Glossary of Digital Video Terms

24P: 24 frame per second, progressive scan. This has been the frame rate of motion picture film since talkies arrived. It is also one of the rates allowed for transmission in the DVB and ATSC television standards – so they can handle film without needing any frame-rate change (3:2 pull-down for 60 fields-per-second systems or running film at 25fps for 50 Hz systems). It is now accepted as a part of television production formats – usually associated with high definition 1080 lines, progressive scan. A major attraction is a relatively easy path from this to all major television formats as well as offering direct electronic support for motion picture film and D-cinema.

24Psf: 24 frame per second, progressive segmented frame. A 24P system in which each frame is segmented – recorded as odd lines followed by even lines. Unlike normal television, the odd and even lines are from the same snapshot in time – exactly as film is shown today on 625/50 TV systems. This way the signal is more compatible (than normal progressive) for use with video systems, e.g. VTRs, SDTI or HD-SDI connections, mixers/switchers etc., which may also handle interlaced scans. It can also easily be viewed without the need to process the pictures to reduce 24-frame flicker.

3:2 pull-down: Method used to map the 24 fps of film onto the 30 fps (60 fields) of 525-line TV, so that one film frame occupies three TV fields, the next two, etc. It means the two fields of every other TV frame come from different film frames making operations such as rotoscoping impossible, and requiring care in editing. Some sophisticated equipment can unravel the 3:2 sequences to allow frame-by-frame treatment and subsequently re-compose 3:2. The 3:2 sequence repeats every five TV frames and four film frames, the latter identified as A-D. Only film frame A is fully on a TV frame and so exists at one time code only, making it the editable point of the video sequence.

4fsc: Four times the frequency of SC (sub-carrier). The sampling rate of a D2 digital video signal with respect to the sub-carrier frequency of an NTSC or PAL analog video signal. The 4fsc frequency is 14.3 MHz in NTSC and 17.7 MHz in PAL.

4:1:1: This is a set of sampling frequencies in the ratio 4:1:1, used to digitize the luminance and color difference components (Y, R-Y, B-Y) of a video signal. The four represents 13.5 MHz, the sampling frequency of Y, and the ones each 3.75 MHz for R-Y and B-Y.

With the color information sampled at half the rate of the 4:2:2 system, this is generally used as a more economical form of sampling for 525-line picture formats. Both luminance and color difference are still sampled on every line. But the latter has half the horizontal resolution of 4:2:2, while the vertical resolution of the color information is maintained. For 525-line pictures, this means the color is fairly equally resolved in horizontal and vertical directions.

4:2:0: A sampling system used to digitize the luminance and color difference components (Y, R-Y, B-Y) of a video signal. The four represents the 13.5 MHz sampling frequency of Y, while the R-Y and B-Y are sampled at 6.75 MHz--effectively between every other line only (one line is sampled at 4:0:0, luminance only, and the next at 4:2:2).

This is generally used as a more economical system than 4:2:2 sampling for 625-line formats so that the color signals have a reasonably even resolution in the vertical and horizontal directions for that format.

4:2:2: A commonly used term for a component digital video format.

A ratio of sampling frequencies used to digitize the luminance and color difference components (Y, R-Y, B-Y) of a video signal. It is generally used as shorthand for ITU-R 601. The term 4:2:2 describes that for every four samples of Y, there are two samples each of R-Y and B-Y, giving more chrominance bandwidth in relation to luminance compared to 4:1:1 sampling.

ITU-R 601, 4:2:2 is the standard for digital studio equipment and the terms "4:2:2" and "601" are commonly (but technically incorrectly) used synonymously. The sampling frequency of Y is 13.5 MHz and that of R-Y and B-Y is each 6.75 MHz providing a maximum color bandwidth of 3.37 MHz--enough for high-quality chromakeying. The format specifies eight bits of resolution.

The details of the format are specified in the ITU-R BT.601-2 standard document. See also: ITU-R BT.601-2.

4:2:2:4: Same as 4:2:2, but with the addition of a key channel that is sampled four times for every four samples of the luminance channel.

4:4:4: Similar to 4:2:2, except that for every four luminance samples, the color channels are also sampled four times.

4:4:4:4: Similar to 4:2:2:4, except that for every four luminance samples, the color and key channels are also sampled four times.

48sF: 48 segmented frames. The process of taking 24-frame progressive images and deconstructing them to produce 48 interlaced frames each with half of the number of lines of resolution to allow some HDTV processors to pass the signal and for viewing on an interlaced monitor without flicker.

5.1: A type of surround sound. Six discrete audio channels are used: Left, Center, Right, Left Rear (or side) Surround, Right Rear (or side) Surround, and a subwoofer (considered the ".1" as it is limited in bandwidth).

601: See: **ITU-R BT.601-2.**

8-VSB: Eight discrete amplitude level vestigial side-band broadcast transmission technology, used in the ATSC digital television transmission standard. See also: ATSC, VSB and the Engineering & Transmission chapter.

AC-3: See: **Dolby Digital**.

ADC (A-D, A/D, A-to-D): Analog to Digital Conversion. Also referred to as digitization or quantization. The conversion of an analog signal into the digital data representation of that signal--normally for subsequent use in a digital machine. For TV, samples of audio and video are taken, the accuracy of the process depending on both the sampling frequency and the

resolution of the analog amplitude information--how many bits are used to describe the analog levels. For TV pictures eight or 10-bits are normally used; for sound, 16 or 20-bits are common, and 24-bits are being introduced. The ITU-R 601 standard defines the sampling of video components based on 13.5 MHz, and AES/EBU defines sampling of 44.1 and 48 kHz for audio.

For pictures, the samples are called pixels, each containing data for brightness and color.

See also: **Binary, Bit.**

AES: Audio Engineering Society that promotes standards in the professional audio industry. International Headquarters--60 East 42nd Street, Room 2520, New York, New York 10165-2520. Tel: 212-661-8528. Fax: 212-682-0477. Email: HQ@aes.org. Internet: www.aes.org.

AES/EBU: Informal name for a digital audio standard established jointly by the AES (Audio Engineering Society) and EBU (European Broadcasting Union) organizations. The sampling frequencies for this standard vary depending on the format being used; the sampling frequency for D1 and D2 audio tracks is 48 kHz.

AIF (Audio Interchange File): An audio file format developed by Apple Computer to store high quality sampled sound and musical instrument information. The AIF files are a popular format for transferring between the Macintosh and the PC.

See also: **AU, WAV**.

Algorithm: A formula or set of steps used to simplify, modify, or predict data. Complex algorithms are used to selectively reduce the high digital audio and video data rates. These algorithms utilize physiologists' knowledge of hearing and eyesight. For example, we can resolve fine detail in a still scene, but our eye cannot resolve the same detail in a moving scene. Using knowledge of these limitations, algorithms are formulated to selectively reduce the data rate without affecting the viewing experience.

See also: **Compression, MPEG**.

Aliasing: Defects or distortion in a television picture. In analog video, aliasing is typically caused by interference between two frequencies such as the luminance and chrominance frequencies or the chrominance and field scanning frequencies. It appears as moirŽ or herringbone patterns, straight lines that become wavy, or rainbow colors. In digital video, aliasing is caused by insufficient sampling or poor filtering of the digital video. Defects are typically seen as jagged edges on diagonal lines and twinkling or brightening (beating) in picture detail.

Alpha channel: A relative transparency value. Alpha values facilitate the layering of media object on top of each other. In a four digit digital sampling structure (4:2:2:4) the alpha channel is represented by the last digit.

Analog: 1. An adjective describing any signal that varies continuously as opposed to a digital signal, which contains discrete levels. 2. A system or device that operates primarily on analog signals.

Anti-aliasing: The smoothing and removing of aliasing effects by filtering and other techniques. Most, but not all, DVEs and character generators contain anti-aliasing facilities.

Archive: Off-line storage of video/audio onto backup tapes, floppy disks, optical disks, etc.

Artifacts: Undesirable elements or defects in a video picture. These may occur naturally in the video process and must be eliminated in order to achieve a high-quality picture. Most common in analog are cross color and cross luminance. Most common in digital are macroblocks, which resemble pixilation of the video image.

ASCII: American Standard Code for Information Interchange. A standard code for transmitting data, consisting of 128 letters, numerals, symbols, and special codes each of which is represented by a unique binary number.

ASIC: Application specific integrated circuit. An integrated circuit designed for special rather than general applications.

Aspect ratio: The ratio of television picture width to height. In NTSC and PAL video, the present standard is 4:3. In widescreen video, it is typically 16:9, however, 14:9 has been used as a transition.

Asynchronous: Lacking synchronization. In video, a signal is asynchronous when its timing differs from that of the system reference signal. A foreign video signal is asynchronous before it is treated by a local frame synchronizer.

ATM: Asynchronous Transfer Mode. A data transmission scheme using self-routing packets of 53 bytes, 48 of which are available for user data. Typically 25, 155, and 622 Mbps--the latter of which could be used to carry non-compressed ITU-R 601 video as a data file.

ATSC: Advanced Television Systems Committee. Formed to establish technical standards for advanced television systems, including digital high definition television (HDTV). 1750 K Street NW, Suite 800, Washington, DC 20006. Tel: 202-828-3130. Fax: 202-828-3131. Email: atsc@atsc.org. Internet: www.atsc.org.

ATSC Formats are 18 voluntary video formats, known as Table 3.

The U.S. digital television transmission standard using MPEG-2 compression and the audio surround-sound compressed with Dolby Digital (AC-3). So that a wide variety of source material, including that from computers, can be best accommodated, two line standards are included--each operating at 24, 30, and 60 Hz.

The Consumer Electronics Manufacturers Association (CEMA) has said that all receivers will be capable of operating with all of the formats.

All pixels are square and pixel sampling rates vary, but all are around 75 MHz. There is a Transport Layer that packages video, audio and auxiliary data and allows their mix to be dynamically varied--opening the door to new services and forms of programming (e.g., many channels of stereo audio, distribution of computer software, or very high resolution images).

The data is compressed to 19.39 Mbits per second and delivered using a 6 MHz bandwidth channel. HD and SD assignments are per ATSC announcement on February 20, 1998.

Note that 1,088 lines are actually coded in order to satisfy the MPEG-2 requirement that the coded vertical size be a multiple of 16 (progressive scan) or 32 (interlaced scan).

See also: **HD0, HD1, HD2, MPEG-2, HDTV**.

Attached: A physical channel of a digital picture manipulator is attached to a logical channel of a controller if the physical channel is successfully acquired by the controller. A physical channel may be attached to only one logical channel of one controller at a time.

ATV: Advanced television. Digital television, including standard, enhanced and high-definition versions.

AU (also SND): Interchangeable audio file formats used in the Sun Sparc station, Nest and Silicon Graphics (SGI) computers. Essentially a raw audio data format proceeded by an identifying header. The .au file is cross-platform compatible.

See also: **AIF, WAV.**

Autotiming: Capability of some digital video equipment to automatically adjust input video timing to match a reference video input. Eliminates the need for manual timing adjustments.

AVI: Audio video interleaving. The Microsoft Video for Windows file format for combining video and audio into a single block in time such as a 1/30th second video frame. In this file format, blocks of audio data are woven into a stream of video frames. ASF is intended to supersede AVI.

AVO: Audiovisual object. In MPEG-4, audiovisual objects (also AV objects) are the individual media objects of a scene--such as video objects, images, and 3D objects. AVOs have a time dimension and a local coordinate system for manipulating the AVO are positioned in a scene by transforming the object's local coordinate system into a common, global scene coordinate system.

Axis: Relating to digital picture manipulation, the X axis is a horizontal line across the center of the screen, the Y axis is a vertical line, and the Z axis is in the third dimension, perpendicular to the X and Y axes, and indicates depth and distance.

B frames: Bi-directional predictive frames used in the MPEG-2 signal. These are composed by assessing the difference between the previous and the next frames in a television picture sequence. As they contain only predictive information, they do not make up a complete picture and so have the advantage of taking up much less data than the I frames. However, to see that original picture requires a whole sequence of MPEG-2 frames to be decoded.

See also: **I frames, P frames, MPEG.**

Back channel: A means of communication from users to content providers. At the same time that content providers are transmitting interactive television (analog or digital) to users, users can connect through a back channel to a Web site--for example, for the original content

provider or an advertiser. The back channel can be used to provide feedback, purchase goods and services, and so on. A simple type of back channel is an Internet connection using a modem.

Bandwidth: 1. The complete range of frequencies over which a circuit or electronic system can function with minimal signal loss, typically less than 3 dB. 2. The information-carrying capability of a particular television channel. In PAL systems, the bandwidth limits the maximum visible frequency to 5.5 MHz, in NTSC, 4.2 MHz. The ITU-R 601 luminance channel sampling frequency of 13.5 MHz was chosen to permit faithful digital representation of the PAL and NTSC luminance bandwidths without aliasing. In transmission, the United States analog and digital television channel bandwidth is 6 MHz.

Baseband: A signaling technique in which the signal is transmitted in its original form and not changed by modulation. Local Area Networks as a whole fall into two categories: baseband and broadband. Baseband networks are simpler and cheaper; the entire bandwidth of the LAN cable is used to transmit a single digital signal. In broadband networks, the capacity of the cable is divided into channels, which can transmit many simultaneous signals. Broadband networks may transmit a mixture of digital and analog signals, as will be the case in hybrid fiber/coax interactive cable television networks.

Baud: A unit of signaling speed equal to the number of signal events per second. Baud is equivalent to bits per second in cases where each signal event represents exactly one bit. Often the term baud rate is used informally to mean baud, referring to the specified maximum rate of data transmission along an interconnection. Typically, the baud settings of two devices must match if the devices are to communicate with one another.

BCD: Binary coded decimal. A coding system in which each decimal digit from 0 to 9 is represented by four binary (0 or 1) digits.

Bel: A measure of voltage, current, or power gain. One bel is defined as a tenfold increase in power. If an amplifier increases a signal's power by 10 times, its power gain is 1 bel or 10 decibels (dB). If power is increased by 100 times, the power gain is 2 bels or 20 decibels. 3 dB is considered a doubling.

BER: Bit error rate.

Betacam: An analog component VTR system using a 1/2-inch tape cassettes. This was developed by Sony and is marketed by them and several other manufacturers. Although recording the Y, R-Y and B-Y component signals onto tape many machines are operated with coded (PAL or NTSC) video in and out. The system has continued to be developed over the years to offer models for the industrial and professional markets as well as full luminance bandwidth (Betacam SP), PCM audio and SDI connections. Digital versions exist as the high-end Digital Betacam and Betacam SX for ENG and similar applications.

Betacam SX: A digital tape recording format developed by Sony which uses a constrained version of MPEG-2 compression at the 4:2:2 profile, Main Level (422P@ML) using 1/2-inch tape cassettes.

BIFS: Binary format for scenes. In MPEG-4, a set of elements called nodes that describe the layout of a multimedia layout BIFS-Update streams update the scene in time, BIFS-Anim streams animate the stream in time. BIFS are organized in a tree-lined hierarchical scene graph node structure derived from VRML.

Binary: A base-2 numbering system using the digits 0 and 1 (as opposed to 10 digits [0 - 9] in the decimal system). In computer systems, the binary digits are represented by two different voltages or currents, one corresponding to 0 and the other corresponding to 1. All computer programs are executed in binary form.

Binary representation requires a greater number of digits than the base 10 decimal system more commonly used. For example, the base 10 number 254 is 11111110 in binary.

The result of a binary multiplication contains the sum of digits of the original numbers. So:

10101111 x 11010100 = 1001000011101100

(In decimal 175 x 212 = 37,100)

(From right to left, the digits represent 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768)

Each digit is known as a bit. This example multiplies two 8-bit numbers to produce a 16-bit result--a very common process in digital television equipment.

See also: **Bit, Byte, Digital**.

BISDN: Broadband integrated services digital network. See: **ISDN.**

Bit: Binary digit. The smallest unit of data in a digital system. A bit is a single one or zero. A group of bits, such as 8-bits or 16-bits, compose a byte. The number of bits in a byte depends upon the processing system being used. Typical byte sizes are 8, 16, and 32.

Bit bucket: Any device capable of storing digital data--whether it be video, audio or other types of data.

Bit budget: The total amount of bits available on the media being used. In DVD, the bit budget of a single sided/single layer DVD5 disk is actually 4.7 GB.

Bit depth: The number of levels that a pixel might have, such as 256 with an 8-bit depth or 1,024 with a 10-bit depth.

Bitmap: 2-D array of pixels representing video and graphics.

Bit parallel: Transmission of digital video a byte at a time down a multi-conductor cable where each pair of wires carries a single bit. This standard is covered under SMPTE 125M, EBU 3267-E, and ITU-R BT.656 (CCIR 656).

Bit rate reduction: See: **Compression**.

Bit serial: Transmission of digital video a bit at a time down a single conductor such as coaxial cable. May also be sent through fiber optics. This standard is covered under ITU-R BT.656 (CCIR 656).

Bit slippage: 1. Occurs when word framing is lost in a serial signal so that the relative value of a bit is incorrect. This is generally reset at the next serial signal (TRS-ID for composite and EAV/SAV for component). 2. The erroneous reading of a serial bit stream when the recovered clock phase drifts enough to miss a bit. 3. A phenomenon that occurs in parallel digital data buses when one or more bits get out of time in relation to the rest. The result is erroneous data. Differing cable lengths is the most common cause.

Bit stream: A continuous series of bits transmitted on a line.

Block: Rectangular area of picture, usually 8 x 8 pixels in size, which are individually subjected to DCT coding as part of a digital picture compression process.

Artifact of compression generally showing momentarily as misplaced rectangular areas of picture with distinct boundaries. This is one of the major defects of digital compression, its visibility generally depending on the amount of compression used, the quality of the original signal, and the quality of the coder. The visible blocks may be 8 x 8 DCT blocks or "misplaced blocks"--16 x 16 pixel macroblocks, due to the failure of motion prediction/estimation in encoder or other motion vector system, such as a standards converter.

See also: **DCT, JPEG, Macroblock, MPEG-2.**

Boot up: To start up. Most computers contain a system operating program that they read out of memory and operate from after power up or restart. The process of reading and running that program is called boot up.

BPSK: Bi-phase shift keying. BPSK is a digital frequency modulation technique used for sending data over a coaxial cable network. This type of modulation is less efficient--but also less susceptible to noise--than similar modulation techniques, such as QPSK and 64QAM.

Broadband: 1. A response that is the same over a wide range of frequencies. 2. Capable of handling frequencies greater than those required for high-grade voice communications (higher than 3 to 4 kilohertz).

Broadcast FTP Protocol (BFTP): A one-way IP multicast based resource transfer protocol, the unidirectional Broadcast File Transfer Protocol (BFTP) is a simple, robust, one-way resource transfer protocol that is designed to efficiently deliver data in a one-way broadcast-only environment. This transfer protocol is appropriate for IP multicast over television vertical blanking interval (IPVBI), in IP multicast carried in MPEG-2, like with the DVB multiprotocol encapsulation, or in other unidirectional transport systems. It delivers constant bitrate (CBR) services or opportunistic services, depending on the characteristics and features of the transport stream multiplexor or VBI insertion device.

Buffer: 1. A circuit or component that isolates one electrical circuit from another. 2. A digital storage device used to compensate for a difference in the rate of flow of information or the time of occurrence of events when transmitting information from one device to another. 3. In

telecommunications, a protective material used in cabling optical fiber to cover and protect the fiber. The buffer material has no optical function.

Buffer overload: See: Video coder overload.

Bus: A group of conductors that together constitute a major signal path. A signal path to which a number of inputs may be connected to feed to one or more outputs.

Bus address: A code number sent out to activate a particular device on a shared communications bus.

BWF Broadcast WAV: An audio file format based on Microsoft's WAV. It can carry PCM or MPEG encoded audio and adds the metadata, such as a description, originator, date and coding history, needed for interchange between broadcasters.

See also: **WAV.**

Byte: A group of data bits that are processed together. Typically, a byte consists of 8, 16, 24 or 32 bits.

1 Byte = 8 bits = 256 discrete values (brightness, color, etc.)

1 kilobyte = 210 bytes = 1,024 bytes: (not 1000 bytes)

1 Megabyte = 220 bytes = 1,048,576 bytes: (not 1 million bytes)

1 Gigabyte = 230 bytes = 1,073,741,824 bytes: (not one billion bytes)

1 Terabyte = 240 bytes = 1,099,511,627,776 bytes: (not one trillion bytes)

A full frame of digital television, sampled according to ITU-R 601, requires just under 1 Mbyte of storage (701 kbytes for 525 lines, 829 kbytes for 625 lines). HDTV frames are 4-to-5 times as large and digital film frames may be that much larger again.

Cable modem: A data modem that uses the bandwidth of a given cable system, which promise speeds of up to 80 times faster than an ISDN line or six times faster than a dedicated T1 line (the type of connection most large corporations use). Because cable modems provide Internet access over cable TV networks (which rely primarily on fiber optic or coaxial cable), they are much faster than modems that use phone lines. Bandwidths are typically up to 30 Mbps in the downstream direction.

Cache: Local or temporary storage.

CBR: Constant bit rate. CBR refers to the delivery of multimedia where there is dedicated bandwidth and the data can be delivered at a guaranteed constant bit rate. MPEG-1 and 2 are designed for CBR delivery. Constant bit rate cannot be assured on the Internet or most Intranets. Protocols such as RSVP are being developed and deployed to provide bandwidth guarantees.

CCD: Charge coupled device. A device that stores samples of analog signals. Used in cameras and telecines as an optical scanning mechanism. Advantages include good sensitivity in low light and absence of burn-in and phosphor lag found in CRTs.

CCIR: Comité Consultatif International des Radiocommunications (International Radio Consultative Committee), an international standards committee no longer in operation and replaced by the International Telecommunications Union (ITU).

CCIR-601: See: **ITU-R BT.601-2**.

CCIR-656: See: **ITU-R BT.656**.

CDDI: Copper data distributed interface. A high speed data interface--like FDDI but using copper.

Channel: 1. A digital effects processing path for video. 2. A particular signal path. 3. A portion of the television broadcast spectrum assigned to a particular broadcasting station.

Channel coding: Data encoding and error correction techniques used to protect the integrity of data that is being transported through a channel. Typically used in channels with high bit error rates such as terrestrial and satellite broadcast and videotape recording.

Checksum: A simple check value of a block of data, calculated by adding all the bytes in a block. It is easily fooled by typical errors in data transmission systems; so that for most applications, a more sophisticated system such as CRC is preferred.

Chromakeying: The process of overlaying one video signal over another, the areas of overlay being defined by a specific range of color, or chrominance, on the foreground signal. For this to work reliably, the chrominance must have sufficient resolution, or bandwidth. PAL or NTSC coding systems restrict chroma bandwidth and so are of very limited use for making a chromakey which, for many years, was restricted to using live, RGB camera feeds. An objective of the ITU-R 601 digital sampling standard was to allow high quality chromakeying in post production. The 4:2:2 sampling system allowed far greater bandwidth for chroma than PAL or NTSC and helped chromakeying, and the whole business of layering, to thrive in post production. High signal quality is still important and anything but very mild compression tends to result in keying errors appearing--especially at DCT block boundaries. Chromakeying techniques have continued to advance and use many refinements, to the point where totally convincing composites can be easily created. You can no longer "see the join" and it may no longer be possible to distinguish between what is real and what is keyed.

See also: **Digital chromakeying**.

Chromininance: The color component of a video signal that includes information about hue and saturation.

CIF: Common image format used to trade content worldwide. 1. For computers the size is 352x240 pixels. 2. For digital high definition, ratified by the International Telecommunications Union (ITU) in June 1999, the 1920x1080 digital sampling structure is a world format. All supporting technical parameters relating to scanning, colorimetry, transfer characteristics, etc.

are universal. The CIF can be used with a variety of picture capture rates: 60p, 50p, 30p, 25p, 24p, as well as 60i and 50i. The standard is identified as ITU-R BT 709-3.

Cinepak: A high-quality medium bandwidth compression that is not real-time but can play back in software. Its 24-bit format produces high-quality video at

320 x 240 resolution and 15 frames per second at a 150 Kbps data rate. Commonly a CD-ROM solution developed a number of years ago and not a competitor to more modern techniques.

Click and drag: A computer term for the user operation of clicking on an item and dragging it to a new location.

Cliff effect: Refers to the abrupt failure of a system over a few dB or less of increasing impairment. In digital television, when a receiver can no longer receive a viable signal.

Clip: 1. In keying, the trigger point or range of a key source signal at which the key or insert takes place. 2. The control that sets this action. To produce a key signal from a video signal, a clip control on the keyer control panel is used to set a threshold level to which the video signal is compared. 3. In digital picture manipulators, a menu selection that blanks portions of a manipulated image that leave one side of the screen and "wraps" around to enter the other side of the screen. 4. In desktop editing, a pointer to a piece of digitized video or audio that serves as source material for editing.

Clip sheet: A nonlinear editing term for the location of individual audio/video clips (or scenes). Also known as a clip bin.

Clock frequency: The master frequency of periodic pulses that are used to synchronize the operation of equipment.

Clock jitter: Undesirable random changes in clock phase.

Clock phase deviation: See: **Clock skew**.

Clock recovery: The reconstruction of timing information from digital data.

Clock skew: A fixed deviation from proper clock phase that commonly appears in D1 digital video equipment. Some digital distribution amplifiers handle improperly phased clocks by re-clocking the output to fall within D1 specifications.

Clone: An exact copy, indistinguishable from the original. As in copying recorded material, for example a copy of a non-compressed recording to another non-compressed recording. If attempting to clone compressed material care must be taken not to decompress it as part of the process or the result will not be a clone.

C/N (also CNR): Carrier-to-noise ratio.

C/N threshold: The C/N at threshold of visibility (TOV) for random noise.

Codec: Coder-decoder. A device that converts analog video and audio signals into a digital format for transmission over telecommunications facilities and also converts received digital signals back into analog format.

Co-channel interference: The interference from a signal on the same channel.

Coding: Representing each video signal level as a number, usually in binary form.

COFDM: Coded orthogonal frequency division multiplexing. Orthogonal Frequency Division Multiplexing (OFDM) is a modulated multi-carrier transmission technique, which splits the available bandwidth into many narrow sub-band channels (typically 2000-8000). Each carrier is modulated by a low rate data stream. The modulation scheme can vary from a simple QPSK to a more complex 64-QAM (or other) depending on the required binary rate and the expected transmission robustness.

For those familiar with Frequency Division Multiple Access (FDMA), OFDM is similar. However, OFDM uses the spectrum much more efficiently by providing a closer packing of the sub-band channels. To achieve this, all the carriers are made orthogonal to one another. By providing for orthogonality of carriers, each carrier has a whole number of cycles over a given symbol period. By doing this, the occupied bandwidth of each carrier has a null at the center frequency of each of the other carriers in the system. This results in minimal interference between the carriers, allowing then to be spaced as close together as is possible. Each individual carrier of the OFDM signal has a narrow bandwidth (for example 1kHz), and the resulting symbol rate is low. This results in the signal having high immunity to multi-path delay spread, as the delay spread must be very long to cause significant inter-symbol interference (> 500 milliseconds).

Coded Orthogonal Frequency Division Multiplexing (COFDM) has the same principle as OFDM except that Forward Error Correction (FEC) is applied to the signal prior to transmission. This overcomes errors in the transmission as a result of lost carriers from multiple propagation effects including frequency selective fading and channel noise.

COFDM can transmit many streams of data simultaneously, each one occupying only a small portion of the total available bandwidth. This approach can have many advantages with proper implementation: 1. Because the bandwidth occupied by each sequence of symbols is relatively small, its duration in time is bigger. As a result, the immunity against multi-path echoes can be higher. 2. Frequency selective fades are spread over many carriers. Instead of completely destroying a number of adjacent symbols, many symbols are instead distorted only slightly. 3 By dividing available bandwidth in multiple narrow sub-bands, the frequency response over each of the individual sub-band channels is essentially flat even with steep multi-path induced fade. This can mean easier equalization requirements.

See also: **DVB and the Engineering & Transmission chapter**.

Collision: The result of two devices trying to use a shared transmission medium simultaneously. The interference ruins both signals, requiring both devices to retransmit the data lost due to the collision.

Co-location: In transmission, one or more transmitters located on the same antenna mast.

Color depth: The number of bits used to represent the color of a pixel and thus how many colors can be displayed. Color depth is typically 8-, 16-, or 24-bit. 8-bit would give 256 colors. A high color pixel requires at lest 24-bit color (1.1164 billion colors).

Color space: The color range between specified references. Typically references are quoted in television: RGB, Y, R-Y, B-Y, YIQ, YUV and Hue Saturation and Luminance (HSL). In print, Cyan, Magenta, Yellow and Black (CMYK) are used. Moving pictures between these is possible but requires careful attention to the accuracy of processing involved. Operating across the media--print, film and TV, as well as between computers and TV equipment--will require conversions in color space.

Color space conversion: The translation of color value form one color space to another. Since different media types, like video and computer graphics, use different color spaces, color space is often performed on the fly by graphics hardware.

Combiner: In digital picture manipulators, a device that controls the way in which two or more channels work together. Under software control, it determines the priority of the channels (which picture appears in front and which in back) and the types of transitions that can take place between them.

Component (video): The normal interpretation of a component video signal is one in which the luminance and chrominance remain as separate components, such as analog components in MII and Betacam VTRs, digital components Y, B-Y, R-Y(Y, Cr, Cb) in ITU-R 601. RGB is also a component signal. Component video signals retain maximum luminance and chrominance bandwidth.

Component digital: A digital representation of a component analog signal set, most often Y, B-Y, R-Y. The encoding parameters are specified by ITU-R BT.601-2 (CCIR 601). The parallel interface is specified by ITU-R BT.656 (CCIR 656) and SMPTE 125M.

Component digital post production: A method of post production that records and processes video completely in the component digital domain. Analog sources are converted only once to the component digital format and then remain in that format throughout the post production process.

Composite (video): Luminance and chrominance are combined along with the timing reference "sync" information using one of the coding standards--NTSC, PAL or SECAM--to make composite video. The process, which is an analog form of video compression, restricts the bandwidths (image detail) of components. In the composite result color is literally added to the monochrome (luminance) information using a visually acceptable technique. As our eyes have far more luminance resolving power than for color, the color sharpness (bandwidth) of the coded single is reduced to far below that of the luminance. This provides a good solution for transmission but it becomes difficult, if not impossible, to accurately reverse the process (decode) into pure luminance and chrominance which limits its use in post production.

Composite digital: A digitally encoded video signal, such as NTSC or PAL video, that includes horizontal and vertical synchronizing information.

Compress: A digital picture manipulator effect where the picture is squeezed (made proportionally smaller).

Compressed serial digital interface (CSDI): A way of compressing digital video for use on SDI-based equipment proposed by Panasonic. Now incorporated into Serial digital transport interface.

See: **Serial digital transport interface.**

Compression: Reduction of the size of digital data files by removing redundant information (lossless) or removing non-critical data (lossy).

Pictures are analyzed looking for redundancy and repetition and so discard unnecessary data. The techniques were primarily developed for digital transmission but have been adopted as a means of handling digital video in computers and reducing the storage demands for digital VTRs. Compression can be at either a set rate or a variable rate. Also known as Bit Rate Reduction (BRR)

Compression artifacts: Compacting of a digital signal, particularly when a high compression ratio is used, may result in small errors when the signal is decompressed. These errors are known as "artifacts," or unwanted defects. The artifacts may resemble noise (or edge "busyness") or may cause parts of the picture, particularly fast moving portions, to be displayed with the movement distorted or missing.

Compressionist: One who controls the compression process to produce results better than would be normally expected from an automated system.

Compression ratio: The ratio of the data in the non-compressed digital video signal to the compressed version. Modern compression techniques start with the ITU-R 601 component digital television signal so the amount of data of the non-compressed video is well defined--76 Gbytes/hour for the 525/60 standard and 75 Gbytes/hour for 625/50.

The compression ratio should not be used as the only method to assess the quality of a compressed signal. For a given technique greater compression can be expected to result in worse quality but different techniques give widely differing quality of results for the same compression ratio. The only sure method of judgment is to make a very close inspection of the resulting pictures.

Concatenation: Linking together (of systems). Although the effect on quality resulting from a signal passing through many systems has always been a concern, the use of a series of compressed digital video systems is, as yet, not well known. The matter is complicated by virtually all digital compression systems differing in some way from each other--hence the need to be aware of concatenation. For broadcast, the current NTSC and PAL analog compression systems will, more and more, operate alongside digital MPEG compression systems used for transmission and, possibly, in the studio.

Even the same brand and model of encoder may encode the same signal in a different manner.

Conditional access: Digital television signals can be scrambled in such a way that they cannot be understood by a conventional decoder. Only when unscrambled by a special system can the original pictures be seen by the viewer. By controlling the operation of the de-scrambling system through the use of a pre-paid access card, or by a transmitted code, the broadcaster can control access to a particular channel or service. Conditional access can be used to control many things from pay-per-view subscription through to target viewing areas. The ATSC specification, at press time, was not complete.

Contouring: Digital video picture defect caused quantizing at too coarse a level.

Contribution quality: The level of quality of a television signal from the network to its affiliates. For digital television this is approximately 45 Mbps.

Core: In fiber optic cable, the core is the light-transmitting material at the center of the fiber.

Co-siting: Relates to SMPTE 125M component digital video, in which the luminance component (Y) is sampled four times for every two samples of the two chrominance components (Cb and Cr). Co-siting refers to delaying transmission of the Cr component to occur at the same time as the second sample of luminance data. This produces a sampling order as follows: Cb1/Y1/Cr1, /Y2/, Cb2/Y3/Cr2, /Y4/, 4:2:2 with co-siting on the first, third, and fifth. Co-siting reduces required bus width from 30 bits to 20 bits.

Coverage area: Coverage area is the area within an NTSC station's Grade B contour without regard to interference from other television stations which may be present. For an ATV station, coverage area is the area contained within the station's noise-limited contour without regard to interference which may be present.

CRC: Cyclic redundant check. Used in data transfer to check if the data has been corrupted. It is a check value calculated for a data stream by feeding it through a shifter with feedback terms "EXORed" back in. It performs the same function as a checksum but is considerably harder to fool.

A CRC can detect errors but not repair them, unlike an ECC--which is attached to almost any burst of data that might possibly be corrupted. They are used on disks, ITU-R 601 data, Ethernet packets, etc.

CSDI: See: Compressed serial digital interface.

D1: A format for component digital video tape recording working to the ITU-R 601, 4:2:2 standard using 8-bit sampling. The tape is 19 mm wide and allows up to 94 minutes to be recorded on a cassette. Being a component recording system it is ideal for studio or post production work with its high chrominance bandwidth allowing excellent chroma keying. Also multiple generations are possible with very little degradation and D1 equipment can integrate without transcoding to most digital effects systems, telecines, graphics devices, disk recorders, etc. Being component there are no color framing requirements. Despite the advantages, D1 equipment is not extensively used in general areas of TV production, at least partly due to its high cost. (Often used incorrectly to indicate component digital video.)

D2: The VTR standard for digital composite (coded) NTSC or PAL signals that uses data conforming to SMPTE 244M. It uses 19 mm tape and records up to 208 minutes on a single cassette. Neither cassettes nor recording formats are compatible with D1. D2 has often been used as a direct replacement for 1-inch analog VTRs. Although offering good stunt modes and multiple generations with low losses, being a coded system means coded characteristics are present. The user must be aware of cross-color, transcoding footprints, low chrominance bandwidths and color framing sequences. Employing an 8-bit format to sample the whole coded signal results in reduced amplitude resolution making D2 more susceptible to contouring artifacts. (Often used incorrectly to indicate composite digital video.)

D3: A composite digital video recording format that uses data conforming to SMPTE 244M. Uses 1/2-inch tape cassettes for recording digitized composite (coded) PAL or NTSC signals sampled at 8 bits. Cassettes are available for 50 to 245 minutes. Since this uses a composite signal the characteristics are generally as for D2 except that the 1/2-inch cassette size has allowed a full family of VTR equipment to be realized in one format, including a camcorder.

D4: A format designation never utilized due to the fact that the number four is considered unlucky (being synonymous with death in some Asian languages).

D5: A VTR format using the same cassette as D3 but recording component signals conforming to the ITU-R BT.601-2 (CCIR 601) recommendations at 10-bit resolution. With internal decoding D5 VTRs can play back D3 tapes and provide component outputs. Being a non-compressed component digital video recorder means D5 enjoys all the performance benefits of D1, making it suitable for high-end post production as well as more general studio use. Besides servicing the current 625 and 525 line TV standards the format also has provision for HDTV recording by use of about 4:1 compression (HD D5).

See also: **HD D5.**

D6: A digital tape format which uses a 19mm helical-scan cassette tape to record uncompressed high definition television material at 1.88 GBps (1.2 Gbps). D6 is currently the only high definition recording format defined by a recognized standard. D6 accepts both the European 1250/50 interlaced format and the Japanese 260M version of the 1125/60 interlaced format which uses 1035 active lines. It does not accept the ITU format of 1080 active lines. ANSI/SMPTE 277M and 278M are D6 standards.

D7: DVCPRO. Panasonic's development of native DV component format which records a 18 micron (18x10-6m, eighteen thousandths of a millimeter) track on 6.35 mm (0.25-inch) metal particle tape. DVCPRO uses native DCT-based DV compression at 5:1 from a 4:1:1 8-bit sampled source. It uses 10 tracks per frame for 525/60 sources and 12 tracks per frame for 625/50 sources, both use 4:1:1 sampling. Tape speed is 33.813mm/s. It includes two 16-bit digital audio channels sampled at 48 kHz and an analog cue track. Both Linear (LTC) and Vertical Interval Time Code (VITC) are supported. There is a 4:2:2 (DVCPRO50) and progressive scan 4:2:0 (DVCPRO P) version of the format, as well as a high definition version (DVCPROHD).

See also: **DVCPRO50, DVCPROHD, DVCPRO P**.

D8: There is no D8. The Television Recording and Reproduction Technology Committee of SMPTE decided to skip D8 because of the possibility of confusion with similarly named digital audio or data recorders (DA-88).

D9 (Formerly Digital-S): A 1/2-inch digital tape format developed by JVC which uses a high-density metal particle tape running at 57.8mm/s to record a video data rate of 50 Mbps. The tape can be shuttled and search up to 32x speed. Video sampled at 4:2:2 is compressed at 3.3:1 using DCT-based intra-frame compression (DV). Two or four audio channels are recorded at 16-bit, 48 kHz sampling; each is individually editable. The format also includes two cue tracks. Some machines can play back analog S-VHS. D9 HD is the high definition version recording at 100 Mbps.

D9 HD: A high definition digital component format based on D9. Records on 1/2-inch tape with 100 Mbps video.

D16: A recording format for digital film images making use of standard D1 recorders. The scheme was developed specifically to handle Quantel's Domino (Digital Opticals for Movies) pictures and record them over the space that sixteen 625 line digital pictures would occupy. This way three film frames can be recorded or played every two seconds. Playing the recorder allows the film images to be viewed on a standard monitor; running at 16x speed shows full motion direct from the tape.

DA-88: A Tascam-brand eight track digital audio tape machine using the 8 mm video format of Sony. It has become the de facto standard for audio post production though there are numerous other formats, ranging from swappable hard drives to analog tape formats and everything in between.

DAC (D-A, D/A, D-to-A): Digital-to-analog converter.

Data compression: A technique that provides for the transmission or storage, without noticeable information loss, of fewer data bits than were originally used when the data was created.

Data recorders: Machines designed to record and replay data. They usually include a high degree of error correction to ensure that the output data is absolutely correct and, due to their recording format, the data is not easily editable. This compares with video recorders which will conceal missing or incorrect data by repeating adjacent areas of picture and which are designed to allow direct access to every frame for editing. Where data recorders are used for recording video there has to be an attendant "workstation" to see the pictures or hear the sound, whereas VTRs produce the signals directly. Although many data recorders are based on VTRs' original designs, and vice versa, VTRs are more efficient for pictures and sound while data recorders are most appropriate for data.

dB (decibel): A measure of voltage, current, or power gain equal to 1/10 of a bel. Given by the equations 20 log Vout/Vin, 20 log Iout/Iin, or 10 log Pout/Pin. See also: Bel.

DBS: Digital broadcast system. An alternative to cable and analog satellite reception initially utilizing a fixed 18-inch dish focused on one or more geostationary satellites. DBS units are able to receive multiple channels of multiplexed video and audio signals as well as programming

information, Email, and related data. DBS typically uses MPEG-2 encoding and COFDM transmission. Also known as digital satellite system.

D-Cinema: Digital cinema. Typically the process of using video at 1080/24p instead of film for production, post production and presentation.

DCT: 1. Discrete cosine transform. A widely used method of data compression of digital video pictures basically by resolving blocks of the picture (usually 8 x 8 pixels) into frequencies, amplitudes, and colors. JPEG and DV depend on DCT. 2. Also an Ampex data videotape format using discrete cosine transform.

DD2: Using D2 tape, data recorders have been developed offering (by computer standards) vast storage of data (which may be images). A choice of data transfer rates is available to suit computer interfaces. Like other computer storage media, images are not directly viewable, and editing is difficult.

DDR: Digital disk recorder. See: Disk recorder.

DDS: Digital data service.

Demultiplexing: Separating elementary streams or individual channels of data from a single muti-channel stream. For example, video and audio streams must be demultiplexed before they are decoded. This is true for multiplexed digital television transmissions.

See also: **Multiplex**.

DEMUX: Demultiplexer. See: Demultiplexing.

Deserializer: A device that converts serial digital information to parallel digital.

Desktop video: Video editing and production done using standard desktop computing platforms running add-on video hardware and software.

D/I: Drop and insert. A point in the transmission where portions of the digital signal can be dropped out and/or inserted.

Diagnostics: Tests to check the correct operation of hardware and software. As digital systems continue to become more complex, built-in automated testing becomes an essential part of the equipment. Some extra hardware and software has to be added to make the tests operate. Digital systems with such provisions can often be quickly assessed by a trained service engineer, so speeding repair.

Digital: Circuitry in which data carrying signals are restricted to either of two voltage levels, corresponding to logic 1 or 0. A circuit that has two stable states: high or low, on or off.

Digital Betacam: A development of the original analog Betacam VTR which records digitally on a Betacam-style cassette. It uses mild intra-field compression to reduce the ITU-R 601 sampled video data by about 2:1. Some models can replay both digital and analog Betacam cassettes.

Digital chromakeying: Digital chromakeying differs from its analog equivalent in that it can key uniquely from any one of the 16 million colors represented in the component digital domain. It is then possible to key from relatively subdued colors, rather than relying on highly saturated colors that can cause color spill problems on the foreground.

A high-quality digital chromakeyer examines each of the three components of the picture and generates a linear key for each. These are then combined into a composite linear key for the final keying operation. The use of three keys allows much greater subtlety of selection than does a chrominance-only key

Digital components: Component video signals that have been digitized.

Digital disk recorder (DDR): A video recording device that uses a hard disk drive or optical disk drive mechanism. Disk recorders offer nearly instantaneous access to recorded material.

Digital effects: Special effects created using a digital video effects (DVE) unit.

Digital parallel distribution amplifier: A distribution amplifier designed to amplify and fan-out parallel digital signals.

Digital-S: See: **D9.**

Digital word: The number of bits treated as a single entity by the system.

Digitizing time: Time taken to record footage into a disk-based editing system, usually from a tape-based analog system, but also from newer digital tape formats without direct digital connections.

D-ILA: Direct Image Light Amplifier. JVC's™ LCOS display device technology.

Distribution quality: The level of quality of a television signal from the station to its viewers. For digital television this is approximately 19.39 Mbps.

Dither: A form of smart conversion from a higher bit depth to a lower bit depth, used in the conversion of audio and graphic files. In the conversion from 24-bit color to 8-bit color (millions of colors reduced to 256), the process attempts to improve on the quality of on-screen graphics with reduced color palettes by adding patterns of different colored pixels to simulate the original color. The technique is also known as "error diffusion," and is applied to audio bit rate reduction and graphic resolution.

DLP: Digital Light Processing. Texas Instrument's™ micro-mirror display solution technology that uses a reflective optical semiconductor to manipulate light digitally.

DLP Cinema: A version of DLP technology specifically developed for digital movie presentation. It contains extended color management and control, and enhanced contrast performance.

DNG: Digital news gathering. Electronic news gathering (ENG) using digital equipment and/or transmission.

DMD: Digital Micro-Mirror Device. Texas Instrument's™ micro-mirror display solution technology that uses an optical semiconductor to manipulate light digitally.

Dolby Digital (formerly Dolby AC-3): The approved 5.1 channel (surround-sound) audio standard for ATSC digital television, using approximately 13:1 compression

Six discrete audio channels are used: Left, Center, Right, Left Rear (or side) Surround, Right Rear (or side) Surround, and a subwoofer (considered the ".1" as it is limited in bandwidth). The bit rate can range from 56 kbps to 640 kbps, typically 64 kbps mono, 192 kbps two-channel, 320 kbps 35mm Cinema 5.1, 384 kbps Laserdisc/DVD 5.1 and ATSC, 448 kbps 5.1.

When moving from analog recording to a digital recording medium, the digital audio coding used yields an amount of data often too immense to store or transmit economically, especially when multiple channels are required. As a result, new forms of digital audio coding--often known as "perceptual coding"--have been developed to allow the use of lower data rates with a minimum of perceived degradation of sound quality.

Dolby's third generation audio coding algorithm (originally called AC-3) is such a coder.

This coder has been designed to take maximum advantage of human auditory masking in that it divides the audio spectrum of each channel into narrow frequency bands of different sizes, optimized with respect to the frequency selectivity of human hearing. This makes it possible to sharply filter coding noise so that it is forced to stay very close in frequency to the frequency components of the audio signal being coded. By reducing or eliminating coding noise wherever there are no audio signals to mask it, the sound quality of the original signal can be subjectively preserved. In this key respect, a coding system like Dolby Digital is essentially a form of very selective and powerful noise reduction.

Dolby E: A new coding system designed specifically for use with video available from Dolby Laboratories. The audio framing is matched to the video framing, which allows synchronous and seamless switching or editing of audio and video without the introduction of gaps or A/V sync slips. All of the common video frame rates, including 30/29.97, 25, and 24/23.976, can be supported with matched Dolby E audio frame sizes. The Dolby E coding technology is intended to provide approximately 4:1 reduction in bit rate. The reduction ratio is intentionally limited so that the quality of the audio may be kept very high even after a number of encode-decode generations. The fact that operations such as editing and switching can be performed seamlessly in the coded domain allows many coding generations to be avoided, further increasing quality.

A primary carrier for the Dolby E data will be the AES/EBU signal. The Dolby E coding will allow the two PCM audio channels to be replaced with eight encoded audio channels. A VTR PCM track pair will become capable of carrying eight independent audio channels, plus the accompanying metadata. The system is also intended to be applied on servers and satellite links. A time delay when encoding or decoding Dolby E is unavoidable. In order to facilitate the provision of a compensating video delay, the audio encoding and decoding delay have been fixed at exactly one frame. When applied with video recording formats which incorporate frame based video encoding, it can be relatively easy to provide for equal video and audio coding delays. When applied with uncoded video, it may be necessary to provide a compensating one frame video delay.

Dolby Surround (Dolby Stereo, & Dolby 4:2:4): Matrix Analog coding of four audio channels--Left, Center, Right, Surround (LCRS), into two channels referred to as Right-total and Left-total (Rt, Lt). On playback, a Dolby Surround Pro Logic decoder converts the two channels to LCRS and, optionally, a subwoofer channel. The Pro Logic circuits are used to steer the audio and increase channel separation. The Dolby Surround system, originally developed for the cinema, is a method of getting more audio channels but suffers from poor channel separation, a mono limited bandwidth surround channel and other limitations. A Dolby Surround track can be carried by analog audio or linear PCM, Dolby Digital and MPEG compression systems.

Down converting: The process which changes the number of pixels and/or frame rate and/or scanning format used to represent an image by removing pixels. Down converting is done from high definition to standard definition.

See also: **Side converting, up converting.**

DQPSK: Differential quadrature phase shift keying. DQPSK is a digital modulation technique commonly used with cellular systems. Motorola's CyberSurfr cable modem uses DQPSK to carry data upstream from the subscriber's computer to the Internet on a narrower frequency band than standard QPSK. Narrower bands allow more upstream channels, so the CyberSurfr has additional noise-free channels to choose from when it's installed.

DRAM: Dynamic RAM (Random Access Memory). High density, cost-effective memory chips (integrated circuits). Their importance is such that the Japanese call them the "rice of electronics." DRAMs are used extensively in computers and generally in digital circuit design, but also for building framestores and animation stores. Being solid state, there are no moving parts and they offer the densest available method for accessing or storing data. Each bit is stored on a single transistor, and the chip must be powered and clocked to retain data.

DS0: Digital signal level zero, 64 kbps.

DS1: A telephone company format for transmitting information digitally. DS1 has a capacity of 24 voice circuits at a transmission speed of 1.544 megabits per second.

See also: **T1.**

DS3: A terrestrial and satellite format for transmitting information digitally. DS3 has a capacity of 672 voice circuits at a transmission speed of 44.736 Mbps (commonly referred to as 45 Mbps). DS3 is used for digital television distribution using mezzanine level compression--typically MPEG-2 in nature, decompressed at the local station to full bandwidth signals (such as HDTV) and then re-compressed to the ATSC's 19.39 Mbps transmission standard.

DSL: Digital subscriber line. The ability to use a standard telephone line to transport data. xDSL is the generic term for each of two varieties: ADSL (asynchronous), where the upstream and downstream data rates are different, and SDSL (synchronous), where the upstream and downstream data rates are the same.

DSS: Digital satellite system. Due to trademark issues, the abbreviation is no longer used. See DBS.

DTT: Digital terrestrial television. The term used in Europe to describe the broadcast of digital television services using terrestrial frequencies.

DTIM: Digital Theatre Interim Mastering Format. An interchange format that allows one digital master to be played on projectors from different manufacturers.

DTV Team, The: Originally Compaq, Microsoft and Intel, later joined by Lucent Technologies. The DTV Team promotes the computer industry's views on digital television--namely, that DTV should not have interlace scanning formats but progressive scanning formats only. (Intel, however, now supports all the ATSC Table 3 formats, including those that are interlace, such as 1080i.) Internet: www.dtv.org.

DV: This digital VCR format is a cooperation between Hitachi, JVC, Sony, Matsushita, Mitsubishi, Philips, Sanyo, Sharp, Thomson and Toshiba. It uses 6.35 mm (0.25-inch) wide tape in a range of products to record 525/60 or 625/50 video for the consumer (DV) and professional markets (Panasonic's DVCPRO, Sony's DVCAM and Digital-8). All models use digital intra-field DCT-based "DV" compression (about 5:1) to record 8-bit component digital video based on 13.5 MHz luminance sampling. The consumer versions, DVCAM, and Digital-8 sample video at 4:1:1 (525/60) or 4:2:0 (625/50) video (DVCPRO is 4:1:1 in both 525/60 and 625/25) and provide two

16-bit/48 or 44.1 kHz, or four 12-bit/32 kHz audio channels onto a 4 hour 30 minutes standard cassette or smaller 1 hour "mini" cassette. The video recording rate is 25 Mbps.

DVB: Digital video broadcasting. The group, with over 200 members in 25 countries, which developed the preferred scheme for digital broadcasting in Europe. The DVB Group has put together a satellite system--DVB-S--that can be used with any transponder, current or planned, a matching cable system--DVB-C, and a digital terrestrial system--DVB-T. Internet: www.dvb.org.

See also: **DVB-T**.

DVB-T: The DVB-T is a transmission scheme for terrestrial digital television. Its specification was approved by ETSI in February 1997 and DVB-T services began in 1998. As with the other DVB standards, MPEG-2 sound and picture coding form the basis of DVB-T. It uses a transmission scheme based on Coded Orthogonal Frequency Division Multiplexing (COFDM), which spreads the signals over a large number of carriers to enable it to operate effectively in very strong multipath environments. The multipath immunity of this approach means that DVB-T can operate an overlapping network of transmitting stations with a single frequency. In the areas of overlap, the weaker of the two received signals is rejected.

See also: **COFDM, DVB**.

DVCAM: Sony's development of native DV which records a 15 micron (15x10-6m, fifteen thousandths of a millimeter) track on a metal evaporated (ME) tape. DVCAM uses DV compression of a 4:1:1 signal for 525/60 (NTSC) sources and 4:2:0 for 625/50 (PAL). Audio is recorded in one of two forms--four 12-bit channels sampled at 32 kHz, or two 16-bit channels sampled at 48 kHz.

DVCPRO: See: **D7**.

DVCPRO50: This variant of DV uses a video data rate of 50 Mbps--double that of other DV systems--and is aimed at the higher quality end of the market. Sampling is 4:2:2 to give enhanced chroma resolution, useful in post production processes (such as chromakeying). Four 16-bit audio tracks are provided. The format is similar to Digital-S (D9).

DVCPRO HD: This variant of DV uses a video data rate of 100 Mbps--four times that of other DV systems--and is aimed at the high definition EFP end of the market. Eight audio channels are supported. The format is similar to D9 HD.

DVCPRO P: This variant of DV uses a video data rate of 50 Mbps--double that of other DV systems--to produce a 480 progressive picture. Sampling is 4:2:0.

DVD: Digital versatile disk: A high density development of the compact disk. It is the same size as a CD but stores from 4.38 GB (seven times CD capacity) on a single sided, single layer disk. DVDs can also be double sided or dual layer-storing even more data. The capacities commonly available at present:

DVD-5: 4.7 GB (1 side, 1 layer)

DVD-9: 8.5 GB (1 side, 2 layers)

DVD-10: 9.4 GB (2 sides, 1 layer each)

DVD-18: 17.0 GB (2 sides, 2 layers)

DVD-R: 4.7 GB (1 side, 1 layer) (write once)

DVD-RAM: 2.6 GB (per side, 1 layer) (rewritable)

***DVD-RAM:** 4.7 GB (per side, 1 layer) (rewritable)

*Expected in 2000.

DVE: Digital video effects. A registered trademark of Nippon Electric Company. Refers to video equipment that performs digital effects such as compression and transformation.

DVTR: Digital videotape recorder.

Dynamic Rounding: The intelligent truncation of digital signals. Some image processing requires that two signals are multiplied, for example in digital mixing, producing a 16-bit result from two original 8-bit numbers (see: Byte). This has to be truncated, or rounded, back to 8-bits. Simply dropping the lower bits can result in visible contouring artifacts especially when handling pure computer generated pictures.

Dynamic Rounding is a mathematical technique for truncating the word length of pixels--usually to their normal 8-bits. This effectively removes the visible artifacts and is non-cumulative on any number of passes. Other attempts at a solution have involved increasing the number of bits, usually to 10, making the LSBs (least significant bit) smaller but only masking the problem for a few generations.

Dynamic Rounding is a licensable technique, available from Quantel and is used in a growing number of digital products both from Quantel and other manufacturers.

EAV: End of active video in component digital systems.

EBU: European Broadcasting Union. An organization of European broadcasters that, among other activities, produces technical statements and recommendations for the 625/50 line television system. CP 67, CH-1218 Grand-Saconnex GE, Switzerland. Tel: 011-41-22-717-2221. Fax: 011-41-22-717-2481. Email: ebu@ebu.ch. Internet: www.ebu.ch.

ECC: Error Check and Correct. A block of check data, usually appended to a data packet in a communications channel or to a data block on a disk, which allows the receiving or reading system both to detect small errors in the data stream (caused by line noise or disk defects) and, provided they are not too long, to correct them.

E-Cinema: Electronic cinema. Term for non-feature film content projected in cinemas.

EDH: Error detection and handling for recognizing inaccuracies in the serial digital signal. It may be incorporated into serial digital equipment and employ a simple LED error indicator.

Electronic Programming Guide (EPG): An application that provides an on-screen listing of all programming and content that an interactive television service subscriber or digital television viewer has available to them.

Embedded audio: Digital audio that is multiplexed and carried within an SDI connection--so simplifying cabling and routing. The standard (ANSI/SMPTE 272M-1994) allows up to four groups each of four mono audio channels. Generally VTRs only support Group 1 but other equipment may use more, for example Quantel's Clipbox server connection to an edit seat uses groups 1-3 (12 channels). 48 kHz synchronous audio sampling is pretty well universal in TV but the standard also includes 44.1 and 32 kHz synchronous and asynchronous sampling. Synchronous means that the audio sampling clock is genlocked to the associated video (8,008 samples per five frames in 525/60, 1,920 samples per frame in 625/50). Up to 24-bit samples are allowed but mostly only up to 20 are currently used. 48 kHz sampling means an average of just over three samples per line, so three samples per channel are sent on most lines and four occasionally--the pattern is not specified in the standard. Four channels are packed into an Ancillary Data Packet and sent once per line (hence a total of 4 x 3 = 12 or 4 x 4 = 16 audio samples per packet per line).

Enhancements: Producers add these to interactive and digital television, as well as other digital content to enhance program material. Examples are supplementary text and graphics that add more depth and richness, or links to reach a Web site, as is done using TV Crossover Links. In analog, the vertical blanking interval (VBI) is used to broadcast enhancements, while in digital, the enhancements are part of the ATSC MPEG-2 stream. Enhancements can be created using industry-standard tools and technologies, like HTML and the ECMA Internet Scripting.

Encryption: The process of coding data so that a specific code or key is required to restore the original data. In broadcast, this is used to make transmissions secure from unauthorized reception as is often found on satellite or cable systems.

Error concealment: In digital video recording systems, a technique used when error correction fails. Erroneous data is replaced by data synthesized from surrounding pixels.

Error correction: In digital video recording systems, a scheme that adds overhead to the data to permit a certain level of errors to be detected and corrected.

Error detection: Checking for errors in data transmission. A calculation is made on the data being sent and the results are sent along with it. The receiver then performs the same calculation and compares its results with those sent. If an error is detected the affected data can be deleted and retransmitted, the error can be corrected or concealed, or it can simply be reported.

Error detection and handling: See: **EDH**.

Essence: The actual program (audio, video and/or data) without metadata.

Ethernet (IEEE 802.3): A type of high-speed network for interconnecting computing devices. Ethernet can be either 10 or 100 Mbps (Fast Ethernet). Ethernet is a trademark of Xerox Corporation, Inc.

Extended Studio PAL: A 625-line video standard that allows processing of component video quality digital signals by composite PAL equipment. The signal can be distributed and recorded in a composite digital form using D2 or D3 VTRs.

FDDI: Fiber Distributed Data Interface. Standards for a 100 Mbps local area network, based upon fiber optic or wired media configured as dual counter rotating token rings. This configuration provides a high level of fault tolerance by creating multiple connection paths between nodes--connections can be established even if a ring is broken.

Fiber bundle: A group of parallel optical fibers contained within a common jacket.

A bundle may contain from just a few to several hundred fibers.

Fiber optics: Thin glass filaments within a jacket that optically transmits images or signals in the form of light around corners and over distances with extremely low losses.

Fibre Channel (also Fiber Channel): A high speed data link planned to run up to 2 Gbps on a fiber optic cable. A number of manufacturers are developing products to utilize the Fiber Channel--Arbitrated Loop (FC-AL) serial storage interface at 1 Gbps so that storage devices such as hard disks can be connected. Supports signaling rates from 132.8 Mbps to 1,062.5 Mbps, over a mixture of physical media including optical fiber, video coax, miniature coax, and shielded twisted pair wiring. The standard supports data transmission and framing protocols for the most popular channel and network standards including SCSI, HIPPI, Ethernet, Internet Protocol, and ATM.

Field: In an interlaced-scanning format, a frame consists of a field of even scan lines or a field of odd scan lines captured or displayed at different times. In a progressive-scanning format, a field is the same as a frame.

See also: **Frame**

FireWire: Apple Computer's trademark for IEEE 1394.

See: **IEEE 1394**.

Fixed data rate compression: Techniques designed to produce a data stream with a constant data rate. Such techniques may vary the quality of quantization to match the allocated bandwidth.

Format conversion: The process of both encoding/decoding and re-sampling digital rates to change a digital signal from one format to another.

Fractual compression: A technique for compressing images that uses fractals. It can produce high quality and high compression ratios. The drawback to fractal compression is that it is computationally expensive, so therefore takes a long time.

Fragmentation: The scattering of data over a disk caused by successive recording and deletion operations. Generally this will eventually result in slow data recall--a situation that is not acceptable for video recording or replay. The slowing is caused by the increased time needed to randomly access data. With such stores, defragmentation routines arrange the data (by copying from one part of the disk to another) so that it is accessible in the required order for replay. Clearly any change in replay, be it a transmission running order or the revision of an edit, could require further de-fragmentation. True random access disk stores, able to play frames in any order at video rate, never need de-fragmentation.

Frame: A frame is one complete image in a sequence of images. In video, the frame captures and displays all pixels and lines of an image. In a progressive-scanning format, there is no decomposition into fields. In an interlaced-scanning format, the frame consists of odd and even line fields, captured or displayed at different times, which in combination contain all pixels and lines of an image. The frame rate of a progressive scan format is twice that of an interlace scan format.

Frame buffer: Memory used to store a complete frame of video.

Frame synchronizer: A digital buffer that, by storage, comparison of sync information to a reference, and timed release of video signals, can continuously adjust the signal for any timing errors.

Freeze: In digital picture manipulators, the ability to stop or hold a frame of video so that the picture is frozen like a snapshot.

Freeze frame: The storing of a single frame of video.

Generation (loss): The signal degradation caused by successive recordings. Freshly recorded material is first generation, one re-recording, or copy, makes the second, etc. This is of major concern in analog linear editing but much less so using a digital suite. Non-compressed component DVTRs should provide at least twenty generations before any artifacts become noticeable, but the very best multi-generation results are possible with disk-based systems.

Generations are effectively limitless. Besides the limitations of recording, the action of processors such as decoders and coders will make a significant contribution to generation loss. The decode/recode cycle of NTSC and PAL is well known for its limitations but equal caution is needed for digital video compression systems, especially those using MPEG, and the color space conversions that typically occur between computers handling RGB and video equipment using Y, Cr, Cb.

See also: **Color space, concatenation, error concealment, error correction, error detection.**

GIF (pronounced jif): Graphics interchange format. A computer graphics file format developed by CompuServe for use in compressing graphic images, now commonly used on the Internet. GIF compression is lossless, supports transparency, but allows a maximum of only 256 colors. Images that will gain the most from GIF compression are those which have large areas (especially horizontal area) with no changes in color.

GoP: See: **Group of pictures**.

Grand Alliance: The United States grouping, formed in May 1993, to produce "the best of the best" initially proposed HDTV systems. The participants are: AT&T, General Instrument Corporation, Massachusetts Institute of Technology, Philips Consumer Electronics, David Sarnoff Research Center, Thomson Consumer Electronics and Zenith Electronics Corporation.

The format proposed is known as the ATSC format.

Group of pictures: In an MPEG signal the GoP is a group of frames between successive I frames, the others being P and/or B frames. In the widest used application, television transmission, the GoP is typically 12 frames but this can vary--a new sequence starting with an I frame may be generated if there is a big change at the input, such as a cut. If desired, SMPTE time code data can be added to this layer for the first picture in a GoP.

H.263: A standard for variable low bit rate coding of video. H.263 is better than MPEG-1/MPEG-2 for low resolutions and low bit rates. H.263 is less flexible than MPEG, but therefore requires much less overhead.

HD-0: A set of formats based partially on the ATSC Table 3, suggested by The DTV Team as the initial stage of the digital television rollout. Pixel values represent full aperture for ITU-R 601.

The DTV Team's HD0 Compression Format Constraints

HD-1: A set of formats partially based on the ATSC Table 3, suggested by The DTV Team as the second stage of the digital television rollout, expected to be formalized in the year 2000. Pixel values represent full aperture for ITU-R 601. (Items in bold have been added to HD-0.)

The DTV Team's HD1 Compression Format Constraints

HD-2: A set of formats partially based on the ATSC Table 3, suggested by The DTV Team as the third stage of the digital television rollout contingent on some extreme advances in video compression over the next five years. Pixel values represent full aperture for ITU-R 601. (Items in bold have been added to HD-1.)

HD D5: A compressed recording system developed by Panasonic which uses compression at about 4:1 to record HD material on standard D5 cassettes. HD D5 supports the 1080 and the 1035 interlaced line standards at both 60 Hz and 59.94 Hz field rates, all 720 progressive line standards and the 1080 progressive line standard at 24, 25 and 30 frame rates. Four uncompressed audio channels sampled at 40 kHz, 20 bits per sample, are also supported.

HDCAM: Sometimes called HD Betacam--is a means of recording compressed high-definition video on a tape format (1/2-inch) which uses the same cassette shell as Digital Betacam, although with a different tape formulation. The technology is aimed specifically at the USA and Japanese 1125/60 markets and supports both 1080 and 1035 active line standards. Quantization from 10 bits to 8 bits and DCT intra-frame compression are used to reduce the data rate. Four uncompressed audio channels sampled at 48 kHz, 20 bits per sample, are also supported.

HDTV: High definition television. The 1,125-, 1,080- and 1,035-line interlace and 720 and 1,080-line progressive formats in a 16:9 aspect ratio. Officially a format is high definition if it has at least twice the horizontal and vertical resolution of the standard signal being used. There is a debate as to whether 480-line progressive is also high definition. It is the opinion of the editors that 480-line progressive is not an HDTV format, but does provide better resolution than 480-line interlace, making it an enhanced definition format.

HFC: Hybrid fiber coax. A type of network that contains both fiber-optic cables and copper coaxial cables. The fiber-optic cables carry TV signals from the head-end office to the neighborhood; the signals are then converted to electrical signals and then go to coaxial cables.

HIPPI: High performance parallel interface. A parallel data channel used in mainframe computers that supports data transfer rates of 100 Mbps.

Huffman coding: This compresses data by assigning short codes to frequently-occurring sequences and longer ones to those less frequent. Assignments are held in a Huffman Table. The more likely a sequence is to occur the shorter will be the code that replaces it. It is widely used in video compression systems where it often contributes a 2:1 reduction in data.

I frames: One of the three types of frames that are used in MPEG-2 coded signals. These contain data to construct a whole picture as they are composed of information from only one frame (intraframe). The original information is compressed using DCT.

See also: **B frames, P frames, MPEG.**

Icon: In desktop computing and editing, a graphic symbol that represents a file, a tool, or a function.

IEEE 1394 (FireWire): A low-cost digital interface originated by Apple Computer as a desktop LAN and developed by the IEEE 1394 working group. Can transport data at 100, 200, or 400 Mbps. One of the solutions to connect digital television devices together at 200 Mbps.

Serial Bus Management provides overall configuration control of the serial bus in the form of optimizing arbitration timing, guarantee of adequate electrical power for all devices on the

bus, assignment of which IEEE 1394 device is the cycle master, assignment of isochronous channel ID, and notification of errors.

There are two types of IEEE 1394 data transfer: asynchronous and isochronous. Asynchronous transport is the traditional computer memory-mapped, load and store interface. Data requests are sent to a specific address and an acknowledgment is returned.

In addition to an architecture that scales with silicon technology, IEEE 1394 features a unique isochronous data channel interface. Isochronous data channels provide guaranteed data transport at a pre-determined rate. This is especially important for time-critical multimedia data where just-in-time delivery eliminates the need for costly buffering.

i.LINK: Sony's trademark for IEEE 1394.

See: **IEEE 1394.**

Illegal colors: Colors that force a color system to go outside its normal bounds. Usually these are the result of electronically painted images rather than direct camera outputs. For example, removing the luminance from a high intensity blue or adding luminance to a strong yellow in a paint system may well send a subsequent NTSC or PAL coded signal too high or low--producing at least inferior results and maybe causing technical problems. Out of gamut detectors can be used to warn of possible problems.

Interactive television: A combination of television with interactive content and enhancements. Interactive television provides better, richer entertainment and information, blending traditional TV-watching with the interactivity of a personal computer. Programming can include richer graphics, one-click access to Web sites through TV Crossover Links, electronic mail and chats, and online commerce through a back channel.

Interframe coding: Data reduction based on coding the differences between a prediction of the data and the actual data. Motion compensated prediction is typically used, based on reference frames in the past and the future.

Interlaced: Short for interlaced scanning. Also called line interlace. A system of video scanning whereby the odd- and even-numbered lines of a picture are transmitted consecutively as two separate interleaved fields. Interlace is a form of compression.

Interpolation (spatial): When re-positioning or re-sizing a digital image inevitably more, less or different pixels are required from those in the original image. Simply replicating or removing pixels causes unwanted artifacts. For far better results the new pixels have to be interpolated--calculated by making suitably weighted averages of adjacent pixels--to produce a more transparent result. The quality of the results will depend on the techniques used and the number of pixels (points--hence 16-point interpolation), or area of original picture, used to calculate the result.

Interpolation (temporal): Interpolation between the same point in space on successive frames. It can be used to provide motion smoothing and is extensively used in standards converters to reduce the judder caused by the 50/60 Hz field rate difference. The technique can also be adapted to create frame averaging for special effects.

Intraframe Coding: Video coding within a frame of a video signal.

See also: **I frames.**

I/O: Input/output. Typically refers to sending information or data signals to and from devices.

IP: See: **TCP/IP**.

ISDB: Integrated services digital broadcasting. Japan's transmission specification for digital broadcasting. ISDB uses a new transmission scheme called BST-OFDM that ensures the flexible use of transmission capacity and service expandability in addition to the benefits of OFDM. Since OFDM uses a large number of carriers that are digitally modulated. It provides sufficient transmission quality under multipath interference. The basic approach of BST-OFDM is that a transmitting signal consists of the required number of narrow band OFDM blocks called BST-segments, each with a bandwidth of 100 kHz.

ISDN: Integrated services digital network. Allows data to be transmitted at high speed over the public telephone network. ISDN operates from the Basic Rate of 64 kbits/sec to the Primary Rate of 2 Mbps (usually called ISDN-30 as it comprises 30 Basic Rate channels). Most of the Western world currently has the capability to install ISDN-2 with 128 kbps and very rapid growth is predicted for ISDN generally. In the television and film industries, audio facilities are already using it. The cost of a call is usually similar to using a normal telephone.

Nominally ISDN operates internationally, but there are variations in standards, service and ISDN adapter technologies. Some operators in the USA use a similar system, Switch 56 (56 kbits/sec and upwards), although the availability of ISDN is becoming wider.

ITU: International Telecommunications Union. An international broadcast standards committee that replaced the CCIR. Place des Nations, CH-1211 Geneva 20, Switzerland. Tel: 011-41-22-730-5111. Fax: 011-41-22-733-7256. Email: itumail@itu.int. Internet: www.itu.int.

ITU-R 601: See: **ITU-R BT.601-2**.

ITU-R BT.601-2: Formerly known as CCIR 601. This international standard defines the encoding parameters of digital television for studios. It is the international standard for digitizing component television video in both 525 and 625 line systems and is derived from the SMPTE RP125. ITU-R 601 deals with both color difference (Y, R-Y, B-Y) and RGB video, and defines sampling systems, RGB/Y, R-Y, B-Y matrix values and filter characteristics. It does not actually define the electro-mechanical interface--see ITU-R BT.656. ITU-R 601 is normally taken to refer to color difference component digital video (rather than RGB), for which it defines 4:2:2 sampling at 13.5 MHz with 720 luminance samples per active line and 8 or 10-bit digitizing. Some headroom is allowed with black at level 16 (not 0) and white at level 235 (not 255)--to minimize clipping of noise and overshoots. Using 8-bit digitizing approximately 16 million unique colors are possible: 28 each for Y (luminance), Cr and Cb (the digitized color difference signals) = 224 = 16,777,216 possible combinations. The sampling frequency of 13.5 MHz was chosen to provide a politically acceptable common sampling standard between 525/60 and 625/50 systems, being a multiple of 2.25 MHz, the lowest common frequency to provide a static sampling pattern for both.

ITU-R BT.656: Formerly known as CCIR 656. The physical parallel and serial interconnect scheme for ITU-R BT.601-2 (CCIR 601). ITU-R BT.656 defines the parallel connector pinouts as well as the blanking, sync, and multiplexing schemes used in both parallel and serial interfaces. Reflects definitions in EBU Tech 3267 (for 625-line signals) and in SMPTE 125M (parallel 525) and SMPTE 259M (serial 525).

ITU-R BT.709-3: Ratified by the International Telecommunications Union (ITU) in June 1999, the 1920x1080 digital sampling structure is a world format. All supporting technical parameters relating to scanning, colorimetry, transfer characteristics, etc. are universal. The CIF can be used with a variety of picture capture rates: 60p, 50p, 30p, 25p, 24p, as well as 60i and 50i.

ITU-R BS.775: An international recommendation for multichannel stereophonic sound systems with and without accompanying picture. This recommendation gives speaker placements for various types of sound systems.

Java: A general purpose programming language developed by Sun Microsystems and best known for its widespread use on the World Wide Web. Unlike other software, programs written in Java can run on any platform type (including set-top boxes), as long as they contain a Java Virtual Machine. Internet: java.sun.com.

See also: **Windows CE.**

Jitter: An undesirable random signal variation with respect to time.

JPEG: Joint Photographic Experts Group. ISO/ITU-T. JPEG is a standard for the data compression of still pictures (intrafield). In particular its work has been involved with pictures coded to the ITU-R 601 standard. JPEG uses DCT and offers data compression of between two and 100 times and three levels of processing are defined: the baseline, extended and "lossless" encoding. See also: Motion-JPEG.

Kell Factor: The vertical definition of a scanned image is only around 70% (the Kell Factor) of the line count due to a scan's inability to show detail occurring between the lines. Note that, for interlaced scans, vertical definition is further reduced by the Interlace Factor to 50% or less overall during most vertical image movement.

Keyframe: A set of parameters defining a point in a transition, such as a DVE effect. For example, a keyframe may define a picture size, position and rotation. Any digital effect must have a minimum of two keyframes, start and finish, although more complex moves will use more--maybe as many as 100. Increasingly, more parameters are becoming "keyframeable," meaning they can be programmed to transition between two, or more, states. Examples are color correction to made a steady change of color, and keyer settings, perhaps to made an object slowly appear or disappear.

Latency: The factor of data access time due to disk rotation. The faster a disk spins the quicker it will be at the position where the required data can start to be read. As disk diameters have decreased so rotational speeds have tended to increase but there is still much variation. Modern 31/2-inch drives typically have spindle speeds of between 3,600 and 7,200 revolutions per minute, so one revolution is completed in 16 or 8 milliseconds (ms) respectively. This is represented in the disk specification as average latency of 8 or 4 ms.

Layered embedded encoding: The process of compressing data in layers such that successive layers provide more information and thus higher quality reconstruction of the original. That is, a single stream of data can supply a range of compression and thus, in the case of video, a scalable range of video resolution and picture quality. This is particularly useful for a multicast where a single stream is sent out and people are connecting over varying bandwidths. The low bandwidth connection can take just the lower layers while the high-bandwidth connection can take all of the layers for the highest quality.

Letterbox: Image of a widescreen picture on a standard 4:3 aspect ratio television screen, typically with black bars above and below. Used to maintain the original aspect ratio of the source material.

See also: **Side panels and pillarbox.**

Live-streaming: Streaming media that is broadcast to many people at a set time.

See also: **On-demand streaming.**p> **Lossless compression:** Reducing the bandwidth required for transmission of a given data rate without loss of any data.

Lossy compression: Reducing the total data rate by discarding data that is not critical. Both the video and audio for DTV transmission will use lossy compression.

LSB: Least significant bit. The bit that has the least value in a binary number or data byte. In written form, this would be the bit on the right.

For example: Binary 1101 = Decimal 13

In this example the right-most binary digit, 1, is the least significant bit--here representing 1. If the LSB in this example were corrupt, the decimal would not be 13 but 12. See also: MSB.

Luminance: The component of a video signal that includes information about its brightness.

Macroblock: In the typical 4:2:0 picture representation used by MPEG-2, a macroblock consists of four eight by eight blocks of luminance data (arranged in a 16 by 16 sample array) and two eight by eight blocks of color difference data which correspond to the area covered by the 16 by 16 section luminance component of the picture. The macroblock is the basic unit used for motion compensated prediction.

MAMA: The Media Asset Management Association. MAMA serves as a advanced user-group and independent international industry consortium, created by and for media producers, content publishers, technology providers, and value-chain partners to develop open content and metadata exchange protocols for digital media creation and asset management. Internet: www.mamgroup.org.

Mbone: Multicast backbone. A virtual network consisting of portions of the Internet in which multicasting has been enabled. The Mbone originated from IEFT in which live audio and video were transmitted around the world. The Mbone is a network of hosts connected to the Internet communicating through IP multicast protocols, multicast-enabled routers, and the point-to-point tunnels that interconnect them.

Megabyte (Mbyte): One million bytes (actually 1,048,576); one thousand kilobytes.

Metadata (side information): Informational data about the data itself. Typically information about the audio and video data included in the signal's data stream.

Mezzanine compression: Contribution level quality encoded high definition television signals. Typically split into two levels: High Level at approximately 140 Mbps and Low Level at approximately 39 Mbps (for high definition within the studio, 270Mbps is being considered). These levels of compression are necessary for signal routing and are easily re-encoded without additional compression artifacts (concatenation) to allow for picture manipulation after decoding. DS3 at 44.736 will be used in both terrestrial and satellite program distribution.

Modem: Modulator/demodulator. A device that transforms a typical two-level computer signal into a form suitable for transmission over a telephone line. Also does the reverse--transforms an encoded signal on a telephone line into a two-level computer signal.

Mole Technology: A seamless MPEG-2 concatenation technology developed by the ATLANTIC project (BBC [U.K.], Centro Studi e Laboratori telecomunicazione [Italy], Ecole Nationale Superieure des Telecommunications [France], Ecole Polytechnique FŽdŽrale de Lausanne [Switzerland], Electrocraft [U.K.], Fraunhofer-Institut fŸr Integrierte Schaltungen [Germany], Instituto de Engenharia de Sistemas e Computadores [Portugal], Snell & Wilcox [U.K.]) in which an MPEG-2 bit stream enters a Mole-equipped decoder, and the decoder not only decodes the video, but the information on how that video was first encoded (motion vectors and coding mode decisions). This "side information" or "metadata" in an information bus is synchronized to the video and sent to the Mole-equipped encoder. The encoder looks at the metadata and knows exactly how to encode the video. The video is encoded in exactly the same way (so theoretically it has only been encoded once) and maintains quality.

If an opaque bug is inserted in the picture, the encoder only has to decide how the bug should be encoded (and then both the bug and the video have been theoretically encoded only once).

Problems arise with transparent or translucent bugs, because the video underneath the bug must be encoded, and therefore that video will have to be encoded twice, while the surrounding video and the bug itself have only been encoded once theoretically.

What Mole can not do is make the encoding any better. Therefore the highest quality of initial encoding is suggested.

Montreux International Television Symposium & Technical Exhibition (TV Montreux): A bi-annual international conference for the television broadcast industry. Internet: www.montreux.ch/symposia/TV/home.html.

Moore's Law: A prediction for the rate of development of modern electronics. This has been expressed in a number of ways but in general states that the density of information storable in silicon roughly doubles every year. Or, the performance of silicon will double every eighteen months, with proportional decreases in cost. For more than two decades this prediction has held true. Moore's law initially talked about silicon but it could be applied to disk drives: the capacity of disk drives doubles every two years. That has been true since 1980, and will

continue well beyond 2000. Named after Gordon E. Moore, physicist, co-founder and chairman emeritus of Intel Corporation.

Motion compensation: The use of motion vectors to improve the efficiency of the prediction of pixel values. The prediction uses motion vectors to provide offsets into past and/or future reference frames containing previously decoded pixels that are used to form the prediction and the error difference signal.

Motion estimation: An image compression technique that achieves compression by describing only the motion differences between adjacent frames, thus eliminating the need to convey redundant static picture information from frame to frame. Used in the MPEG standards.

Motion-JPEG: Using JPEG compressed images as individual frames for motion. For example, 30 Motion-JPEG frames viewed in one second will approximate 30-frame per second video.

MP@HL: Main Profile at High Level for HDTV and is implemented in DVB and ATSC systems with bitstreams running up to 19.4 Mb/s.

MP@ML: Main Profile at Main Level covers broadcast television formats up to 720 pixels x 576 lines and 30 fps so includes 720 x 486 at 30 fps and 720 x 576 at 25 fps. The economy of 4:2:0 sampling is used and bit rates vary from as low as 2 Mb/s on multiplexed transmissions, up to 9 Mb/s on DVD-video.

MOV: The file extension used by MooV format video files on Windows. These MOV files are generated with Apple Computer's QuickTime and played on Windows systems via QuickTime for Windows.

MPEG: Compression standards for moving images conceived by the Motion Pictures Expert Group, an international group of industry experts set up to standardize compressed moving pictures and audio. MPEG-2 is the basis for ATSC digital television transmission.

Its work follows on from that of JPEG to add interfield compression, the extra compression potentially available through similarities between successive frames of moving pictures. Four MPEG standards were originally planned, but the accommodation of HDTV within MPEG-2 has meant that MPEG-3 is now redundant. MPEG-4 is intended for unrelated applications, however, can be used to display ATSC formats on a PC. The main interest for the television industry is in MPEG-1 and MPEG-2. A group of picture blocks, usually four, which are analyzed during MPEG coding to give an estimate of the movement between frames. This generates the motion vectors that are then used to place the macroblocks in decoded pictures.

See also: **B frames, GoP, I frames, P frames.**

MPEG-1: A group of picture blocks, usually four, which are analyzed during MPEG coding to give an estimate of the movement between frames. This generates the motion vectors that are then used to place the macroblocks in decoded pictures. This was designed to work at 1.2 Mbps, the data rate of CD-ROM, so that video could be played from CDs. However the quality is not sufficient for TV broadcast.

MPEG-2: This has been designed to cover a wide range of requirements from "VHS quality" all the way to HDTV through a series of algorithm "profiles" and image resolution "levels." With data rates of between 1.2 and 15 Mbps, there is intense interest in the use of MPEG-2 for the digital transmission of television--including HDTV--applications for which the system was conceived. Coding the video is very complex, especially as it is required to keep the decoding at the reception end as simple and inexpensive as possible. MPEG-2 is the compression used by the ATSC and DVB standards.

MPEG can offer better quality pictures at high compression ratios than pure JPEG compression, but with the complexity of decoding and especially coding and the 12-long group of pictures (GoP), it is not an ideal compression system for editing. If any P or B frames are used then even a cut will require the re-use of complex, and not perfect, MPEG coding. However, MPEG Splicers are beginning to appear to alleviate this difficulty.

Of the six profiles and four levels creating a grid of 24 possible combinations, 12 have already been implemented. The variations these define are so wide that it would not be practical to build a universal coder or decoder. Interest is now focused on the Main profile, Main level, sometimes written as MP@ML, which covers broadcast television formats up to 720 pixels x 576 lines at 30 frames per second. These figures are quoted as maximums so 720 x 486 at 30 frames are included, as are 720 x 576 at 25 frames. As the coding is intended for transmission the economy of 4:2:0 sampling is used.

A recent addition to MPEG-2 is the studio profile. Designed for studio work its sampling is 4:2:2. The studio profile is written as 422P@ML. To improve the picture quality, higher bit rates are used. The first applications for this appear to be in electronic news gathering (ENG), and with some video servers.

See also: **B frames, Compression, GoP, I frames, JPEG, P frames.**

MPEG-4: The third standard developed by MPEG. Started in July 1993 MPEG-4 has benefited from the huge R&D investments made by participating companies and provides a harmonized range of responses to the diverse needs of the digital audio-visual industry, including compatibility with other major standards such as H.263 and VRML.

MPEG 4:2:2: Also referred to as Studio MPEG, Professional MPEG and 442P@ML. Sony's Betacam SX is based on MPEG 4:2:2. See: MPEG-2.

MPEG-7: A standardized description of various types of multimedia information. This description will be associated with the content itself, to allow fast and efficient searching for material that is of interest to the user. MPEG-7 is formally called "Multimedia Content Description Interface." The standard does not comprise the (automatic) extraction of descriptions/features. Nor does it specify the search engine (or any other program) that can make use of the description. It is not a new compression standard, but an attempt to manage motion imaging and multimedia technology.

MPEG-21: The Motion Picture Experts Group's attempt to get a handle on the overall topic of content delivery. By defining a Multimedia Framework from the viewpoint of the consumer, they hope to understand how various components relate to each other and where gaps in the

infrastructure might benefit from new standards. A technical report on the MPEG-21 framework is scheduled for mid-2000.

MPEG IMX: Sony's trademark for a family of devices, such as DVTRs, that are I frame-only 50 Mbps MPEG-2 streams using Betacam style cassettes. Plays Digital Betacam, Betacam SX, Betacam SP, Betacam, and, MPEG IMX, outputting 50 Mbps MPEG I-frame on SDTI-CP regardless of the tape being played. It can also handle other (lower) input and output data rates, but the recordings are 50 Mbps I-frame in any case.

MPEG splicing: The ability to cut into an MPEG bit stream for switching and editing, regardless of type of frames (I, B, P).

MSB: Most significant bit. The bit that has the most value in a binary number or data byte. In written form, this would be the bit on the left.

For example: **Binary 1110 = Decimal 14**

In this example, the left-most binary digit, 1, is the most significant bit--here representing 8. If the MSB in this example were corrupt, the decimal would not be 14 but 6.

See also: **LSB.**

Multicast: 1. Data flow from single source to multiple destinations; a multicast may be distinguished from a broadcast in that number of destinations may be limited. 2. A term often used incorrectly to describe digital television program multiplexing.

Multimedia content description interface: See: **MPEG-7.**

Multipath interference: The signal variation caused when two RF signals take multiple paths from transmitter to receiver. In analog television, this creates ghosting. In digital television, this can cause the receiver not to output a signal as it can not differentiate between signals.

Multipoint: A term used by network designers to describe network links that have many possible endpoints.

Multiplex: 1. To transmit two or more signals at the same time or on the same carrier frequency. 2. To combine two or more electrical signals into a single, composite signal, such as ATSC multicasting.

Multiplexer: Device for combining two or more electrical signals into a single, composite signal.

Mux: See: **Multiplex**.

MXF: The Material Exchange Format is aimed at the exchange of program material between file servers, tape streamers and digital archives. It usually contains one complete sequence but this may comprise a sequence of clips and program segments. There are six operational patterns: Simple, Compiled, Compound, Uncompiled Simple, Uncompiled Compound and Metadata-only.

As MXF is derived from the AAF data model it integrates closely with AAF files as well as stream

formats. Bridging file and streaming transfers, MXF helps move material between AAF file-based post production and streaming program replay using standard networks. This set up extends the reliable essence and metadata pathways of both formats to reach from content creation to playout. The MXF body carries the content. It can include compressed formats such as MPEG and DV as well as uncompressed video and contains an interleaved sequence of picture frames, each with audio and data essence plus frame-based metadata.

MXF has been submitted to the SMPTE as a proposed standard.

Netshow: Microsoft NetShow is a service that runs on Windows NT servers, delivering the high-quality streaming multimedia to users on corporate intranets and the Internet. It consists of server and tools components for delivering audio, video, illustrated audio, and other multimedia types over the network. NetShow provides the foundation for building rich, interactive multimedia applications for commerce, distance learning, news and entertainment delivery, and corporate communications.

Nonlinear: A term used for editing and the storage of audio, video and data. Information (footage) is available anywhere on the media (computer disk or laser disc) almost immediately without having to locate the desired information in a time linear format.

Nonlinear editing: Nonlinear distinguishes editing operation from the "linear" methods used with tape. Nonlinear refers to not having to edit material in the sequence of the final program and does not involve copying to make edits. It allows any part of the edit to be accessed and modified without having to re-edit or re-copy the material that is already edited and follows that point. Nonlinear editing is also non-destructive--the video is not changed but the list of how that video is played back is modified during editing.

NTSC: National television system committee. The organization that developed the analog television standard currently in use in the U.S., Canada, and Japan. Now generally used to refer to that standard. The NTSC standard combines blue, red, and green signals modulated as an AM signal with an FM signal for audio.

NVOD: Near video on demand. Rapid access to program material on demand achieved by providing the same program on a number of channels with staggered start times. Many of the hundreds of TV channels soon to be on offer will be made up of NVOD services. These are delivered by a disk-based transmission server.

Nyquist frequency (Nyquist rate): The lowest sampling frequency that can be used for analog-to-digital conversion of a signal without resulting in significant aliasing. Normally, this frequency is twice the rate of the highest frequency contained in the signal being sampled.

Off-line (editing): A decision-making process using low-cost equipment usually to produce an EDL or a rough cut which can then be conformed or referred to in a high quality on-line suite--so reducing decision-making time in the more expensive on-line environment. While most off-line suites enable shot selection and the defining of transitions such as cuts and dissolves, very few allow settings for the DVEs, color correctors, keyers and layering that are increasingly a part of the on-line editing process.

On-demand streaming: Streaming media content that is transmitted to the client upon request.

See also: **Live streaming.**

On-line (editing): Production of the complete, final edit performed at full program quality--the buck stops here! Being higher quality than off-line, time costs more but the difference is reducing. Preparation in an off-line suite will help save time and money in the on-line. To produce the finished edit on-line has to include a wide range of tools, offer flexibility to try ideas and accommodate late changes, and to work fast to maintain the creative flow and to handle pressured situations.

OC3: Optical Carrier Level 3. A 155 Mbps ATM SONET signal stream that can carry three DS3 signals.

Open Cable: A project aimed at obtaining a new generation of set-top boxes that are interoperable. These new devices will enable a new range of interactive services to be provided to cable customers.

Operating system: The base program that manages a computer and gives control of the functions designed for general purpose usage--not for specific applications. Common examples are MS-DOS and Windows for PCs, Mac OS8 for Apple Macintosh, and UNIX (and its variations IRIX and Linux). For actual use, for example, as a word processor, specific applications software is run on top of the operating system.

Optical disks: Disks using optical techniques for recording and replay of material. These offer large storage capacities on a small area, the most common being the 5-1/4-inch compact disk, being removable and having rather slower data rates than fixed magnetic disks--but faster than floppies. Write Once, Read Many or "WORM" optical disks first appeared with 2 GB capacity on each side of a 12-inch platter--useful for archiving images. In 1989 the read/write magneto-optical (MO) disk was introduced which can be re-written around a million times. With its modest size, just 5-1/4-inches in diameter, the ISO standard cartridge can store 325 MB per side--offering low priced removable storage for over 700 TV pictures per disk. A variant on the technology is the phase change disk but this is not compatible with the ISO standard.

An up-rated MO disk system introduced in 1994 has a capacity of 650 MB per side, 1.3 GB per disk. In 1996 a second doubling of capacity was introduced offering 2.6 GB on a removable disk. Besides the obvious advantages for storing TV pictures this is particularly useful where large format images are used, in print and in film for example.

The NEC DiskCam system uses optical disks for storage.

Oversampling: Sampling data at a higher rate than normal to obtain more accurate results or to make it easier to sample.

P frames: One of the three types of frames used in the coded MPEG-2 signal. These contain only predictive information (not a whole picture) generated by looking at the difference between the present frame and the previous one. They contain much less data than the I

frames and so help towards the low data rates that can be achieved with the MPEG signal. To see the original picture corresponding to a P frame a whole MPEG-2 GoP has to be decoded.

See also: **B frames, I frames and MPEG**.

PAL: Phase alternate line. The television broadcast standard throughout Europe (except in France and Eastern Europe, where SECAM is the standard). This standard broadcasts 625 lines of resolution, nearly 20 percent more than the U.S. standard, NTSC, of 525.

Palette: In 8-bit images or displays, only 256 different can be displayed at any one time. This collection of 256 colors is called the palette. In 8-bit environments, all screen elements must be painted with the colors contained in the palette. The 256-color combination is not fixed--palettes can and do change frequently. But at any one time, only 256 colors can be used to describe all the objects on the screen or image.

Pan and Scan: The technique used to crop a widescreen picture to conventional 4:3 television ratio, while panning the original image to follow the on-screen action.

Pan and Scanner: One who pans and scans, typically during a live event originating in a widescreen format (16:9) but simulcast in 4:3.

Parallel: One transmission path for each bit.

Parallel cable: A multi-conductor cable carrying simultaneous transmission of digital data bits. Analogous to the rows of a marching band passing a review point.

Parallel data: Transmission of data bits in groups along a collection of wires (called a bus). Analogous to the rows of a marching band passing a review point. A typical parallel bus may accommodate transmission of one 8-, 16-, or 32-bit byte at a time.

Parallel digital: A digital video interface which uses twisted pair wiring and 25-pin D connectors to convey the bits of a digital video signal in parallel. There are various component and composite parallel digital video formats.

Parity: A method of verifying the accuracy of transmitted or recorded data. An extra bit appended to an array of data as an accuracy check during transmission. Parity may be even or odd. For odd parity, if the number of 1's in the array is even, a 1 is added in the parity bit to make the total odd. For even parity, if the number of 1's in the array is odd, a 1 is added in the parity bit to make the total even. The receiving computer checks the parity bit and indicates a data error if the number of 1s does not add up to the proper even or odd total.

PCM: Pulse code modulation. A method by which sound is digitally recorded and reproduced. Sounds are reproduced by modulating (changing) the playback rate and amplitude of the sampled (stored) digital pulses (waves). This enables the PCM sound to be reproduced with a varying pitch and amplitude.

Picture: A source image or reconstructed data for a single frame or two interlaced fields. A picture consists of three rectangular matrices of eight-bit numbers representing the luminance and two color difference signals.

PID: Packet identifier. The identifier for transport packets in MPEG-2 Transport Streams.

Pillarbox: Describes a frame that the image fails to fill horizontally (a 4:3 image on a 16:9 screen), in the same way that a letterbox describes a frame that the image fails to fill vertically (a 16:9 image on a 4:3 screen)

See also: **Letterbox and side panels.**

Pixel: A shortened version of "Picture cell" or "Picture element." The name given to one sample of picture information. Pixel can refer to an individual sample of R, G, B luminance or chrominance, or sometimes to a collection of such samples if they are co-sited and together produce one picture element.

Plant native format: A physical plant's highest video resolution.

Point-to-multipoint: An arrangement, either permanent or temporary, in which the same data flows or is transferred from a single origin to multiple destinations; the arrival of the data at all the destinations is expected to occur at the same time or nominally the same time.

Pre-read: See: Read before write.

Progressive: Short for progressive scanning. A system of video scanning whereby lines of a picture are transmitted consecutively, such as in the computer world.

Protocol: Set of syntax rules defining exchange of data including items such as timing, format, sequencing, error checking, etc.

PSIP: Program and system information protocol. A part of the ATSC digital television specification that enables a DTV receiver to identify program information from the station and use it to create easy-to-recognize electronic program guides for the viewer at home. The PSIP generator insert data related to channel selection and electronic program guides into the ATSC MPEG transport stream.

See also: **Electronic Program Guide**.

QAM: Quadrature amplitude modulation. A downstream digital modulation technique that conforms to the International Telecommunications Union (ITU) standard ITU-T J. 83 Annex B which calls for 64 and 256 quadrature amplitude modulation (QAM) with concatenated trellis coded modulation, plus enhancements such as variable interleaving depth for low latency in delay sensitive applications such as data and voice. Using 64 QAM, a cable channel that today carries one analog video channel could carry 27 Mbps of information, or enough for multiple video programs. Using 256 QAM, the standard 6 MHz cable channel would carry 40 Mbps.

See also: **The Engineering & Transmission chapter**.

QPSK: Quadrature phase shift keying. QPSK is a digital frequency modulation technique used for sending data over coaxial cable networks. Since it's both easy to implement and fairly resistant to noise, QPSK is used primarily for sending data from the cable subscriber upstream to the Internet.

Quantization: The process of sampling an analog waveform to convert its voltage levels into digital data.

Quantizing: The process of converting the voltage level of a signal into digital data before or after the signal has been sampled.

Quantizing error: Inaccuracies in the digital representation of an analog signal. These errors occur because of limitations in the resolution of the digitizing process.

Quantizing noise: The noise (deviation of a signal from its original or correct value) which results from the quantization process. In serial digital video, a granular type of noise that occurs only in the presence of a signal.

QuickTime: Apple Computer's system-level software architecture supporting time-based media, giving a seamless integration of video, sound, and animation. For Macintosh and Windows computers.

RAID: Redundant array of independent disks. A grouping of standard disk drives together with a RAID controller to create storage that acts as one disk to provide performance beyond that available from individual drives. Primarily designed for operation with computers RAIDs can offer very high capacities, fast data transfer rates and much-increased security of data. The latter is achieved through disk redundancy so that disk errors or failures can be detected and corrected.

A series of RAID configurations is defined by levels and, being designed by computer people, they start counting from zero. Different levels are suited to different applications.

Level 0: No redundancy--benefits only of speed and capacity--generated by combining a number of disks. Also known as "striping."

Level 1 Complete mirror system--two sets of disks both reading and writing the same data. This has the benefits of level 0 plus the security of full redundancy--but at twice the cost. Some performance advantage can be gained in read because only one copy need be read, so two reads can occur simultaneously.

Level 2: An array of nine disks. Each byte is recorded with one bit on each of eight disks and a parity bit recorded to the ninth. This level is rarely, if ever, used.

Level 3: An array of n+1 disks recording 512 byte sectors on each of the n disks to create n x 512 "super sectors" + 1 x 512 parity sector on the additional disk which is used to check the data.

The minimum unit of transfer is a whole superblock. This is most suitable for systems in which large amounts of sequential data are transferred--such as for audio and video. For these it is the most efficient RAID level since it is never necessary to read/modify/write the parity block. It is less suitable for database types of access in which small amounts of data need to be transferred at random.

Level 4: The same as Level 3 but individual blocks can be transferred. When data is written it is necessary to read the old data and parity blocks before writing the new data as well as the updated parity block, which reduces performance.

Level 5: The same as Level 4, but the role of parity the disk is rotated for each block. In level 4 the parity disk receives excessive load for writes and no load for reads. In Level 5 the load is balanced across the disks.

Soft RAID: A RAID system implemented by low level software in the host system instead of a dedicated RAID controller. While saving on hardware, operation consumes some of the host's power.

RAM: Random access memory. A temporary, volatile memory into which data can be written or from which data can be read by specifying an address.

Rate conversion: 1. The process of converting from one digital sample rate to another. The digital sample rate for the component digital video format is 13.5 MHz. For the composite digital video format, it is either 14.3 MHz for NTSC or 17.7 MHz for PAL. 2. Often used incorrectly to indicate both resampling of digital rates and encoding/decoding.

Read before write: A feature of some videotape recorders that plays back the video or audio signal off of tape before it reaches the record heads, sends the signal to an external device for modification, and then applies the modified signal to the record heads so that it can be re-recorded onto the tape in its original position.

RealAudio: Popular software for streaming audio and video over the Internet. Made by RealNetworks of Seattle, Washington.

Realtime: Computation or processing done in the present to control physical events occurring in the present. For example, when a digital effects system operator moves a joystick and the video images on the monitor appear to move simultaneously, the computations required to make the images move are said to have occurred in realtime.

See also: **Rendering.**

RealVideo: Popular software for streaming audio and video over the Internet. Made by RealNetworks of Seattle, Washington.

Rec. 601: See: **ITU-R BT.601-2.**

Reclocking: The process of clocking digital data with a regenerated clock.

Rendering: The process of non-realtime drawing of a picture relying on computer processing speed for graphics and compositing.

Resolution: 1. Detail. In digital video and audio, the number of bits (four, eight, 10, 12, etc.) determines the resolution of the digital signal. Four bits yields a resolution of one in 16. Eight bits yields a resolution of one in 256. Ten bits yields a resolution of one in 1,024. Eight bits is the minimum acceptable for broadcast television. 2. A measure of the finest detail that can be

seen, or resolved, in a reproduced image. While influenced by the number of pixels in an image (for high definition approximately 2,000 x 1,000, broadcast NTSC TV 720 x 487, broadcast PAL TV 720 x 576), note that the pixel numbers do not define ultimate resolution but merely the resolution of that part of the equipment. The quality of lenses, display tubes, film process and film scanners, etc., used to produce the image on the screen must all be taken into account. This is why a live broadcast of the Super Bowl looks better than a broadcast recorded and played off of VHS, while all are NTSC or PAL.

Resolution independent: Term used to describe the notion of equipment that can operate at more than one resolution. Dedicated TV equipment is designed to operate at a single resolution although some modern equipment, especially that using the ITU-R 601 standard, can switch between the specific formats and aspect ratios of 525/60 and 625/50.

By their nature, computers can handle files of any size, so when applied to imaging, they are termed resolution independent. As the images get bigger so the amount of processing, storage and data transfer demanded increases--in proportion to the resulting file size. So, for a given platform, the speed of operation slows. Other considerations when changing image resolution may be reformatting disks, checking if the RAM is sufficient to handle the required size of file, allowing extra time for RAM/disk caching and how to show the picture on an appropriate display.

Return loss: A measure of the ratio of signal power transmitted into a system to the power reflected or returned. It can be thought of as an echo that is reflected back by impedance changes in the system. Any variation in impedance from the source results in some returned signal. Real-life cabling systems do not have perfect impedance structure and matching, and therefore have a measurable return loss. Twisted pairs are not completely uniform in impedance. Changes in twist, distance between conductors, cabling handling, cable structure, length of link, patch cord variation, varying copper diameter, dielectric composition and thickness variations, and other factors all contribute to slight variations in cable impedance. In addition, not all connecting hardware components in a link may have equal impedance. At every connection point there is the potential for a change in impedance. Each change in the impedance of the link causes part of the signal to be reflected back to the source. Return loss is a measure of all the reflected energy caused by variations in impedance of a link relative to a source impedance of 100 ohms. Each impedance change contributes to signal loss (attenuation) and directly causes return loss.

RGB: The abbreviation for the red, green and blue signals, the primary colors of light (and television). Cameras and telecines have red, blue and green receptors, the TV screen has red, green and blue phosphors illuminated by red, green and blue guns. Much of the picture monitoring in a production center is in RGB. RGB is digitized with 4:4:4 sampling which occupies 50 percent more data than 4:2:2.

Ringing: An oscillatory transient on a signal occurring as a result of bandwidth restrictions and/or phase distortions. A type of ringing causes ghosting in the video picture.

RLE: Run length encoding. A compression scheme. A run of pixels or bytes of the same color or value are coded as a single value recording the color or byte value and the number duplications in the run.

ROM: Read only memory. A memory device that is programmed only once with a permanent program or data that cannot be erased.

RP-125: A SMPTE parallel component digital video recommended practice. Now SMPTE 125M.

RS-232: A standard, single-ended (unbalanced) interconnection scheme for serial data communications.

RS-422: A medium range (typically up to 300 m/1000 ft or more) balanced serial data transmission standard. Data is sent using an ECL signal on two twisted pairs for bi-directional operation. Full specification includes 9-way D-type connectors and optional additional signal lines.

RS-422 is widely used for control links around production and post areas for a range of equipment.

Run-length coding: A system for compressing data. The principle is to store a pixel value along with a message detailing the number of adjacent pixels with that same value. This gives a very efficient way of storing large areas of flat color and text but is not so efficient with pictures from a camera, where the random nature of the information, including noise, may actually mean that more data is produced than was needed for the original picture.

Sampling: Process by which an analog signal is measured, often millions of times per second for video, in order to convert the analog signal to digital. The official sampling standard for standard definition television is ITU-R 601.

For TV pictures eight or 10 bits are normally used; for sound, 16 or 20-bits are common, and 24-bits are being introduced. The ITU-R 601 standard defines the sampling of video components based on 13.5 MHz, and AES/EBU defines sampling of 44.1 and 48 kHz for audio.

Sampling frequency: The number of discrete sample measurements made in a given period of time. Often expressed in megahertz for video.

SAV: Start of active video. A synchronizing signal used in component digital video.

Scaling: Analogue video signals have to be scaled prior to digitizing in an ADC so that the full amplitude of the signal makes best use of the available levels in the digital system. The ITU-R BT.601 digital coding standard specifies, when using 10 bits, black to be set at level 64 and white at 940. The same range of values is ascribed should RGB be used. Computer applications tend to operate with a different scaling with black set to level 0 and white at 1023. For color they usually use RGB from 0-1023. However, most still keep to 8-bit accuracy so the scale runs from 0-255. Clearly, going between computers and TV requires processing to change color space and scaling.

Scalable coding: The ability to encode a visual sequence so as to enable the decoding of the digital data stream at various spatial and/or temporal resolutions. Scalable compression techniques typically filter the image into separate bands of spatial and/or temporal data. Appropriate data reduction techniques are then applied to each band to match the response characteristics of human vision.

Scalable video: Refers to video compression that can handle a range of bandwidths, scaling smoothly over them.

Scrambling: 1. To transpose or invert digital data according to a prearranged scheme in order to break up the low-frequency patterns associated with serial digital signals. 2. The digital signal is shuffled to produce a better spectral distribution.

See also: **Encryption.**

SCSI: Small computer systems interface. A very widely used high data rate general purpose parallel interface. A maximum of eight devices can be connected to one bus, for example a controller, and up to seven disks or devices of different sorts--Winchester disks, optical disks, tape drives, etc.--and may be shared between several computers.

SCSI specifies a cabling standard (50-way), a protocol for sending and receiving commands and their format. It is intended as a device-independent interface so the host computer needs no details about the peripherals it controls. But with two versions (single ended and balanced), two types of connectors and numerous variations in the level of implementation of the interface, SCSI devices cannot "plug and play" on a computer with which they have not been tested. Also, with total bus cabling for the popular single ended configuration limited to 18 feet (6 meters), all devices must be close.

SCSI is popular and has continued development over a number of years resulting in the following range of maximum transfer rates:

Standard SCSI: 5 Mbps (max.)

Fast SCSI: 10 Mbps (max.)

Ultra SCSI: 20 Mbps (max.)

For each of these there is the 8-bit normal "narrow" bus (1 byte per transfer) or the 16-bit Wide bus (2 bytes per transfer), so Wide Ultra SCSI could transfer data at a maximum rate of 40 Mbps. Note that these are peak rates. Continuous rates will be considerably less. Also, achieving this will depend on the performance of the connected device.

Differential SCSI: An electrical signal configuration where information is sent simultaneously through sets of wires in a cable. Information is interpreted by the difference in voltage between the wires. Differential interfaces permit cable lengths up to 75 feet (25 meters).

Single-Ended SCSI: An electrical signal configuration where information is sent through one wire in a cable. Information is interpreted by the change in the voltage of the signal. Single-ended interfaces permit cable lengths up to 18 feet (6 meters).

SDDI: See: **Serial digital data interface.**

SDI: See: **Serial digital interface.**

SDTI: See: **Serial digital transport interface.**

SDTI-CP: Serial digital transport interface-content package. Sony's way of formatting MPEG IMX (50 Mbps, I frame MPEG-2 streams) for transport on a serial digital transport interface.

See also: **Serial digital transport interface.**

SECAM: Sequential couleur avec mŽmoire. The television broadcast standard in France, the Middle East, and most of Eastern Europe, SECAM provides for sequential color transmission and storage in the receiver. The signals used to transmit the color are not transmitted simultaneously but sequentially line for line. SECAM processes 625 lines, a maximum of 833 pixels per line and 50 Hz picture frequency. SECAM is used as a transmission standard and not a production standard (PAL is typically used).

Sequence: A coded video sequence that commences with a sequence header and is followed by one or more groups of pictures and is ended by a sequence end code.

Serial: One bit at a time, along a single transmission path.

Serial digital: Digital information that is transmitted in serial form. Often used informally to refer to serial digital television signals.

Serial digital data interface (SDDI): A way of compressing digital video for use on SDI-based equipment proposed by Sony. Now incorporated into Serial digital transport interface.

See: **Serial digital transport interface.**

Serial digital interface (SDI): The standard based on a 270 Mbps transfer rate. This is a 10-bit, scrambled, polarity independent interface, with common scrambling for both component ITU-R 601 and composite digital video and four channels of (embedded) digital audio. Most new broadcast digital equipment includes SDI which greatly simplifies its installation and signal distribution. It uses the standard 75 ohm BNC connector and coax cable as is commonly used for analog video, and can transmit the signal over 600 feet (200 meters) depending on cable type.

Serial digital transport interface (SDTI): SMPTE 305M. Allows faster-than-realtime transfers between various servers and between acquisition tapes, disk-based editing systems and servers, with both 270 Mb and 360 Mb are supported. With typical realtime compressed video transfer rates in the 18 Mbps to 25 Mbps to 50 Mbps range, SDTI's 200+ Mbps payload can accommodate transfers up to four times normal speed.

The SMPTE 305M standard describes the assembly and disassembly of a stream of 10-bit data words that conform to SDI rules. Payload data words can be up to 9 bits. The 10th bit is a complement of the 9th to prevent illegal SDI values from occurring. The basic payload is inserted between SAV and EAV although an appendix permits additional data in the SDI ancillary data space as well. A header immediately after EAV provides a series of flags and data IDs to indicate what's coming as well as line counts and CRCs to check data continuity.

Serial interface: A digital communications interface in which data is transmitted and received sequentially along a single wire or pair of wires. Common serial interface standards are RS-232 and RS-422.

Serializer: A device that converts parallel digital information to serial.

Serial storage architecture (SSA): A high speed data interface developed by IBM and used to connect numbers of storage devices (disks) with systems. Three technology generations are planned: 20 Mbps and 40 Mbps are now available, and 100 Mbps is expected to follow.

Serial video processing: A video mixing architecture where a series of video multipliers, each combining two video signals, is cascaded or arranged in a serial fashion. The output of one multiplier feeds the input of the next, and so on, permitting effects to be built up, one on top of the other.

Server (file): A storage system that provides data files to all connected users of a local network. Typically the file server is a computer with large disk storage which is able to record or send files as requested by the other connected (client) computers--the file server often appearing as another disk on their systems.

The data files are typically around a few kilobytes in size and are expected to be delivered within moments of request

Server (video): A storage system that provides audio and video storage for a network of clients. While there are some analog systems based on optical disks, most used in professional and broadcast applications are based on digital disk storage.

Aside from those used for video on demand (VOD), video servers are applied in three areas of television operation: transmission, post production and news. Compared to general purpose file servers, video severs must handle far more data, files are larger and must be continuously delivered.

There is no general specification for video servers and so the performance between models varies greatly according to storage capacity, number of channels, compression ratio and degree of access to store material--the latter having a profound influence.

Store sizes are very large, typically up to 500 Gigabytes or more. Operation depends entirely on connected devices, edit suites, automation systems, secondary servers, etc., so the effectiveness of the necessary remote control and video networking is vital to success.

Set-top box (STB): These receivers (named because they typically sit on top of a television set) convert and display broadcasts from one frequency or type--analog cable, digital cable, or digital television) to a standard frequency (typically channel 3 or 4) for display on a standard analog television set.

Side converting: The process which changes the number of pixels and/or frame rate and/or scanning format used to represent an image by interpolating existing pixels to create new ones at closer spacing or by removing pixels. Side converting is done from standard resolution to standard resolution and high definition to high definition.

See also: **Down converting, up converting.**

Side panels: Image of a standard 4:3 picture on a widescreen 16:9 aspect ratio television screen, typically with black bars on the side. Used to maintain the original aspect ratio of the source material.

See also: **Letterbox, pillarbox.**

SIGGRAPH: The Association of Computing Machinery (ACM)'s Special Interest Group on Computer Graphics (SIGGRAPH). Internet: www.siggraph.org.

Signaling rate: The bandwidth of a digital transmission system expressed in terms of the maximum number of bits that can be transported over a given period of time. The signaling rate is typically much higher than the average data transfer rate for the system due to software overhead for network control, packet overhead, etc.

Simple profile: MPEG image streams using only I and P frames is less efficient than coding with B frames. This profile, however, requires less buffer memory for decoding.

Simulcast: To broadcast the same program over two different transmission systems. Currently, some AM and FM stations simulcast the same program for part of the day, and some radio stations simulcast the audio from televised music events.

Although not initially required by the FCC, it is believed that most television stations will simulcast their DTV and NTSC signal. Simulcasting will be required towards the end of the DTV transition period to protect the public interest.

Slice: A series of macroblocks. A slice is the basic synchronizing unit for reconstruction of the image data and typically consists of all the blocks in one horizontal picture interval--typically 16 lines of the picture.

SMPTE: 1. Society of Motion Picture and Television Engineers. A professional organization that sets standards for American television. 595 W. Hartsdale Ave., White Plains, NY, 10607-1824. Tel: 914-761-1100. Fax: 914-761-3115. Email: smpte@smpte.org Internet: www.smpte.org. 2. An informal name for a color difference video format that uses a variation of the Y, R-Y, and B-Y signal set.

SMPTE 125M (formerly RP-125): The SMPTE standard for a bit parallel digital interface for 55-line interlace component video signals. SMPTE 125M defines the parameters required to generate and distribute component video signals on a parallel interface.

SMPTE 244M: The SMPTE standard for a bit parallel digital interface for composite video signals. SMPTE 244M defines the parameters required to generate and distribute composite video signals on a parallel interface.

SMPTE 259M: The SMPTE standard for standard definition serial digital component and composite interfaces.

SMPTE 272M: The SMPTE standard for formatting AES/EBU audio and auxiliary data into digital video ancillary data space.

SMPTE 292M: The SMPTE standard for bit-serial digital interface for high-definition television systems.

SMPTE 293M: The SMPTE standard defining the data representation of the 720x483 progressive signal at 59.94 Hz.

SMPTE 294M: The SMPTE standard defining the serial interfaces for both 4:2:2P (progressive) on two-SMPTE 259M links and 4:2:0P (progressive) on a single SMPTE 259M link (at 360Mbps).

SMPTE 299M: The SMPTE standard for 24-bit digital audio format for HDTV bit-serial interface. Allows eight embedded AES/EBU audio channel pairs.

SMPTE 305M: The SMPTE standard for Serial Digital Transport Interface (SDTI).

SMPTE 310M: The SMPTE standard for synchronous serial interface (SSI) for MPEG-2 digital transport streams; used as the "standard" for the output from the ATSC systems multiplexer and the input to DTV transmitters.

Soft RAID: A RAID system implemented by low level software in the host system instead of a dedicated RAID controller. While saving on hardware, operation consumes some of the host's power.

Sonet: Synchronous optical network. A set of standards for the digital transmission of information over fiber optics. Based on increments of 51 Mbps. It was developed to cost effectively support broadband services and multi-vendor internetworking.

Spatial resolution: The number of pixels horizontally and vertically in a digital image.

Sprites: In MPEG-4, static background scenes. Sprites can have dimensions much larger than what will be seen in any single frame. A coordinate system is provided to position objects in relation to each other and the sprites. MPEG- 4's scene description capabilities are built on concepts used previously by the Internet community's Virtual Reality Modeling Language (VRML).

SRAM: Static RAM. This type of memory chip in general behaves like dynamic RAM (DRAM) except that static RAMs retain data in a six-transistor cell needing only power to operate (DRAMs require clocks as well). Because of this, current available capacity is 4 Mbits--lower than DRAM--and costs are higher, but speed is also greater.

SSA: See: **Serial Storage Architecture.**

Statistical multiplexing: Increases the overall efficiency of a multi-channel digital television transmission multiplex by varying the bit-rate of each of its channels to take only that share of the total multiplex bit-rate it needs at any one time. The share apportioned to each channel is predicted statistically with reference to its current and recent-past demands.

Storage capacity: Using the ITU-R 601 4:2:2 digital coding standard, each picture occupies a large amount of storage space--especially when related to computer storage devices such as DRAM and disks. So much so that the numbers can become confusing unless a few benchmark

statistics are remembered. Fortunately, the units of mega, giga, tera and penta make it easy to express the very large numbers involved. The capacities can all be worked out directly from the 601 standard. Bearing in mind that sync words and blanking can be regenerated and added at the output, only the active picture area need be stored.

For the 525 line TV standard the line data is: 720(Y) + 360(Cr) + 360(Cb) = 1,440 pixels/line

487 active lines/picture there are 1,440 x 487 = 701,280 pixels/picture

(sampling at 8-bits, a picture takes 701.3 kbytes)

1 sec takes 701.3 x 30 = 21,039 kbytes, or 21 Mbytes

For the 625 line TV standard the active picture is: 720(Y) + 360(Cr) + 360(Cb) = 1,440 pixels/line

With 576 active lines/picture there are 1,440 x 576 = 829,440 pixels/picture

(sampling at 8-bits, a picture takes 830 kbytes)

1 second takes 830 x 25 = 20,750 kbytes, or 21 Mbytes

So both 525 and 625 line systems require approximately the same amount of storage for a given time:

1 minute takes 21 x 60 = 1,260 Mbytes, or 1.26 Gbytes

1 hour takes 1.26 x 60 = 76 Gbytes

Useful numbers (referred to non-compressed video):

1 Gbyte will hold 47 seconds.

1 hour takes 76 Gbytes.

Stream: 1. To transmit multimedia files that begin playing upon arrival of the first packets, without needing to wait for all the data to arrive. 2. To send data in such a way as to simulate real-time delivery of multimedia.

Streaming media: Multimedia content--such as video, audio, text, or animation--that is displayed by a client a client as it is received from the Internet, broadcast network, or local storage.

Sub-pixel: A spatial resolution smaller than that of pixels. Although digital images are composed of pixels it can be very useful to resolve image detail to smaller than pixel size, i.e., sub-pixel. For example, the data for generating a smooth curve on television needs to be created to a finer accuracy than the pixel grid itself, otherwise the curve will look jagged. Again, when tracking an object in a scene or executing a DVE move, the size and position of the manipulated picture must be calculated, and the picture resolved, to a far finer accuracy than the pixels, otherwise the move will appear jerky.

Sweetening: Electronically improving the quality of an audio or video signal, such as by adding sound effects, laugh tracks, and captions.

Synchronous: A transmission procedure by which the bit and character stream are slaved to accurately synchronized clocks, both at the receiving and sending end.

T1: In telecommunications, the paired cable used to transport DS1 service.

Table 3 Compression Format Constraints: See: **ATSC**.

TCP/IP: Transmission control protocol/internet protocol. An Internet protocol suite developed by the U.S. Department of Defense in the 1970s. TCP governs the exchange of sequential data. IP routes outgoing and recognizes incoming messages.

TDM: Time division multiplex. The management of multiple signals on one channel by alternately sending portions of each signal and assigning each portion to particular blocks of time.

Tearing: A lateral displacement of the video lines due to sync instability. Visually it appears as though parts of the images have been torn away.

Temporal aliasing: A defect in a video picture that occurs when the image being sampled moves too fast for the sampling rate. A common example occurs when the rapidly rotating spokes of a wagon's wheels appear to rotate backwards because of video scanning that moves more slowly than the spokes.

Temporal resolution: The ability of the display to reproduce adequate detail to allow the visual system to distinguish the separate parts or components of an object that is moving through the display.

Time code: 1. Vertical interval time code (VITC). This is SMPTE time code that is recorded as video signals in the vertical interval of the active picture. It has the advantage of being readable by a VTR in still or jog. Multiple lines of VITC can be added to the signal allowing the encoding of more information than can be stored in normal LTC. 2. Linear time code (LTC). Time code recorded on a linear analog track (typically an audio channel) on a videotape. Also called longitudinal time code. Time code can be drop frame (59.94 Hz) that matches actual elapsed time by dropping occasional frames or non-drop frame (60 Hz) that runs continuously although it does not exactly match actual elapsed time.

Timeline: In nonlinear editing, the area in which audio and video clips are applied, typically giving duration in frames and seconds. Also seen in animation and composition software.

TOV: Threshold of visibility. The impairment level (or D/U in dB) beyond which a source of impairment or interference may introduce visible deficiencies in more sensitive program material. For all tests, TOV was determined by expert observers.

Transcode: The process of converting a file or program from one format or resolution to another.

Truncation: Removal of the lower significant bits on a digital word--as could be necessary when sending a 16-bit word on an 8-bit bus. If not carefully handled it can lead to unpleasant artifacts on video signals.

See also: **Dynamic Rounding.**

TV Crossover Links: A type of enhancement which notifies users that there is enhanced or Web content associated with a program or an advertisement. A TV Crossover Link appears as a small icon in the corner of the TV screen at a point in time determined by content producers. Clicking the link displays a panel, giving the viewer an option to go to the content enhancement (Web site) or continue watching TV. If the viewer chooses to go to the Web site, the receiver connects to the site, while the current program or advertisement remains on-screen. Pressing the View button on the remote control or keyboard returns to TV viewing. The term is a trademark of the Microsoft Corporation.

Up converting (up-resing): The process which increases the number of pixels and/or frame rate and/or scanning format used to represent an image by interpolating existing pixels to create new ones at closer spacing. Despite its name the process does not increase the resolution of the image. Up converting is done from standard definition to high definition.

See also: **Down converting, side converting.**

Vaporware: Software or hardware that is promised or talked about but is not yet completed--and may never be released.

Variable bit rate reduction: See: **Compression.**

Video coder overload (also buffer overload): Video coder overload is tested using rapid scene cuts, at most only a few frames apart, to stress digital compression systems by presenting them with a video signal that contains little or no temporal redundancy (frame-to-frame correlation).

Video for Windows: Microsoft's system-level Windows software architecture that is similar to Apple Computer's QuickTime.

Video-on-demand (VOD): When video can be requested at any time and is available at the discretion of the end-user, it is then video-on-demand.

VRML: Virtual reality modeling language. An ISO standard for 3-D multimedia and shared virtual worlds on the Internet.

VSB: Vestigial side band. VSB is a digital frequency modulation technique used to send data over a coaxial cable network. Used by Hybrid Networks for upstream digital transmissions, VSB is faster than the more commonly used QPSK, but it's also more susceptible to noise.

VSWR: Voltage standing wave ratio. The ratio of the maximum value of a standing wave to its minimum value and is related to the return loss by the equation: RL = 20log [(VSWR + 1)/(VSWR-1)] Thus a VSWR of 1.5:1 corresponds to a return loss of 20log(5) = 13.97dB.

WAV (pronounced wave): The Windows-compatible audio file format. The WAV file can be recorded at 11 kHz, 22 kHz, and 44 kHz, and in 8- or 16-bit mono and stereo.

See also: **AIF, AU.**

Wavelet-based compression: An asymmetrical image compression technique that is scalable and can provide high quality. The drawback is that it becomes more computationally expensive as the picture resolution and frame rates go up. The encode and decode are asymmetrical in that one side is a lot more expensive computationally than the other. The ImMix Cube and TurboCube used wavelet-based compression.

WebTV: WebTV Networks, Inc. is a leading manufacturer of set-top boxes used for viewing interactive television and regular television. These receivers let users access the Internet, including use of electronic mail and online chats. WebTV set-top boxes like the WebTV Plus Receiver connect to a standard television and a phone line. The WebTV Plus Receiver supports TV Crossover Links and WebPIP. WebPIP lets users simultaneously view Web pages and TV programming on the same screen, without a special picture-in-picture TV. WebTV is a trademark and service of the Microsoft Corporation.

Widescreen: Term given to picture displays that have a wider aspect ratio than normal. For example, TV's normal aspect ratio is 4:3 and widescreen is 16:9. Although this is the aspect ratio used by HDTV, widescreen is also used with standard definition systems.

Window: 1. Video containing information or allowing information entry, keyed into the video monitor output for viewing on the monitor CRT. A window dub is a copy of a videotape with time code numbers keyed into the picture. 2. A video test signal consisting of a pulse and bar. When viewed on a monitor, the window signal produces a large white square in the center of the picture. 3. A graphical user interface that presents icons and tools for manipulating a software application. Most applications have multiple windows that serve different purposes.

Window shades: See also: **Pillar box, side panels.**

Windows CE: Microsoft Windows CE is a 32-bit real-time embedded operating system (RTOS) designed from the ground up to empower the development of a new range of emerging computing appliances, including set-top boxes, digital versatile disc (DVD) drives, entertainment consoles, smart phones, highly portable and personal computing devices like handheld computers, and home appliances. Windows CE is modular, allowing use of a minimum set of software components needed to support receiver requirements. This uses less memory and improves operating system performance. Windows CE provides a subset of the Win32 application program interface (API) set, which provides an effective amount of application source-code level portability and compatibility and user interface consistency with other Microsoft Windows operating systems and Windows applications.

Windows Media Player: Delivers the most popular streaming and local audio and video formats, including ASF, WAV, AVI, MPEG, Quick-Time, and more. Windows Media Player can play anything from low-bandwidth audio to full-screen video.

WORM: Write Once/Read Many--describes storage devices on which data, once written, cannot be erased or re-written. Being optical, WORMs offer very high recording densities and are removable, making them very useful for archiving.

WYSIWYG: What you see is what you get--usually, but not always. Referring to the accuracy of a screen display to show how the final result will look. For example a word processor screen showing the final layout and typeface that will appear from the printer.

Y, B-Y, R-Y: These are the analogue luminance, Y, and color difference signals (R-Y) and (B-Y) of component video. Y is pure luminance information whilst the two color difference signals together provide the color information. The latter are the difference between a color and luminance: red – luminance and blue – luminance. The signals are derived from the original RGB source (e.g. a camera or telecine).

The Y, (R-Y), (B-Y) signals are fundamental to much of television. For example in ITU-R BT.601 it is these signals that are digitized to make 4:2:2 component digital video, in the PAL and NTSC TV systems they are used to generate the final composite coded signal and in DTV they are sampled to create the MPEG-2 video bitstream.

Y, Cr, Cb: The digital luminance and color difference signals in ITU-R BT.601 coding. The Y luminance signal is sampled at 3.5 MHz and the two color difference signals are sampled at 6.75 MHz co-sited with one of the luminance samples. Cr is the digitized version of the analogue component (R-Y), likewise Cb is the digitized version of (B-Y). For the HD SMPTE 274M standard, sampling rates are 5.5 times greater – 74.25 MHz for Y and 37.125 MHz for Cr and Cb.

YUV: A color model used chiefly for video signals in which colors are specified according to their luminance--the Y component--and their hue saturation--the U and V components.