Terms and Definitions

[Note: need to do a pass through the relevant section that contains Table 100–1—CLT RF Output Requirements to align those definitions with these or vice versa.]

Active Subcarrier	Any subcarrier other than an excluded subcarrier. In the upstream unused subcarriers are considered active subcarriers because they are used in probes.
Adaptive Equalizer Tap	See *tap*.
Adaptive Pre-Equalizer	A circuit in a cable modem that pre-equalizes or pre-distorts the transmitted upstream signal to compensate for channel response impairments. In effect, the circuit creates a digital filter that has approximately the opposite complex frequency response of the channel through which the desired signal is to be transmitted.
Bit Loading	The technique of assigning the optimum number of bits (modulation order) for transmission per OFDM/OFDMA subcarrier.
Burst	A single continuous RF signal from the cable modem upstream transmitter, from transmitter on to transmitter off.
Burst Marker	A two-dimensional pattern assigned to *resource elements* by each CNU and detected by the CLT for start and stop burst length delineation.
Carrier-To-Noise Ratio (CNR or C/N)	The ratio of signal (or carrier) power to noise power in a defined measurement bandwidth. 1) For OFDM and OFDMA signals, the ratio of average signal power (P_{SIGNAL}) in the occupied bandwidth to the average noise power in the occupied bandwidth given by the noise power spectral density integrated over the same occupied bandwidth, expressed mathematically as $CNR = 10\ log_{10}[P_{SIGNAL}/\int N(f)df]$ dB. Note: This is a lower bound on the actual received signal-to-noise ratio. 2) For analog television signals, the ratio of visual carrier peak envelope power during the transmission of synchronizing pulses (P_{PEP}) to noise power (N), where the visual carrier power measurement bandwidth is nominally 300 kHz and the noise power measurement bandwidth is 4 MHz for NTSC signals. For the latter, the noise measurement bandwidth captures the total noise power present over a 4 MHz band centered within the television channel, and is expressed mathematically as CNR = 10 $\log_{10}(P_{PEP}/N)$ dB. Note: For analog PAL and SECAM channels, the noise measurement bandwidth is a larger value than the 4 MHz specified for NTSC (4.75 MHz, 5.00 MHz, 5.08 MHz, or 5.75 MHz, depending on the specific system). *[Note: do we need to above Note: for EPoC?]*
Ceiling (Ceil)	A mathematical function that returns the lowest-valued integer that is greater than or equal to a given value.
Channel	A portion of the electromagnetic spectrum used to convey one or more RF signals between a transmitter and receiver. May be specified by parameters such as center frequency or bandwidth.
Codeword	Forward error correction data block, comprising a combination of information bits and parity bits.
Coefficient	Complex number that establishes the gain of each tap in an adaptive equalizer or adaptive pre-equalizer.
Complementary Pilots	Subcarriers that carry data, but with a lower modulation order than other data subcarriers in a given Resource Block. Complementary pilots allow phase tracking along the time axis for frequency offset and phase noise correction, and used by the CLT upstream receiver for signal processing.

Composite Noise Floor	*[Note: need definition here or in text (it is used once).]*
Continuous Pilots	Pilots that occur at the same subcarrier location in every OFDM symbol, and which are used for frequency and phase synchronization.
Cyclic Prefix (CP)	A copy of the end of an OFDM symbol that is added to the beginning of the same symbol, in order to help mitigate the effects of micro-reflections and similar impairments.
Data Channel	A set of contiguous OFDM subcarriers of a *channel* constituting a "sub-channel" of the OFDM or OFDMA channel used to exchange MAC data between the CLT and one or more CNUs. The data channel is separate from the *PHY Link channel*.
Decibel Carrier (dBc)	Ratio of the power of a signal to the power of a reference carrier, expressed mathematically as $dBc = 10\log_{10}(P_{signal}/P_{carrier})$.
Decibel Millivolt (dBmV)	Unit of RF power expressed in terms of voltage, defined as decibels relative to 1 millivolt, where 1 millivolt equals 13.33 nanowatts in a 75 ohm impedance. Mathematically, $dBmV = 20\log_{10}(\text{value in mV}/1\text{ mV})$.
Decibel Reference (dBr)	Ratio of a signal level to a reference signal level. When the signals are noise or noise-like, the measurement bandwidth for the two signals is the same. When both signal levels are in the same units of power, the ratio is expressed mathematically as $dBr = 10\log_{10}(P_{signal}/P_{reference})$. When both signal levels are in the same units of voltage, and assuming the same impedance, the ratio is expressed mathematically as $dBr = 20\log_{10}(V_{signal}/V_{reference})$.
Discrete Fourier Transform (DFT)	Part of the family of mathematical methods known as Fourier analysis, which defines the decomposition of signals into sinusoids. Discrete Fourier transform defines the transformation from the time to the frequency domain. See also *inverse discrete Fourier transform*.
Downstream	The direction of RF signal transmission from the CLT to one or more CNUs.
Downstream Channel	A single OFDM channel in the downstream direction.
DS	See *Downstream*.
Encompassed Spectrum	For an OFDM or OFDMA channel, the range of frequencies from the center frequency of the channel's lowest active subcarrier minus half the subcarrier spacing, to the center frequency of the channel's highest active subcarrier plus half the subcarrier spacing.
Excluded Subcarrier	A subcarrier that is not used and is set to zero-value by the transmitter.
Exclusion Band	A set of contiguous subcarriers within the OFDM or OFDMA channel bandwidth and that are set to zero-value by the transmitter. There may be one or more non-overlapping and non-adjacent sets within a channel.
Fast Fourier Transform (FFT)	An algorithm to compute the discrete Fourier transform from the time domain to the frequency domain, typically far more efficiently than methods such as correlation or solving simultaneous linear equations. See also *discrete Fourier transform*, *inverse discrete Fourier transform*, and *inverse fast Fourier transform*.
FFT Duration	Reciprocal of subcarrier spacing. Sometimes called "useful symbol duration." See also *symbol duration*.
Fiber Node	See *node*.
Floor	A mathematical function that returns the highest-valued integer that is less than or equal to a given value.
Forward	See *downstream*.

Group Delay (GD)	The negative derivative of phase with respect to frequency, expressed mathematically as GD = -(dφ/dω) and stated in units of time such as nanoseconds or microseconds.
Group Delay Ripple	Group delay variation which has a sinusoidal or scalloped sinusoidal shape across a specified frequency range.
Group Delay Variation (GDV) or Group Delay Distortion	The difference in group delay between one frequency and another in a circuit, device, or system.
Guard Interval	In the time domain, the period from the end of one symbol to the beginning of the next symbol, which includes the cyclic prefix and applied transmit windowing. Also called guard time.
Guard Band	A narrow range of frequencies in which user data is not transmitted, located at the lower and upper edges of a *channel*, at the lower and upper edges of a gap within a channel, in between channels, or between *resource blocks*.
Headend	A central facility that is used for receiving, processing, and combining broadcast, narrowcast and other signals to be carried on a cable network.
Hum Modulation	Amplitude distortion of a signal caused by the modulation of that signal by components of the power source (e.g., 60 Hz) and/or its harmonics.
Hybrid Fiber/Coax (HFC)	A broadband bidirectional shared-media transmission system or network architecture using optical fibers between the headend and fiber nodes, and coaxial cable distribution from the fiber nodes to the subscriber locations.
Inverse Discrete Fourier Transform (IDFT)	Part of the family of mathematical methods known as Fourier analysis, which defines the "decomposition" of signals into sinusoids. Inverse discrete Fourier transform defines the transformation from the frequency to the time domain. See also *discrete Fourier transform*.
Inverse Fast Fourier Transform (IFFT)	An algorithm to compute the inverse discrete Fourier transform from the frequency domain to the time domain. See also *discrete Fourier transform*, *fast Fourier transform*, and *inverse discrete Fourier transform*.
LDPC	An forward error correction process known as Low Density Parity Check..
Mean Time To False Packet Acceptance (MTTFPA)	The average time in which a post FCS check MAC frame will contain errors. The MTTFPA is defined to be greater than 1.4×10^{10} years.
Modulated Spectrum	1) Downstream modulated spectrum – Encompassed spectrum minus the excluded subcarriers within the encompassed spectrum. Excluded subcarriers include any individually excluded subcarriers and all the subcarriers in any exclusion bands. This also is the spectrum comprising all active subcarriers. 2) Upstream modulated spectrum – The spectrum comprising all non-zero-valued subcarriers of a CNU's OFDMA transmission. The width of a transmitted subcarrier is equal to the subcarrier spacing.
Modulation Error Ratio (MER)	The ratio of average signal constellation power to average constellation error power – that is, digital complex baseband signal-to-noise ratio – expressed in decibels. MER is a measure of the cluster variance that exists in a transmitted or received waveform at the output of an ideal receive matched filter. MER includes the effects of all discrete spurious, noise, carrier leakage, clock lines, synthesizer products, linear and nonlinear distortions, other undesired transmitter and receiver products, ingress, and similar in-channel impairments.
Next Codeword Pointer (NCP)	A message block contained within a downstream PHY Link message used to identify where a data codeword begins in the next downstream cycle.
Node	A bi-directional optical-to-electrical RF interface between a fiber optic cable and the coaxial cable distribution network. Also called fiber node.

Occupied Bandwidth	1) Downstream – The sum of the bandwidth in all standard channel frequency allocations (e.g., 6 MHz or 8MHz spaced television channels) that are occupied by the OFDM channel. Even if one active subcarrier of an OFDM channel is placed in a given standard channel frequency allocation, that standard channel frequency allocation in its entirety is said to be occupied by the OFDM channel. 2) Upstream – For a single OFDMA channel, the sum of the bandwidth in all the subcarriers of that OFDMA channel which are not excluded calculated as the number of subcarriers which are not excluded, multiplied by the subcarrier spacing.
Orthogonal Frequency Division Multiplexing (OFDM)	A data transmission method in the downstream direction in which a large number of closely-spaced or overlapping very-narrow-bandwidth orthogonal QAM signals are transmitted within a given channel. Each of the QAM signals, called a subcarrier, carries a small percentage of the total payload at a very low data rate.
Orthogonal Frequency Division Multiple Access (OFDMA)	An OFDM-based multiple-access scheme in which different subcarriers or groups of subcarriers are assigned to different devices in the upstream direction.
OFDMA Frame	In the upstream: a grouping of a number of repeating (M) consecutive OFDMA symbols. A frame comprises either a group of probing symbols or a column of Resource Blocks across the spectrum of the OFDMA channel. Multiple CNUs can share the same OFDMA frame simultaneously by transmitting data and pilots on allocated subcarriers within the frame. The value M is configured by the CLT via the PHY Link.
OFDM Symbol	See *symbol duration*.
PHY Link Channel (PLC)	A set of contiguous OFDM subcarriers constituting a "sub-channel" of the OFDM or OFDMA channel used to exchange physical layer management parameters between the CLT and one or more CNUs. The PLC is separate from the *data channel*. *[Note: need to fin PHY Link, pilots, and any guard bands, etc. In this definition?]*
PHY Link Channel Frame	In downstream OFDM transmission, a repeating group of 128 consecutive OFDM symbols, signaled as the beginning of the first OFDM symbol containing the PHY Link preamble. The PHY Link channel frame establishes the downstream OFDM frame for the data channel. *[Note: sanity check on alignment of preamble, etc, needed.]*
Pilot	A dedicated OFDM subcarrier that may be used for such purposes as channel estimation (measurement of channel condition), synchronization, and other purposes. See also *complementary pilots*, *continuous pilots* and *scattered pilots*.
Preamble	A data sequence transmitted at or near the beginning of a frame, allowing the receiver time to achieve lock and synchronization of transmit and receive clocks.
Pre-equalizer	See *adaptive pre-equalizer*.
Profile	The set of parameters that defines how information is transmitted from a CLT to a CNU or from a CNU to a CLT. Elements of a profile include: modulation order, forward error correction, preamble, and guard interval. *[Note: need to refine when we define what is in a profile.]*
Propagation Delay	The time required for a signal to propagate between the CLT and a CNU over the network. Also called transit delay.
Pseudo Random Binary Sequence (PRBS)	A deterministic sequence of bits that appears to be random, that is, with no apparent pattern. Also called pseudo random bit stream.

QAM Signal	Analog RF signal that uses quadrature amplitude modulation to convey information such as digital data.
Quadrature (Q)	The imaginary part of a vector that represents a signal, with 90 degrees phase angle relative to a reference carrier. See also *in-phase (I).*
Quadrature Amplitude Modulation (QAM)	A modulation technique in which an analog signal's amplitude and phase vary to convey information, such as digital data. The name "quadrature" indicates that amplitude and phase can be represented in rectangular coordinates as in-phase (I) and quadrature (Q) components of a signal.
Quadrature Phase Shift Keying (QPSK)	A form of digital modulation in which four phase states separated by 90 degrees support the transmission of two bits per symbol. Also called 4-QAM.
Randomizer	A process (also known as a scrambler), in which the data to be transmitted is randomized using a PRBS scrambler. Randomization spreads out the energy across the spectrum, ensures uniform population of all of the data constellation points, and minimizes the likelihood of long strings of all zeros or ones.
Resource Block (RB)	In the upstream OFDMA channel, a frequency and time grouping of *resource elements* defined by a dedicated set of (N) contiguous subcarriers and a consecutive number of (M) symbols defined by the *OFDMA frame* length. There are multiple non-overlapping Resource Blocks defined for each OFDMA frame. A CNU may be assigned to transmit in one or more contiguous Resource Blocks in an OFDMA frame. The allocation (profile) of RBs within the OFDMA frame is known by the CLT and each CNU and is configured via management.
Resource Element (RE)	In the upstream OFDMA channel, a one-subcarrier by one-symbol element that is allocated within *a resource block* and used to convey a portion of the upstream signal; e.g. data, pilot, or burst marker information.
Return	See *upstream*.
Return Loss (R)	The ratio of incident power P_I to reflected power P_R, expressed mathematically as $R = 10\log_{10}(P_I/P_R)$, where R is return loss in decibels.
Reverse	See *upstream*.
RF Channel	See *channe*l.
Roll-off Period (RP)	Duration in microseconds, or the equivalent number of IFFT output sample periods, used for the ramping up (or ramping down) transition region of the Tukey raised-cosine window, which is applied at the beginning (and end) of an OFDM symbol. In the case of no transmit windowing, the roll-off duration is zero and there are no samples in the roll-off period.
Scattered Pilots	Pilots that do not occur at the same frequency in every symbol that are used for channel estimation. The locations of scattered pilots change from one OFDM symbol to another following a pattern known by the CLT and each CNU.
Scrambler	See *randomizer*.
Signal-To-Composite Noise (SNC)	The ratio of signal power to composite noise power in a defined measurement bandwidth, where composite noise is the combination of thermal noise and composite intermodulation distortion (noise-like distortion).
Standard Frequencies (STD)	Used in North America, the method of spacing channels on a cable television system defined in [CEA-542-D]. Channels 2-6 and 7-13 use the same frequencies as over-the-air channels 2-6 and 7-13. Other cable channels below Ch. 7 down to 91.25 MHz and above Ch. 13 are spaced in 6 MHz increments. *[Note: only keep above if STD is used in the draft. If kept, provide CEA reference]*

Subcarrier	One of a large number of closely spaced or overlapping orthogonal narrow-bandwidth data signals within an OFDM channel. Also called a tone. See also *excluded subcarrier*, *unused subcarrier*, and *used subcarrier*.
Symbol Duration	Sum of the FFT duration and cyclic prefix duration.
Tap	1) In the feeder portion of a coaxial cable distribution network, a passive device that comprises a combination of a directional coupler and splitter to "tap" off some of the feeder cable RF signal for connection to the subscriber drop. So-called self-terminating taps used at feeder ends-of-line are splitters only and do not usually contain a directional coupler. Also called a multitap. 2) The part of an adaptive equalizer where some of the main signal is "tapped" off, and which includes a delay element and multiplier. The gain of the multipliers is set by the equalizer's coefficients. 3) One term of the difference equation in a finite impulse response or an infinite impulse response filter. The difference equation of a FIR follows: $y(n) = b_0x(n) + b_1x(n-1) + b_2x(n-2) + \ldots + b_Nx(n-N)$.
Thermal Noise	The fluctuating voltage across a resistance due to the random motion of free charge caused by thermal agitation. Also called Johnson-Nyquist noise. When the probability distribution of the voltage is Gaussian, the noise is called additive white Gaussian noise (AWGN).
Unused Subcarrier	Subcarriers in an upstream OFDMA channel which are not excluded, but are not assigned to Resource Blocks. Unused subcarriers do not convey data and may be used for probe signals.
Upstream **Upstream Channel**	The direction of RF signal transmission from a CNU to the CLT. Also called return or reverse.
Used Subcarrier	An upstream subcarrier that is part of a Resource Block. The cable modem transmits data, ranging, and probes on these subcarriers as directed by the CLT.
Useful Symbol Duration	See *FFT duration*.
Windowing	A technique to shape data in the time domain, in which a segment of the start of the IFFT output is appended to the end of the IFFT output to taper or roll-off the edges of the data using a raised cosine function. Windowing maximizes the capacity of the channel by sharpening the edges of the OFDM/A signal in the frequency domain.
Word	Information part of a codeword, without parity. See also *codeword*.
Zero Bit-Loaded-Subcarrier	A subcarrier with power but not carrying user data that could be modulated by a PRBS.
Zero-Valued Subcarrier	A subcarrier with no power. See also *excluded subcarrier*.