequence of digits in the original signal is divided into successive groups of digits, some of which, when encoded, may be represented by one of two combinations of signal elements of equal and opposite disparity, the specific combinations used being chosen such that the digital sum tends to zero whenever possible, and in which the other groups of digits, if any, in the original signal are represented by combinations of signal elements of zero disparity.

2.2.13 *Alternate Mark Inversion Code; AMI; Bimolar Code* — A paired-disparity employing a ternary signal to convey binary digits in which the binary 1 states are represented by signal elements that are normally of alternate positive and negative polarity but equal in amplitude, and in which binary 0 states are represented by signal elements having zero amplitude.

NOTE — In telegraphy and data communication, the binary 1 state is known as the *Z* state (or 'mark') and the binary 0 state is known as the *A* state (or 'space').

2.2.14 *Alternate Mark Inversion Signal; AMI Signal; Bipolar Signal* — The encoded signal produced by alternate mark inversion code.

2.2.15 *Alternate Mark Inversion Violation; AMI Violation; Bipolar Violation* — A non-zero signal element, in an alternate mark inversion signal, having the same polarity as the previous non-zero signal element.

2.2.16 *Modified Alternate Mark Inversion Code; Modifed AMI* — A line code, based on alternate mark inversion code, in which alternate mark inversion violations occur in accordance with a defined set of rules.

NOTE — Examples of such codes are HDB3, B6ZS.

2.2.17 *Redundant Line Code* — A line code using more encoded signal elements than strictly necessary to represent groups of digits of the original signal.

2.2.18 *Redundant Digital Signal* — The encoded signal produced by encoding a given original signal in accordance with a given redundant line code.

NOTE — For a redundant *N*-ary digital signal, the average binary equivalent content per encoded signal element is less than $\log_2 n$ bits.

2.2.19 *Pseudo-Ternary Signal* — A redundant ternary digital signal which is derived from a binary digital signal without change of line digit rate.

NOTE — An alternative mark inversion signal is an example of a pseudo-ternary signal.

2.2.20 *Pseudo N-ary Signal* — A redundant *N*-ary digital which is derived from a *M*-ary digital signal without change of the line digit rate and for which *N* is greater than *M*.

2.2.21 *Digit Sequence Integrity* — The property of a digital transmission channel, circuit, or connection, that permits a digital signal to be conveyed over it without change in the sequence of the signal elements.

2.2.22 *Octet Sequence Integrity* — The property of a digital transmission channel, circuit, or connection which permits a digital signal to be conveyed over it without change in the sequence of the octets.

2.2.23 *Bit Sequence Independence* — The property of a binary transmission channel, circuit or connection which permits all sequences of binary signal elements to be conveyed over it as its specified bit rate.

2.2.24 *Quasi Bit Sequence Independence* — The property of a binary transmission channel, circuit, or connection which permits almost all sequences of binary signal elements to be conveyed over it as its specified bit rate, the exceptional sequences being completely specified together with their prohibition and allowance conditions.

2.2.25 *Scrambler (in Digital Transmission)* — A device used to combine a digital signal with a pseudo random sequence and intended to produce a randomized digital signal which conveys the same information and facilitates its transmission.

Associated term:

To scramble

2.2.26 *Descrambler (in Digital Transmission)* — A device for processing a scrambled signal in order to restore the original signal.

2.3 Digital Errors

2.3.1 *Digital (Bit) Error* — A difference between a digit (bit) in a transmitted digital signal and the corresponding digit (bit) in the received digital signal.

2.3.2 *Error Ratio; Error Rate* (Deprecated) — The ratio of the number of digital errors received in a specified period to the total number of digits received in the same period.

NOTE — Numerical values of this ratio are usually expressed in the form:

$$n \times 10^{-p}$$

where p is a positive integer.

2.3.3 *Bit Error Ratio; BER; Bit Error Rate* (deprecated) — The error ratio for a binary signal.

2.3.4 *Error Multiplication; Error Extension* — A property of a device which causes more than one error to occur in its output signal when a single digital error is present in its input signal.

NOTE — Line decoders and descramblers are examples of devices which may cause error multiplication.

2.3.5 *Error Multiplication Factor* — The ratio of number of errors in the output signal to the number of digital errors in the input signal.

NOTE — The error multiplication factor may be expressed as an average value under defined operating conditions, or else as the maximum value that could result from a single digital error in the input signal.

2.3.6 *Error Spread* — The number of a consecutive digits of the output signal over which digital errors are distributed when a single digital error in the input signal causes error multiplication.

2.3.7 *Errored Second* (*Errored Decisecond*) — That period of time, of duration one second (one decisecond) during which one or more digital errors occur in a given digital signal.

2.3.8 *Error-Free Second* (*Error-Free Decisecond*) — That period of time, of duration one second (one decisecond) during which no digital errors occur in a given digital signal.

2.3.9 *Slip* — The loss or gain of a digit time-slot or a set of consecutive digit time-slots in a digital signal, and in which this loss or gain of digit time-slots cannot be corrected.

2.3.10 *Octet Slip* — The loss or gain of eight consecutive digit time-slots conveying an octet in a digital signal, and in which this loss or gain of the octet cannot be corrected.

2.3.11 *Frame Slip* — The loss or gain of a complete frame of consecutive digit time-slots in a digital signal, and in which this loss or gain of the frame cannot be corrected.

2.3.12 *Controlled Slip* — The controlled loss or gain of a set of consecutive digit time-slots in a digital signal to enable it to accord with a digit rate different from its own digit rate, and in which this loss or gain of digit time-slots cannot be corrected.

NOTE — The term may be qualified, for example, controlled octet slip, controlled frame slip.

2.3.13 *Uncontrolled Slip* — The uncontrolled loss or gain of a digit time-slot or a set of consecutive digit time-slots in a digital signal, possibly as the result of an aberration of the timing processes associated with transmission or switching of that signal, and in which this loss or gain of digit time-slots cannot be corrected.

2.4 Digital Transmission Networks

2.4.1 *Digital Distribution Frame* — A distribution frame for channels and circuits carrying digital signals.

NOTE — A digital distribution frame may be qualified to indicate the digit rate.

2.4.2 *Digital Section* — The whole of the means of transmission, in both directions unless otherwise specified, for digital signals of specified digit rate between two consecutive digital distribution frames, or equivalent points.

NOTE — A digital section may be qualified to indicate its digit rate or multiplex order.

2.4.3 *Digital Link; Digital Path* (deprecated in this sense) — A digital section or a number of tandem-connected digital section operating at the same digit rate between two digital distribution frames, or equivalent points, at which switches or terminal equipments are connected.

NOTE 1 — Terminal equipments are those at which signals at the specified digit rate originate or terminate.

NOTE 2 — A digital link may be qualified to indicate its digit rate or multiplex order.

2.4.4 *Digital Transmission System*

2.4.4.1 An organized set of principles defining a particular method of digital transmission.

2.4.4.2 A particular implementation of a digital section comprising of:

a) Transmission medium,

b) Terminal equipment,

c) Any necessary intermediate equipment, and

d) Any equipment provided for such ancillary purposes as power feeding, supervision, testing, etc:

2.4.5 *Digital Line Section* — A digital section implemented on a manufactured transmission medium, such as a symmetric pair, a coaxial pair, or an optical fibre.

2.4.6 *Digital Line Link; Digital Line Path* (deprecated) — A digital link comprising a digital line section or a number of tandem-connected digital line sections.

2.4.7 *Digital Line System* — A digital transmission system providing a digital line section.

2.4.8 *Digital Radio Section* — A digital section implemented by means of radio waves.

2.4.9 *Digital Radio Link; Digital Radio Path* (deprecated) — A digital link comprising of a digital radio section or a number of tandem-connected digital radio sections.

2.4.10 *Digital Radio System* — A digital transmission system providing a digital radio section.

2.5 Digital Multiplexing

2.5.1 *Digital Multiplexing* — A form of time division multiplexing applied to digital channels which convey digital signals.

2.5.2 *Digital Multiplexer* — Equipment for combining, by time division multiplexing, two or more tributary digital signals into a single composite digital signal.

NOTE — A digital multiplexer may be qualified by the digit rate or the multiplex order of the composite digital signal.

2.5.3 *Digital Demultiplexer* — Equipment for separating, by time division demultiplexing, a comsposite digital signal into its component tributary digital signals.

NOTE — A digital demultiplexer may be qualified by the digit rate or the multiplex order of the composite digital signal.

2.5.4 *Digital Multiplex Equipment* — The combination of a digital multiplexer and a digital demultiplexer at the same location but working in opposite directions.

NOTE 1 — The multiplexer and demultiplexer may or may not be combined into a single equipment.

NOTE 2 — A digital multiplex equipment may be qualified by the digit rate or the multiplex order of the composite digital signal it handles.

2.5.5 *Digital Muldex* — The combination of a digital multiplexer and a digital demultiplexer in the same equipment but working in opposite directions.

NOTE — A digital muldex may be qualified by the digit rate or the multiplex order of the composite digital signal it handles.

2.5.6 *Digital Block* — The combination of an appropriate digital link and digital multiplex equipment at its end.

NOTE — A digital block is qualified by the digit rate or the multiplex order of the digital link.

2.5.7 *Digital Multiplex Hierarchy* — A series of levels of digital multiplexing in which each level is characterized by a defined digit rate, and in which each level handles a digital signal assembled by multiplexing digital signals of a lower level.

NOTE — CCITT has defined a standardized digital multiplex hierarchy.

2.5.8 *Primary Digital Group; Digroup; Primary Block* (deprecated) — The assembly, by digital multiplexing, of a specified number of digital signals constituting the first level of the standardized digital multiplex hierarchy, operating at a standardized digit rate of 1 544 or 2 048 kbit/s.

NOTE 1 — Normally, each time-slot has 8-digit time-slots and an effective digit rate of 64 kbit/s.

NOTE 2 — In normal usage, the term 'digroup' is used to designate a primary digital group operating at a digit rate of 1 544 kbit/s.

2.5.9 *Secondary Digital Group* — The assembly by digital multiplexing, of a specified number of primary digital groups constituting the second level of the standardized digital multiplex hierarchy, operating at a standardized digit rate of 6 312 or 8 448 kbit/s.

2.5.10 *Tertiary Digital Group* — The assembly, by digital multiplexing, of a specified number of secondary digital groups constituting the third level of the standardized digital multiplex hierarchy, operating at a standardized digit rate of 32 064, 34 468, or 44 736 kbit/s.

2.5.11 *Quaternary Digital Group* — The assembly, by digital multiplexing, of a specified number of tertiary digital groups constituting the fourth level of the standardized digital multiplex hierarchy, operating at a standardized digit rate of 97 728 or 13 9264 kbit/s.

2.5.12 *Standardized Digital Signal* — A digital signal having a digit rate standardized by CCITT, primarily for use in the standardized digital multiplex hierarchy.

NOTE 1 — A standardized digital signal may or may not be a multiplexed assembly of standardized digital signals from a lower hierarchical level.

NOTE 2 — Examples of such signals are 'standardized 2 048 kbit/s digital signal' and 'standardized 44 736 kbit/s digital signal' which may be abbreviated to '2' 048 kbit/s digital signal' and '44 736 kbit/s digital signal' 'or, by convention, to '2 Mbit/s signal' and '45 Mbit/s signal'.

2.5.13 *Standardized 64 kbit/s Digital Signal; 64 kbit/s Signal* — A standardized digital signal having a standardized digit rate of 64 kbit/s and which constitutes the normal basis of a primary digital group.

2.6 Justification

2.6.1 *Justification; Pulse Stuffing* — The process of changing the digit rate of a digital signal in a controlled manner without loss or mutilation of information.

NOTE — Justification is usually employed as an adjunct to digital multiplexing to enable the multiplexing to be applied to tributary channels that are not synchronized to the multiplex equipment. Where this is done, the original signal of each channel is independently justified.

Associated terms:

To justify, to stuff

2.6.2 *Justification Instant, Stuffing Instant* — An instant at which zero, one, or two digits of the original digital signal are transmitted according to the timing relationship between the time-slots of the original signal and the time-slots provided for conveying that signal.

2.6.3 *Justifiable Digit Time-Slot; Stuffable Digit Time-Slot* — A time-slot provided at regular time intervals for justification of a digital signal.

2.6.4 *Justifying Digit; Stuffing Digit* — An arbitrary digit inserted in a justifiable digit time-slot when the prevailing timing relationship does not require the transmission of a digit of the original signal at that instant.

2.6.5 *Justification Service Digit; Stuffing Service Digit* — A digit that transmits information concerning the action taken at a justification instant.

2.6.6 *Positive Justification; Positive Pulse Stuffing* — A method of justification in which the digit time-slots used to convey a digital signal have a digit rate that is always higher than the digit rate of the original signal, and in which at each justification instant, depending on the prevailing conditions, either

a) no digit of the original is transmitted but, instead, a justifying digit is transmitted in the justifiable digit time-slot, or

b) one digit of the original signal is transmitted in the justifiable digit time-slot,

with these two alternative justification states being indicated by unique signals formed from justification service digits.

2.6.7 *Negative Justification; Negative Pulse Stuffing* — A method of justification in which the digit time-slots used to convey a digital signal have a digit rate that is always lower than the digit rate of the original signal, and in which at each justification instant, depending on the prevailing conditions, either

a) one digit of the original signal is transmitted in the justifiable digit time-slot, or

b) two digits of the original signal are transmitted, one in the justifiable digit time-slot with the other digit being removed and then transmitted by other means,

with these alternative justification states being indicated by unique signals formed from justification service digits.

2.6.8 *Positive/Zero/Negative Justification; Positive/Zero/Negative Pulse Stuffing* — A method of justification in which the digit time-slots used to convey a digital signal have a digit rate that, at various times, may be higher than, the same as, or lower than the digit rate of the original signal, and in which at each justification instant, depending on the prevailing conditions, either

a) no digit of the original is transmitted but, instead, a justifying digit is transmitted in the justifiable digit time-slot, or

b) one digit of the original is transmitted in the justifiable digit time-slot, or

c) two digits of the original signal are transmitted; one in the justifiable digit time-slot with the other digit being removed and then transmitted by other means,

with these three alternative justification states being indicated by unique signals formed from justification service digits.

2.6.9 *Justification Rate; Stuffing Rate* — The number of instants per second at which a digital signal is justified either by the insertion of a justifying digit or by the transmission of one of the digits of that signal by other means.

2.6.10 *Nominal Justification Rate; Nominal Stuffing Rate* — The justification rate which theoretically would occur if the original signal and the channel provided for conveying it by justification were both to have their nominal digit rates.

2.6.11 *Justification Capacity; Stuffing Capacity; Maximum Justification Rate; Maximum Stuffing Rate* — The maximum possible justification rate that can be accommodated by the justification process.

NOTE 1 — In practice, the tolerance limits on the digit rates of the original signal and the channel provided for conveying it by justification shall be such that the justification rate is always less than the justification capacity.

NOTE 2 — Because of the confusion which arises from the similarity of the terms 'maximum justification rate' and 'maximum justification ratio', it is strongly recommended that 'justification capacity' shall be used instead of the first of these terms.

2.6.12 *Justification Ratio; Stuffing Ratio* — The ratio of the justification rate to the justification capacity.

2.6.13 *Nominal Justification Ratio; Nominal Stuffing Ratio* — The justification ratio that occurs when the original digital signal and the channel provided for conveying it by justification both have their nominal digit rates.

2.6.14 *Maximum (Minimum) Justification Ratio; Maximum (Minimnm) Stuffing Ratio* — The justification ratio that occurs when the digit rate of the original digital signal is at its lower (upper) tolerance limit and the digit rate of the channel provided for conveying it by justification is at its upper (lower) tolerance limit.

NOTE — The maximum and minimum justification ratios are the limiting values that can actually occur under practical operating conditions.

Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 65 TRANSMISSION

Section 5 Pulse Code Modulation

1. SCOPE

1.1 This standard (Part 65/Sec 5) covers definitions of terms relating to pulse code modulation.

2. TERMINOLOGY

2.1 Basic Terms in Pulse Code Modulation

2.1.1 *Analogue-to-Digital Conversion*; *A/D Conversion* — A process designed to convert an analogue signal into a digital signal with essentially the same information.

NOTE — There is always some minor loss of information in analogue-to-digital conversion.

2.1.2 *Digital-to-Analogue Conversion*; *D/A Conversion* — A process designed to convert a digital signal into an analogue signal with essentially the same information.

NOTE — Normally, there is no significant loss of information in digital-to-analogue conversion.

2.1.3 (*Generic*) *Pulse Code Modulation*; *Generic PCM* — Any form of analogue-to-digital conversion that employs sampling, quantizing, and encoding to convert an analogue signal into an equivalent digital signal.

NOTE — The shortened term 'Pulse code modulation' is widely used in the generic sense defined above.

2.1.4 (*Basic*) *Pulse Code Modulation*; (*Basic*) *PCM* — A process in which

a) a signal is sampled,

b) each sample is quantized independently of other samples, and

c) the succession on quantized values is converted by encoding into a digital signal.

2.1.5 *Differential Pulse Code Modulation*; *DPCM* — A process in which

a) a signal is sampled;

b) the difference between each sample and its predicted value derived from the previous sample(s), is quantized; and

c) the succession of quantized values is converted by encoding into a digital signal.

2.1.6 *Prediction* (*in Differential Pulse Code Modulation*) — The process of estimation the value of a sample from the succession of previous samples or quantized values.

Associated terms:

Prediction law, predictor

2.1.7 *Delta Modulation*; (*M*) — A form of differential pulse code modulation in which only the sign of the difference between each sample and its predicted value is encoded by a single bit.

2.1.8 *Adaptive Differential Pulse Code Modulation*; *ADPCM* — A form of differential pulse code modulation in which the prediction law and/or the quantizing law are automatically adjusted according to some characteristic of the signal or channel concerned.

2.1.9 *Adaptive Prediction* (*in ADPCM*) — Prediction in which one or more parameters of this process are automatically adjusted according to some characteristic of the signal or channel concerned.

Associated term:

Adaptive predictor

2.2 Sampling in Pulse Code Modulation

2.2.1 *Sample* (*of a Signal*) — A representative value of a signal at a chosen instant, derived from the relevant portion of that signal.

NOTE — Ideally, the value of a sample is equal to the value of a given signal at a chosen instant; in practice, it is equal or proportional to a weighted average of the varying value of the signal near this instant.

2.2.2 *Sampling* (*of a Signal*) — The process of taking samples of a signal, usually at equal time intervals.

Associated term:

To sample (a signal)

2.2.3 *Sampling Rate*; *Sampling Frequency* — The number of samples of a signal taken per unit time.

2.2.4 *Aliasing*; *Foldover Distortion* — The distortion caused by sampling a signal at an inappropriate rate and which results in overlapping of the sidebands.

2.3 Quantizing in Pulse Code Modulation

2.3.1 *Quantizing* — A process in which a continuous range of values that a quantity may assume is divided into a number of predetermined adjacent intervals, and in which any value within a given interval is represented by a single predetermined value within the interval.

Associated terms:

To quantize, quantizer

2.3.2 *Quantizing Interval* — One of the adjacent intervals used in quantizing.

2.3.3 *Quantized Value* — The single discrete value used to represent any value in a particular quantizing interval.

2.3.4 *Decision Value* — A value defining the boundary between two adjacent quantizing intervals.

2.3.5 *Virtual Decision Value* — Each of the two values obtained by extrapolation from the actual decision values.

NOTE — These values are taken to represent hypothetical outer bounds for the two extreme quantizing intervals of the quantizing law.

2.3.6 *Quantizing Law; Coding Law* (deprecated) — A law in quantizing that defines:

a) The number of quantizing intervals,

b) The virtual decision values,

c) The decision values,

d) The quantized values, and

e) Where appropriate, the rules governing adaptive working.

NOTE — Examples are quantizing laws A and mu standardized by CCITT for voice-frequency signals.

2.3.7 *Uniform Quantizing* — Quantizing in which all the quantizing intervals lying between the two virtual decision values are equal.

2.3.8 *Non-Uniform Quantizing* — Quantizing in which not all the quantizing intervals lying between the two virtual decision values are equal.

2.3.9 *Adaptive Quantizing* — Quantizing in which one or more parameters of this process are automatically adjusted according to some characteristic of the signal or the channel concerned.

2.3.10 *Working Range* (of a Quantizer) — The range of input values to a quantizer lying between the two virtual decision values.

NOTE — The distortion in quantizing is conventionally attributed to overload distortion for values falling outside the working range.

2.3.11 *Load Capacity* (*of a Quantizer*); *Overload Point* (deprecated) — The level of a sinusoidal signal whose positive and negative peaks coincide with the virtual decision values in basic pulse code modulation.

2.3.12 *Peak Limiting* (*in Quantizing*) — The effect whereby any value to be quantized lying outside the working range is replaced by the nearest quantized value.

2.3.13 *Quantizing Distortion; Quantizing Noise* — The distortion of a signal resulting from the process of quantizing samples of the corresponding original signal within the working range.

2.3.14 *Overload Distortion* (*in Basic Pulse Code Modulation*) — The distortion of a signal resulting from peak limiting in quantizing.

2.3.15 *Slope Overload Distortion* (*in DPCM*) — The distortion due to peak limiting in a DPCM quantizer.

NOTE — Slope overload distortion arises from the inability of the quantizer to respond adequately to large differences among a succession of samples applied to the input of the DPCM system.

2.4 Coding in Pulse Code Modulation

2.4.1 *Encoding* (*in Pulse Code Modulation*) — The process of representing a given quantized value by a set of digits in accordance with a defined set of rules.

2.4.2 *Pulse Code* — A set of rules defining the equivalence between each quantized value and the particular set of digits used to represent it.

2.4.3 *PCM Binary Code* — A pulse code in which the quantized values, from the most negative to the most positive, are identified by binary numbers taken in natural order.

2.4.4 *Symmetrical Binary Code* — A pulse code in which the positive or negative sign of a quantized value is represented by one binary digit, and in which the magnitude is represented by the remaining digits.

NOTE — The order of the digits and the use made of the binary symbols 0 and 1 in the various digit positions must be specified.

2.4.5 *Code Word* (*in Pulse Code Modulation*); *PCM Word* — A set of digits representing a quantized value in basic pulse code modulation or differential pulse code modulation.

NOTE — A set of signal elements representing a code word is sometimes called a 'character signal' by analogy with telegraphy and data communication. This usage is deprecated.

2.4.6 *Decoding* (*in Pulse Code Modulation*) — The process applied to a succession of code words for restoring the original signal.

2.4.7 *PCM Encoder* — A device for implementing encoding in pulse code modulation.

2.4.8 *PCM Decoder* — A device for implementing decoding in pulse code modulation.

2.4.9 *PCM Codec; PCM Encoder-Decoder* — An assembly of a PCM encoder and a PCM decoder operating in opposite directions, in the same equipment.

NOTE — The meaning of the term is often widened to embrace an assembly of equipment for quantizing a signal sample, encoding the quantized value as a code word generating the required digital signal, and for performing the complementary processes in the opposite direction.

2.4.10 *Transcoding (in Pulse Code Modulation)* — The conversion of a succession of PCM words, in a given pulse code, into the corresponding succession of PCM words representing the equivalent succession of quantized values in another pulse code.

NOTE — The term may be qualified to indicate the particular pulse codes concerned.

Associated term:

Transcoder

2.4.11 *Digital Test Sequence; DTS* — A defined sequence of digits used for testing digital transmission systems.

NOTE — An example of a digital test sequence is a specified pseudo-random sequence.

2.4.12 *PCM Digital Reference Sequence; DRS* — A defined sequence of PCM code words which, when applied to an ideal PCM decoder, produces a OdBmO sinusoidal reference signal at a particular test reference frequency.

NOTE — Examples of test reference frequencies are 804 Hz and 1 020 Hz.

2.5 Multiplexing in Pulse Code Modulation

2.5.1 *(PCM) (Telephone) Channel* — A channel that has a standardized effective digit rate suitable for transmission of telephone quality speech in multichannel PCM transmission, and that occupies one of a number of channel time-slots in the frame.

NOTE 1 — In most multichannel PCM systems using basic pulse code modulation the standardized effective digit rate is 64 kbit/s.

NOTE 2 — Signals, other than speech signals, having appropriate specified characteristics may occupy the whole or part of a PCM telephone channel.

2.5.2 *PCM Multiplex Equipment* — Equipment for deriving a single digital signal at a defined digit rate from several voice-frequency channels by a combination of pulse code modulation and time-division multiplexing, and also for carrying out complementary functions in the opposite direction of transmission.

NOTE — The single digital signal is normally that of a primary digital group.

2.5.3 *Primary PCM Group A* — A primary digital group of PCM channels, usually 30, assembled by PCM multiplex equipment which uses the CCITT quantizing law A; the composite digital signal has a frame consisting of 32 octet time-slots and operates at a digit rate of 2 048 kbit/s.

NOTE — This term should be used only when all the available channels are used as PCM channels.

2.5.4 *Primary PCM Group mu* — A primary digital group of 24 PCM channels assembled by PCM multiplex equipment which uses the CCITT quantizing law mu; the composite digital signal has a frame consisting of 24 octet time-slots and a single digit time-slot, and operates at a digit rate of 1 544 kbit/s.

NOTE — This term should be used only when all the available channels are used as PCM channels.

2.5.5 *Transmultiplexing* — The conversion of a frequency division multiplexed signal, such as a group or a supergroup, into a corresponding digital multiplexed signal which has the same structure and channels as if it were derived from PCM multiplex equipment, and the complementary process in the opposite direction of transmission.

Associated term:

Transmultiplexer

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*Rules for making alphabetical indices.

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