NUMERALS

1.2 Mbps   A data transfer rate measured in megabits per second, for which the original MPEG-1 video standard was designed. It is the approximate data transfer rate that is offered by single-speed CD variants such as CD-ROM. 1.2 Mbps = 1 200 000 bits per second. 1.2 Mbps approximates 150 Kbyte per second.

(See CD-ROM.)

1.2 Mbyte   The approximate formatted data capacity of a standard IBM, high-density, 5.25 in floppy disk.

1.2 mm   The thickness of a DVD or CD disc variant.

(See CD-ROM and DVD-ROM.)

1.44 Mbyte   The formatted data capacity of a 3.5 in high-density floppy disk for the PC.

1.544 Mbps   1. The data transfer rate offered by a single T1 line. *(See T1.)* 2. The data transfer rate of a primary rate multiplex of 24 channels of 64 Kbps ISDN channels.

(See ISDN.)

2B+D   Using the basic rate interface (BRI), this denotes two bearer (2B) channels and one (D) ISDN channel.

(See ISDN.)

2-D (two-dimensional)   A 2-D computer image or animation might be stored and generated using absolute or relative coordinates that include X (horizontal) and Y (vertical) dimensions. Authentic 2-D animations depend upon matrix multiplication, where sets of coordinates are multiplied by a transformation matrix. 2-D vectors $[X\ Y]$ might be exchanged for homogeneous vector coordinates $[X\ Y\ H]$. The homogeneous dimension

(*H*) is added to accommodate a three-row transformation matrix, so increasing the number of possible 2-D transformations.
(See 3-D.)

2 Mbps   The threshold bandwidth beyond which a network or access technology may be described as broadband. 2 Mbps=2 000 000 bits per second.
(See Access technology and B-ISDN).

3:4   A standard aspect ratio adopted in broadcast television, video and graphics display technology. The IBM VGA graphics standard and the MPEG-1/2/3/4 video standards offer resolutions that have 3:4 aspect ratio.
(See MPEG.)

3-D (three-dimensional)   A 3-D computer image or animation stored and generated using absolute or relative coordinates that include X (horizontal), Y (vertical) and Z (depth) dimensions. Standard file formats and standard languages for developing 3-D animations for multimedia and virtual reality (VR) have emerged. The VRML (Virtual Reality Modeling Language) is suitable for the development of 3-D World Wide Web (WWW) pages. Web content development tools may be used to create 3-D graphics and animations for Web pages, and often do not require knowledge of VRML. Chips aimed at the acceleration of 3-D graphics include the Glint family which was developed by 3DLabs. Creative Labs licensed Glint technology from 3DLabs in 1994, following which they collaborated to develop the GLINT 3-D processor. This is used in the Creative 3D Blaster, which was first shown at Creativity '95 in San Francisco – a milestone in the development of 3-D graphics cards. 3-D engines that can be used to generate 3-D animations include:

- Microsoft Direct3D
- Apple QuickDraw3D
- Silicon Graphics OpenGL

Authentic 3-D animations depend upon matrix multiplication where sets of coordinates are multiplied by a transformation matrix. 3-D vectors, or ordinary 3-D coordinates [*X Y Z*], may be exchanged for homogeneous vector coordinates [*X Y Z H*]. The homogeneous dimension (*H*) is added to accommodate a four-row transformation matrix, so increasing the number of possible 3-D transformations. The transformation of homogeneous coordinates is given by:

$$[X\ Y\ Z\ H] = [x\ y\ z\ 1]\mathbf{T}$$

The resulting transformed coordinates can be normalised to become ordinary coordinates:

$$[x^*\ y^*\ z^*\ 1] = [X/H\ Y/H\ Z/H\ 1]$$

Consider the 4 × 4 transformation matrix:

$$\begin{bmatrix} a & b & c & p \\ d & e & f & q \\ h & i & j & r \\ l & m & n & a \end{bmatrix} = \mathbf{T}$$

Scaling, shearing and rotation are achieved using the 3 × 3 matrix sector:

$$\begin{bmatrix} a & b & c \\ d & e & f \\ h & i & j \end{bmatrix}$$

The transformation matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & \sin\theta & 0 \\ 0 & -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

is used to rotate a 3-D object by the angle θ around the X-axis. A rotation of an angle θ about the y-axis is achieved using the transformation matrix:

$$\begin{bmatrix} \cos\theta & 0 & -\sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ \sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

A rotation of an angle θ about the z-axis is achieved using the transformation matrix:

$$\begin{bmatrix} \cos\theta & \sin\theta & 0 & 0 \\ -\sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

It is possible to concatenate the rotational transformation matrices so as to perform two rotations concurrently through one matrix multiplication. However, the rotations are non-commutative, so attention must be paid to the order of the transformation matrices during multiplication. To perform a rotation about the x-axis and the y-axis, the transformation matrix can be achieved as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & \sin\theta & 0 \\ 0 & -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \cos\theta & 0 & -\sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ \sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \cos\theta & 0 & -\sin\theta & 0 \\ \sin2\theta & \cos\theta & \cos\theta\sin\theta & 0 \\ \cos\theta\sin\theta & -\sin\theta & \cos2\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Translation is achieved through the 1×3 matrix sector:

$$[l \quad m \quad n]$$

Perspective transformation is achieved using the 3×1 matrix sector:

$$\begin{bmatrix} p \\ q \\ i \end{bmatrix}$$

The remaining element a produces overall scaling. For instance, overall scaling is achieved using the transformation matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & s \end{bmatrix}$$

Normalising the transformed coordinates drives the scaling effect:

$$[x^* \quad y^* \quad z^* \quad 1] \;=\; [x/s \quad y/s \quad z/s \quad 1]$$

It is important to note that 3-D images may also be stored using 2-D vector matrices that include X and Y dimensions only. Graphics transformation algorithms may be written in appropriate high-level languages such as C++, Java and Visual Basic, and even in machine code or assembly language. Any high-level programming language that supports arrays may be used to develop graphics transformation software. However, APIs for popular 3-D engines such as Microsoft Direct3D and Apple QuickDraw3D provide the necessary high-level programming statements to bypass the underlying mathematical elements. Intel MMX Technology gives improved delivery of 3-D graphics and animations.

(See MMX Technology and VRML.)

3-D curves A curve or space curve that exists in three dimensions. Algorithms that include the necessary mathematical elements drive the generation of 3-D curves. APIs for popular 3-D engines such as Microsoft Direct3D and Apple QuickDraw3D provide the necessary high-level interface for their creation. Equally, Web content development tools may be used to create 3-D graphics and animations.

(See 3-D.)

3-D modeller An artist who creates 3-D animations.

(See Autodesk Animator Pro.)

3DO 1. A company engaged in the manufacture of multimedia related products, including video capture hardware. It produces real-time MPEG-2

video encoding hardware used to capture and to compress video in real time.

(See MPEG-2 and Video capture.) 2. A consumer multimedia appliance based on a 32 bit RISC processor and manufactured by a company of the same name.

3-D surfaces   A surface that exists in three dimensions. APIs for popular 3-D engines such as Microsoft Direct3D and Apple QuickDraw3D provide the necessary high-level programming statements.

(See 3-D.)

4GL (Fourth-Generation Language)   A programming language/environ-ment that does not require programming code on a line-by-line basis. One of the earliest 4GL programming tools for the PC was Sperry's Mapper. Sperry later became part of Unisys.

(See C++, Java, OOP and Visual Basic.)

4 kHz   The bandwidth of POTs (plain old telephone services).

(See Shannon's Theorem.)

4.7 Gbyte   The maximum data capacity of a single-sided, single-layer DVD-ROM disc.

(See CD-ROM and DVD-ROM.)

8 bit image depth   An 8 bit image depth gives a maximum of 256 colours for digital video and computer-generated animations and images. The colour information for each pixel (or dot) is stored using eight bits, giving a maximum of 256 (2^8) colours. The 8 bit colour information can be edited using a palette editor such as Microsoft PalEdit, which is part of the complete implementation of Microsoft Video for Windows, or Asymetrix Multimedia ToolBook. A palette editor may be used to:

- alter the order of colour cells in a palette
- reduce the number of colours in a palette by deleting unwanted colour cells
- alter brightness
- alter colour contrast
- fade and tint colours
- copy colour cells from one palette to another
- merge two or more palettes into one
- develop common colour palettes that can be used with a number of different 8 bit video sequences so as to reduce any flicker that may occur as a result of palette switching, which occurs when one image, animation

> or video sequence is exchanged for another. This operation may also be implemented using a palette optimiser

Palettes can be pasted into 8 bit video sequences using a video-editing program such as Adobe Premier, Asymetrix Digital Video Producer or Microsoft VidEdit (which is part of the full implementation of Microsoft Video for Windows). Palettes can be applied to a complete video sequence, a pre-selected portion of a video sequence, or even to a single frame. They can be pasted in still 8 bit images using an editing program such as Microsoft BitEdit, which is supplied with Microsoft Video for Windows.

(See AVI, MPEG*, Streaming*, and Video*.)

8 kHz   A standard sampling rate featured by many sound cards.

8.5 Gbyte   A data capacity offered by a DVD variant.

(See DVD.)

10base2   An industry name for thin-Ethernet or cheapernet LAN technology. It uses inexpensive coaxial cable, and is popular for small networks. Network computers/devices are fitted with Ethernet cards (or chipsets) and connected using coaxial cables.

(See Ethernet and LAN.)

10base5   An industry name for basic Ethernet LANs, technology. Network computers/devices are fitted with Ethernet cards (or chipsets) and connected using coaxial cables. It provides 10 Mbps data rates over distances of 500 m

(See Ethernet and LAN.)

10baseT   An industry name for larger Ethernet LANs, which are based on structured cabling. Unshielded twisted-pair telephone cabling and LAN hubs are included in the structured cabling system, which is built around a star LAN topology. It delivers data to connected workstations at a rate of 10 Mbps.

(See Ethernet and LAN.)

10 Mbps   A data transfer rate for which the MPEG-2 video standard was created. The Motion Pictures Experts Group (MPEG) and its many sub-groups were given the task of creating MPEG-2. This second phase of MPEG work began in 1990.

(See CD-ROM, DCT, DVD, JPEG, MPEG* and Video.)

11.025 kHz   A standard sampling rate featured by many sound cards.

(See Sound card and Wave audio.)

12.1 in   A standard TFT/DSTN display size used in modern notebook computers.

15 in   A standard display size. The CRT (Cathode Ray Tube) is measured diagonally. The measurement cannot always be equated to the screen image size, which may or may not be the same.
(See Monitor.)

16 bit   A sample size which modern sound cards commonly use for recording and playing wave audio. When the sampling frequency is set at 44.1 kHz, the resulting quality is that of audio CD.
(See Sound card and Wave audio.)

16 bit image depth   A 16 bit digital video, computer-generated image or animation is generated and stored using 16 bits of colour information for each pixel (or dot). This results in a maximum of about 65 536 (or 2^{16}) colours.
(See 24 bit image depth.)

16 kHz   A standard sampling rate featured by many sound cards, resulting in 16 000 samples per second during the sound recording process.
(See ADC, ISDN and Sound card.)

17 Gbyte   A data capacity offered by a DVD variant.
(See DVD.)

22.05 kHz   A standard sampling rate featured by many sound cards, resulting in 22 050 samples per second during the sound recording process.
(See Sound card and Wave audio.)

24   A playback frame rate of a movie recording.

24 bit image depth   A 24 bit digital video, computer-generated image or animation is generated and stored using 24 bits of colour information for each pixel (or dot). This results in a maximum of over 16.7 million (2^{24}) colours. 24 bit digital videos, animations and images are described as *true colour*. Red, green and blue are each represented by eight bits, giving 256 tones of each, which in turn leads to over 16.7 million ($256 \times 256 \times 256$) colours. 24 bit graphics make possible near-photographic-quality images.
(See Computer graphics.)

25   The playback frame rate of a PAL or SECAM broadcast television/video signal. It prevails in most countries outside the USA and Japan.
(See MPEG*.)

30   The playback frame rate of an NTSC broadcast television/video signal. It is used in the USA and Japan.
(See MPEG*.)

30 bit image depth   A 30 bit digital video, computer-generated image or animation is generated and stored using 30 bits of colour information for each pixel (or dot). This results in a maximum of about one billion (or 2^{30}) colours.
(See 24 bit image depth.)

32   The maximum number of subtitle channels that can be stored on a DVD disc.
(See DVD.)

32 bit   1. A program or operating system that uses 32 bit instructions. 32 bit operating systems include Windows 95, Windows 98, Windows NT and OS/2 Warp. Windows 95 and Windows 98 are not pure 32 bit operating systems due to certain 16 bit instructions, but are generally regarded as 32 bit operating systems. 32 bit software is able to access memory more efficiently than 16 bit variants. It is capable of flat memory addressing in which 4 Gbyte (2^{32}) memory segments can be addressed. A 32 bit segment register is used to point to addresses within a 4 Gbyte range. *(See Operating system and Windows.)* 2. A 32 bit processor uses 32 bit instructions. The earliest Intel 32 bit processor was the third-generation 80386. 3. A data bus width (in terms of the number of its lines) connected to a device such as a processor, hard disk controller, memory card or graphics card. 4. An extension of the 24 bit image depth, an additional byte (or Alpha channel) provides control over the transparency of pixels. Red, green and blue are each represented by eight bits, giving 256 tones of each, which in turn leads to over 16.7 million ($256 \times 256 \times 256$) colours. The additional eight bits *(*the Alpha channel in Apple parlance*)* are used to control transparency. 32 bit graphics make possible photographic quality images. The Apple Macintosh is remembered as the first platform upon which the 32 bit graphics capability became commercially available.

36 bit   An image depth.
(See 24 bit image depth, 30 bit image depth and 32 bit.)

44.1 kHz   A sampling frequency used to record CD-quality audio. All MPC-2 and MPC-3 compliant sound cards can record in stereo at 44.1 kHz. The incoming analogue signal is digitised at least 44 100 times per second.

(See Sound card and Wave audio.)

50 Hz   An interlaced field rate yielding 25 frames or picture updates per second, in accordance with the PAL video/broadcast standard. One field scans odd numbered lines, while a second field scans evenly numbered lines.

53   The number of bytes in the cells used in ATM networks, which include a five-byte header.

(See ATM and Frame relay.)

56.6 Kbps   A standard analogue modem speed. It exceeds the proven bandwidth limit calculated using Shannon's theorem. The higher speed is achieved using PCM and a digital link between the telephone company and the ISP. 56.6 Kbps modems are asymmetrical, offering wider downstream bandwidths; thus downloading times are shorter than those of uploading. The ITU considered two industry standards:

- X2
- K56flex

The resulting V.90 standard was specified provisionally and finally released in 1998.

(See Modem.)

60 Hz   An interlaced field rate yielding 30 frames or picture updates per second, in accordance with the NTSC video/broadcast standard. One field scans odd numbered lines, while a second field scans evenly numbered lines.

64 bit   1. A 64 bit processor has 64 bit registers, and is able to execute 64 bit instructions. High-performance servers, upon which client/server applications are platformed, often comprise 64 bit processors such as high-specification members of Digital's Alpha family of processors. Intel's seventh-generation processors, currently named Merced, are 64 bit, and will supersede the Pentium Pro and Pentium II as the chosen Intel processor for high-performance workstations and high-end PC servers. 2. A 64 bit program or operating system able to use 64 bit instructions and 64 bit registers. *(See Operating system.)* 3. A 64 bit peripheral device has a data bus with 64 lines.

64 Kbps   A bandwidth of an ISDN (Integrated Services Digital Network) line. ISDN is used widely for videoconferencing and high-speed Internet access.

(See B-ISDN, ISDN and Videoconferencing.)

100baseT   A network technology which yields a data transfer rate of 100 Mbps. Its implementation requires structured cabling and compatible network interface cards (NICs) on network systems.
(See Ethernet and LAN.)

120 mm   The diameter of a CD, CD-ROM or DVD disc.

133 minutes   The typical video playing time of a single-sided, single-layer DVD. This requires an average data transfer rate of 4.69 Mbps, and includes 3 audio channels and 4 subtitle channels. The video complies with MPEG-2, which is often referred to as DVD video.
(See DVD, MPC-3 and MPEG.)*

150 Kbyte/s   1. The average user data transfer rate of a pure single-speed CD-ROM drive operating in Mode 1. The data transfer rate of a CD-ROM drive broadly increases in multiples of 150 Kbyte/s:
- $10 \times$ speed: approx. 1500 Kbyte/s
- $20 \times$ speed: approx. 3000 Kbyte/s
- $24 \times$ speed: approx. 3600 Kbyte/s

In practical tests, the data transfer rate rarely increases in precise multiples of 150 Kbyte/s. *(See CD-ROM and DVD.)* 2. The average user data transfer rate of a CD-I Form 1 track when read using a pure single-speed player.
(See CD-I.)

170.2 Kbyte/s   The average user data transfer rate of a CD-I track composed of Form 2 blocks when read using a pure single-speed player.
(See CD-I.)

171 Kbyte/s   The average user data transfer rate of a pure single-speed CD-ROM drive operating in Mode 2.
(See CD-ROM.)

171.1 Kbyte/s   The data transfer rate of an audio CD encoded according to the CD-DA or Red Book audio standard.

286   An abbreviation for the second-generation Intel 16 bit 80286 processor. Launched by Intel in 1982, it proved the basis for the IBM PC AT (Advanced Technology).
(See Pentium and Processor.)*

352 × 288 pixels   A frame resolution described as the SIF (Source Input Format) for an MPEG-1 video sequence encoded using a PAL broadcast television/video source.
(See MPEG.)*

352 × 240 pixels   A frame resolution described as the SIF (Source Input Format) for an MPEG-1 video sequence encoded using an NTSC broadcast television/video source. The playback frame rate is standardised at 30 frames/second.
(See MPEG*.)

360 Kbyte   The approximate formatted data capacity of a standard IBM, 40 track, single-density, double-sided, .25in floppy disk. It was the most popular software distribution medium used for much of the 1980s.

386   An abbreviation for the third-generation Intel 80386 processor. Launched in 1985, it comprises a 32 bit instruction set. It was reverse engineered by numerous chip makers, including AMD (Advanced Micro Devices), which succeeded in winning a legal battle for entitlement to manufacture a 386-compatible processor.

386sl   An Intel processor designed and developed for laptops. It was essentially a 386sx variant, but consumed less power and had an internal memory cache. A static design, it did not require the constant refreshing associated with the 386sx. It was used in conjunction with the 82360sl companion chip.

386sx   An Intel processor launched in 1988 as an inexpensive route to 386 processing.

486   An abbreviation for the Intel 80486 processor, which was launched in 1989. Much of this fourth-generation technology provided the basis of the fifth-generation Pentium processor.

486sx   An abbreviation for the Intel fourth-generation 80486SX processor.

527.3 Mbyte   The user data capacity of a one hour Mode 1 CD-ROM disc and Form 1 CD-I disc.
(See CD-ROM.)

598.4 Mbyte   The user data capacity of a one hour Form 2 CD-I disc.
(See CD-I.)

602 Mbyte   The user data capacity of a one hour Mode 2 CD-ROM disc.
(See CD-ROM.)

640 × 480 pixels   The standard resolution of a super VGA (SVGA) display.

720 × 480 pixels A video frame resolution commonly associated with MPEG-2 video that has been encoded using an NTSC broadcast signal. The playback frame rate of such video is standardised at 30 fps.

(See D1 and MPEG-2.)

720 × 576 pixels A video frame resolution commonly associated with MPEG-2 video that has been encoded using a PAL broadcast signal. The playback frame rate of such video is standardised at 26 fps.

(See D1 and MPEG-2.)

0800 A four-digit prefix used in freephone or toll-free services in the UK and in other parts of the world. Network intelligence plays the role of:

1. Converting 0800 numbers into recipient numbers (using a service control point or SCP).
2. Recording the 0800 calls made, so the recipient subscriber is charged appropriately.

Such toll-free services around the world are normally restricted to domestic calls only.
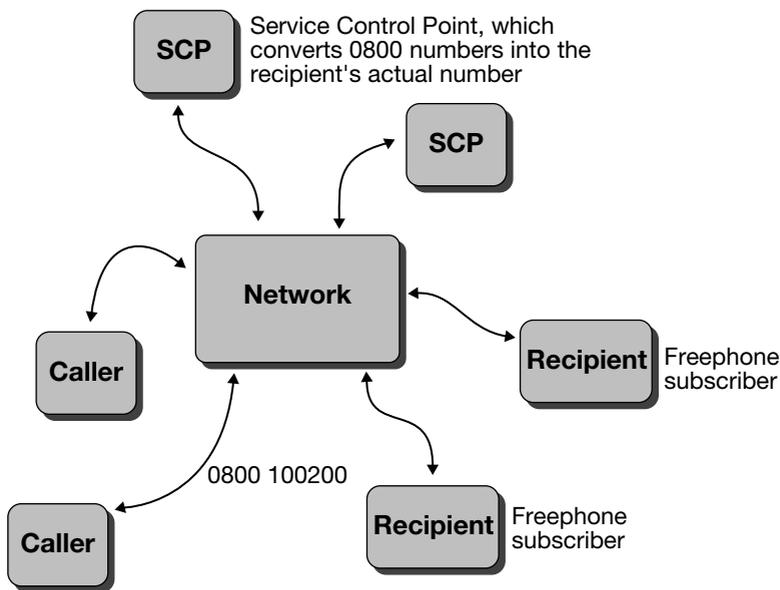
Freephone or toll-free service

800 × 600 pixels   A standard display screen resolution.

1000   The number of bits transferred in one second, using the unit Kbps.

1024   1. A kilobyte has 1024 bytes. 2. A megabyte has 1024 kilobytes. 3. A gigabyte has 1024 megabytes. 4. A terabyte has 1024 gigabytes.

1024 × 768 pixels   The standard resolution of an extended implementation of the IBM VGA graphics standard, which was introduced in mid-1987 as part of the PS/2 range of personal systems. The launch also saw the release of the OS/2 OS, the microchannel architecture (MCA) bus, 16 colour VGA, 256 colour MCGA, and of course an analogue graphics port.

1240 × 1024 pixels   A standard graphics resolution used on many PCs. Its delivery requires an appropriate graphics card and display.

1600 × 1200 pixels   A standard graphics resolution used on many highly specified PCs. Its delivery requires an appropriate graphics card and display. The display can be assumed to measure at least 17 in, while a more practical display is the 21 in variety.

2048 bytes   1. The user data capacity of a CD-ROM mode 1 data block. 2. The user data capacity of a CD-I Form 1 sector.

2324 bytes   The user data capacity of a CD-I Form 2 sector.

2336 bytes   1. The user data capacity of a CD-ROM Mode 2 data block. 2. The user data capacity of an audio CD sector.

2352 bytes   1. The total data capacity of a standard CD-ROM data block. 2. The total data capacity of a CD-I/CD-ROM XA sector.

3270   A family of industry-standard client/server products from IBM, which includes dumb terminals.

6502   An early 8 bit processor use in the BBC microcomputer and other similar machines of the early eighties. (*See BASIC.*) Other popular 8 bit processors of the same period include the Zilog Z80, Texas Instruments 9980A and the Intel 8080. As is the case today, these first-generation microprocessors shared similar assembly languages, and the transfer of programming skills between them was not difficult. Their assembly

language instruction sets overlapped, and mnemonics such as LDA (Load Accumulator) and DEC (Decrement) were almost standard.

(See Pentium and Processor.)

8859-1   An abbreviation for the ISO 8859-1 standard Latin character set.

9600   A standard modem speed measured in bps.

(See Modem.)

9660   An abbreviation for the ISO9660 standard, which is the official designation for a refined version of the High Sierra Group (HSG) industry standard for storing data on CD-ROM.

(See CD-ROM and DVD.)

9980A   An 8 bit processor produced by Texas Instruments in the early 1980s.

(See Processor.)

14 400   A standard modem speed measured in bps.

(See Access technology and Modem.)

16550 UART (Universal Asynchronous Receive/Transmit)   A family of serial communications devices used in modern personal computers.

28 800   The standard modem speed in bps of a V34 or VFAST modem.

(See Access technology and Modem.)

33 600   A standard modem speed measured in bps. It was superseded by the V.90 56.6 Kbps analogue modem standard.

(See 56.6 Kbps, Access technology and Modem.)

56 600   A standard modem speed measured in bps.

(See 56.6 Kbps, Access technology and Modem.)

68 000   A family of processors manufactured by Motorola. Its continuum began with the 8 bit 6809, which was used in such early designs as the Dragon 32 microcomputer which was engineered and developed in the UK. It was one of the first personal computer designs to incorporate cartridges as storage devices. These were composed of PROM devices, and were used for software distribution and for program storage.

1 000 000   The number of bits transferred in one second using a 1 Mbps data transfer rate.

16.7 million   A 24 bit digital video, animation or colour graphic may have up to 16.7 (2^{24}) million colours.

1 billion   A 30 bit digital video, animation or colour graphic may have up to (around) 1 billion (2^{30}) colours.