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FRANCIS BOTTO

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PREFACE

'Thinking is a function of man's immortal soul. God has given an immortal soul to every man and woman, but not to any other animals, or to machines, hence no animal or machine can think. I am unable to accept any part of this.'
Alan Mathison Turing
Computing Machinery and Intelligence (1950 MIND paper)

The most significant paradigm shift since Caxton's printing press, the Internet and its surrounding technologies advance relentlessly. The Internet is augmenting humanity's intellect as surely as its founding fathers, among them Vannevar Bush, predicted that it would.

The Internet is quite literally expediting evolution, echoing the impact of the most primitive tools and media. At the same time, its advancing technological infrastructure provides improved global communications and the foundations upon which to build future interactive media.

Rapidly evolving from specialist markets to the mass market, the Internet has ceased to be a preserve of the upper strata of society. Rather, it has affected everyone, and has cut like a sabre through market boundaries.

A global network of computer networks, the Internet is synonymous with marketing, advertising, publishing, electronic commerce, software distribution, real-time communications, and radio and television broadcasting.

The emergence of the World Wide Web in the early 1990s added hypertext-based navigation to the *global network*, and was a catalyst for growth. Now offering multimedia playback of video, graphics and sound, the evolving Web is a universal medium.

Day-to-day Internet applications include e-mail, information browsing and file transfer. Increasingly, electronic commerce, low-cost Internet telephony and videoconferencing are entering into mainstream computing habits.

The Internet and multimedia are now standard features of modernity, and are used as widely in the home as they are at work. The growing global dependence on the Internet has created lucrative markets for all Internet-related industries. These include telecommunications, Internet service providers (ISPs), Internet application development, PC manufacturers,

software publishing etc.. Almost every possible industry could be listed, as it is difficult to cite one that is untouched by the Internet.

The Internet has become a ubiquitous word, as has its synonym, information superhighway. Earlier labels such as Infobahn and Global network may now be consigned to history. Call it what you will, knowledge of the Internet is an essential prerequisite within many professions and for studying at school, college or university.

This dictionary provides detailed explanations of important Internet-related terms and phrases. Also included are the significant attributes of defined technologies, so presenting decision-makers with factors that must be considered. The more important entries are explained concisely and then elaborated upon through detailed articles.

It is hoped that you find this book a useful source of information.

USING THIS DICTIONARY

An asterisk following a cross-reference (e.g. Java*) indicates that there are many cross-references beginning with the term preceding the asterisk, some or all of which are likely to be useful sources of further information.

Most software applications appear under the name of their manufacturer. A few major applications appear under their own names (e.g. Windows and Visual Basic).

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INTRODUCTION

'I propose to consider the question: can machines think? This should begin with definitions of the meaning of the terms "machine" and "think . The definitions might be framed so as to reflect, as far as possible, the normal use of the words, but this attitude is dangerous.

Could a judge asking questions over a teletype link decide whether a human being or a machine was sending back the answers? If not, we would surely have to concede that the machine could be said to think.'

Alan Mathison Turing
Computing Machinery and Intelligence (1950 MIND paper)

The spontaneity with which the Internet has drilled down through the strata of society has yielded stories of success and stories of failure. For many enterprises, timely investment in the technology has driven higher profits, growing workforces and improved competitiveness in markets both at home and abroad. Those that ignored it, invested incorrectly or mistimed their investment may tell of success stories, but the informed will know otherwise.

The Internet, like many new and emerging technologies, is the venture capitalist's dream. Numerous Internet-related startups with minimal revenues have taken that well-worn path to becoming successful public companies in what seems like a fleeting moment.

Opportunities to invest in the Internet and to create startups remain. These are driven by the continual launch of new and improved associated technologies, while government intervention also plays a role. Growth is also significant; one current estimate indicates that the number of Web servers doubles every 55 days, and a new Web site appears every five seconds.

Advancements in the Internet see faster digital networks, growing use of more efficient internationally agreed protocols, an increasing variety of access technologies including those that are wireless, and client systems and appliances that help harness the Web to better effect.

New protocols can be designed for modern high-speed data pathways that are less susceptible to error. They can therefore be devoid of the demanding

error detection and correction schemes that were prevalent in established protocols for earlier packet switched networks.

Similarly, access technologies advance in terms of specification and variety. Users may choose between conventional analogue modems, ISDN, cable, ADSL and wireless technologies such as GSM and Direct Broadcast Satellite (DBS).

Increasingly sophisticated client systems include personal digital assistants (PDAs), palmtop and notebook systems, desktop PCs, Apple Macintosh systems, RISC workstations, network computers (NCs), and Internet access appliances for the home.

Client software, such as Web browsers, and the underlying component architectures also advance. The addition of such software components as ActiveX controls and plug-ins yields such functionality gains as the playback of audio-visual broadcasts from streaming media sites, which form one of the many focuses of this text.

Equally, the Java Virtual Machine (JVM), a software processor, enables browsers to interpret Java applets. Such components may integrate both dynamic and static features into Web applications and distribute processing to the client.

Glues are the fabric of such modern distributed processing and of component architectures such as JavaBeans, ActiveX, OLE and OpenDoc. Low- and high-level glues include protocols like IP and HTTP, respectively. Glues also include schemes for inter-component communications and interactions, enabling them to transmit and receive messages over local and remote paths.

Client-side operating systems are also significant, with Microsoft Windows variants advancing at a pace which (understandably) lags behind that of the underlying processor technology. Logically, the next significant advancement of Windows will be the introduction of a 64 bit implementation.

Of the many component parts that drive client system performance, processors are perhaps the most important; and Intel PC processors, as well as equivalent processors from competing vendors such as AMD, are most important of all.

The inclusion of Intel's MMX multimedia technology within processor architectures sees improved delivery of multimedia, audio, video, 2D/3D animations, and speech recognition. Processor clock speeds also advance relentlessly, but the most significant quantum leap is the emergence of seventh generation Intel processors. This sees the introduction of affordable 64 bit processor architectures, which will outperform today's fifth and sixth generation processors by considerable margins.

Similarly, the active Web model is seeing heightened levels of server-side processing, and advancing server hardware architectures, which are moving

toward symmetric multiprocessing (SMP), non-uniform memory architectures (NUMA), and even massively parallel processing (MPP).

Such improved server-side architectures might in future make feasible the idea of users purchasing remote processing. This may become as common as buying server-side hard disk space for personal Web pages/sites or files, or paying that little extra for an improved mail gateway through which to send larger file attachments. The user may simply buy MIPS or FLOPS from a *processing site* as easily as megabytes or gigabytes are bought today.

Such a paradigm might see acquired applications or objects running remotely and possibly locally through applets. Software publishers, distributors and perhaps dealers would not require removable distribution media such as DVD, CD-ROM or floppy disk; rather, applications could simply be written directly to host sites using FTP or a similar future protocol. Users may have their entire application library and associated files stored remotely, as might be their book libraries and their video, music and photograph collections.

The geographical location of users' acquired objects, processing and files won't matter; they may be spread across the continents, and in cities such as London, New York, Tokyo and Peking. *It won't matter!*

The partial displacement of processing, application logic and data from the client side yields an opportunity to design and manufacture unobtrusive client systems. The degree of unobtrusiveness is naturally a function of time, et cetera. *Et cetera is an appropriate phrase at this point, because the possibilities are endless.*

At the same time, levels of miniaturisation at the processing site become less significant; such a scenario sees compactness of design relegated to levels associated with that of mainframe computer design and manufacture.

The emergence of such remote processing hinges on the speed of two data paths: the first is that between the client processor and its memory and mass storage devices; the second is that of the access technology itself. The former offers a bandwidth many orders of magnitude wider than the latter.

Developments in recent years indicate that the gulf that separates the two is widening, but this might not always be the case, as is highlighted by Internet 2 and the forthcoming Internet 3. Incremental improvements in access technologies could yield such a Web model, particularly when considering OO systems, distributed computing and MPP architectures.

As the hardware infrastructure develops in momentous leaps and bounds, it is left to operating systems, programming languages, development tools and even programming models to do the same. The gradual shift to improved concurrency and MPP brings parallel programming closer to the mainstream.

Solid evidence of this is provided by the Java concurrent programming language. This is the first general purpose (and successful) programming

language to integrate such a facet, which came to prominence through earlier concurrent programming languages, most notably Occam.

The parallel programming model and associated MPP architectures are perceived by many as the Holy Grail of computing, and a paradigm shift more significant than the first generation of programming languages. If some of the world's greatest computer scientists are correct, these will unlock artificial intelligence and drive a plethora of new technology paradigms, many of which have been visualised conceptually but have yet to be realised.

In essence, developers of all sorts will be presented with a more persuasive medium within which to work, and one that will be considerably more empowering for the end user.

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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=2000000 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:

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

$$= \begin{bmatrix} \cos\theta & 0 & -\sin\theta & 0 \\ \sin 2\theta & \cos\theta & \cos\theta\sin\theta & 0 \\ \cos\theta\sin\theta & -\sin\theta & \cos 2\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

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:

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

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/environment 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 subgroups 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 × speed: approx. 1500 Kbyte/s
- 20 × speed: approx. 3000 Kbyte/s
- 24 × 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.)

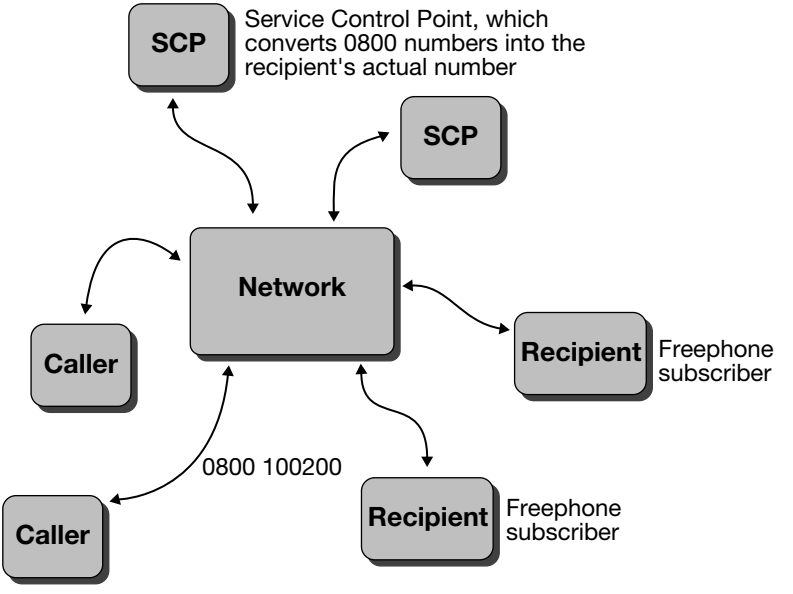
720 × 576 pixels A video frame resolution commonly associated with MPEG-2 video that has been encoded using a PAL broadcast signal. The playback frame rate of such video is standardised at 26 fps.

(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.

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A

AAAS (American Association for the Advancement of Sciences) An American organisation dedicated to the sciences.

AAIM (Association for Applied Interactive Multimedia) An organisation that serves multimedia professionals.
(See www.aaim.org)

Abel, Robert A pioneering multimedia author. His early works include Guernica, an interactive documentary about the destruction of the Basque Town of the same name during the Spanish Civil War. Picasso's famous painting Guernica is used to promote the central theme. Guernica was initially platformed on the Apple Macintosh computer.

Absolute addressing A method of addressing stored information, where addresses are independent of one another. CD-ROM block addresses include measurements of time and data blocks read. Minutes, seconds and blocks provide enough information to locate information. For example, a one-hour CD-ROM would use the addressing scheme:

- Minutes (M): 0–59
- Seconds (S): 0–59
- Blocks (B): 0–74

A track beginning midway through the CD-ROM might be addressed 29:29:37 (M:S:B). This addressing technique is also reflected in CD-I.
(See CD-ROM and DVD.)

Accelerator 1. A graphics card offering high-speed operation and optimised for GUIs such as the X Window system, Windows and OS/2. *(See 3-D and Graphics card.)* 2. A video accelerator is a graphics card that is able to speed up the playback frame rate of video sequences. The acceleration is achieved by inserting duplicate frames. VideoLogic was one of the first companies to demonstrate the acceleration of Windows .AVI video files using this technique. *(See MPEG*.)*

Acceptance cone A range of angles at which a laser beam may be injected into a fibre optic cable so that the ray is propagated for the entire fibre's length. It is a function of the numerical aperture (NA), which is greater with multi-mode fibres than it is with mono- or single-mode fibres.

(See Optical fibre.)

Access A process by which users gain the rights to operate a local or remote system, application or program. The user may be required to enter an ID and password.

(See Encryption and Security.)

Access technology A method used to connect to the Internet or to a remote network or computer system. Access technologies include:

- PSTN and analogue modem offering speeds up to 56.6 Kbps
- analogue and digital GSM
- ISDN
- Cable
- DSL
- ADSL
- GSM
- DBS (Direct Broadcast Satellite)

(See 56.6 Kbps, ADSL, ATM, B-ISDN, Cable modem, ISDN and Modem.)

Access time The interval between a data request and data retrieval. Hard disk and CD-ROM access times are measured in milliseconds (ms) (or thousandths of a second.) The length of access time depends largely on the electromechanical architecture, but increasingly controllers play an important role. For instance, hard disk cache controllers may reduce the measured disk access time to tenths of a millisecond. In the perspective of DVD and CD-ROM, average access time is the time taken for the laser head to locate and begin reading an appropriate region of the disc. Access time tends to increase with turns of track that are farthest from the disc's centre.

(See CD-ROM, DVD and Hard disk.)

Accumulator The part of a processor architecture that can be used to store the results of arithmetic operations. It consists of one or more registers, and its overall size often indicates the size of instructions that can be processed.

(See Processor.)

ACID (Atomicity, Consistency, Isolation and Durability) A series of properties which define the real-world requirements for transaction processing (TP).

Atomicity A process of ensuring that each transaction is a single workload unit. If any subaction fails, the entire transaction is halted and rolled back.

Consistency A process of ensuring that the system is left in a stable state. If this is not possible the system is rolled back to the pre-transaction state.

Isolation A process of ensuring that system state changes invoked by one running transaction do not influence another running transaction. Such changes must only affect other transactions when they result from completed transactions.

Durability A process of guaranteeing that the system state changes of a transaction are involatile, and impervious to total or partial system failures.

(See Server and Transaction.)

Acoustic coupler A device that may be fitted to a telephone handset, enabling data communications.

Acrobat *(See Adobe Acrobat.)*

ActionMedia II An i750 chipset-based graphics card that can play video compressed according to the Intel Indeo video standard. It is an evolved version of the original i750-based ActionMedia board developed to play and record video according to the Intel Digital Video Interactive (DVI) technology. Two ActionMedia DVI boards were required: one for playback and another for video capture and compression. DVI was a notable milestone in the development of the PC as a multimedia device and in the evolution of digital video in the PC environment.

(See DVI and MPEG.)*

Active Channels A connection to a Web site which sees information pushed to the Windows Active Desktop.

(See Active Desktop.)

Active Control Pad A development tool which may be used to develop interactive Web pages. It supports JScript and VBScript, and can be used to integrate ActiveX controls. The program is supplied with a number of user interface-related ActiveX controls, which include:

- Forms 2.0 Label for creating labels on Web pages
- Forms 2.0 Text Box
- Forms 2.0 Combo Box
- Form 2.0 List Box

- Forms 2.0 Check Box
- Forms 2.0 Option Button
- Forms 2.0 Toggle
- Forms 2.0 CommandButton

(See Active Desktop, Active Document, ActiveX, Java, JavaScript, VBScript and Visual Basic.)*

Active Desktop 1. A term used to describe the client side of an Active Web application, and to describe the addition of Active Desktop Components (ADCs) to the Windows Desktop. The Web page uses ActiveX scripting (with VBScript or JScript) in order to integrate and coordinate:

- Active Desktop Components (ADC)
- HTML code
- ActiveX controls
- Java Applets.

(See Active Desktop Component, Active server, ActiveX control, Java, JScript, OLE, VBScript and Visual Basic.) The integration of Web browsing capabilities in the Windows 95 or 98 Desktop. It is intended to provide the user with seamless connection to, and use of, the Internet. Whether applications and data are local or remote (i.e. on the Internet or an intranet) is transparent to the user. Active Desktop Compondents (ADCs) are arranged on the desktop in the form of Active Channels, and offer various functions. Connectivity to Web sites is provided by Active Channels in the form of Channel bars, which may be selected from the Windows Desktop.

Active Desktop Component (ADC) A component, which might be an ActiveX control, that is integrated into an Active Desktop. For instance, the PointCast ADC is an example, and may be configured to receive selected information from news services.

(See Active Desktop.)

Active document A term which describes the integration of Internet Explorer with documents. For instance, Microsoft Office documents might be opened using Internet Explorer.

(See Microsoft Office.)

ActiveMovie A Microsoft streaming video technology which is integrated in Internet Explorer. It supports the video formats QuickTime, MPEG and AVI.

(See ASF and www.microsoft.com/imedia.)

Active server A server that pushes data to a client's Active Desktop and delivers Active Channels. Server-side application components are common in type to the Active Desktop. These may include:

- ActiveX controls
- Java applets
- JScript
- VBScript
- HTML.

The server-side implementation may integrate the MCIS server components.

(See ASP, Java, JScript, MCIS, OLE, VBScript and Visual Basic.)

Active Server Components *(See ASP.)*

Active Server Page (ASP) *(See ASP.)*

Active Template Library (ATL) A development tool used to develop Active Server Components, which may be in-process or out-process.

(See ASP.)

Active Web Architecture An architecture which provides bi-directional information flow between the HTTP server and HTTP client. The resulting interactivity on the client side permits data entry and the editing of HTML documents. It uses the Common Gateway Interface (CGI) between the HTTP server and its applications and databases. CGI is a protocol which provides the necessary communications. CGI scripts are created using a scripting language or programming tool. (See Figure on page 22).

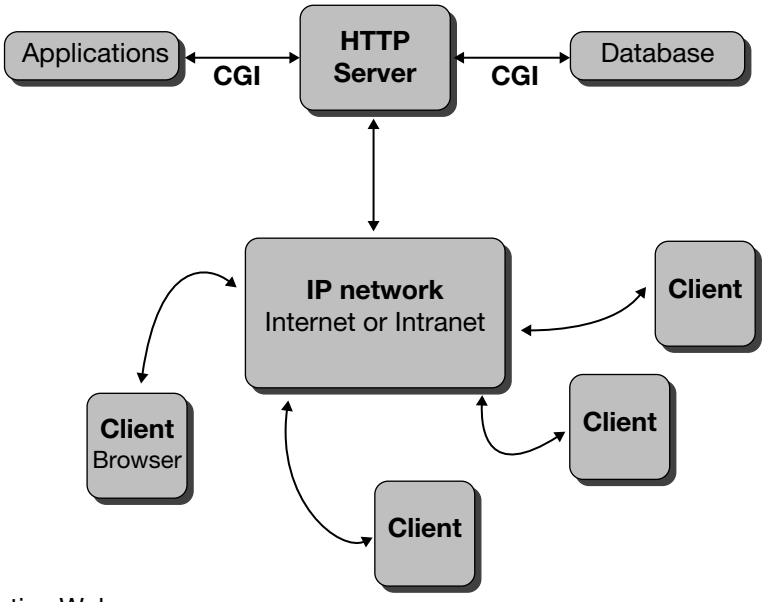
(See CGI and Perl.)

Active window A window which is currently selected by the user. The window might be activated when the user:

- clicks on the window
- selects its related application button from the Taskbar
- selects the window from the Window menu
- selects the window using the keyboard by pressing Alt-Esc, or by pressing Alt-Tab.

(See Windows.)

ActiveX control An object or component that adds functionality to an application which may be standalone or deployed over the Web or network. Microsoft ActiveX is an object architecture based on OLE 2.0, and is intended for deployment over the Internet and compatible IP networks.



Active Web

More accurately, ActiveX is a reincarnation of OCX and may use COM and DCOM as glues. ActiveX provides cost-effective functionality gains for Web browsers. An ActiveX control might take the form of a streaming video player, or a streaming audio player that might be added to Internet Explorer (which is a Web browser). ActiveX controls may be created using Visual C++, Visual Basic 5 Control Creation Edition or Java.

Guidelines for creating ActiveX controls

- Refer to existing active controls in the public domain, to those that are shareware, and to those that might be conventionally marketed and sold. The economics of recreating that which has already been created might prove undesirable. Study the functionality of the ActiveX controls and try to obtain real-world reviews of them, in order to gain an understanding of what may be expected from them.
- Use the latest editions of development tools such as Visual Basic Control Edition and Visual Studio.
- Supply detailed design, architecture, implementation and functionality documentation. If the ActiveX control may be modified at the code level, provide adequate comments in the source listing. Also include an impact statement of how the ActiveX control changes targeted applications, together with reusing a strategy of useful code segments or algorithms designed.
- Do not intentionally integrate patented algorithms in your ActiveX control. It

is accepted that such infringements can be implemented unwittingly by the developer/programmer.
- Test the ActiveX control.
- Provide case scenarios giving real-world examples of their integration in Web applications.
- Refer to Microsoft's Web site for the latest ActiveX specification and development tools.
- Integrate configuration features which may be used from within the application where the ActiveX control is embedded.
- State the development environments/tools with which the ActiveX control has been tested.

(See Authenticode.)

ActiveX components running on the same system may interact using the COM protocol as a glue. Industry-wide support beyond Microsoft in ActiveX-compatible development tools includes:

- Borland Delphi
- Powersoft PowerBuilder *(See www.powersoft.com)*
- Powersoft Optima++ *(See www.powersoft.com)*
- Symantec C++ *(See www.symantec.com)*
- MetroWerks Code Warrior *(See www.metrowerks.com)*.

(See Active Desktop, Active document, Active server, Authenticode, COM, DCOM, Glue, HTML, Java and Visual Basic.)

ActiveX scripting A process by which ActiveX controls and Java Applets may be integrated into the underlying HTML code of an interactive Web application. Such scripting is generally used with Web applications, though standalone applications may also be built using the same. The scripting languages JScript and VBScript are used widely. A basic HTML listing may be given functionality and responses to events through:

- JScript code
- VBScript code
- ActiveX Controls such as Shockwave and multimedia streaming components
- Java applets.

Such a development strategy can be used to give the client-side a level of intelligence. Validations of user data and interactions distribute processing away from the server-side. This lessens the volume of data traffic and serves to optimise application performance. ActiveX scripting may also be applied to the server-side; it is possible to create Active Server Pages (ASPs).

(See ASP, CGI, HTML, Java, Java applet, JavaScript, Shockwave, VBScript.)

ActiveX SDK (Software Development Kit) A programming tool for creating ActiveX controls. ActiveX controls can also be produced using:

- C++
- Java
- Visual Basic.

(See ActiveX control, Java and Visual Basic.)*

ActiveX security A term used to describe the filtering of unwanted ActiveX controls or presenting the user with an option to do so.

(See Authenticode and Security gateway.)

ADA A high-level programming language and the namesake of Lord Byron's daughter, who became the world's first technical writer in computing when documenting Charles Babbage's mechanical computer.

Adaptive data compression A proprietary data compression technique integrated into the design of many Hayes modems. The algorithm adapts itself so as to optimise compression.

ADC (Analogue to Digital Converter) 1. A device or electronic assembly used to convert continuously varying analogue signals into digital form. The accuracy achieved depends largely on the size of samples and on the sampling rate. Video capture boards and sound cards include analogue to digital converters. Standard PC and Macintosh sound cards tend to record using 8 bit or 16 bit samples at sampling rates of 11.25 kHz, 22.05 kHz or 44.1 kHz. Highly specified sound cards may record using sampling rates of up to 48 kHz, which equates to DAT quality. Video capture cards generally play a dual ADC role, converting audio as well as video into digital form. Normally audio is digitised using the same sample sizes and sampling frequencies available on most fully specified sound cards. Whether capturing from a VHS or S-VHS video source recording, the process of digitising a video signal requires a great deal more computation than that of an analogue audio signal. The maximum frame capture rate of a video capture card is a function of its maximum sampling rate, which is linked to the maximum data rate at which it can operate. 2. Active Desktop Component.

(See Active Desktop and Active Desktop Component.)

Address 1. *(See IP address.)* 2. CD-ROM addresses include measurements of time and data blocks read. *(See Absolute addressing.)* 3. A binary address of data or instructions that are stored in memory. 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. At the machine code level, the addresses of data and instructions are held in a register called a program counter. Typically its contents grow by increments of one, except when a conditional or unconditional jump occurs to a new memory location. This normally occurs when a subroutine is executed. At such times, the contents of the program counter are placed on a stack, which is a portion of memory that operates according to the LIFO (last in, first out) system. This ensures that the last address placed on the stack is the first to be retrieved. When the subroutine is completed (perhaps using the RET command), the return address is recovered from the stack and placed back into the program counter register.

Address Book A Windows NT-based server which is part of the Microsoft Commercial Internet System (MCIS). *(See MCIS.)* Address Book allows users to query a database of users, which may include dynamic values such as IP addresses as well as static values that might include names, addresses, age, interests and occupation. It is compatible with:

- NetMeeting, which supports Internet telephony and conferencing
- an Internet Locator server, which may be used to query the database
- a Microsoft SQL Server, which can be used as the database.

(See Internet telephony and Microsoft SQL Server.)

Address bus A unidirectional address bus on a processor. It consists of a number of lines, and interfaces with memory devices and memory decoders.

Adobe Acrobat An Adobe file format that permits formatted documents to be deployed efficiently over the Web. Adobe Acrobat Reader is required to read Acrobat files (which have the .PDF extension). Using Netscape Navigator, the Acrobat Reader requires a plug-in, while Microsoft Internet Explorer uses an ActiveX control.

(See ActiveX control.)

Adobe After Effects A 2-D/3-D animation program which permits various effects and enhancements.

Adobe Dimensions A 3-D graphics program.

Adobe Illustrator A graphics program used widely for Web and multimedia production and to originate images for print.

Adobe PageMill A Web site development tool which may be used to develop Web applications.

(See ActiveX control, CGI, Java, MCIS and Web Server.)*

Adobe PhotoShop A program used widely for image manipulation, enhancement and editing.

Adobe Premiere A video editing tool.

(See Multimedia production and Video capture.)

Adobe Streamline A graphics package that provides a number of tools, and can convert images into line drawings.

(See PaintShop Pro.)

ADPCM (Adaptive Delta Pulse Code Modulation) A process by which an analogue signal is converted into digital form. It is a development of Pulse Code Modulation (PCM). The sampling rate influences how accurately sharply varying analogue signals are digitised. It is used in CD-I and many other digital audio, video and multimedia technologies.

ADSL (Asymmetric Digital Subscriber Line) An access technology that uses the existing copper wire networks that are synonymous with POTS (Plain Old Telephone Services), though these may also include fibre optics. Its downstream bandwidth is considerably wider than its upstream bandwidth:

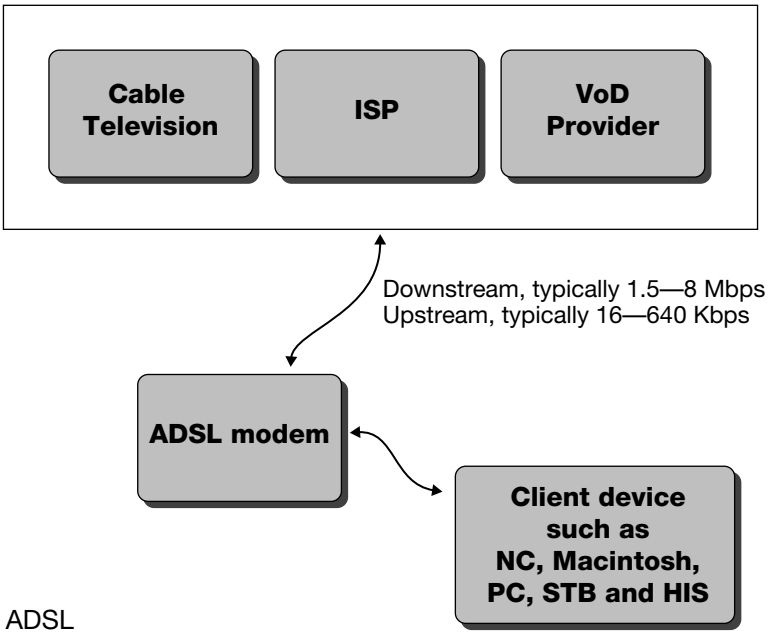
- Downstream bandwidth of between 1.5 Mbps and 8 Mbps. Typically it is 1.5 Mbps.
- Upstream bandwidth of the order of 16 to 640 Kbps, which can be a function of the line length. Typically it is 384 Kbps.
- Line lengths of up to 5 km are quoted. Typically a repeater is required for distances greater than 1800 feet in order to overcome attenuation.

Applications include:

- high-speed Internet access
- VHS quality videoconferencing
- VoD (video-on-demand)
- multimedia networks

Discrete multitone (DMT) modulation according to ANSI T1.413 separates upstream data from downstream data by separating the signal into separate 43 kHz carrier bands.

(See Access technology.)



ADSL

Aftertouch A keyboard which is sensitive to the firmness of touch, e.g. musical volume is increased by pressing harder on the key(s).

Agent 1. An agent/manager architecture used for system management in client/server systems. The agents represent managed subjects, which are communicated with and manipulated by managers. 2. A triggered agent is a program that responds to events with appropriate actions. The actions might be little more than answering a telephone call. More sophisticated agents might modify software, build databases or even data warehouses, or add items to a cache, in response to usage habits. Events such as changes to files or directories might also be used as triggers. 3. An habitual agent can be programmed to implement tasks at a precise frequency, such as hourly or daily. 4. A Microsoft ActiveX control intended to enhance the UI of local and Web applications. 5. In a telecommunications network, an agent interprets various commands and responds to them appropriately.

AGP (Accelerated Graphics Port) A high-speed graphics controller implementation which uses a 66 MHz bus. This doubles the speed of PCI cards, which exploit a 33 MHz bus connection.
(See Graphics card.)

AI (artificial intelligence) A term used to describe the use of a system to emulate human decision-making and learning abilities. The founding father

of artificial intelligence is Alan Mathison Turing, through his writings, which include *Computing Machinery and Intelligence* (1950). Turing, an English mathematician, Second World War code-breaker, computer scientist and inventor, also described the 'Turing machine', and how it could theoretically implement logical processes. Expert systems (or knowledge-based systems (KBSs)) and neural networks are perceived as part of AI. It is believed that massively parallel processing (MPP) systems will unleash and emulate many human-like thought processes. Neural networks represent a key area of AI.
See: Cawsey, Alison, *The Essence of Artificial Intelligence*, Prentice Hall, 1998.

(See KBS, MPP and Neural network.)

AIX A Unix operating system variant.

A-Level audio A CD-I audio quality level, which is equivalent to the first play of a vinyl disc under optimum conditions. Such conditions are devoid of the noise caused by static and the physical stylus contact. A-Level audio consumes half the data capacity of audio CD data. The transfer occupies half the data channel, leaving more bandwidth for other multimedia elements such as video, computer graphics and text.

Algol A high-level programming language.

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

Algorithm 1. '*An algorithm is a set of rules for getting a specific output from a specific input. Each step must be so precisely defined that it can be translated into computer language and executed by machine*' (Donald E. Knuth). 2. A collective name describing the components of the problem solving process. It can be a program or series of steps defining a *modus operandi*, which yields what is regarded to be an acceptable solution. 3. A term used loosely to describe a program or program segment. Algorithms for compression, and those that perform other operations, are often patented.

Allen, Paul A co-founder of Microsoft and sole founder of Asymetrix. He is *one* of the world's richest men.

(See Asymetrix and ToolBook.)

Alpha 1. A family of RISC processors manufactured by Digital. 2. A pre-release copy of an application, which is distributed and tested in-house. It is the penultimate development stage that precedes beta testing. *(See Beta.)*

3. An 8 bit data channel on 32 bit colour systems that provides control over the transparency of pixels, thus facilitating numerous video effects.

AMD (Advanced Micro Devices) A chip manufacturer that produces PC processors. AMD came to prominence when it reverse engineered Intel's third-generation 80386 processor and won the legal right to market and sell it. More modern AMD offerings include the K6 MMX processor.

(See Pentium.)

Amiga A personal computer manufactured by Commodore Business Machines. With its excellent graphics, four digital sound channels and multi-tasking OS, the original Amiga 1000 was suited to multimedia. In 1990 Commodore launched the more powerful Amiga 3000, and introduced the 3000T-040/200 and 4000-040/120 in 1992.

Amplitude A measurement of the magnitude of a digital or analogue signal.

Analogue A signal which does not vary in precise preset steps but passes smoothly from one level of amplitude to another. Waveforms are used to represent analogue entities such as sound. For storage and processing using computers, analogue signals are converted into a digital form using analogue to digital converters (ADCs), of which many variants exist.

Analogue RGB A method by which red, green and blue components are excited in accordance with individual (analogue) constantly varying signals.

Analogue video editing A process of editing analogue video typically stored on media such as standard VHS or S-VHS tape. With appropriate software such as Video Director (Gold Disk) it is possible to edit analogue video using a PC. Video Director interfaces with camcorders that have either a Sony LANC (Control-L) or a Panasonic RMC (5-pin) edit terminal. It controls the recording or target VCR through infrared commands.

And 1. A logic gate that has two or more inputs and a single output. The output is one, or positive, when all inputs are set to one. 2. A logical operation in a search string that requires the presence of two or more words or phrases. 3. An operator in a program that tests for two or more conditions.

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

Andreessen, Marc A computer scientist and entrepreneur, who created the Netscape Navigator Web Browser and is the founder of Netscape. He

also worked on one of the earliest Web Browsers, Mosaic, which was developed at the National Center for Supercomputing Applications at the University of Illinois.

(See Browser, Hypertext and Web.)

Animatic A film or video summary of a multimedia production. It is the motion picture equivalent of storyboard.

Animation A series of frames used to create the illusion of movement. Animation types include:

- morphing, which dissolves one image into another, and may be created using dedicated morphing programs or equivalent features in animation programs
- sprite, where one or more screen objects are moved
- cell-based, where entire frames are updated fully or partially to give the illusion of movement
- micons, where a continuous series of frames is repeated conditionally. The condition might be a mouse-click event.

(See Animation program.)

Animation program A program designed for the production of 2-D and 3-D animations. Autodesk Animator Pro and Autodesk 3D Studio are popular off-the-shelf packages. Other 3-D animation development tools include NewTek's LightWave 3D, Strata Studio and the Electric Image Animation System.

Anonymous FTP (File Transfer Protocol) An FTP server to which users may connect, browse its files, download files and possibly upload files without the need for an individual password.

(See Archie and TCP/IP.)

ANSI (American National Standards Institute) A highly influential standards institution. The array of ANSI standards covers everything from character sets to programming languages such as C++.

AOL (America Online) A large international ISP, which has POPs (points of presence) in many major cities. The Compuserve ISP is part of the AOL corporation.

API (Application Program Interface) An interface which provides programmers with high-level instructions and possibly routines. An API for a

3-D engine, for instance, would provide statements that permit graphics to be drawn and manipulated. The complex underlying matrix transformations (*see 3-D*) and mathematical elements are transparent to the programmer.

Apple Computer A computer manufacturer renowned for innovative designs and for consistently setting high standards later sought by competing companies. Co-founded by Steve Jobs, the company underwent a meteoric rise to become a heavyweight multinational in the eighties. The first Apple computer was designed by Steve Wozniak, a co-founder of Apple Computer. The launch of the highly successful Macintosh (Mac) computer in 1984 represented a significant point in its history. The Macintosh has since been refined into several versions and is an excellent platform for multimedia delivery and development. HyperCard is synonymous with the Macintosh and marked the beginning of a deserved reputation for suitability to multimedia. HyperCard was the birth of hypertext/hypermedia in mainstream computing.

(See Apple Macintosh.)

Apple Computer Human Interface Guidelines A set of guidelines drafted by Apple Computer to promote consistency between different applications and programs, thus making them easier to use and learn.

Apple Macintosh A range of desktop computers produced by Apple Computer. When introduced in 1984 the Macintosh pushed forward the boundaries of desktop computing through the:

- graphical user interface (GUI or gooey)
- mouse input device
- analogue graphics port; PC users had to wait until 1987 before gaining analogue graphics.

It marked the beginning of affordable desktop publishing, with PageMaker becoming the chosen application. It was first advertised during the Super Bowl in January 1984. The advertisement was based on Orwell's novel 1984 where the Apple Macintosh was portrayed as saving society from the nightmare of Orwell's Big Brother scenario/theory. It became hugely successful and led Apple Computer to produce a series of Apple Macintosh computers. The Apple Macintosh has consistently led the way in multimedia, being significantly more advanced than the PC.

(See GUI.)

Apple Media Tool A multimedia authoring environment.

Applet A program that resides on a server and when requested is downloaded and executed by the client browser. Such applets deployed on the Web require machine independence and a virtual processor such as the Java Virtual Machine installed on the client. The applet concept is not new, predating Java by a considerable margin.

(See ActiveX control, Java and UltraJava.)*

Applet Designer Professional A development tool that permits the development of Java-based database applications and is able to port Visual Basic applications to Java.

(See www.vbnet.com.)

AppleTalk™ A network capability built into Macintosh computers that permits integration into heterogeneous environments. It may be used with LocalTalk™ cabling, Token Ring and Ethernet.

(See Ethernet and Token Ring.)

Appliance controller A generic name for hardware through which a computer controls an appliance, such as a mass storage device.

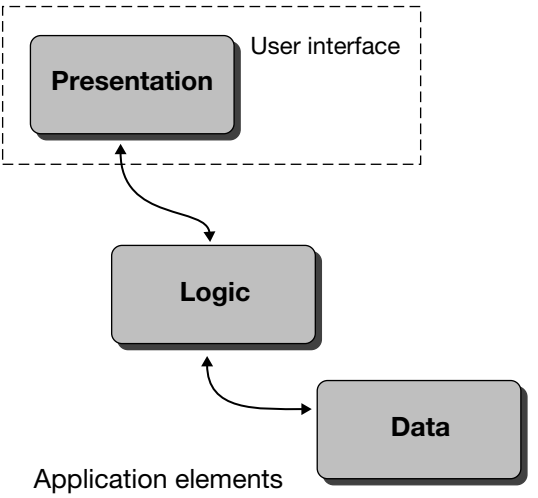
(See Hard disk.)

Application development A process by which an application is created. In terms of authoring multimedia, the development life cycle might include various standard stages that include:

- project planning
- design
- scripting
- prototyping a storyboard design
- multimedia production
- production
- coding in a multimedia language such as OpenScript or Lingo
- coding in an Internet-related language such as Java, VBScript, JScript, HTML, VRML or Perl.
- coding in general purpose languages such as Visual Basic or Visual C++
- alpha testing
- beta testing
- packaging the application for distribution on a CD variant, or for deployment on a network.

From the perspective of the Web or Internet, application development may require the use of:

- content authoring programs, such as those that permit the generation of animations and carry out multimedia production tasks



- Web site development tools that permit production tasks such as integrating media with navigation schemes etc.

(See C++, Java, MCIS, VBScript and Visual Basic.)

Application-level gateway An application-level gateway is able to process store-and-forward traffic and provide security features. It may be programmed to maintain logs of application usage. Users must log in to the application gateway machine.

(See Firewall and Security gateway.)

Application Message Queue A buffer used in Microsoft Windows to store messages posted by an application using the PostMessage routine. The size of the queue can be set using SetMessageQueue.

Application Programming Interface (API) An interface that provides programmers with the necessary high-level instructions to implement what would otherwise require a great deal of coding and specialist skills. For example, an API might provide access to the complex functions of a 3-D graphics engine through simple instructions. The underlying mathematical elements are transparent to the programmer, and need not be understood or coded. Multimedia-related APIs are released constantly.

Application renovation An upgrade path used to modernise legacy systems, such as those based on older mainframe computers. It essentially adds new client and connectivity components. Wall Data is one company linked with both the term and the products that make possible application renovation. The process can be viewed as an alternative to migrating from a

mainframe-based solution to more modern client/server implementations. It offers the advantage of reduced costs, but the relatively high maintenance costs associated with mainframe computers are seen as a disadvantage.

(See Client/server.)

Application software A program or suite of programs designed to perform a particular task, or set of tasks. Mainstream business applications include word processors, spreadsheets, relational databases and contact managers. These are generally included in integrated packages. Examples of applications include:

- integrated packages such as Microsoft Office, Microsoft Works and ClarisWorks
- word processors such as Microsoft Word, WordPerfect and Lotus Word Pro
- spreadsheets such as Microsoft Excel, Lotus 1-2-3 and Quattro Pro
- databases such as Microsoft Access, Paradox and DataEase
- contact managers such as Outlook, Goldmine and those supplied with many integrated packages

The three staple elements of an application are:

- presentation, which is required by those applications that feature user interaction
- logic, which is required to process and manipulate information
- data, which may be of many different types.

The physical, or perceived, locations of the three functional elements depend upon a series of logical topologies devised by the Gartner Group. This is explained under the entry *Client/server*.

(See Client/server and Microsoft Office.)

Arbitrated loop *(See Fibre channel.)*

Archie An on-line database of indexed words from FTP sites that was developed at Montreal's McGill University. The database can be searched using TelNet or by sending e-mail messages that have simple instructions to Archie servers. For example, to find FTP sites and files that contain the word 'occam', the e-mail message would read:

```
set search sub
find occam
```

Archie would then return a listing of appropriate files and FTP sites. This information can be used to download the files using an FTP client program. Alternatively, e-mail messages with appropriate instructions can be sent to the relevant sites.

Architecture 1. A processor architecture refers to the processor's internal design in terms of:

- whether it includes a CISC or RISC instruction set
- multimedia functionality such as MMX technology
- internal cache, and internal cache size
- size of registers
- external and internal data buses
- types of registers
- whether the processor is a von Neumann serial design (such as an Intel Pentium II) or a parallel variant.
- number of devices

2. A system architecture generally refers to the type of operating system and the types of hardware it uses. For example, the hardware and software might be proprietary. 3. An underlying object architecture of an application in terms of the types of objects used, which might be ActiveX controls or even OLE objects. Its glues, such as COM and DCOM, may also form part of an architectural description. *(See Glue.)* 4. An open system architecture is an attempt to standardise hardware and software. The rationalisation of hardware and software standards means that products from numerous manufacturers can be integrated into one system. 5. A firewall architecture includes component parts such as screening routers. *(See Firewall and Security gateway.)* 6. A general term that might be used to refer to the design of hardware and software, ranging from mainframes and networks to applications programs and operating systems (OSes).

Archive A method of storing files for backup or long-term storage. Removable media that might be used for archiving purpose include 100 Mbyte Zip disks and 1 Gbyte Jaz disks from Iomega, as well as media devices from SyQuest. Other media include conventional hard disks, and CD-R discs and DVD-RAM discs. Various file compression utilities can be used for backup purposes, including the popular WinZip program.

(See DVD.)

ARM 1. Acorn RISC Machine: a computer manufactured by Acorn (UK), which incorporates a RISC (Reduced Instruction Set Computer) processor. It was the first such computer/processor to be brought to market. 2. Argonne Remote Manipulator: an input or user communication device that provides 6 DOF (degrees of freedom).

ARP (Address Resolution Protocol) An IP protocol that can be used to convert logical IP addresses (such as 18.170.103.34) into physical addresses. An ARP request results in a node's physical address, which might be used by

Ethernet networks, Token Ring and FDDI (which may have a bandwidth of up to 100 Mbps).

(See TCP/IP.)

ARPA (Advanced Research Projects Agency) A US government agency formerly called DARPA (Defense Advanced Research Projects Agency).

ARPANET (Advanced Research Projects Agency NETwork) An early network developed by the then DARPA (Defense Advanced Research Projects Agency) for researchers. Originally coined DARPANET, its development was commissioned in 1969, resulting in a working network of four computers by 1970, growing to 37 computers by 1972, at which time it became ARPANET. Some assert that DARPANET was the technical and possibly conceptual birth of the information superhighway or Internet. The key development resulting from ARPANET is the TCP/IP family of protocols. ARPANET ceased to exist in 1990.

(See TCP/IP.)

Array 1. A two- or three-dimensional matrix of data values. The values might be characters, numerals or even binary objects. All modern high-level programming languages support arrays. The concept is similar to the use of tables in databases and data warehouses. *(See Data warehouse.)* 2. An uncommitted logic array (ULA) is an electronic package that has electronic devices (or gates) that are unconnected. By adding the connections in the form of a metallisation layer, the ULA is given a specific functionality. 3. A transformation array is used to manipulate a 2-D or 3-D set of coordinates.

(See 3-D.)

AS/400 An industry-standard IBM computer system.

ASCII (American Standard Code for Information Interchange) A standard set of codes introduced to promote compatibility in terms of characters and symbols. Originally it consisted of 127 ASCII characters derived from seven bits. The eighth bit was not used in order to preserve the sign bit. ASCII has since been extended into a larger highly standardised character set.

ASF (Advanced Streaming Format) A storage container data format (and standard) for streaming multimedia. The contents of the container are not defined, and neither is the communications protocol which may be:

- HTTP
- TCP

- RTP
- UDP.

The ASF container file contents are read by an appropriate media server and transmitted to the client, where they may be stored or played.

(See MPEG and Streaming*.)*

ASP (Active Server Page) A web page technology which supports ActiveX scripting and all modern Internet languages. It has a .ASP extension, and its components may be altered independently, following which they are compiled when the Web page is loaded. The technology is included with IIS 3.0, which may be used to develop scalable browser-independent Internet applications. DCOM and COM may be used as glues within ASP-based applications. The resulting Web applications can acquire information about the client browser and act accordingly. This enables compatible HTML pages to be served to the browser without error messages. Web browsers that are not ActiveX-compliant, for instance, can be served appropriate Web pages. This intelligence facet is integrated into the architecture using server-side scripting. The Microsoft Active Server provides the component parts to implement the aforementioned functionality, and includes the following:

- browser capabilities, which acquire the connected browser's key features
- ActiveX Data Object (ADO), which provides access to back-end data (irrespective of its location) and is not limited to ODBC-compliant data sources
- TextStream, which is used to create and open files.

Third-party and bespoke components can be integrated into an Active Web site. Such components are devoid of user interfaces (UIs), and can be developed using an ActiveX control developer's workbench, including:

- Visual Basic
- Visual C++
- Visual C++ ControlWizard, which is used for OLE development
- ActiveX Software Development Kit

Active Server components fall into the categories of:

- in-process
- out-process.

Active Server Pages (ASPs) are seen as an alternative to CGI, and offer the advantages of:

- shorter Web application development life cycle, particularly with developers/development teams that have little CGI programming experience

- optimised server-side processing, because calls to CGI programs may invoke new processes on the server.
- easier renovation through independent alteration of server components /files. *(See Active Desktop, Active server, ActiveX and CGI.)*
- support for ActiveX scripting and for modern Internet languages.

Aspect ratio 1. The ratio of the height and width of a display. Scaling still or moving images proportionately requires maintenance of the aspect ratio. Typical resolutions include 640 × 480 pixels, 800 × 600 pixels, 1024 × 768 pixels, 1280 × 1024 pixels and 1600 × 1200 pixels. Each yields an aspect ratio of exactly 3:4 (except for 1280 × 1024, which has a 4:5 aspect ratio). DVD video playback offers a choice of aspect ratio in order to accommodate the wide-screen film format. 2. The ratio between the height and the width of a pixel, which can be used to determine how close they become to being square-shaped, which is often desirable. The aspect ratio of pixels depends on the monitor's screen design. In the case of CRT monitors, the aspect ratio hinges on the deposits of red, green and blue phosphors and on the mask or screen behind them, which helps focus the electron gun. Early computer monitors tended to feature rectangular pixels, but things changed most noticeably when Apple introduced displays with square pixels. Manufacturers in the PC market quickly followed suit.

Assembler 1. A compiler which converts assembly language mnemonics into machine code. *(See Assembly language.)* 2. A device which assembles received packets in a packet-switched network.

Assembly language A low-level language used to program processors directly. It consists of mnemonics (such as LDA, DEC A and INC A), as opposed to the more readable statements associated with high-level languages such as Java and C++. Assembly language is loosely referred to as machine code, when in actual fact it requires an assembler to compile it into machine code. Of all the generations of program languages, it is the closest to machine code.

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

As We May Think A prophetic and momentous article published in July 1945 in *Atlantic Monthly*. Its author, Vannevar Bush, Science Adviser to President Roosevelt, put forward a new paradigm for information storage and retrieval. He foresaw the imminent miniaturisation of storage media, and described a central repository of published information accessible via multiple access points. Calling it Memex, its functionality approximated that of the evolving Internet, Infobahn, or information superhighway. As such,

Memex may be considered the conceptual birth of the Internet. Vannevar's vision relates to hypertext. Hypertext set a familiar continuum in motion, first yielding hypermedia that introduced still images and later modern multimedia that added computer animation, motion video, synthesised sound and digitally recorded waveform audio to hypermedia. Multimedia currently drives an ongoing re-evaluation of the way we store, retrieve and communicate information, as well as the way we generally think. It is reasonable to state that the near-term final stage in the continuum will be immersive virtual reality (VR) and a total integration of multimedia as an information communication medium within that environment. A noticeable underlying trend in the evolution of modern media is an increasing dependence upon concurrency; the growing number of human sensory channels interfaced concurrently renders tours within the medium more memorable.

Asymetrix A company founded in 1985 by Paul Allen, who, along with Bill Gates, also founded Microsoft. Asymetrix is a leading developer and publisher of Windows-based multimedia and client/server application development tools. Its headquarters are in Bellevue, Washington, and its European operation centres around its Paris offices, with further subsidiaries in London and Munich. Its flagship product is Multimedia ToolBook.

(See OpenScript and ToolBook.)

Asymmetrical compression A compression/decompression algorithm in which the processes that constitute compression are not reflected in decompression.

(See DCT, JPEG and MPEG.)*

Asynchronous A data transmission technique where the sending device and receiver are not synchronised in real time. Each transmitted item, or packet, is encoded with start and stop bits, so that the receiving device can decode it without ever receiving a timing signal from the sending device. Because the asynchronous data transmission technique makes good use of available bandwidth or data rates, it is particularly suitable for networked multimedia.

Asynchronous messaging A mode of communications between running threads, where a call from one thread to another does not require a response before it may continue processing. Rather it proceeds processing, and receiving and sending messages.

AT (Advanced Technology) The suffix used in IBM's PC AT, which saw the introduction of the ISA expansion bus.

ATA-2 A disk interface technology, which includes a controller. Like all others, it is an evolving disk controller specification.

(See Hard disk.)

AT command set A set of attention commands that can be used to control modem functions. The commands were devised by Hayes for use in its modems, and are often called Hayes commands. They can be used to set various modem properties, and all but two of them have the prefix AT. AT commands are entered using a communications program such as Windows HyperTerminal or Windows Terminal. In certain instances the communications software might generate AT commands automatically in response to the user's selected options. AT commands include the following:

- ATA: Answers a call manually when the modem returns the RING result code
- ATDT <number>: Dial a number
- ATE command: Character echo
- ATE<0 | 1>: Toggle character echo, which allows you to see characters as they are typed
- ATE, ATE0: Disable character echo
- ATE1: Enable character echo
- ATH Command: Hang up
- ATH: Disconnect a connection
- ATI Command: Product information
- ATI, ATI0: Product identification code request
- ATI1: Fetch checksum of firmware revision
- ATO Command: Return to online data state
- ATO: Return the modem to the data state if the modem had been in the offline mode
- ATQ Command: Enable result
- ATQ<0 | 1>: Control the modem's handling of result codes
- ATQ, ATQ0: Enable result codes (default)
- ATQ1: Disable result codes
- ATS Command: Display/configure S registers manage s register(s)
- ATS<reg>=<value>: Sets S register <register_number> to <value>
- ATS<reg>?: Show the value of a specified S register
- ATS?!: Show all configurable S registers
- ATS?: Show the contents of the register last accessed
- ATS=<value>: Load a value into the register that was last accessed
- ATV Command: Result code format. Result codes are stored in some communications programs when opening and closing connections. These can be returned in the form of numbers or words
- ATV, ATV0: Show numeric result messages

- ATV1: Show numeric result messages
- ATW: Extended result code support
- ATW1: Enable extended result codes

(See Access technology and Modem.)

ATM (Asynchronous Transfer Mode) An internationally agreed telecommunications standard which supports transmission line speeds of up to 622 Mbps. Other line speeds include 2 Mbps, 12 Mbps, 25 Mbps, 34 Mbps, 45 Mbps, 52 Mbps and 155 Mbps. The CCITT accepted ATM in 1990 as an internationally agreed standard for data, voice and multimedia networks. ATM bases itself on cell relay, which is a form of statistical multiplexing similar to packet switching. The data transmission consists of cells which have 53 octets or bytes, including a 5 octet header. Using 52 Mbps line speed, a single cell can be transmitted in:

$$53 \times 8/52 \text{ Mbits} = 8.15 = 10^{-6}$$
$$= 8.15 \text{ microseconds}$$

The cells from different signals are interleaved, and the signal propagation delay or jitter is a function of the transmission line speed. It is sufficiently low to give a stream of contiguous cells, which is acceptable for real-time data, voice, audio and video transmission. Like packet headers, cell headers contain destination addresses.

(See Frame relay.)

AT&T (American Telephone and Telegraph) A telecommunications company (or telco).

Attachment A file that is sent and received along with an e-mail message. The file may be binary or text, and is opened using an appropriate application.

(See E-mail.)

Audio block A block of audio data on a CD-DA or CD-ROM disc used to store audio data. There are 2336 bytes in a CD-DA block.

(See CD-ROM.)

Audio compression A general term used to describe the process of reducing the size of audio data. Compressed audio data may be decompressed and played using streaming audio technologies. In uncompressed form the large size of wave audio files occasionally places unreasonable demands on distribution media in terms of data capacity and/or bandwidth. Wave audio compression operates on the actual audio data, compacting it in

order to give smaller file sizes. It is decompressed on playback using either dedicated hardware and software or software alone, such as an appropriate driver in the Windows environment. Standard wave audio compression algorithms include A-Law, IMA (Interactive Multimedia Association) ADPCM and MPEG-1. MPEG-1 compression wave audio tools include PixelShrink, XingCD and XingSound. The latter can compress wave audio files and record and compress audio from an analogue source in real time. It can also be used to perform standard editing operations on MPEG-1 wave audio files, including cut and paste. Whatever compression standard is used, the resultant file sizes, or the compression ratios achieved, depend on the compressor parameter settings chosen. As the compression ratio is increased, the resultant playback quality diminishes. High-quality wave audio, therefore, tends to be compressed by a great deal less than a dialogue recording, for instance.

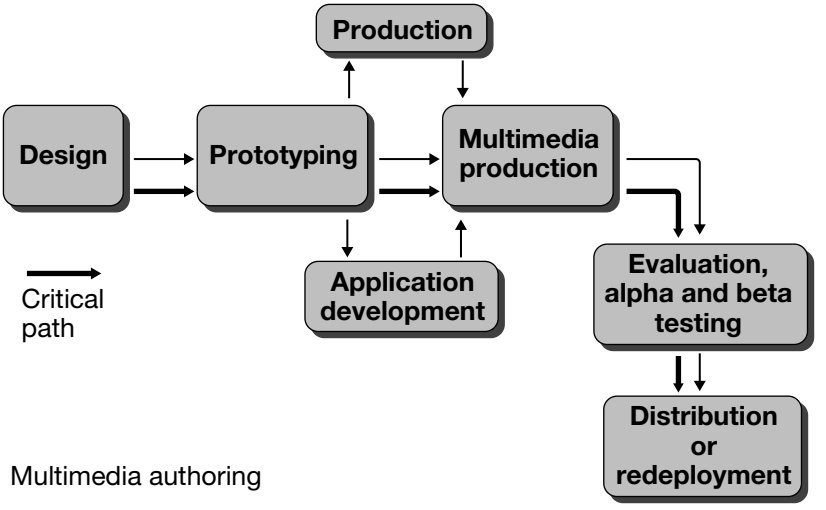
(See Streaming.)*

Audio Video Interleave *(See AVI.)*

Authenticode A technology supported by the Microsoft Internet Explorer, which permits components such as ActiveX Controls and Java applets to be digitally signed. When such a signed component is encountered, Explorer checks its signature status. An unsigned component causes Explorer to display an appropriate prompt, while a signed component causes Explorer to display a certificate. The certificate includes information about the component and its author. The user is given the option to download the component.

Authoring The process of developing a multimedia application, which may include the processes of:

- design
- scripting
- agreeing on the content required in terms of images, video, text and sound
- developing an interactive design
- prototyping
- implementing the interactive design
- testing the interactive design
- multimedia production
- digitising text
- digitising images and retouching them in-house or using an appropriate bureau
- recording wave audio files
- composing Midi files



Multimedia authoring

- capturing video files
- application development
- implementing the interactive design
- production
- uniting acquired media files with the interactive design
- testing.

CD-based authoring requires an authoring station and authoring tool such as Icon Author, Macromedia Authorware Professional or Asymetrix ToolBook. For Multimedia production, or the creation and gathering of all necessary media files, it might be necessary to use:

- video capture software and hardware such as VidCap and a VideoBlaster card
- video editing software such as VidEdit
- wave audio recording and editing software
- a midi sequencer such as CakeWalk.

Authoring consists of design, multimedia production, navigational scheme design and production. For distribution purposes, disc pressing or deployment over a network may constitute a final stage.

(See Authorware, Lingo, OpenScript and ToolBook.)

Authoring station A hardware platform and software tool required to author a multimedia application. Normally it will have a video capture card and a digital sound recording facility. It may also provide a means through

which the resultant material can be submitted to a replication company for mastering and manufacture.

Authoring tool A program or program suite which permits the creation of multimedia applications. Generally it is more complex than a presentation program, providing more advanced features such as indigenous or standard authoring/programming languages which are often visual in nature. *(See Authoring language, Lingo and OpenScript.)* Occasionally, authoring tools are bundled with bitmap editors (graphics programs), palette editors, and video capture and editing programs. Modern authoring tools permit the deployment of applications over the Internet. Popular authoring tools include:

- Authorware Professional
- Asymetrix ToolBook Assistant/Instructor
- IconAuthor.

Modern authoring tools aimed at the production of CD-based multimedia should provide cost-effective migration paths to the Internet. They should also provide support for Java applets, as does Asymetrix ToolBook Assistant.

(See Authorware Professional and ToolBook.)

Authorware Professional An authoring tool for Windows-based multimedia applications produced by Macromedia. The authoring process consists of dragging objects onto a flowline, which runs vertically in its own window. Authorware is considered to require no programming skills.

(See Lingo, OpenScript and ToolBook.)

Auto-answer A feature that permits a modem to respond appropriately to an incoming call.

Autodesk 3D Studio A 3-D animation development program.

Autodesk Animator Pro A 2-D animation development program.

Auto-dial A feature integral to all fully specified communications (comms) programs that permits stored telephone numbers to be dialled automatically.

Automatic speed fallback A modem that matches its data transfer rate with that of a communicating device or network.

Availability *(See MTBF and Reliability.)*

AVI (Audio Video Interleave) A Microsoft file format for storing interleaved audio and video. When introduced in 1990 it quickly became an industry standard. Many video editing and video capture tools allow the interleave ratio to be varied. The ratio can be specified as a single figure where, for instance, an interleave ratio of 7 indicates that seven video frames separate each audio chunk. Using Microsoft VidEdit, the statistics of a video file can be shown, where the interleave ratio is displayed alongside the phrase Interleave Every. Generally, high interleave ratios are applicable to video stored on hard disk, whereas .AVI video stored on a CD variant is optimised using lower interleave ratios, which often equate to one video frame for every audio chunk. Video stored in the AVI format can be compressed using various schemes, including Intel Indeo, Microsoft, Cinepak and Microsoft 1. The sound track quality commonly found in AVI files ranges from mono 8 bit recordings digitised at 11 kHz to 16 bit stereo recordings digitised at 44.1 kHz.

(See MPEG and Video*.)*

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B

Backbone A core high-speed transmission line which serves a number of networks. Switches and bridges provide the physical connections between it and the multiple networks for which it provides bi-directional data traffic paths. A backbone is comparable to a main artery in human anatomy, which divides into smaller veins and capillaries that might be thought of as switches and networks. A backbone might comprise ATM backbone switches, which comprise a number of ports for connection to networks. Enterprise backbones that have ATM backbone switches offer scalability and fault tolerance, and are based on internationally agreed standards.

(See ATM and Frame relay)

Backbone switch A device that acts as a distribution point for data traffic flowing on a backbone. ATM backbone switches have a number of ports for connection to multiple networks and/or devices. ATM backbone switches are:

- scalable, because upsizing is possible through the replacement or addition of switches; downsizing is also possible where switches are removed or replaced
- fault-tolerant
- based on internationally agreed standards.

Specifications for ATM backbone switches include the:

- number of ports per switch
- number of calls that the switch can route per second
- speed of the backplane, or its data transfer rate in bits per second; the number of ports per switch.

Makers of ATM backbone switches include 3Com Corporation, Cabletron Systems, DEC, Cisco, FORE systems and NEC.

Backdoor A flaw in the security defences of a system or a network. For

example, modem access, either inbound or outbound, may bypass the network collective security infrastructures.

(See Firewall and Security.)

Backdrop A background image or colour in a multimedia presentation or title that remains constant for a given number of frames.

Back-end application A term used to describe a server-side application, which may drive or provide services for client applications and systems. The latter tier is the front-end, with which the user interacts. Between the back- and front-end applications is middleware or glues, which exist at a number of levels. These may bind together and coordinate application logic, data and presentation distributed across the back- and front -ends.

(See Application, Client/server, Front-end and Glue.)

Background 1. Multi-tasking operating systems, such as Windows 98, Windows NT and OS/2 Warp, are able to run applications in the background of others. Background applications and tasks generally receive less processing time and run more slowly. 2. A background sound may be added to a Web page using FrontPage or other Web development tools. The sound technology used may be wave audio or MIDI.

(See FrontPage, MIDI and Wave audio.)

Background mode In Windows, background mode permits the background colour to be toggled between opaque (on) and transparent (off).

Backtracking The process of retracing a user's path of interaction. Using Windows Help systems the Back button provides a means of doing this. All fully specified authoring tools – such as Multimedia ToolBook – and Help System development tools allow the developer to integrate a backtracking feature in applications. Web browsers also feature backtracking controls.

(See Hypertext and Multimedia.)

Backward-compatible A hardware component, program object, language compiler, program or operating system that is compatible with an earlier version.

Bandwidth The rate at which data is transferred to, or from, a computer or appliance, using a medium that might be physical or wireless. Media and their bandwidths include:

- A single-speed CD-ROM has a bandwidth of 1.2 Mbps (or 150 Kbyte/s), and generally CD-ROM drives exhibit data transfer rates which are broadly multiples of 150 Kbyte/s.

- A single ISDN line will provide a bandwidth of 64 Kbps, whereas B-ISDN may offer multiples of that rate.
- The average bandwidth of a 24-speed CD-ROM drive is about 3600 Kbyte/s.
- ADSL has a downstream bandwidth of between 1.5 Mbps and 8 Mbps. Typically it is 1.5 Mbps.
- ADSL upstream bandwidth of the order of 16 to 640 Kbps, which can be a function of the line length. Typically it is 384 Kbps.

(See Access technology, ADSL, ATM, B-ISDN, CD-ROM, DBS, DVD and ISDN.)

Base case A system that is specified as being a base case is the minimum implementation, or the bottom of a product range. A base case MPC-3 will have only the essential elements of the official specification, as will a base case NC.

(See MPC and NC.)

BASIC (Beginners All-purpose Symbolic Instructional Code) A high-level language developed by Kemeny and Kurtz in the 1960s. Early implementations for personal computers include the BASIC interpreter developed by Microsoft founders Bill Gates and Paul Allen in the mid-1970s for the MITS Altair, the world's first affordable computer. Interpreted languages differ from compiled languages in that they are not compiled into object code (such as an .EXE file) before execution. Instead, the source code is interpreted in real-time when the program is run. In the late 1970s and early 1980s, almost every microcomputer (or personal computer) had its own BASIC interpreter stored in a ROM variant. Even the original IBM PC XT had a BASIC ROM. It was at this time that Acorn Computer (UK) introduced Structured BASIC, advancing the language to structured programming. *(See Structured programming.)* Structured BBC BASIC gave procedures and routines names, such as `PROCfind`, for instance, and were ended using commands like `ENDPROC`. BBC BASIC was also recursive in that procedures could be called from within procedures. Its most unusual feature, however, was the ability to include 6502 assembly language code within the high-level listing itself. This feature gave it flexibility, and helped programmers increase the speed of program execution by confining certain procedures to assembly language or machine code. This functionality evades many of the industry-standard languages of today. The structured programming model adopted by BBC BASIC made the `GOTO` command redundant, and later did the same to line numbers, though BBC BASIC did include the `GOTO` command. Until the advent of structured programming, the flow of program execution was directed solely using the `GOTO <line`

number> command. After structured programming, the next significant advancement for BASIC came when visual and object-oriented programming (OOP) arrived. Such Visual Basic development tools allowed programmers to draw objects in order to, perhaps, create a user interface. All the programmer then needed to do was to add code to the objects in order to define their behaviour in response to events such as mouse clicks. The BASIC syntax has changed dramatically, though it continues to be a procedural high-level language, and one that is considerably more than a language for novice programmers. It can be used to tackle demanding programming projects, and is considerably more portable than the early interpreted versions for popular microcomputers.

(See Visual Basic and BBC BASIC.)

Bastion host A host that is critical to a network's security and Firewall architecture. This is the focus of network management and security monitoring, and is a network's principal defence against illegal use. A dual-homed host may play the role of a bastion host.

(See Firewall.)

Batch file compression A technique by which several files may be compressed into a single file for distribution, archiving or backup purposes. It is appropriate for modem-based file transfer and DSM-based distribution. It can be used to compress any binary file. In the context of video distribution its main disadvantage is the fact that end-users have to decompress or unpack the files before they can be played. Decompression can be carried out using an installation program, a program such as PKUNZIP or, in the case of a self-extracting compressed file by simply typing the name of the compressed file. Standard batch file compression programs include WinZip.

Baud rate The rate at which data is transferred from one point to the next, which broadly equates to bps. More precisely it is a measure of logic/bit changes per second over media which may be physical or wireless. It is named after French telegraphic communications pioneer J. M. E. Baudot (1845–1903). It is a rarely used term nowadays, and is replaced by bps (bits per second), which is not quite the same thing.

(See Modem.)

BBC BASIC A version of BASIC introduced with the BBC microcomputer in 1982. It supported structured programming where top-down analysis could be used design and develop software.

BBC procedures
BBC BASIC procedures are defined using the syntax:

```
100 DEF PROCTRANSFORM
110 FOR X%=1 TO 2
120 INPUT A%(X%)
130 NEXT
150 ENDPROC
```

BBC functions
BBC BASIC functions have the syntax:

```
100 DEF FUNCTION(X%)
110 INPUT X%
120 ENDFUNCTION
```

BBC variables
BBC BASIC supports global and local variables, which may be

- integer

```
100 A%=100
```

- floating point

```
100 X=125.23
```

- string

```
100 INPUT$="Please enter the time."
```

BBC loop structures
A `for ... next` loop:

```
100 FOR X%=1 TO 2
120 INPUT A%(X%)
130 NEXT
```

A `Repeat ... until` loop:

```
100 REPEAT
120 INPUT A%(X%)
130 UNTIL A%(X%)= 100
```

BBC arrays
Two-dimensional string and numeric arrays (with two rows and 1000 columns) are defined thus:

```
100 DIM A$(2,100)
110 DIM A%(2,100)
```

BBC comments
Program comments have the REM prefix

BBC reserved words
Built-in functions include `ABC`, `SIN` and `COS`.
(NB. Several BBC BASIC emulators for the PC may be found on the Internet.)

(See Visual Basic.)

BBS (Bulletin Board Service) A dial-up service that is independent of the Internet. It can be used for publishing information, distributing files and electronic conferencing.

BCPL (Basic Combined Programming Language) A high-level programming language, BCPL was designed by Martin Richards in 1967 as a compiler-writing and system programming tool. It was based on CPL (Combined Programming Language), which was developed jointly by Cambridge and London Universities. BCPL is a forerunner to C and C++.

See: BCPL the Language and its Compiler, Martin Richards and Colin Whitby Stevens, Cambridge University Press 1980.

(See C, C++, Java, JScript, VBScript and Visual Basic.)

Bend A bend in an optical fibre results in increased attenuation. Such losses can be used to determine the degree to which a fibre is bent. This forms the basis of operation for many gloves and suits used in VR, where the fibres run along the lengths of fingers or limbs.

(See LED and Optical fibre.)

BER (bit error rate) A measurement of how error-free the storage or transmission of data is. Typically expressed as the average number of bits in which one bit-error will occur. CD-ROM has appropriate error detection and correction codes. In Mode 1 CD-ROM data blocks, 4 bytes are reserved for error detection and 276 bytes are reserved for error correction. The three layers of error detection and correction integrated in the CD-ROM format include CIRC, EDC and ECC. Typically the bit error rate of CD-ROM equates to 10^{-18}, which amounts to one error for every 1 000 000 000 000 000 000 bits.

Berners-Lee, Tim The original architect of the World Wide Web, and inventor of its accompanying HTML (Hypertext Markup Language). The birthplace of HTML is considered to be CERN in Geneva. These origins led the original server to be referred to as the CERN server. The conceptual birth of the Web might be accredited to the visionary Vannevar Bush through his momentous article, 'As We May Think'. Theodore Nelson is also significant (but much more contemporary), through his work *Literary Machines* and the project Xanadu. If Vannevar Bush and Ted Nelson were responsible for putting forward the concept of the Web, then Tim Berners-Lee must be considered its architect.

(See HTML, HTTP, IP, Web and Xanadu.)

Beta copy A test copy of a software product that has yet to be com-

mercially released. Usually beta copies are distributed externally to beta test sites.

(See Alpha.)

Bi-directional 1. A highly compressed frame in an MPEG-1 data stream. *(See MPEG*.)* 2. A link which offers upstream and downstream data transmission. 3. A link in an information structure that can be followed in either direction.

Bi-directional link A link in a hypertext-based information structure, such as a Web application, which may be followed in either direction.

Big Blue A nickname for IBM. It originates from the fact that early IBM mainframes were painted blue.

Binary A counting system comprising only two states, either '1' or '0'. All electronic files are stored in binary form. Binary files generally contain executable programs and program data.

BIOS (Basic Input Output System) A program stored in firmware on all PCs which includes low-level code for implementing I/O operations, startup code and the setup program. The setup program permits the system to be configured, and is invoked by pressing a specific key (possibly Del or F1) during the memory check when the system is booting.

B-ISDN (Broadband ISDN) An access technology that offers a wider bandwidth than conventional (narrow bandwidth) N-ISDN, which offers data transfer rates of 64 Kbps per single connection. Low-end B-ISDN implementations include multiple 64 Kbits/s channels. For instance video-conferencing architectures that feature full motion, full-screen video might include 6×64 Kbps channels, yielding a collective bandwidth of 384 Kbps.

(See Access technology and ISDN.)

Bit A single indivisible item of binary data that might be '1' or '0'.

BitBlt 1. BIT-Block Transfer: a method of copying areas of an image from one point to the next. 2. BIT-Boundary Block Transfer: a Windows GDI (Graphics Device Interface) function that moves rectangular geometric shapes such as windows and dialogue boxes.

BitEdit An 8 bit bitmap editor supplied with Video for Windows (VfW) and Asymetrix Multimedia ToolBook.

Bit error rate *(See BER.)*

Bitmap An image represented by pixel data which defines each pixel. The pixel data is referred to as a bitmap. Can provide intricate control over graphics, resulting in high quality.

(See DCT, Image compression and JPEG.)

Bitmapped display Graphic controller and display partnership, where pixel data representing each pixel is stored in memory

(See Bitmap).

Black box A conceptual view of software or hardware, where the internal architecture and operation are ignored. All that is considered are input and output values.

BLOB (Binary Large Object) An item of binary data that is of no specific type, but is identified simply as containing some sort of digital data. It may be a graphic, a video file, a midi file, a wave audio file, a program file or any type of digital data. PC database programs that support the BLOB field type include Paradox for Windows, which can be used to create databases of video files.

(See DBMS and OODBMS.)

Block 1. A segment of code that is enclosed within opening and closing braces ({ and }). 2. A block of 2352 bytes on a CD/CD-ROM track.

(See CD-ROM.)

Block address *(See Absolute addressing.)*

Blue Book A specification for multi-session CDs which was announced by Sony, Philips, Apple and Microsoft.

(See CD-ROM.)

BMP A graphics file format that tends to lead to larger files than more compressed variants such as GIF and JPEG.

(See GIF and JPEG.)

BNC A connector consisting of a round socket and plug which are locked together with a twist. It was invented by the engineers Neill and Concelman at Bell Laboratories.

Body suit An item of clothing that provides a means of interfacing a user with a virtual or synthesised environment. It permits user interaction to varying degrees that extend from giving simple hand signals to grasping and manipulating virtual objects; it may also provide a means of stimulating the user's sensory organs through changes in temperature, pressure, moisture levels and so on. It may be used for:

- telepresence and telemanipulation
- computer-aided design
- computer games
- translating sign language into speech
- researching the effectiveness of manual or semi-automatic processes so as to refine ergonomic environments and minimise the risk of RSI (Repetitive Strain Injury)
- sports medicine.

Low-specification suits simply sense the flexing of limbs and fingers using silica fibres of the sort commonly used for data transmission and telephone networks. A silica or optic fibre is embedded along the length of jointed limbs. The operation hinges on the fact that the losses experienced by a beam of light propagated in a silica fibre increase when the fibre is physically bent. The resultant varying signal is referred to as bend information. The light sources use LEDs (light-emitting diodes). More highly specified variants include a greater number of optic fibres or flex sensors to relay a greater number of movements. These will also contain a detection system that provides the spatial 3-D coordinates of the entire suit. The level of sophistication can extend to integrated transducers that sense angular rotation in three dimensions, temperature, pressure and moisture. Tactile feedback devices might also be included in the form of inflatable bladders.

(See LED, Optical fibre and VR.)

Bookmark A marker inserted at a specific point in a document so that it may be revisited with ease.

Boolean A variable type that has one of two states: either yes or no. Named after Irish mathematician George Boole who pioneered logic-based *Boolean algebra*, these variables feature in programming languages, search engines and databases. AND, OR, NOR, NAND and NOT are Boolean operators. They are also logic gates used in electronics and in the architecture of digital components, and their behaviour can be described using a truth table. A truth table is a simple table which shows the output obtained for each and every combination of inputs.

Borland

(See C++ and Inprise.)

Borland Turbo C++ An implementation of C, based on the object-oriented programming (OOP) model.

(See C++, Java, Object and OO*.)*

Bottom-up analysis A design approach, where the process begins with the design of low-level components and progresses to the design of higher level components.

(See Top-down analysis.)

Bps (bits per second) A measurement of data transfer rate. Modems are frequently specified in terms of their data transmission and reception speeds.

(See Modem and V standards.)

BRI ISDN (Basic Rate Interface Integrated Services Digital Network) An access technology that provides two 64 Kbps bearer (B) channels, and one 16 Kbps data (D) channel for signalling. The B channels carry user data. ISDN drives improvements through voice telephony, Internet access and videoconferencing. Internationally agreed ISDN standards are maintained by the ITU. International ISDN standards include:

- North America – National ISDN-1AT&T 5ESS
- Europe – Euro ISDN (CTR 4)
- Japan – INS-64
- France – VN-3
- Australia – AUSTEL TS013

(See ISDN.)

Broadband A term used to describe access technologies and networks that typically offer bandwidths of 2 Mbps and more, though some narrower bandwidth networks and access technologies may also be described as broadband. Broadband offers high-speed data transfer and is useful for multimedia networks.

(See Access technology, ATM and ISDN.)

Broadcast quality 1. A video recording whose quality approximates that of broadcast television. *(See MPEG*.)* 2. A camcorder able to provide video recordings that are considered broadcast quality.

Brondmo, Hans Peter A Norwegian computer specialist credited with the

invention of the motion icon (micon). He is believed to have invented it in 1989 at MIT (Massachusetts Institute of Technology).

(See Micon.)

Browse (browsing) A process of following the intricate paths through a hypertext-based information structure. The user passes to and from nodes or objects. In the context of the Internet, it has come to be known as surfing. It normally takes place at the micro-level but can also exist at the macro-level, where the user may be described as navigating as opposed to browsing. The line that divides navigating from browsing is made clearer by considering the difference between a walker and a motorist. The motorist gains a high-level view of travel, and is thus navigating. The walker's experience of a journey is infinitely more detailed, hence the walker is browsing.

(See Browser, Client, Microsoft Internet Explorer and Netscape Navigator.)

Browser An application that permits the user to browse the World Wide Web. The most popular Web browsers are Netscape Navigator and Microsoft Internet Explorer. Earlier implementations include Cello and Mosaic. A modern browser allows users to:

- add Web sites/pages to an address book
- navigate backwards and forwards through visited Web pages
- open a URL, which is entered using the keyboard
- playback streaming audio and video using a plug-in or ActiveX control
- playback streaming multimedia using an appropriate plug-in or ActiveX control
- send e-mail messages, though a browser is not an e-mail client/application
- specify various preferences including the appearance of Web pages when displayed
- open HTML files that might be local or remote
- chat in real-time using an appropriately enabled browser
- view Web pages that contain Java applets (using a Java-enabled browser)
- download files
- make telephone calls over the Internet using an appropriate Web phone
- take part in videoconferences using appropriate hardware and software.

(See ActiveX control, Client/server, Java and Videoconferencing.)

BT (British Telecom) A UK-based international telecommunications operator (or telco). It evolved as a state-owned enterprise, but was privatised in the 1980s.

BTLZ (British Telecom Lempel-Ziv) A data compression technique synonymous with modem-based data communications. It can be assumed to yield a compression ratio of around 4:1.

(See Compression.)

Buffer A quantity of RAM (Random Access Memory) that improves the rate at which data may be transferred between computers and peripheral devices.

(See Queue.)

Bug A hardware or software fault. The term was originally coined by Grace Hopper, a computer pioneer who did much work in developing valve computers and high-level languages. Using the Harvard Mk 2 computer she discovered a hardware fault caused by a moth caught between the contacts of a relay. After debugging the system, the unfortunate moth was entered in the computer's log at 15:45, 9 September 1945. The process of authoring or developing multimedia often requires extensive testing and debugging.

Build 1. A version number which denotes the version of a program or operating system. It is interchangeable with the term *development build*. 2. A word used to describe the process of developing hardware or software.

Burst mode data transfer 1. A heightened volume of data traffic over a network. 2. The maximum unsustainable data transfer rate from a CD-ROM drive. It is many times greater than the average data transfer rate, and is sustainable for a limited period only.

Bush, Vannevar A science advisor to President Roosevelt. He put forward a paradigm for information storage and retrieval in the 1940s. He may be considered the originator of the Internet concept, and of the 'relational model' for storing and retrieving information. His name, therefore, is linked with standalone multimedia as well as with multimedia on the Internet. Principal facets of the Internet such as the World Wide Web (WWW) and the many hypertext-based navigation and browsing tools have their origins in Bush's vision. His momentous article 'As We May Think' covering what he called Memex was published in *Atlantic Monthly*. Hypertext evangelist Ted Nelson admitted publicly that he may have read this article.

(See Hypertext, Web and Xanadu.)

Business audio A program that permits you to control a computer using voice commands. It is possible to do the same with dictation systems such as

IBM ViaVoice. Depending upon which system is used, you may also have proofreading and text-to-speech capabilities. Microsoft Windows Sound System is a typical example of a business audio system. Modern business audio tools are voice-independent.

(See Speech recognition, Wave audio and ViaVoice.)

Business system engineering A collective term used to describe the processes of implementing business system, which fulfils an enterprise's requirements. The business system includes:

- business processes
- IS (Information Systems)
- personnel.

Button An active area on a screen, which may be an iconic representation of an option, feature or application. Windows buttons are labelled with appropriate identifying text such as Close or OK. Using visual programming tools, buttons can be created simply by drawing them on screen. Once drawn they become objects that can be moved or copied. Their colour, frame thickness, fonts and other attributes can be altered, usually by right-clicking them and selecting from the options presented. As is the case with all event-driven applications development tools, the button is responsive to a mouse click. Its behaviour or response to such an event is determined by its method, which usually takes the form of a short segment of code. The method or code might run a video clip, for instance. Buttons can also be selected using the keyboard, usually by pressing the Alt key together with an appropriate letter that corresponds to a letter in the button's label. Using development tools such as MS Visual Basic, you simply draw buttons and then add methods (code) to them, thus determining their behaviour.

(See ToolBook and Visual Basic.)

Byte 1. A piece of digital information that is eight bits in length. 2. A computer magazine (*BYTE*) published by McGraw-Hill.

Bytecode A machine language used by virtual processors for interpretation and program execution. Such programming languages include the OO variants Java and Smalltalk. These languages are suited to heterogeneous environments, and may therefore be deployed effectively over the Web as applets. The virtual processor physically exists on the client, is implemented in software and is independent of hardware and accompanying operating systems. Bytecode may not be as responsive as native code components, where perhaps an ActiveX control is running on a Windows platform.

However, any performance difference may be eradicated through the hardware implementation of the virtual processor on the client system, in which case it ceases to be virtual.

(See Java, Java Virtual Machine and OOP.)*

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C

C A general-purpose high-level programming language. Designed by Dennis Ritchie in 1972, it was used to develop the first implementation of the Unix operating system at Bell Labs. C programs are comparatively portable, and the transition from one platform to another can often be done by simply recompiling, though some recoding may be required. Most C programming tools are supplied with comprehensive function libraries, which include facets of those developed for the purpose of programming Unix. These provide high-level functions such as file and memory management. Commercial C programming tools are produced by Microsoft, Inprise, Powersoft and Symantec. Since its introduction, C has evolved into C++, an object-oriented programming (OOP) language. Visual C++ programming tools are also available. The RAD tool Optima++ (from Powersoft) generates C code without the need for programming on a line by line basis.

(See C++, RAD tool and Visual Basic.)

C++ An object-oriented version of the C programming language. Like modern programming languages such as Java, it provides the programmer with OO methodologies. Bjarne Stroustrup evolved C++ from C, which has links with BCPL (Basic Combined Programming Language). It extends the C programming language through the inclusion of the OO concepts of:

- inheritance
- polymorphism
- encapsulation
- data hiding

(See Data hiding, Encapsulation, Inheritance and Polymorphism.)
ANSI C++ is an internationally agreed standard for the C++ programming language.

`#include <file>` When compiled, the `#include` statement is implemented by the preprocessor, which reads the contents of a named file.

`main ()` A C++ program must have a `main ()` function, which begins and ends with open `{` and close `}` braces. This is the first function called when the program is run, and can be used to define variable types.

Comments Single-line comments in a C++ program must begin with `//`, and multiple line comments begin and end with `/*` and `*/`.

Syntax (basic) All statements have a semi-colon (`;`) as their suffix. White space can be included, which is ignored by the compiler. Compound statements such as those of a function or a subroutine begin with a single open brace `{` and end with a closing brace `}`.

C++ variables C++ variable types can be defined as follows:

```
#include iostream()
main()
{
    char find;
    float prime;
    double prime_large;
    short int xx;
    long int xxxx;
    unsigned short int yy;
    yy=35;                          //assign the
    unsigned long int yyyy;
}
/* the character variable find may store 256
character values */
// the variable prime may store signed 4 byte values
/* the variable prime_large may store signed 8 byte
values*/
// the variable xx may store signed 2 byte values
// the variable xxxx may store signed 4 byte values
// the variable yy may store unsigned 2 byte values
// the variable yyyy may store unsigned 4 byte values
```

Defined variables may be equated to values using a statement such as:

```
yy=35;
```

Variables may be defined and assigned values using a statement like:

```
unsigned short int xx=45;
```

Multiple variables of the same type are defined using a comma as a separator:

```
unsigned long int yyyy, yflow
```

`typedef` Using `typedef`, mnemonics can be assigned to the statements used to define variables and their types. The following statement assigns the word `xxxx` to the `unsigned short int` statement:

```
#include <filename>
typedef unsigned short int xxxx;
```

```
  int main ()
{
  xxxx coordinate;
  // define coordinate as an unsigned short integer variable
}
```

C++ literal constants A variable may be assigned a value, which is considered a literal constant:

```
  int yearsAfter=25;
```

A literal constant may also be used when performing arithmetic operations on variables. In the following statement, where the `time` variable is assigned to the product of the variable `present` and 10, 10 is considered a literal constant:

```
  time=present*10
```

C++ symbolic constant A symbolic constant has a name, and is assigned an unchanging value. It can be used just like an integer constant. Symbolic constants improve program maintenance and updating; a single change made to a symbolic constant is echoed at every point it may occur.

A symbolic constant *multiplier* can be assigned the value 10 using the statement:

```
  #define multiplier 10
```

or

```
  const unsigned short int multiplier = 10
```

C++ enumerated constants Enumerated constants take the form of a type, and are a useful shorthand for defining a number of what might be related constants. The following code defines the constants `back`, `forward`, `left` and `right`, where `Move` is the *enumeration*.

```
  enum Move { back=4, forward, left=6, right=3};
```

The `forward` constant is assigned the value 5, an increment (of one) relative to the previously defined constant `back`.

C++ precedence In C++, arithmetic operators have a precedence value. These indicate the order in which such operators are implemented, which is significant with expressions such as:

```
  dev = xx + yy * zz + yy;
```

Control over such arithmetic operations is obtained using parentheses, i.e.:

```
  dev = (xx + yy) * zz;
```

Parentheses may be nested.

C++ `if` statement The `if` statement determines whether or not the ensuing statement is executed, based on a single condition:

```
  {
    if  (xxx = yyy)
      transform = Scale;
  }
```

C++ `if ... else` statement The `if ... else` statement is used to implement either one of two statements:

```
{
  if  (xxx = yyy)
      transform = Scale;
  else
      transform = Scale * adjust;
}
```

C++ logical operators Logical AND, OR and NOT are implemented using the syntax '`&&`', '`||`', and '`!`'.

(See Java, Object* and OOP.)*

Cabbing A method of compressing objects such as ActiveX controls and Java objects into a single CAB file. This optimises their rate of transfer across networks.

(See ActiveX control.)

Cable modem A modem that may operate over cable TV networks. The speed of operation is many times greater than the fastest analogue modems. Typically a cable modem's data transfer rate is considerably greater downstream than it is upstream. For example, the Motorola CyberSurf cable modem offers an upstream rate of 768 Kbps and a downstream rate of 10 Mbps. Competing cable modems have downstream rates approaching 30 Mbps and faster. Cable modems offer high-speed access to the Internet, and are offered as extras by such ISPs as Telstra Big Pond (Australia).

(See Access technology, ADSL and ISDN.)

Cache 1. A segment of SRAM (Static Random Access Memory) that drives processor performance gains. Its rationale is to expedite the rate at which data can be read from and written to memory. It can be an integral part of the processor (internal), or external in the form of dedicated SRAM chips on the PC motherboard. The fast speed of SRAM overcomes the slower speed of the DRAM (Dynamic Random Access Memory) making up the system memory. This significantly improves system performance. External memory cache sizes are relatively small, ranging from just 128 Kbyte to 1 Mbyte in size. An algorithm is used to estimate what portions of system memory should reside in the memory cache. The Pentium Pro has an internal cache accommodated on a single die or chip. 2. An area of memory or hard disk used as a temporary store for downloaded HTML files and data, including URLs. The size of the cache may be specified. *(See Browser.)* 3. A hard disk controller that expedites hard disk performance. A hard disk cache controller typically comprises a few megabytes of RAM, and is usually expandable. It speeds up read/write operations by using its

on-board RAM as an intermediate data store between disk and system memory. Based upon which data is most often requested, a caching algorithm estimates which portions of hard disk should reside in on-board RAM, thus making it more readily available. The ingenuity of this technique simply takes advantage of the inescapable fact that a small percentage of disk data is rewritten and accessed most frequently. The decision-making process, which is insulated from the system processor, fuels the view that it is an intelligent controller. Cache controllers are the most expensive of all variants, and in terms of random access and data transfer rate they can be assumed to outperform all others. A RAID often features a cache for improved performance.

(See RAID.)

CAD (Computer-Aided Design) An application of computers in design. The many CAD applications include the design of:

- Architecture
- Mechanical components
- Printed circuit boards (PCB)
- Microcircuits
- Electronic circuits

AutoCAD is possibly the best known CAD program for the PC. Such is the intense arithmetic nature of graphical CAD, high-performance workstations are often required.

CAL (Computer-Aided Learning) A process by which a computer program is used as a learning aid. One of the earliest modern multimedia CAL applications for the PC platform was Palenque. This presented the user with a surrogate tour of a Mayan site. Developed with the cooperation of Bank Street College (NY), it includes video compressed according to the DVI standard. CAL software is now mass marketable, mainly through hybrid edutainment titles that combine educational and entertainment value. Multimedia is acknowledged widely as an educational tool. It is able to assist both the pupil/student and teacher/lecturer in new ways. For the teacher or lecturer it provides a means of putting across information and ideas, and for the pupil or student it can represent a one-to-one teaching environment that moves at the required pace. That pupils/students should interact with multimedia is a key aspect of its role in education. An early Intel paper on Digital Video Interactive (DVI) confirmed that interactive multimedia can yield as much as 70 per cent recall, as opposed to 45 per cent for audiovisual aids, and just 25 per cent for audio. Many CAL experts are undecided as to the precise improvement such interaction gives.

(See Multimedia.)*

Carrier A carrier signal is used to transport a signal over media which may be physical or wireless. The carrier might be encoded using frequency modulation (FM), amplitude modulation (AM) or another technique.

Casting A process by which one data type is converted into another.

CAV (Constant Angular Velocity) A disk that rotates at a fixed rate of r.p.m. (revolutions per minute) is designated a CAV disk.
(See CD-ROM.)

CBT (Computer-Based Training) An application for training purposes. Multimedia often features prominently in CBT. Numerous CBT applications exist for the MPC platform. Early CBT multimedia applications for standard platforms include Ediris for the CD-I platform, which was designed for training car mechanics and was used by Renault. Ranging from simple induction courses to sales techniques, corporate and industrial training has in recent years become ever more dependent upon technology. Computer-based training (CBT) now forms a substantial market.

CCIR 601 A standard for uncompressed digital video, also known as D1. CCIR 601 digitises a 525-line NTSC signal running at 25 frames per second, and its chrominance elements U and V and its luminance Y elements are digitised individually. The Y element is digitised using 858 samples per line, and the U and V elements are each digitised using 429 samples per line. Each pixel is generated using 10 bits per sample. The digital video is coded at 270 Mbps which is derived as follows:

```
Y: 858 * 525 * 30 * 10= 135 Mbps
U: 429 * 525 * 30 * 10= 67.5 Mbps
V: 429 * 525 * 30 * 10= 67.5 Mbps
                        270 Mbps
```

(See DCT, MPEG, MPEG-1, MPEG-2, Multimedia and Video.)*

CCITT (Committée Consultatif Internationale Téléphonique et Télégraphic) An international standards organisation that issues recommendations and standards for communications.

CCITT V.42 An international standard for error correction using modem-based communications. Error correction is provided by MNP2-4 (Microcom Networking Protocol) and LAPM (Link Access Procedure M).

CCITT V.42bis An international standard for error correction and compression using modem-based communications. Error correction is provided

by MNP2-4 (Microcom Networking Protocol) and LAPM (Link Access Procedure M). Compression is provided by BTLZ (British Telecom Lempel-Ziv) which yields an average compression ratio of around 4:1.

CD-DA (Compact Disc-Digital Audio) An alternative (and correct) acronym for audio CD, which is encoded according to the Red Book Audio standard agreed by Philips and Sony. Audio CD became available in October 1982 and was developed by Philips (Netherlands). The 12 cm diameter CD offers:

- an improved dynamic range
- no background noise
- imperceptible wow and flutter
- no outer sound disturbances.

One or more CD tracks are physically encoded using pits and areas of land. With the aid of lenses and mirrors laser light is focused upon tracks, and reflected light is picked up by a photo sensor. Simple electronics then decode the reflected light signal into a digital signal. A single CD track spiralling from the disc's centre might measure up to 5 km in length with a width of just 0.6 microns or micrometres (one millionth of a metre). Pits may measure between 0.9 microns and 3.3 microns in length depending upon the encoded track length. The official CD-DA specification placed a 72 minute ceiling on the play time, but in reality considerably longer play times are achievable. Up to 99 tracks are possible. A CD track is encoded at a constant density, so the disc has to rotate at higher speed as the read head converges on its centre. Initially CD was a CLV (Constant Linear Velocity) system, though CAV drives are available. The speed of rotation is linked to the read head position, ensuring that CD audio blocks are read at a rate of 75 per second. This linear speed of rotation translates to about 1.25 metres per second. This spin speed is equal to that of a single-speed CD-ROM drive. The disc might be spun at around 500 r.p.m. for the innermost turns of track, and at about 200 r.p.m. for the outermost turns of track. These speeds of rotation are typical for single-speed drives. A single track may accommodate between four seconds and 72 minutes of audio, where the location of each track is determined using an absolute addressing system.

(See CAV, CD-ROM, CLV, DVD and LED.)

CD disc master A master disc etched from glass. The master disc is used to create stampers or metal father recording moulds, achieved first by plating the glass master with silver and then coating it with nickel. The glass master is produced using a laser beam that is modulated in correspondence with the master tape recording of data that the disc contains.

CD graphics A standard method by which text, graphics and animations can be recorded using the sub-channels of a CD. Audio CD contains eight sub-channels, termed P, Q, R, S, T, U, V and W. Sub-channels R, S, T, U, V and W are used for CD graphics. CD graphics decoders, or compatible CD players, are required to play such graphics.

CD-I (Compact Disc-Interactive) A multimedia system and disc format developed by Philips. A minimal implementation of a CD-I player/decoder is set out in the CD-I Full Functional Specification. Such base case players do not include the Philips Digital Video (DV) cartridge, which can be used to deliver what is considered to be full motion, full-screen video (FMFSV). The DV cartridge is used to play MPEG-1 movies in both linear and interactive forms. The complete CD-I Full Functional Specification, known as the Green Book standard, was officially issued in 1987. These standards and technical requirements were designed to take optical discs from an audio and information storage medium to that of a multimedia distribution medium. Comprising an X-Y pointing device for user interaction, and able to drive a domestic television and hi-fi, CD-I players represent cost-effective multimedia delivery. Issued by Philips, Sony Corporation and Microsoft, CD-ROM XA could mean that many CD-I titles can be played using PCs fitted with appropriate CD-ROM XA decoders. CD-ROM blocks are replaced by CDI sectors, but a standard (CLV) read rate of 75 sectors/s remains on many CD-I systems. Sectors each comprise 2352 bytes raw data. Mode 2 (raw mode) is used to store Form 1 and Form 2 sectors. Like Mode 1 blocks, Form 1 sectors contain error detection and error correction codes. Form 1 sectors are therefore useful where data integrity is essential, i.e. program data. A Form 1 sector yields 2048 bytes of user data. The absence of such codes from Form 2 sectors makes them useful for data which is less susceptible to error, i.e. audio and video data. Form 2 sectors yield 2324 bytes of user data as opposed to the standard 2336 bytes associated with Mode 2. Form 2 sectors deliver less user data because of the inclusion of a sub-header which contains identifying code. These codes indicate the data type of each sector, and they help increase the speed of reading interleaved data.

CD-I data transfer rates The average data transfer rate yielded by CD-I Form 1 and Form 2 sectors can be calculated as follows:

```
Average user data transfer rate = sectors/s *
usable sector data (Bytes)
Form 1:
Average user
data transfer rate = 75 * 2048
                   = 153 600 bytes/s
                   = 150 Kbytes/s
```

```
Form 2:
Average user
data transfer rate=75 * 2324
                  =174 300 bytes/s
                  =170.2 Kbytes/s
```

CD-I data capacity Calculating exactly how much can be stored on a CD-I disc, or any disc for that matter, is complex when considering interleaved data. Note that authoring systems/tools can keep the CD-I designer abreast of available data capacity during development. It is possible to calculate the raw data capacity and user data capacity of a CD-I disc. We can calculate the raw data capacity (of a one-hour disc, for example) by applying the following simple formula relevant to all CD-I and CD-ROM discs, irrespective of Mode or Form:

*Data capacity (Kbyte) = disc length (seconds) * sectors/blocks per second * sector/block data*

```
=3600 * 75 * 2352 bytes
=635 040 000 bytes
=605 Mbyte
```

Turning to user data:
*User data capacity = disc length (seconds) * sectors/blocks per second * user sector/block data*

User data capacity

```
(Form 1)=3600 * 75 * 2048 bytes
        =552 960 000 bytes
        =527.3 Mbyte
```

One hour, Form 2 disc:
User data capacity

```
(Form 2)=3600 * 75 * 2324 bytes
        =627 480 000 bytes
        =598.4 Mbyte
```

In reality, the CD-I disc format is said to support about 650 Mbyte storage capacity. For example, a Form 2 disc with a playing time of 65 mins, 12 s:
User data capacity

```
(Form 2)=3912 * 75 * 2324 bytes
        =681 861 000 bytes
        =650.2 Mbyte
```

See: Preston, J. M. *Compact Disc-Interactive, A Designer's Overview*, Kluwer 1987/88.

(See CD-I audio, CD-I Base Case Player and CD-I sector.)

CD-I audio An audio sequence played using a CD-I system. Because a CD-I disc delivers audio, text, video and computer graphics, the Red Book standard for CD-DA is often inappropriate. Audio and video data are

interleaved on the same track, providing simultaneous delivery. Essentially, there are two methods by which sound may be added to a CD-I multimedia title. The first of these is conventional, in that audio information is read directly from disc and played in real time. The alternative computer-oriented technique involves writing audio data to RAM prior to playback. Called soundmaps, these provide a means of regurgitating frequently played audio sequences. Because RAM access times are typically less than 100 ns as opposed to hundreds of ms associated with CD drives, soundmaps can be invoked almost instantly. A base case CD-I player can deliver three wave audio quality levels, referred to as A, B and C.

- A-Level audio is equivalent to the first play of a vinyl disc under optimum conditions, minus noise caused by static and physical stylus contact. A more compact representation of audio CD data, it requires approximately half the information of CD-DA. An entire disc would give a maximum of two hours of level A stereo playback.
- Level B audio is equivalent to a high-quality stereo FM broadcast transmitted under optimum conditions. An entire CD-I disc gives a maximum of four hours stereo playback. Technically, level B audio is an 8 bit recording digitised at a sampling frequency of 37.7 kHz.
- Level C audio equates to an AM radio broadcast transmitted under optimum conditions. A whole disc could yield over 16 hours playing time. It is also termed mid-fi quality. It equates to a 4 bit ADPCM wave audio recording sampled at 37.7 kHz.

CD-I Base Case Player A minimal implementation of a CDI player/decoder as set out in the CD-I Full Functional Specification.

CD-I sector The tracks on a CD-I disc consist of sectors that are 2352 bytes in length. The user data yielded by each sector is a function of the Form: Form 1 yields 2048 bytes and Form 2 gives 2324 bytes.

CD-quality sound A sound quality that equates to that outlined in the CD-DA specification, which governs the common or garden audio CD. Technically it equates to 16 bit wave audio, which is recorded at a 44.1 kHz sampling frequency.

(See Wave audio.)

CD-R drive (CD-Recordable) A drive capable of writing to blank CD-R discs, usually in a variety of different formats including Video CD, Photo CD, CD-ROM XA, CD-I and CD-ROM. The mid-1990s saw the launch of more affordable CD-R drives, bringing low-volume CD-ROM publishing to the desktop. Undertaking this method of disc production makes the

replication company redundant in the conventional sense, though such companies offer various other useful production and consultancy services. The disc duplication process using CD-R is quite different from that adopted by commercial disc replication companies, as the creation of a master tape and CD master is unnecessary. Whether CD-R is a viable route obviously depends upon the volume of discs required. For example, if CD-R is to be adopted for an archiving application where data is to be committed to a single CD-R disc (or perhaps duplicate copies) on a regular basis, then the services of a replication company are uncalled for. CD-ROMs and other pressed CD variants are well-known for their durability and long life. However, if their hermetic seal breaks down, the discs can be become corrupt. On the positive side, they are not vulnerable to relatively high temperatures. With proper care and storage (with regard to heat) CD-R discs can be reasonably assumed to last up to 25 years, although archival CD-R discs should probably by updated periodically at a frequency considerably less than 25 years. CD-THOR, a disc construction that is comparable to that of CD-R, is erased by heating. One advantage of CD-R discs is that they normally have a gold reflection layer, which is a great deal more enduring than aluminium. There are also specialised tempered glass CD-R discs, which may provide reliable storage for hundreds of years. Important factors to consider when acquiring CD-R drives include the following.

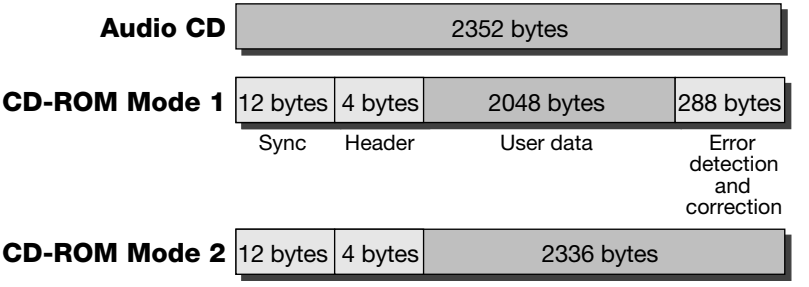
- The maximum data capacities supported.
- The read rate of the drive, which may be single-speed, double-speed, triple-speed, quad-speed or faster.
- The disc recording speed, which may be single-speed, double-speed, triple-speed, quad-speed or even faster. High recording speeds yield savings in terms of person hours consumed.
- The disc formats supported, which might include audio CD, CD-ROM, CD-ROM XA, CD-I, Photo CD and Video CD.
- The interface type. Most operate over SCSI bus variants.
- What type of interface software is provided? It is important that this should be user-friendly.

(See CD-ROM and DVD.)

CD-ROM (Compact Disc – Read Only Memory) A universal distribution medium based on the compact disc. It was the first viable multimedia distribution medium. Announced in 1983, it is typically a 12 cm diameter optical disc offering data capacity in the hundreds of Mbyte range. It is also available in 8 cm diameter form. The standard 12 cm diameter CD-ROM supports up to about 660 Mbyte (692 060 000 bytes) data capacity. A single disc is equivalent to approximately 400 1.44 Mbyte floppy disks or 1500 360 Kbyte floppy disks. 8 cm diameter CD-ROMs are also available. A 12 cm

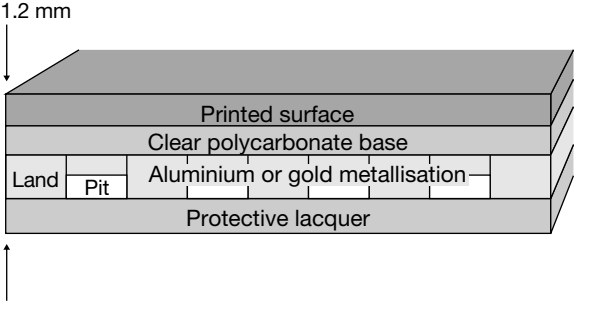
CD-ROM can store up to 250 000 A4 pages of text or approximately 100 000 000 words. Note that these methods of quoting data capacity are rather vague and are not likely to satisfy many people. Like audio CD, a CD-ROM disc physically consists of a metallic disc bonded to a polycarbonate base. This is coated with a transparent, protective lacquer. A track spiralling from its centres some 5 km long, and is arranged at a density of 16 000 tracks per inch. The CD-ROM physical format includes:

- Mode 1 data blocks, which are used to store code and data where accuracy is critical
- Mode 2 data blocks, which are used to store data that might be impervious to minor errors.



CD-ROM/CD block

Data blocks are supported by all fully specified CD-ROM drives. A one hour Mode 1 disc yields 527 Mbyte data capacity and Mode 2 gives 602 Mbyte data capacity.



CD-ROM disc cross-section

A Mode 1 data block will yield just 2048 bytes (2 Kbyte) user data, while Mode 2 holds 2.28 Kbyte user data.

(See CD-ROM drive, CD-ROM data block and DVD.)

CD-ROM data block A CD-ROM data block has 2352 bytes. The amount of user data yielded by each block is a function of the mode of operation.

(See CD-ROM.)

CD-ROM drive A device for reading CD-ROM discs. It can be portable, external or integral to the computer/multimedia system. Modern drives are able to read Mode 1 and Mode 2 discs, as well as audio CDs. The principal factors which govern the performance of a CD-ROM drive include access time and data transfer rate. In general a CD-ROM drive may be specified in terms of the following information:

- Access time; highly specified drives may offer access times little longer than 100 ms.
- Average data transfer rate can be generally specified in terms of how fast the disc is rotated; a single-speed drive will give a data transfer rate of around 150 Kbyte/s. This data rate is broadly doubled, tripled and quadrupled using double-, triple- and quad-speed drives.
- The physical interface type may be proprietary, IDE, SCSI or SCSI-2, or use might be made of the parallel port. Highly specified CD-ROM drives tend to be SCSI-2 based.
- Compatibility in terms of disc formats that can be read is generally specified in terms of 8 cm diameter CD-ROM, CD-ROM XA, linear CD-I, Video CD and Photo CD.
- Physical characteristics include whether the drive is internal, external or portable.
- The maximum number of drives that can be daisychained.

(See DVD.)

CD-ROM extensions A driver developed to meet the demands of CD-ROM on IBM-compatible PCs, and better known as the MS-DOS CD-ROM Extensions or `MSCDEX`. They provide a means of addressing the full CD-ROM data capacity. Prior to their existence, the situation was rather chaotic, with each drive manufacturer supplying programs that would swap individual 32 Mbyte data chunks. In one sense CD-ROM was actually being used like a number of small mass storage devices, negating its fundamental advantage. Through the CD-ROM Extensions the device driver command set is enhanced to include commands specific to CD-ROM. The installation of a CD-ROM driver requires an appropriate device entry in the `CONFIG.SYS` file, which typically approximates the following:

```
DEVICE=\DEV\NEC.SYS /D:NEC001 /N:1
```

Such a statement causes DOS to load the device driver `NEC.SYS` included in the `DEV` directory. For developers of device drivers, and readers that refuse to adhere to the 'black-box' concept, the following passages briefly

Command Code	*Name*
0	INIT
3	IOCTL INPUT
7	INPUT FLUSH
12	IOCTL OUTPUT
13	DEVICE OPEN
14	DEVICE CLOSE
128	READ LONG
129	Reserved
130	READ LONG PREFETCH
131	SEEK
132	PLAY
133	STOP PLAY

Commands 0, 3, 7, 12, 13, 14, 128, 130 and 131 are used for CD-ROM device drivers. Commands 132 and 133 are used for write device drivers that support audio. Commands 1, 2, 4, 5, 6, 8, 9, 10, 11, 15, 16 and 129 (not shown) are pertinent to block device drivers and will return an error code for unknown command.

run through the device driver commands. For anyone writing a device driver, perhaps one of the first decisions which needs to be addressed is which mode of operation to use. The READ LONG command (code 128) provides a data read mode byte, which is set to zero for Mode 1 and set to one for Mode 2. To reiterate, using modern high-specification drives it can be assumed that both modes of operation are supported. READ LONG also accommodates an addressing mode byte, which can be assumed to be zero to invoke the HSG/ISO 9660 format. READ LONG PREFETCH is intended to optimise access time by estimating which block is most likely to be read. In response to these estimates, the device driver positions the read head appropriately or caches relevant sectors. IOCTL calls (commands 3 and 12) take care of the many mundane tasks that control a CD-ROM drive. They allow the application program to send control strings to the device driver. For example, IOCTL INPUT calls are used to retrieve information about the device. Similarly, IOCTL OUTPUT calls send CD-ROM specific commands to the device driver, such as eject disc, for example. The PLAY and STOP PLAY commands are relevant to audio tracks. The SEEK command simply positions the read head over appropriate disc locations. All MS-DOS device drivers require DEVICE OPEN and DEVICE CLOSE commands, without which they become incompatible and inoperable.

CD-ROM network A network that provides multi-user access to a library of CD-ROM discs. Local Area Networks (LANs) present a cost-effective multi-user environment in which computer resources and applications can

be used to best effect. Based around a reasonably powerful file server, 'diskless workstations' (devoid of mass storage devices) or conventional computers provide multi-user access to many applications. CD-ROM networks offer many of the same advantages of conventional LANs. A multi-user environment is created and computer resources are put to optimum use. At the heart of the network lies an optical server which dynamically distributes requested information from CD-ROM drives to LAN users. The optical server is connected directly to CD-ROM drives, with some installations totalling 64 drives per server. Where the maximum number of drives per server is exceeded, additional servers are employed. The incorporation of additional servers, prior to reaching the network maximum of drives per server, can lead to increased speed.

CD-ROM retrieval system CD-ROM data is made available through an appropriate retrieval system, of which many well-known implementations exist. A retrieval system takes the form of a program distributed on the disc itself and is most often installed to hard disk for the benefit of increased speed of operation. It can also be memory-resident, loaded from disc each time the title is invoked. An early CD-ROM retrieval system was BlueFish from Lotus Development Corporation. Proprietary systems, designed exclusively for a particular application or title, are also relatively common. The combination of an exceptionally large amount of information, long access time and slow data transfer rate renders retrieval system design of critical importance. Often providing a means of navigation, its suitability to the task in hand is just as important as the CD-ROM data itself. As one would expect, retrieval systems are specific to applications, where the underlying design features vary considerably. At the simplest level, negotiating a telephone directory on CD-ROM merely requires the entry of simple search criteria. Wildcards or Boolean logic may also play a role. Such systems are termed target systems, and are useful for database applications. Used in hypertext and hypermedia information structures, navigational systems are quite different. These enable the user to browse and navigate, repeatedly building upon searches in order to pursue specific paths.

CD-ROM server *(See Server.)*

CD-ROM XA (Compact Disc–Read Only Memory eXtended Architecture) A CD format published by Microsoft, Philips and Sony in March 1988, CD-ROM XA permits a near-CD-I title to be delivered using a conventional desktop computer with installed CD-ROM drive and CD-ROM XA decoder. It brought CD-I level B and level C audio quality to the PC.
(See CD-ROM and DVD.)

CD-RTOS (Compact Disc–Real-Time Operating System) An enhanced version of the OS/9 operating system that was developed by Philips for CD-I. It is 100 per cent downwardly compatible with OS/9. It consists of libraries, CD-RTOS kernel, managers and drivers. Libraries ensure that high-level commands are able to implement frequently required operations such as I/O functions and synchronisation in CD-I systems. The CD-RTOS kernel is the shell and is an enhanced OS/9 variant. Managers accommodate graphics devices, input devices, audio processing devices, disc I/O and more. Drivers provide the software interface between hardware variants of various kinds and the CD-I system.

CDTV (Commodore Dynamic Total Vision) A CD-ROM-based multimedia player that went down in history as being the world's first such appliance. This, the world's first consumer multimedia system, was launched in 1991; it is low-cost, drives a conventional television receiver, and includes an ISO 9660 CD-ROM drive which supports Mode 1 and Mode 2 operation.

(See Multimedia.)*

CD-V player (Compact Disc–Video Player) A device able to play CD-V and CD-DA discs.

CD-V single (Compact Disc–Video) A CD format developed by Philips. It stores six minutes of motion video with digital stereo and 20 minutes of CD-DA audio. It can be used to store 18 000 stills stored in LaserVision format or 80 Mbyte of data.

CED (Capacitance Electronic Disc) An early videodisc technology. Initial research into videodisc technology concentrated on vinyl disc systems. This led to an unacceptable wear problem of both stylus and disc, and was solved using CED. CED reduced friction by using the disc and stylus as a pair of capacitor plates. The charge varies according to the grooves in the disc.

(See CD-ROM and DVD.)

Cellular communications A term used to describe mobile wireless communications. Mobile phones, mobile fax machines and mobile fax/modem-based notebooks and PDAs are cellular communications devices. Analogue services in different countries can be assumed to be incompatible. Digital services in different countries are compatible.

Cellular Multiprocessing (CMP) An SMP architecture variant which was developed by Unisys.

(See MMP, NUMA and SMP.)

CGI (Common Gateway Interface) A protocol which provides bi-directional information flow between an HTTP server and the HTTP client. The resulting interactivity on the client side permits data entry and the editing of HTML documents. The Common Gateway Interface (CGI) may connect the HTTP server and its applications and databases. CGI scripts are created using a scripting language or programming tool. CGI is used to:

- query databases and post the output to HTML documents
- generate HTML forms for data entry
- interact with the indexes of on-line documents to produce searching and retrieval features
- interact with e-mail.

CGI programming is possible using Unix, Windows and Macintosh servers. CGI scripts may be created using:

- Perl
- Apple Script

CGI programs may be created using (among others):

- C++
- Visual Basic

Active Server Pages (ASPs) may be considered an alternative to CGI, and offer the advantages of:

- shorter Web application development life cycle, particularly with developers/development teams that have little CGI programming experience
- optimised server-side processing, because calls to CGI programs invoke new processes on the server.

(See ASP.)

Chalkboarding A conferencing technique using text and still images. Multiple users may interact with the same document or application. Such conferencing systems may be referred to as whiteboard applications.

(See Videoconferencing.)

CHAP (Challenge Handshake Authentication Protocol) A protocol that verifies the authenticity of a password used to access a server.

Character device An interfaced peripheral device that communicates with a computer using serial streams of data. The serial ports or COM (communications) ports on a PC can be used to interface serial devices. Most of these comply with the RS232 standard, which deals with interfacing serial devices.

Chat 1. A real-time text-based communications medium, carried out over a network or over the Internet. *(See IRC.)* 2. A Windows NT-based server, which is part of the MCIS. *(See MCIS.)* The Chat server provides real-time text-based communications. The communications may be private (one-to-one), one-to-many or conferences. It has its own proprietary protocol and supports the IRC protocol. A Chat SDK and ActiveX control permit the integration of Chat functionality, where a single server may support up to 48 000 users.

Check box A user interface component that usually takes the form of a box that can be checked (ticked) or unchecked (unticked).

Chroma key A method of achieving transparency, so that one image can be laid over another. For example, a figure (person) may be superimposed onto another image, which becomes its background.

Cinemania *(See Microsoft Cinemania.)*

CIRC (Cross-Interleaved Read-Solomon Code) An error correction technique. Developed for Compact Disc, CIRC conceals and corrects burst errors. *(See CD-ROM.)*

Citrix WinFrame A client program that permits the deployment of a Windows applications over IP networks such as the Internet and intranets. It requires Microsoft Internet Explorer.
(See www.citrix.com.)

Class 1. A category of objects used in object-orientated programming (OOP) and software development. A *class* describes the default characteristics of an object in terms of its behaviour and response to events. A class is rather like a template, which offers objects that may be modified by the programmer or developer. Classes are a central theme of OOP technology, and are used by such compliant languages as Visual Basic, C++ and Java. *(See C++, Java, JavaScript, JScript, OOP, VBScript and Visual Basic.)* 2. A type that defines the interface characteristics of a category of object in terms of its variables and methods. 3. A class of IP address. *(See IP Address.)*

Class declaration In C++, a way of declaring a class's functions, data and friends.
(See C++.)

Class hierarchy A tree structure which defines the relationships between superclasses and their subclasses.

(See Class.)

Class identifier A unique identifier (UUID) for OLE objects.

Classless address An IP address format which is an alternative to that of classes A, B and C. A prefix of a fixed size is added, where a 15 bit prefix, for instance, accommodates 128 000 IP addresses. Classless addressing is known formally as Classless Inter-Domain Routing (CIDR); aggregation; and Supernetting.

(See IP address.)

Class library A collection of classes used in a particular type of application. The Microsoft Foundation Class Library is a commercial example.

Class method In Java, methods are activated using the relevant class. This methodology can be equated to the static member functions of C++.

(See Java.)

Class variable In Java, a data entity that pertains to a particular class, as opposed to instances of the class.

(See Java.)

Client 1. A system connected to a server; it might be a:

- PC running Windows 3.1/95/98/NT
- Macintosh
- Network Computer (NC)
- consumer Internet device.

(See Client/server, Fat client, NC and Thin client.) 2. An OLE application that is the recipient of one or more OLE objects from a server application. 3. A software module that passes requests to a server (software module).

Client/server A distributed system architecture where client systems are connected to server systems. The client provides an interface to applications and data that are stored on the server. The interface can be provided through a browser such as:

- Microsoft Internet Explorer
- Netscape Navigator
- Sunsoft HotJava.

Client activity and processing are said to be on the client-side, while server activity and processing are on the server-side. The network that provides the connection between clients and servers might be a:

- LAN
- WAN
- Internet
- intranet.

Industry client/server standards for database manipulation include:

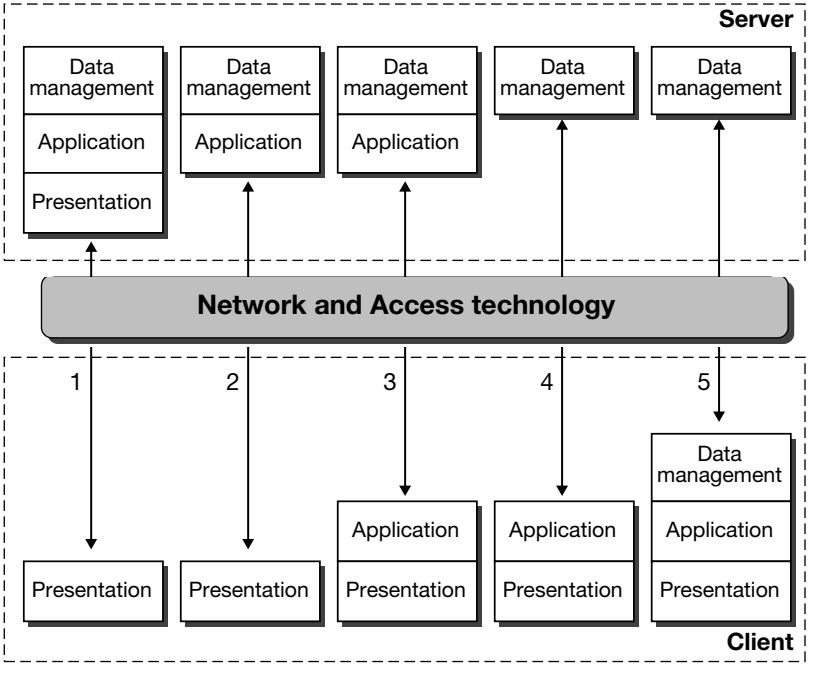
- ODBC (Open Database Connectivity), which is the most common
- IDAPI (Integrated Database Application Programming Interface).

Client/server network protocols include:

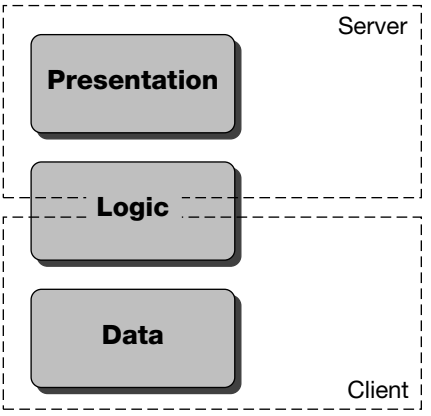
- TCP/IP
- IPX (Internet Packet eXchange).

Using the three-element representation of an application, the client/server model (which is observed by the Web) can be explained. The five shown topologies are:

1. *Distributed presentation*, which distributes a portion of the user interface (UI), and may be equated to the inactive Web model, where the browser is used only to view documents.



Client/server logical topologies as once defined by the Gartner Group



Web client/server model with Java applets/ActiveX controls or plug-ins

2. *Remote presentation*, which distributes the entire UI to the client system.
3. *Distributed function*, which divides application logic between the server and the client. In the Web context this processing distribution may be achieved using appropriate plug-ins and ActiveX controls with Netscape Navigator or Microsoft Internet Explorer.
4. *Remote data access*, which is a model that sees the so-called fat client. This means that the client system is substantial (or 'fat') in terms of application logic.
5. *Distributed database*, which distributes the data management functions between the client- and server-sides. This configuration is used in Webcasting, where users are served information that matches their predefined criteria.

The distribution of the three key application elements (namely Presentation, Logic and Data or Data Management) may be used to explain the many client/server models. This is achieved using the simple diagram above.

(See Application software, Client, Server, Three-tier client/server, Two-tier client/server and Webcasting.)

Client/server application A broad term used to describe an application which is spread across at least two platforms, including a server that may store application logic and data and serve client platforms such as PCs or NCs. The Web is a client/server architecture. A variety of RDBMS

development tools can be used to develop applications that are able to access ODBC-compliant databases stored on servers. RDBMS development tools useful for developing client/server applications will provide SQL (Structured Query Language) links to interface applications with different databases. For instance it might provide links for Oracle, Sybase, MS SQL Server, Informix and InterBase. They may also provide a means of upsizing applications to client/server systems with the minimal amount of coding, or even no coding at all. Report generation tools such as Borland ReportSmith can also provide a gateway to the creation of client server applications. These provide a means of generating reports constructed from server-based databases. Many tools aimed at the development of client/server applications have a RAD (Rapid Application Development) identity, which hinges largely on the visual programming model.

(See Application software, Client, Fat client, Thin client, Three-tier client/server and Two-tier client/server.)

Clipboard A temporary storage area used for objects, text and graphics as they are copied or moved from one Windows application to another. Copying and cutting data from one application to another takes place via the clipboard.

ClipBook A Windows storage area that can be used to share data between different applications and between different users.

Clock doubling A process of running a device at an internal clock speed that is twice that of the external frequency.

Clock speed A measurement of the frequency of pulses used to execute and coordinate digital operations. Processors are often described in terms of their clock speed. Clock speed is expressed in MHz, which equates to millions of cycles or pulses per second. The clock pulses on desktop computers originate from an oscillating circuit that can be assumed to be built into the motherboard design. It produces a constant pulse using a quartz crystal. The clock speed at which a processor is able to operate is influential in determining its overall speed. Generally most processors operate at an internal clock speed that equals that of the external clock speed of their buses. The internal clock speed can be increased by multiples of the external clock speed. Commercially available processors are constantly improving in performance, so consult an authoritative computer magazine (such as McGraw-Hill's *BYTE* at www.Byte.com) before purchasing a computer system or processor upgrade.

CLUT (Colour Look-up Table) A table in memory used to store a colour palette.

CLUT animation An animation achieved by repeatedly changing data in a colour look-up table.

CLV (Constant Linear Velocity) A mode of disc rotation where the disc spins faster as the read head converges on the disc's centre. Most CD-ROM drives operate in CLV mode, where the read head passes above the spiralling track at uniform velocity. The disc is encoded at uniform density, thus spinning faster as the read head converges on its centre.

(See CD-ROM.)

Coaxial cable (Coax) A cable arrangement where signal-carrying conductors are surrounded by a braided sheath (usually copper or aluminium), which eliminates electromagnetic interference. It is a standard cable for connecting TV receivers to aerials and VCRs.

Codec (Compressor/decompressor) A codec is normally considered to be a hardware device or software driver able to compress and decompress audio, video or both. It may operate using standard compressed file formats or proprietary formats such as those generated by the Cinepack codec. Codecs that operate in the Windows environment exist as drivers.

(See MPEG and Streaming*.)*

Code page An information suite that configures DOS appropriately for the country of usage. It contains a character set, date and time format information.

Cognition A thought process viewed at the macro level.

COM (Component Object Model) An object architecture intended to exist in a heterogeneous environment, which has different languages, different OSes, NOSes, and platforms. It may also be perceived as a glue, binding together application component parts. The current Microsoft initiatives in this arena fit the continuum:

1. DLL
2. OLE, which may COM
3. OCX, which may COM
4. ActiveX, which may COM.

As has been the case so many times before (such as the MPC specification, for instance), Microsoft has surrendered COM, DCOM and ActiveX specifications to a standards organisation; they have been given to the Open

Standards Group (OSG). The collective COM specification includes suites of:

- network protocols
- standard interfaces
- APIs.

(See ActiveX, DCOM, OCX and OLE.)*

Combi Player An optical disc drive capable of playing both video discs and audio CDs.

Commodore CDTV (Commodore Dynamic Total Vision) *(See CDTV.)*

Common buffer approach A buffer format that is used by the server and the client and is passed between the server and the client by communications middleware.

Common language approach A feature of a client/server architecture where servers and clients are implemented using the same programming languages.

(See Client/server.)

Common middleware A feature of a client/server architecture where servers and clients are connected using middleware services.

(See Glue.)

Communications middleware A software implementation, facilitating communications between servers and clients. It may be perceived as existing between the server and the client, and serves to isolate the client from network and server protocols.

(See Three-tier client/server and Two-tier client/server.)

Compatibility A common word used to describe the ability of software or a piece of hardware to work with another piece of software or hardware. For example, a PCI graphics card is compatible with systems that have PCI slots. Equally, the medium of audio CD is compatible with all audio CD players and CD-ROM drives.

Compiled A process by which the source code of a high-level language is translated into machine-executable form or machine code. Generally, compiled languages offer better run-time performance than interpreted languages.

(See C++, Java, Object* and OOP.)*

Compiler A program or program module able to convert source code into machine-executable code. Unlike an interpreter, which attaches precise code to high-level statements each time a program is run, a compiler produces machine-executable object code once.

Composite signal A video signal where brightness, chrominance and synchronisation information are combined. It is used in conventional television broadcasting.

Composite video A video signal where brightness, chrominance and sync information are combined.

Compound document A document which may integrate different document types and media types which emanate from different sources. The various documents may be OLE objects provided by an appropriate OLE 2.0 server. Alternatively, they may be objects of a similar architecture such as the more modern Microsoft ActiveX component architecture. Equally, they may be objects that comply with OpenDoc or JavaBeans component architectures.

(See ActiveX, JavaBeans and OLE.)

Compound object An object that is constructed using multiple objects.

(See C++, Java, OOP and OODBMS.)*

Compressed image An image following compression through hardware and/or software means.

(See JPEG and MPEG.)*

Compression 1. A method by which data of any sort (often image and video data) is scaled down in size, eventually consuming less storage space and requiring a narrower bandwidth. 2. Video compression optimises both the bandwidth and data storage capacity of media. Popular video compression schemes include Intel Indeo, MPEG-1, MPEG-2 and M-JPEG. *(See MPEG*.)* 3. Audio compression serves to reduce the data storage requirements of wave audio files and to optimise the bandwidth of the distribution media. *(See Wave audio.)* 4. Disc compression increases the data storage capacity of hard disks. Commercial disk compression programs include Stacker (Stac Electronics), which is also available in hardware form, giving improved performance over software-only solutions. Stac Electronics made international news when it won a $100 000 000 dollar lawsuit, resulting from Microsoft infringing its patents for compression algorithms. 5. Batch file compression is useful for archiving files and compressing them for distribution purposes. Compressed program files have to be unpacked or

uncompressed before they can be run. Popular batch file compression programs include PKZIP and Lharc. 6. Data compression to reduce the size of data parcels transmitted and received using a modem. Standard data compression in this context includes V.42bis.

Compression parameters A video compressor setting can be used to optimise a video sequence for playback using a target system of a given bandwidth. MPEG compression parameters include the placement of I frames. More general compression parameters might include interleave ratio, frame playback speed, and compression ratio requirements. Generally the quality of video diminishes as the compression ratio increases.

(See MPEG.)*

Compression ratio A ratio that relates the sizes of a data file before and after compression. The video compression ratio using fully specified compressors can be altered.

(See MPEG.)*

Compressor A hardware and/or software solution used to compress motion video or still computer graphics. Using video compressors, it is possible to specify a number of compression settings.

Computer A system or appliance that is able to process and store digital information. Its many components and subsystems may include:

- Processor or CPU (Central Processing Unit)
- Modem
- DVD-ROM drive
- Graphics engine or card
- Hard disk
- Sound card
- Electronic memory devices, including RAM, SRAM, VRAM, ROM and NVRAM
- Colour display
- Video playback devices such as MPEG-1 or MPEG-2 decoders
- QWERTY keyboard
- Mouse
- Microphone
- Television tuner
- Radio tuner
- Set-top box decoder
- Scanner

(See Client, Fat client and Thin client.)

Computer-aided design *(See CAD.)*

Computer-aided learning *(See CAL.)*

Computer animation An animation that consists of digital frames that can be played using appropriately specified hardware and software.

Computer-generated images *(See Computer graphics.)*

Computer graphics A process of displayed images using a computer. The advancement of computer graphics has unleashed numerous computer applications, ranging from computer-aided design (CAD) to colour desktop publishing (DTP), VR, multimedia and 3-D graphics. Through the coupling of high-resolution colour monitors and high-specification graphic controllers, truly photographic quality images are now possible. Built up of digitally defined pixels, computer images are invariably complex. For example, a 1024 × 768 pixel image yields 786 432 individual pixels. Digitising such a black and white image requires a corresponding number of bits, or 98 304 bytes (786 432/8), or 96 Kbyte (98 304/1024). Progressing to a grey-scale arrangement using 8 bits per pixel to give 256 (2^8) grey shades, the same 1024 × 768 pixel image requires 768 Kbyte, eight times the storage capacity of its black-and-white equivalent. Such is the complexity of photographic quality images that a minimum of 24 bit colour graphics is required. Red, green and blue are each represented by eight bits, thus facilitating the selection of 256 tones of each. By combining each colour component, over 16.7 million (256 × 256 × 256) colours are made available. Yet higher quality results are achieved using 32 bit and 36 bit graphics. Such 24 bit graphics on a 1024 × 768 pixel resolution monitor mean that a single frame consumes around 3072 Kbyte. Large image files of this sort are costly to process, transmit and store. They are also slow to transfer from computer to screen, as well as to and from the hard disk. A solution to these problems lies in image compression. Many popular image file formats such as JPEG feature image compression.

(See JPEG.)

Computer name The name of the computer/system connected to a network. All Windows 98/NT systems have names when connected to a network. Additionally, their users are given passwords, which may be used to log on and retrieve their specified or default Windows configuration.

(See Windows.)

Concurrent computing An environment in which processes or program elements execute simultaneously.

(See MPP, Occam and Parallel programming.)

CONFIG.SYS A configuration file for DOS (Disc Operating System) that is stored in the root directory of the hard disk which is defined as the active primary DOS partition. Alternatively it can be stored on a floppy disk called a startup disk. It configures DOS automatically each time the system is switched on. For instance, it loads the CD-ROM device driver, as well as other drivers.

Connection rate A rate at which two modems communicate. It may also be referred to as the data transfer rate, DCE–DCE rate, line-speed, modem–modem speed or transmission speed.

Constant angular velocity *(See CAV.)*

Constant linear velocity *(See CLV.)*

Container 1. A framework which permits an OLE 2.0 object to run and to be confined to a particular screen area. *(See Visual Basic.)* 2. An application which provides the environment where a component may run. The component may be an ActiveX control, and its container may be the Microsoft Internet Explorer. Equally, a JavaBean component may run in a container within HotJava. *(See ActiveX* and Glue.)*

Content authoring tool A development tool that permits the creation of Web and multimedia content.

(See Multimedia authoring tool.)

Content provider A company or individual that provides usually copyright material for inclusion in a multimedia production. Content providers typically include publishers, recording companies, photo libraries and so on.

Content replicator A Windows NT-based server, which is part of the MCIS. It is able to replicate Web content from one site to another; the resulting mirror sites distribute user traffic, yielding performance gains.

(See MCIS.)

Control character An ASCII code that does not necessarily write a character to screen but will perform an operation, such as paste text. Control characters have mnemonics such as BEL, which sounds the PC speaker and is invoked by pressing Ctrl-G.

Controller A generic name for a hardware component which controls a peripheral device, such as a disk drive, CD-ROM drive or monitor.

(See Graphics card and Hard disk.)

Cookie A miner transaction, which allows server-side components such as CGI scripts and programs to store and retrieve data from the client system. It gives Web applications the ability to write data to the client which reflects usage habits. For example, the data may relieve the user from repetitive tasks, such as the re-entry of ID numbers or data each time a Web site is visited. Instead, the server-side components may identify the user through cookies on the client system, extract the information and perform the necessary processes.

(See Security gateway.)

Co-processor An additional processor dedicated to a certain type of processing.

CORBA (Common Object Request Broker Architecture) A distributed object-oriented technology developed by the Object Management Group (OMG).

(See ActiveX, Glue and OO.)

Corel Draw A popular graphics program used by many professional illustrators and graphics artists. Used widely in the production of graphics for multimedia applications/titles.

Coupling A term used to describe the efficiency of communication between network hardware and software components. *Tight* coupling between two network components indicates comparatively high-speed communication capabilities. *Loose* coupling indicates the exact opposite.

Courseware A generic term for material used in education/training.

CPU (Central Processing Unit) *(See Processor.)*

Cray, Seymour A computer scientist made famous by his work in the field of MPP.

(See MPP.)

CRC (Cyclic Redundancy Check) An error detection scheme used on CD variants as well as other devices.

Creative Labs A Singapore-based company specialising in sound cards and video capture cards. Its SoundBlaster card became an industry standard. Its video capture cards include the VideoBlaster range, which extends to videoconferencing. It also marketed and sold the rather dated Video-Spigot video capture card, though it did not develop it.

Critical error An error resulting from a hardware or software bug. In DOS, the user will be prompted by R(etry), I(gnore), F(ail), or A(bort).

Cropping The process of trimming an image or frame. In terms of video or picture editing, image or video data is cropped as you would snip a photograph using a pair of scissors. Most editing programs provide an Undo Crop command (on the Edit menu) in order to cancel a previous cropping operation.

Cross-platform A software program, module or object that can be run on more than one platform. Java applications are cross-platform. Such applications may be described as platform- or hardware-independent. For instance, a platform-independent program might run on Windows, OS/2 and 386 Unix.

(See Java.)*

Cross-sensory substitution A phrase applied to exchanging sensory stimuli, such as the transcription of spoken dialogue to text.

CRT (Cathode Ray Tube) A display device used in desktop colour monitors, consisting of a screen area covered with phosphor deposits (or pixels) each consisting of red, blue and green phosphors. The CRT was the first optronic device. The distance between the phosphors is termed the dot pitch. Most monitors feature a dot pitch of 0.26, while more highly specified versions offer a smaller dot pitch. An electron beam is projected from the back of the CRT on to the inner screen using an electron gun. To help focus the electron beam a fine mask is included behind the screen phosphors. This fine gauze separates the three colour phosphors, allowing the electron beam to shine more accurately upon them while improving picture definition in the process. The electron beam scans each of the phosphor-lines horizontally. The rate at which the electron gun scans a single line is termed the horizontal frequency, or the line frequency. There are two methods of scanning the lines:

- interlaced
- non-interlaced

In a non-interlaced arrangement all the lines are scanned one after another. The rate at which all lines are scanned is termed the refresh rate or the vertical frequency. Using an interlaced configuration the lines making up the screen are scanned in two separate fields. One field is used to scan even numbered lines and the other to scan odd numbered lines. This interlaced technique was introduced in television broadcasting specifically to reduce

screen flicker. Today, however, a monitor that operates at high resolutions in an interlaced mode is thought to be one that will flicker. Non-interlaced monitors with sufficiently high screen refresh rates are preferred. These provide flicker-free images with improved stability, and are least likely to cause eye strain. The minimum acceptable refresh rate for a non-interlaced monitor is around 70 Hz.

Cryptography A process which ensures that data or information is read or used only by its intended readers or users. This is achieved through:

- encryption, which disguises input information or data, so it may not be read or used; the resulting encrypted information or data may only be read or used following decryption
- decryption, which returns the decrypted data or information to its original usable and readable form.

Implementations of cryptography are called cryptosystems, and take the form of algorithms. Cryptosystems may be categorised into two main groups:

- secret-key, where the processes of encryption and decryption each require the use of a single key, which is the same for each process. The key is a number, and preferably a large one, hence the phrase 56 bit key, etc. Unless the recipient of the encrypted data already knows the key, it may be left to the sender to transmit its details unencrypted. This is a notable flaw of secret-key encryption, because it exposes the key to unintended users such as eavesdroppers. A remedy is found in public-key encryption, which is described below.
- public-key, where the sender need only know the recipient's public key. This may be obtained in unencrypted form because it may not be used to decrypt data; rather, all it may do is encrypt data. In order to decrypt data, the recipient uses a private key, which is the mathematical inverse of the public key. It may be considered impossible to determine the private key from the public key in so far as most security requirements are concerned.

The mathematics that underlie public-key encryption have a simple goal: namely, to make difficult the derivation of the private key from the public key. This is achieved through a one-way function which describes the difficulty of determining input values when given a result. RSA is among the best-known cryptosystems or algorithms. This was developed by MIT professors Ronald L. Rivest, Adi Shamir, and Leonard M. Adleman.

(See RSA and www.rsa.com.)

Cryptosystem *(See Cryptography and RSA.)*

Crystal Reports A reporting engine which is included with Microsoft IIS. *(See IIS.)*

Current directory An active directory whose files may be listed or executed directly. Using DOS, current directory files may be listed by entering `DIR` at the command prompt. Directories can be changed by entering `CD` followed by the directory name. Using Windows dialogue boxes it is possible to change directories by double-clicking the directory name shown in the Directories box; a root directory is indicated as '..'.

Cursor A visible bitmap that indicates the point of data entry or user-interaction on screen. It may take the form of a pointer, hand or even hourglass when the underlying software is busily computing.

CU-SeeMe An enterprise within Cornell University which produces an Internet videoconferencing solution.

Cut A technique where video footage is switched from one sequence to another.

Cut and paste A process by which a section of a screen image or video sequence is removed (cut) and implanted (pasted) elsewhere.

CVBS (Composite Video Broadcast Signal) A standard colour composite video broadcast signal

Cybercafé A café which offers its customers access to the Internet, usually via coin- (or card) operated computers.

Cyberpunk A person that expends a great deal of time browsing or surfing the Internet.

Cyberspace A term used to describe the Internet (or Net).

Cyclic redundancy check *(See CRC.)*

Cycling RGB (Red Green Blue) values A process by which RGB values can be altered in two sequences including red-green-blue-red and cyan-yellow-magenta-cyan. It can be carried out using a palette editor. The accepted method for altering RGB values is to enter a percentage value,

where a value of 33 per cent, for example, will change shades of red to shades of green, greens to blues, cyans to yellows and so on.

Cyrix A chip maker and manufacturer of PC processors.

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D

D1 *(See CCIR 601.)*

Daemons A program or process dedicated to perform what is usually a singular given task, such as sending mail. TCP/IP daemons include those added by third parties that include SCO.

(See TCP/IP.)

Daisychain A method of uniting a number of CD-ROM drives or other connected devices.

DARPA *(See ARPANET.)*

DAT (Digital Audio Tape) A worldwide standard for digital audio tape recording, covering physical attributes and encoding. DAT cassettes offer two hours of continuous digital audio playback. Standard compact cassettes are encoded horizontally using a fixed magnetic head. The head current induces an analogue magnetic signal on tape, via a head gap. DAT cassettes are encoded diagonally using a twin rotary head. Like CD-DA, CIRC error correction ensures high sound quality and long life.

(See Wave audio.)

Database An electronic information system offering data storage and retrieval. A generic term that describes the storage of information on a record by record basis. Records are divided into fields of different types including text, numeric, date, graphic and even BLOB (Binary Large Object). The records are stored in tables or files. Database types include flat file and relational. The flat file database model embodies no links between different files or tables. A relational database is quite different in that records from one file can be linked to records stored in a separate file or table. Codd's standard text about relational databases published in the 1960s specified different types of relational links. Types of link include one-to-one,

one-to-many and many-to-many. There are many commercial examples of the relational database that base their design on the original writings of Codd. Relational databases are formally referred to as RDBMSes (Relational Database Management Systems) and flat-file databases are termed simply DBMSes (Database Management Systems). Commercial examples of software products that permit the development of RDBMSes include Paradox for Windows, dBase, Microsoft Access, Oracle and Ingres. Relational databases are used to store tabular information in the form of records, and useful versions are able to generate graphs. Popular PC relational databases include Microsoft Access, Borland Paradox, dBase, Q&A and DataEase. Because they are relational, an invoice can extract information from a number of different tables or files. Flat-file databases are used to store isolated records, and cannot be used to link files or tables. They are used for simple applications such as card files. Text databases are used to store documents such as articles and even complete books. Documents can be indexed, where the user interface simply allows users to search for documents which contain target words, phrases or sentences.

(See Data warehouse, DBMS, DSS and RDBMS.)

Database middleware *(See Glue and Middleware.)*

Database server *(See Server.)*

Data capacity A measure of how much data may be stored using DSM (Digital Storage Media). The device might be electronic (such as RAM), magnetic (such as data cartridge), optical (such as CD-ROM) magneto-optical, or even molecular or organic. The physical length of CD-ROM tracks and data block size in terms of user data provide a means of calculating disc capacity. It can be assumed that a standard CD-ROM can store around 660 Mbyte. The new generation of DVD discs have data capacities in the Gbyte range (1 Gbyte = 1024 Mbyte). Hard disk data capacities tend to range from around 100 Mbyte up to several Gbyte. The length of a CD-ROM in minutes and data block size in terms of user data provide a means of calculating disc capacity with pinpoint accuracy. For example, consider the following simple formula:

```
User data capacity = disc length (seconds) * blocks
read per second * usable block data
```

Or, using CD-I discs:

```
User data capacity = disc length (seconds) * sectors
read per second * usable sector data
```

Applying this formula to calculate the precise data capacity of a 65 mins 12 s Mode 1 or CD-I Form 1 disc gives:

```
User data capacity = 3912 * 75 * 2048 bytes
                   = 600 883 000 bytes
                   = 573 Mbyte
```

The capacity of a 65 mins 12 s Mode 2 CD-ROM disc is:

```
User data capacity = 3912 * 75 * 2336 bytes
                   = 685 382 000 bytes
                   = 653.6 Mbyte
```

The data capacity of a 65 mins 12 s CD-I Form 2 disc is:

```
User data capacity = 3912 * 75 * 2324 bytes
                   = 681 861 000 bytes
                   = 650.2 Mbyte
                   = 650.2 Mbyte
```

(See CD-I, CD-ROM and DVD.)

Data compression *(See Compression.)*

Data cube An information storage model. In the context of a data warehouse, data cubes are evolved as a result of extractions from operational data. They can be assumed to be static entities, which do not change and may not be altered or even built from query data. A cube cache is used to store them in memory. If grown beyond three dimensions, the cube becomes a hypercube.

(See Data warehouse.)

Data dictionary A type of metadata which defines stored data along with its relationships. Typically the database dictionary is dynamic, updating its contents as data structural changes occur.

(See Data warehouse and DBMS.)

Data extraction A process that abstracts data from one or more sources in order to build a static database of unchanging data.

(See Data warehouse.)

Data hiding A means of making the underlying workings of types or classes transparent to the programmer. The programmer merely has to understand the behaviour and functionality of the class.

(See C++, Java and OOP.)

Data link A direct serial connection between two nodes or devices; it is devoid of intermediate switches or devices.

(See MPP.)

Data mart A single-subject (and generally small-scale) data warehouse which provides DSS for a limited number of users.
(See Data warehouse.)

Data partitioning A method of segregating data so that it is distributed across different systems. It may serve to store selected records in more secure (and often expensive) mass storage (such as SRAM or an appropriate level of RAID), while storing less important data on conventional storage media, namely hard disks.
(See RAID.)

Data replication A dynamic and changeable verbatim copy of data. A multiplicity of such replicas may exist.

Data schema A term which describes a database structure, such as the entity relationship (E-R) diagram of an RDBMS. The E-R diagram shows the links that unite the database tables.
(See Database, Data warehouse and RDBMS.)

Data sonification A general term used to describe the process of enhancing data through the addition of audio.

Data transfer rate (Average user data transfer rate) 1. The rate at which data is transferred from a CD-ROM, hard disk or DVD-ROM drive. Typically, it is standardised on old-fashioned single-speed drives at either 150 Kbyte/s or circa 171 Kbyte/s. The approximate average user data transfer rate can be calculated using the following simple formula:

```
Average user data transfer rate = blocks/s * user
data/block
```

In Mode 1:

```
Average user data
transfer rate = 75 * 2048
              = 153 600 byte/s
              = 150 Kbyte/s
```

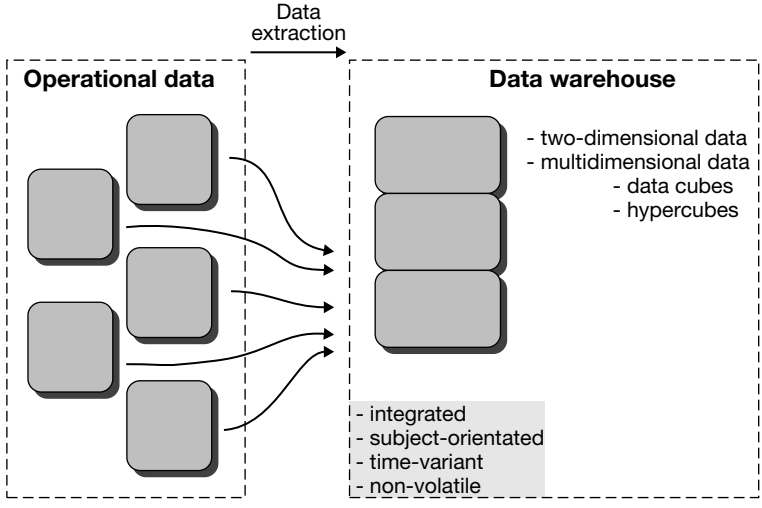
Turning to Mode 2 discs, a noticeable improvement is brought about through increased user block data:

```
Average user data
transfer rate = 75 * 2336
              = 175 200 byte/s
              = 171 Kbyte/s
```

(See CD-ROM and DVD.) 2. The rate at which data is transferred from a mass storage device, such as a hard disk, removable media or RAID.
(See Hard disk and RAID.)

Data type A classification for data. Modern relational databases commonly store the following different data types, including currency, numeric, date, alphanumeric, Boolean, graphical and BLOB (Binary Large Object).
(See Data warehouse, BLOB, Boolean and OODBMS.)

Data warehouse 'An integrated, subject-oriented, time-variant, non-volatile database that provides support for decision making.' (Bill Inman). A unified data repository extracted from multiple data storage structures that may emanate from various data sources. It provides a single interface with relational and/or multi-dimensional data. It is the rebirth of what IBM termed the *Information Warehouse* in the 1980s. Data warehouses form the information storage methodology in modern decision support systems (DSS). Collectively these systems provide a means of querying data that emanates from disparate information storage models. On-Line Analytical Processing (OLAP) is a crucial facet of the data warehouse architecture, providing a means of abstracting and analysing data in a manner which makes transparent the multiple data sources and data storage models used. The data mining system (DMS) is also a key DSS component. Data mining is an attempt to embed intelligence into the interrogation of stored data, and may automate the querying of data, provide user access to new data structures whose information is in close proximity in terms of related subject matter, and assist in solving defined problems. The underlying storage metaphors of a data warehouse may be:



Data warehouse overview

- two-dimensional, where values are stored using the table metaphor, adhering to the established formal RDBMS model for information storage
- multi-dimensional, where data is perceived as a three-dimensional cube or a data cube, where values have x, y and z coordinates.

Data cubes are evolved as a result of extractions from operational data. They can be assumed to be static entities, which do not change and may not be altered or even built from query data. A cube cache is used to store them in memory. If grown beyond three dimensions, the cube becomes a hypercube. According to Inman's definition, a data warehouse is characterised as:

- *integrated*, providing a unified interface to multiple data sources that may use disparate information storage models
- *subject-orientated*, revealing data which is in close proximity in terms of subject matter, providing related information that may be dedicated to specific analysis.
- *time-variant*, permitting data retrieval and analysis using the dimension of time.
- *non-volatile*, making the collective data entities static in definition, except during the periodic instances where updates are driven through the data by the integrated operational systems. On-line updates are impermissible, and the data warehouse can be considered as being read-only.

See: Inman, Bill and Kelley, Chuck, *The 12 Rules Of Data Warehouse For A Client/Server World*, Data Management Review, Vol. 4, May 1994, pp. 6–16.

(See Database, DBMS and DSS.)

DBMS (Database Management System) A system that provides the operations necessary to manage stored data, which may be two-dimensional or multi-dimensional. A DBMS:

- requires a data dictionary, which defines stored data along with relationships. The database dictionary is dynamic, updating its contents as data structural changes occur.
- ensures that entered data undergoes pre-defined validity checks.
- transforms entered data so that it may be stored by the underlying data structure.
- provides storage for data, its relationships, forms, reports, queries and miscellaneous files.
- includes security features, such as the password protection of files and allocated user access rights, and prohibits certain users from accessing certain files and from making data changes.
- may maintain data integrity in a multi-user environment.

- may provide a database communications interface, which might permit users to submit forms-based queries through Web browsers or publish reports and data using various media, which include the Web, e-mail and Lotus Notes.
- provides features pertaining to backup and recovery.
- provides access to data using a query language (such as SQL or a variant thereof), or a querying mechanism which might involve the completion of tables using defined query statements (such as the Borland Query By Example (QBE) technique.)

(See Data warehouse.)

DBS (Direct Broadcast Satellite) A communication and broadcasting technology where information is transmitted (from a geostationary satellite) and received by a satellite dish, which is typically 18 in to 3 ft in diameter. It can also be applied as an access technology which offers downstream bandwidths of perhaps 400 Kbps. Hughes Network Systems (USA) offer such service and implementation. Up to 200 television channels may be chosen using many DBS or Direct To Home (DTH) services. MPEG-2 encoding is used for many DBS services.

(See MPEG-2 and Satellite system.)

DCC (Digital Compact Cassette) An audio distribution medium developed by Philips and launched in 1991. Players able to play both DCC and conventional compact cassettes are commercially available. This dual compatilility is regarded as a significant advantage.

DCE (Data Communications Equipment) A term sometimes applied to a modem.

DCE-DTE (Data Communications Equipment – Data Terminal Equipment) speed The rate at which data is transferred between computer and modem. Synonyms: communications rate and modem-to-computer speed.

D channel (Delta channel) A 16 Kbps signalling channel which supports two 64 Kbps data channels according to the ISDN standard.

(See ISDN standard.)

DCOM (Distributed Component Object Model) A Microsoft technology or protocol which permits interaction between objects or ActiveX components over a network. An open standard, DCOM is operable with standard Internet protocols, including HTTP and TCP/IP.

(See COM and Glue.)

DCT (Discrete Cosine Transform) A widely used mathematical technique for image compression. It provides the basis for lossy image compression where redundant image data is omitted. It is part of the JPEG algorithm, and is also used in videotex. *(See JPEG and Videotex.)* The DCT process operates by converting image data from the *spatial* to the *transform* domain. The complex underlying mathematics are transcribed to matrix manipulations. The resulting intensive arithmetic operations are best implemented using dedicated image processors or general purpose processors that have multimedia capabilities, such as those integrated into Intel MMX. Image energy in the spatial domain is defined as the square of the pixel values. This energy is spread evenly over pixel blocks and the resulting coefficients. Following the transformation, the energy is confined to fewer coefficients. The process involves dividing the image data into 8×8 pixel blocks and performing a forward DCT:

```
F=[T] [P] [T]
```

where [T] is

```
0.3536  -0.3536  -0.3536  -0.3536  -0.3536  -0.3536  -0.3536  -0.3536
0.4904   0.4157   0.2778   0.0975  -0.0975  -0.2778  -0.4157  -0.4904
0.4616   0.1913  -0.1913  -0.4619  -0.4619  -0.1913   0.1913   0.4619
0.4517  -0.0975  -0.4904  -0.2778   0.2778   0.4904   0.0975  -0.4157
0.3536  -0.3536  -0.3536   0.3536   0.3536  -0.3536  -0.3536   0.3536
0.2778  -0.4904  -0.0975   0.4157  -0.4157  -0.0975   0.4904  -0.2778
0.1913  -0.4619  -0.4619  -0.1913  -0.0193   0.4619  -0.4619   0.1913
0.0975  -0.2778  -0.4157  -0.4904   0.4904  -0.4157   0.2778  -0.0975
```

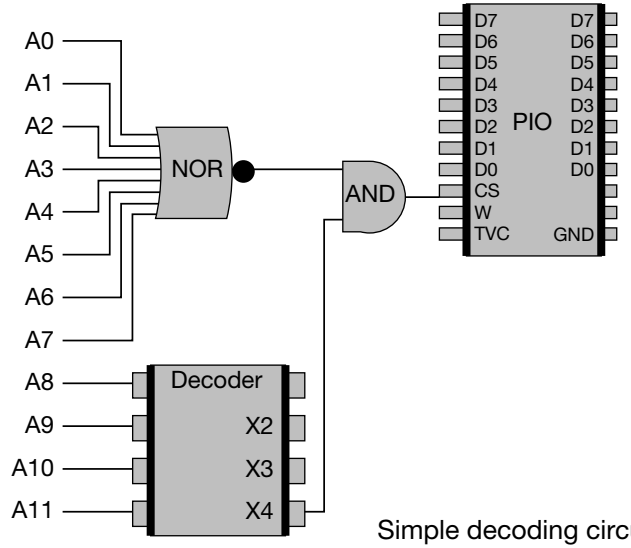
(See JPEG and MPEG.)*

DDE (Dynamic Data Exchange) A standard technique by which data can be exchanged between running Windows applications. For example, a database tool might have a DDE interaction with a spreadsheet in order to draw graphs based on spreadsheet data. A DDE interaction is occasionally called a conversation. Nowadays most Windows users harness OLE (Object Linking and Embedding) rather than DDE. OLE 2.0 compatible applications can be assumed to be considerably less difficult to link.
(See ActiveX and OLE.)*

Debugger A program or feature which permits program code to be corrected or debugged. It assists the process through appropriate prompts and indications as to where the bugs exist in the source code listing.

Decode A process by which encoded data, which may be compressed, is interpreted and delivered to the receiving system or device. For example, the process may involve the decoding of MPEG video.
(See MPEG.)*

Decoder 1. A device which is able to interpret and encode a signal. An MPEG decoder is able to uncompress digital video, as is an MPEG-2 STB. *(See DCT and MPEG*.)* 2. An electronic device which is able to decode digital addresses. A simple two-input device may set up to four digital outputs. Such devices may form part of the address decoding between the processor and connected electronic devices.



Simple decoding circuit

Decryption A process by which encrypted data is unlocked to become readable.

(See Encryption.)

Defragmentation program A program used to defragment a hard disk. It ensures that used data blocks are arranged in a contiguous stream.

Delta channel *(See D channel and ISDN.)*

Density A measure of how densely packed data bits are on a storage medium.

Depth cue A method where distant objects are dimmed or toned down to assist in the achievement of an authentic perspective view.

DES (Data Encryption Standard) An encryption technique; a symmetric cryptosystem. Both senders and receivers use a common 56 bit key to

encrypt and decrypt messages and data. The US government backed DES in 1977, and has since recertified every five years.

(See Cryptography and Encryption.)

Desktop publishing *(See DTP.)*

DESX A version of DES encryption.

Dextrous master An input device used to communicate physical movements usually to a remote robot. This activity is termed telerobotics.

Dhrystone A unit of measurement that provides a guide to the raw processing power of a computer system. Performing such a test does not require a specialised laboratory testbed but a commercially available diagnostics program. One such program is CheckIt (TouchStone Software Corporation, Seal Beach, CA). More sophisticated programs include PC Bench (Ziff-Davis). To determine the practical performance of a machine, comparative tests running everyday programs are often more desirable.

DHTML (Dynamic HyperText Markup Language) A version of HTML where changes may be made to running HTML objects. It was released jointly by Microsoft and the World Wide Web Consortium (W3C).

(See Dylan, HTML and OODL.)

Dialog box A box that establishes communication between an application or environment and the user. In the context of Windows, typical examples include the Open dialog box, which permits a file to be saved. A dialog box might be referred to as a Windows component.

Dialog box control A window contained by a dialog box.

Dialog box editor A tool that can be used to create dialog boxes, commonly integrated into visual programming packages.

Dial-up password file A file used to store passwords, authenticating access to networks via dial-up links.

(See TCP/IP.)

DIB (Device-Independent Bitmap) A bitmap format that provides a device-independent means for storing bitmaps. DIB files can be used to stored intraframe video sequences. Such DIB sequences can be played using Windows Media Player and VidEdit.

Digital A term describing devices such as a computer that process and store data in the form of ones and zeros. In a positive logic representation, 'one' might be +5 volts and zero 0 volts. This lowest of levels at which computers operate is known as machine code. Binary arithmetic and Boolean algebra (named after Irish mathematician George Boole) permit mathematical representation. Boolean algebra and Karnaugh maps are used widely for minimisation of logic algebraic expressions. Though digital signals exist at two levels (one or zero), an indeterminate state is possible.

Digital audio An audio signal recorded in digital form. The most common standard digital format is that defined in the CD-DA specification. Digital audio is used widely in modern multimedia through wave audio files. Audio may be digitised using either video capture boards or sound cards. Audio sources can take the form of a microphone, CD player, audio tape, audio cassette and even electronic musical instruments. Audio cards can be regarded as analogue to digital convertors (ADCs) where the accuracy of digitisation and the subsequent quality achieved largely depend upon the sample rate and number of bits used per sample. The audio quality required can also be preset from within many authoring programs. The memory capacity consumed by a sequence is a function of quality. If it is necessary to calculate the exact memory/data capacity consumed, then the following simple formula can be applied:

```
Memory capacity required (bits) = Sequence duration
(secs) * Sampling rate (Hz) * bits per sample
```

For example, if an 8 bit sound digitiser with a sample rate of 11 kHz were used to digitise a 15 second sequence, then:

```
Data capacity required (bits) = 15 * 11 000 * 8
                              = 1 320 000 bits
                              = 165 000 bytes
                              = 161.13 Kbyte
```

The memory or disk data capacity required naturally increases linearly with increased sample rates.

(See Wave audio.)

Digital camera A camera able to store pictures in digital form. A popular range of digital cameras is the Kodak DC series.

Digital signature Aunique digital code which is attached to a document. It is created using cryptography software such as PGP (Pretty Good Privacy) or Sleet. Digital signatures are created using private keys, which may also be used to unlock the resulting secured documents.

(See Cryptography.)

Digital video A video sequence that is stored and played in digital form. Digital motion video is the most animating feature of modern multimedia. Using videodisc players it has been possible to incorporate colour full-motion, full-screen video (FMFSV) in a computer environment for some time. Because multimedia is a blend of concurrent processes, its storage on a single optical disc requires various elements to be interleaved on the same track. Before this concept could be addressed, the inability of conventional (serial) desktop computers to play motion video stored on CD-ROM represented a significant hurdle. Reasons as to why this is not possible lie in the inadequate rate at which data is transferred from CD-ROM to computer, and in inadequate data storage capacity. A blanket solution to both problems lies in image-compression. For example, if frames of video are compressed significantly, then the need for large data storage capacity and, more importantly, high rates of data transfer is reduced. Intel refined such a technology that it acquired from General Electric in October 1988. Called Digital Video Interactive (DVI), its home was the Intel Princeton Operation, which is part of the Microcomputer Components Group. It originally began in the David Sarnoff Research Centre, New Jersey, the once RCA laboratories. Using DVI, up to 72 minutes of FMFSV (at 30 fps) can be stored on a single 12 cm diameter CD-ROM.

(See D1, M-JPEG, MPEG, Streaming video and Video*.)*

Direct Broadcast Satellite *(See DBS and Satellite system.)*

Direct connection A modem connection without error connection, compression and overflow control. It can be assumed that in such a situation the modem rate equates precisely to the connection rate.

Direct Cosine Transfer (DCT) *(See DCT.)*

Director *(See Macromedia Director.)*

Direct X *(See Microsoft DirectX and SDK.)*

Disc replication A process of manufacturing CD-ROM or DVD discs. With disc data built and stored, a replication company can be employed to create a CD master disc and so produce a specified quantity of discs. However, where a low volume of discs is required, the possibility of using CD-R replication might be considered. If uncertain about data format and submission medium requirements, advice should be sought from the replication company. Mastering involves the physical creation of a glass disc mirroring exactly the CD-ROM disc to be produced. In clean room con-

ditions an electroforming process ensures that the glass master is transcribed onto metal stampers, the output from which is tested electronically as well as mechanically. By injection moulding, clear polycarbonate pressings are produced, to which a metallic disc (holding encoded data) is bonded. Finally, the assembly is coated with a protective lacquer. At advanced manufacturing facilities the complete manufacturing and quality control process is highly automated, where the highest level of personnel interaction will be through the operation of semi-automatic systems and quality control. Quality control normally consists of data verification, manual or automatic inspection, and microscope analysis of pit geometry (for quality analysis).

(See CD-ROM and DVD.)

Disintermediation A term used to describe the Web in its direct selling and information access guise. In essence it refers to the effects of the Web in terms of providing users with direct access to information sources, services and commerce.

(See SET and Web.)

Display *(See Monitor.)*

Dissolve A cut from one image or video sequence to another. More precisely, it is the fading of an image into a background colour or image, or the fading of one image while another image is faded up.

Distributed computing A computing environment where processing, applications and resources are spread across different platforms. It is typically a client/server environment, and may be heterogeneous where disparate operating systems are integrated.

(See Client/server, Three-tier client/server and Two-tier client/server.)

Distributed debugging A methodology for debugging client/server applications where the collective distributed system is perceived as a single system.

(See Distributed computing.)

Distributed glue A name given to the collective entities which bind together (dynamically) running components that are on the client and on the server. As is the case with local glues, standard OO component architectures use different distributed glues.

(See ActiveX, Glue, JavaBeans, OLE and OpenDoc.)*

Dithering A process by which the image depth of a graphic is altered. Programs such as PaintShop Pro are able to dither images, which can be useful for:

- targeting a system which may be limited to simple 8 bit graphics
- improving the quality of displayed graphics (particularly where a machine will attempt to display 24 bit images at 16 bit image depth)
- reducing the size of image files, so improving the response of a Web application.

DLL (Dynamic Link Library) A file that contains a number of functions that may be called by different applications. The Windows architecture is itself based on DLLs. A DLL may be:

- *dynamic*, where programs interact with it at run-time
- *static*, where the DLL is embedded into the application when compiled.

Static libraries tend to make applications *fat*, requiring more memory than their dynamic counterparts. A DLL has:

- a file which contains its source code and entry and exit functions.
- a module definition file
- a resource definition file.

Typically DLLs offer:

- effective program investment through improved reusability
- better code compatibility
- easier migration paths
- cost-effective system renovations
- better program performance
- improved memory management.

(See C++ and Java.)

DMA (Direct Memory Access) A channel used to move data, with minimal use of the processor. For instance, it speeds up the rate at which an expansion card can communicate with a computer's memory. It also allows separate devices using different DMA channels to operate concurrently. Computers based on the 80386 processor (or higher) support eight DMA channels, though some channels are reserved for certain housekeeping tasks. Many sound cards require exclusive use of a DMA channel, while some can share a DMA with another expansion card.

DNS (Domain Name Service) A server that converts domain names (such as www.digital.com) into IP addresses.

(See TCP/IP.)

DNS negotiation A process by which the DNS address is determined by the PPP server and passed to the PPP client.

(See TCP/IP.)

Domain category A collection of servers on the Internet that share the same suffix in their URLs. For example, http://www.cia.com.au is in the domain com.au (which is a mnemonic for a commercial site in Australia). Other domains include .edu (educational), .gov (government), .mil (military) and .net (network).

(See Domain name, E-mail, TCP/IP and URL.)

Domain name The name of a domain. For example, in the URL www.microsoft.com, microsoft is a domain name.

(See E-mail, TCP/IP and URL.)

DOS *(See MS-DOS.)*

Dot pitch A measurement of the distance between addressable pixels on a monitor screen, indicating the clarity of picture and maximum resolution supported.

Double-click A method of selecting options or icons using a mouse. It involves positioning the screen pointer above the icon and pressing the left button twice in succession. When the cursor is transformed into an hourglass (or something similar), you have successfully selected a program icon, for example. Using Windows the interval between the consecutive clicks can be altered using the Mouse icon in the Control Panel window.

Double double An item of data that consists of 64 contiguous bits. It is twice as long as a double word.

(See C++.)

DoubleSpace A real-time disk compression program built into MS-DOS 6.0 to MS-DOS 6.2. Depending upon the file types stored on a hard disk it theoretically doubles disk data capacity. There are numerous other so-called on-the-fly data compression programs on the market for both the PC and Apple Macintosh. Foremost among these is Stacker from Stac Electronics.

(See Compression, DriveSpace and Stacker.)

Double word An item of data that contains 32 contiguous bits. It is twice as long as a 16 bit word.

(See C++.)

Downloading The process of copying files from a remote server to a local computer. The reverse process is called uploading.

(See Browser and FTP.)

Downsizing The process of reducing the complexity of software so that it can be ported to a less powerful system. For instance, a client/server database application could be simplified to run on a PC-based LAN. Equally, an operating system originally developed for a mainframe or workstation can be downsized to run on a PC.

Drag-and-drop The drag-and-drop feature permits the user to move objects on screen simply by dragging them to required locations using a mouse.

DR-DOS (Digital Research Disc Operating System) An operating system, based upon Digital Research CPM (Control Program for Microcomputers), which has minor deviations from MS-DOS. DR-DOS 5.0, for example, is slightly incompatible with MS-DOS 4.01 and MS-DOS 5.0. DR-DOS 6.0 is the most recent version (1993).

DriveSpace A Microsoft real-time disk compression utility which is integrated in Windows 98. It increases the data capacity of a hard disk and of removable magnetic media by around two-fold. The compression ratio attained is a variable, and:

- increases with data files that are largely uncompressed, such as BMP and text files
- diminishes with pre-compressed files such as JPEG and WinZip.

(See Compression, DoubleSpace and Stacker.)

Drop-down list box A Windows component that provides the user with a means of selecting a file or option. Its physical appearance is that of a box with an arrow pointing downwards on its right-hand side. Clicking the arrow produces a list of selectable items.

Dropped A frame in a video source recording which does not appear in a captured digital video file is said to be dropped.

(See Video capture.)

Dropped packet A packet which does not arrive at its intended destination. In certain instances, such as streaming audio and video, such dropped packets are acceptable. In error-sensitive applications, such as program file transfers, dropped packets are unacceptable.

Drum scanner *(See Scanner.)*

DSA An encryption technique.
(See Cryptography and Encryption.)

DSM (Digital Storage Medium/Media) A medium used to store digital data. Commercial examples include audio CD, CD-ROM, CD-ROM XA, CD-I, Digital Versatile Disc (DVD), floppy disk, Sony Mini disc, Philips DCC (Digital Compact Cassette) and DAT (Digital Audio Tape).
(See CD-ROM and DVD.)

DSN (Data Source Name) A means of identifying, and connecting to, a database. A DSN is required for many Web applications that interact with and query databases, which are typically ODBC-compliant.
(See IDC and ODBC.)

DSS (Decision Support System) *(See Data warehouse.)*

DTE (Data terminal equipment) A term rarely used to describe a computer connected to a network.

DTP (Desktop publishing) A term used to describe the use of a desktop computer to design and produce documents of the sort distributed by the publishing sector. Fully specified DTP packages provide the user with a choice of fonts, formatting tools, page make-up features, drawing tools and a means to import pictures into documents. Professional DTP packages include QuarkXPress, PageMaker and Ventura.

Dual-homed host *(See Firewall.)*

Dumb terminal A client device which is restricted to the presentation element of the application. It has no more application logic than that required to send requests and receive visual information. Physically it consists of a keyboard, display and network interface.
(See Client/server.)

DUN (Dial-Up Networking) A technique by which a system/client may be connected with a remote system or network. It is the chosen connection method integrated in Windows 95/98/NT.

Duplex A channel that can be used to transmit data in two directions simultaneously. Where data is unidirectional at any point in time, the channel is termed half-duplex.

DVD An optical disc technology that provides a sufficiently wide bandwidth to play MPEG-2 video. DVD was once an acronym for Digital Video Disc and Digital Versatile Disc. It offers maximum data capacities of 4.7 Gbyte, 8.5 Gbyte and 17 Gbyte, and exists in four forms:

- DVD-ROM, which provides the same functionality as CD-ROM but with a wider bandwidth and considerably more data capacity
- DVD, which is aimed at the consumer market as a replacement for VideoCD and VHS video
- DVD-RAM, which is a rewritable format able to support a data capacity of 2.6 Gbyte
- DVD+RW, which is a rewritable format offering a data capacity of 3.0 Gbyte.

The general DVD specification includes a:

- 1.2 mm thick, 120 mm diameter disc
- 4.7 Gbyte for a single-layered, single-sided disk
- track pitch of 0.74 micrometres
- 650/635 nanometre laser
- RS-PC (Reed Solomon Product Code) error correction scheme
- variable data transfer rate yielding an average of 4.69 Mbps.

DVD-ROM drives offer backward compatibility with CD-ROM, and the important factors that apply to the performance of a dedicated CD-ROM drive are applicable. Features which drive the DVD-ROM specification include the:

- supported data capacities, i.e. 4.7 Gbyte, 8.5 Gbyte and 17 Gbyte
- interface type
- ability to record CD-R discs
- burst transfer rate
- MTBF (mean time between failures)
- DVD disc average access time
- CD-ROM disc average access time
- average CD-ROM data transfer rate, i.e. 16 speed, 24 speed, 32 speed etc.

- CD-ROM burst transfer rate
- disc spin modes, which may be either CAV or CLV
- meeting of MPC3 requirements
- installation which may be vertical or horizontal.

(See CAV, CD-ROM, CLV, LED and MPC.)

DVD-ROM *(See DVD.)*

DVD video An alternative term for MPEG-2 video stored on DVD.

(See MPEG.)*

DVHS (Digital Video Home System) A digital video cassette format developed by JVC.

DVI (Digital Video Interactive) A largely obsolete, but nonetheless pioneering, video compression and decompression technology for the AT and MCA bus, thus aimed at PC ATs and PS/2 systems (beginning with the PS/2 Model 50). Intel Indeo superseded DVI. It is specified as being able to generate full-colour full-motion, full-screen video (FMFSV). The original specification embodied 8 bit digital video. The MPEG were presented with the DVI compression algorithm, but it was rejected. However, the compression techniques used in DVI were influential in the development of the MPEG compression schemes. Digital Video Interactive (DVI) was demonstrated at the second Microsoft CD-ROM conference of 1987. An image compression technology, DVI permits FMFSV in the PC environment. DVI offers full-colour FMFSV at 10 to 30 fps and a frame size of 512 × 480 pixels resolution.

(See MPEG and MMX Technology.)

Dylan An object-oriented dynamic language (OODL) developed by Apple Computer. Popular Dylan development environments include Apple Dylan Technology Release and Early Dylan, which runs on top of Apple Common Lisp. Key Apple Dylan features include:

- automatic memory management
- a system for organising code in a meaningful manner
- an IDE that has incremental compiler, which allows programmers to change the code of a running programs
- a totally object-oriented structure
- an application framework tailored for building Macintosh applications

- the ability to deploy standalone applications that don't require the Dylan environment
- Cross-language support for C code and APIs.

Dylan was developed by the Apple Advanced Technology Group (ATG) in the late 1980s, and was moved from its Cambridge office to Cupertino in the late 1990s. The ATG set about combining the qualities of dynamic languages such as Smalltalk with static languages like C++ and Pascal. Other Dylan implementations include:

- The Marlais (freeware) interpreter for Macintosh, Windows and Unix
- Carnegie Mellon University's Dylan for Unix
- Harlequin's Windows version
- The Mindy bytecode compiler for the Macintosh and Unix environments.

See: *Dylan Reference Manual*, Apple Computer, 1995.

(See C++, DHTML, Java, OODL and Parallel programming.)

Dynamic Data Exchange *(See DDE.)*

Dynamic HTML *(See DHTML.)*

Dynamic language A programming language that supports an incremental compiler where code changes can be made to running programs. For other important characteristics, see Dylan and OODL.

(See Dylan.)

Dynamic Link Library *(See DLL.)*

Dynamic load balancing *(See MPP.)*

Dynamic processor A processor that has to be constantly refreshed electronically. Such processors are commonly used in desktop systems, and include Pentium processors. They tend to consume a comparatively large amount of current when placed in the perspective of the static processor designs used in some notebook computers.

(See Pentium and PowerPC.)*

DYUV (Differential or Delta YUV) An image compression technique used in CD-I. In the context of CD-I it yields a compression ratio of 3:1 and is used for still near-photographic quality images. It operates in the confines

of conventional television broadcast signals, where the Y component represents luminance and U and V chrominance. Refinement and comparatively large data storage requirements make Delta YUV images uneconomic for cartoon-like images. DYUV operates by storing the differences between absolute YU or YV pixel information, rather than the absolute pixel data.

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E

E1 A four-wire digital trunk with a bandwidth of 2.048 Mbps.

EAPROM (Electrically Alterable Programmable Read-Only Memory) An electronic memory device that can be erased electrically.

ECC (Error Correction Code) *(See Mode 1 and Mode 2.)*

E-commerce (Electronic Commerce) An application of the Internet which sees it used in a point-of-sale (POI) guise. One of the earliest e-commerce Web sites was the Amazon on-line book store. A key concern of companies contemplating e-commerce solutions on the Web, and of users also, is the security of transactions using credit cards and other electronic funds transfer systems such as Switch. Encryption plays an important role in maintaining the privacy of customer details. SET is seen as the internationally agreed standard solution for providing such confidentiality.

(See Cryptography, Encryption and SET.)

Ediris A CD-I multimedia title launched by Philips and Renault in October 1989. It was a service training program for mechanics and was used by Renault. On show at the Salon Equip'Auto it received Le Trophée d'Or (The Golden Trophy) for being a most innovative product.

(See CD-I.)

EDO (Enhanced Data Out) A type of random access memory (RAM) which offers access times of the order of approximately 10 nanoseconds (ns), or 10 billionths of a second.

(See SDRAM.)

EIGRP (Extended Interior Gateway Routing Protocol) A protocol developed by Cisco for routers.

EISA (Extended Industry-Standard Architecture) A standard 32 bit expansion bus agreed in the 1980s by nine influential PC clone makers. These included Dell and Olivetti. The EISA bus was developed in response to the IBM MCA (Micro-channel Architecture) bus, the inclusion of which in a PC design requires a licence fee. The rationale behind EISA was to develop a bus that was technically equivalent to (or better than) MCA. EISA offers backward compatibility with ISA (Industry Standard Architecture) cards. EISA cards operate as bus masters in the same manner as MCA cards, performing most operations without consuming a noticeable percentage of processing time.

Electronic mail *(See E-mail.)*

Electronic publishing A term used to describe information made available through electronic means. Through the Internet, hypermedia and hypertext marked the beginning of a renaissance in electronic publishing, radically altering the manner in which information is presented and used. Other media for electronic publishing include CD-ROM and DVD-ROM.
(See Web.)

Electronic storyboard An electronic equivalent to a storyboard. It is used for the development of multimedia material, providing a cost-effective means of early prototyping when, for instance, only salient images have been, or need to be, gathered. Depending upon the computer software used, it can present a blinkered view, where an overall picture is difficult to grasp. For example, depending upon complexity, pinning a storyboard on wall(s) imparts an immediate overview of meaningful paths and possible user interaction and so forth.

E-mail (electronic mail) A method of communicating documents and digital files electronically; a computer-based equivalent of a letter. E-mail addresses generally conform to the format:
name@domain.domain_category.country:

- name might be a login name
- domain might be a company name, such as Microsoft
- domain category is the type of domain *(See Domain category)*
- country is the geographic location of the server, which might be uk (United Kingdom), nz (New Zealand), au (Australia) and so on.

For instance, subscribers to Compuserve have e-mail addresses that have the syntax 123456.7654@compuserve.com. Other ISPs (Internet Service Providers) allow users to use their name as an ID. Examples include F_Botto@compulink.co.uk, or fbotto@cia.com.au. E-mail messages can be

sent using browsers (such as Netscape Navigator and Microsoft Explorer). E-mail applications include Eudora Mail. Typically, a computer fitted with a modem is used for transmission and reception of data. Standards such as MIME (Multi-purpose Internet Mail Extensions) are applicable to such transmission, permitting the integration of program and video files within e-mail documents and communications. E-mail messages can be sent over LANs, intranets and the Internet. Users generally read their e-mail messages by downloading them from a server, and there is often an option within the e-mail program that allows them to choose whether or not to leave a copy of the e-mail message on the server.

(See POP3.)

E-mail hyperlink A hyperlink which invokes an e-mail client or feature.

EMS (Expanded Memory Specification) A method of addressing a large amount of memory in a PC architecture; it is a standard for raising the ceiling on available memory. Introduced by Lotus, Intel and Microsoft (LIM) in 1984, it was used in Windows 1.x to cache DOS applications. The specification has evolved and numerous different versions are available. In the early days, many PCs were fitted with EMS-compliant memory cards. However, the growing use of extended memory (XMS) on motherboards and their EMS compliance drove EMS memory cards into obsolescence. Expanded memory is accessed by reading 16Kbyte pages from EMS into the memory area between 640Kbyte and 1Mbyte Ram. A device driver such as `EMM386` responds to EMS requests.

Encapsulation A term which describes hiding the internal workings of an object. The resulting object encapsulates code and data, which are hidden from the user and the remaining collective OO system. Essentially it becomes a black box, and all that matters is its responses to stimuli, such as defined events, which are intercepted and processed by the object's public interface.

(See C++, Java and OOP.)

Encode The process of converting data, or an analogue signal, into another form in terms of data representation. For example, Video-on-Demand services often use MPEG-2 video, which is encoded using uncompressed source recordings, which may be analogue or digital. Equally, streaming video/multimedia sites store video encoded according to the MPEG-1 specification.

(See MPEG.)*

Encryption The process of ciphering messages or data so that it may be deciphered and read only by the intended recipient(s). Encryption techniques include:

- DES
- TripleDES
- DES X
- RSA
- DSS.

(See Cryptography, Decryption, DES, DESX, DSS, RSA and TripleDES.)

End-user A member of the target audience for a system, application or title.

Engelbart, Douglas An academic credited with the invention of the mouse and the windows concept. Apple Computer eventually brought his work to market.

Enigma A Second World War encryption technique used by Germany. Alan Turing was one British code-breaker assigned the task of its decryption. It is used today on Unix systems, and is accessible via the `crypt` command.

(See Encryption.)

Enterprise computing A general term used to describe the application of computers and Information Technology (IT) in medium-size to large businesses.

Entity relationship diagram A diagram which illustrates the design structure of a relational database, together with all its data tables and links. Programs that can be used to draft such diagrams include EasyCase. Entity relationship diagrams rarely include reports and query information, though some relevant notes might be included.

(See Database.)

Enumerated constants A type of constant supported by C++.

(See C++.)

EPROM (Erasable Programmable Read-Only Memory) An electronic memory device that can be erased by subjecting the chip to ultraviolet light. Once programmed, its transparent window is covered, making the data permanent.

Error correction The process of minimising the risk of receiving corrupt data from DSM such as a CD-ROM or from a modem. Modem-based error

correction generally involves first breaking down files into a number of blocks or frames. The checksum (or total number) of bytes in each block is then calculated and transmitted with each block. The receiving modem then calculates a second checksum for each block and compares it with that it received. If the checksums differ, then the data is re-sent from the transmitting modem.

Ethernet A Local Area Network (LAN) standard. Ethernet adapters included on computers may comprise thin Ethernet or more expensive thick Ethernet connectors and cables. Ethernet was put forward in 1974 by Robert Metcalfe through his Harvard PhD thesis.

Event-driven An environment or program that responds to external events such as mouse clicks. Modern event-driven applications can be assumed to be object-oriented. Objects such as buttons respond to events, triggering a method or item of code that is attached to them. Windows is an event-driven environment.

Expanded memory *(See EMS.)*

Expansion bus A bus used to provide a means of expanding a PC to include various peripheral devices that might range from graphics cards to MPEG players. Standard expansion buses include 16 bit ISA (Industry Standard Architecture), IBM MCA (Micro-channel Architecture) and EISA (Enhanced Industry-Standard Architecture).

(See Local bus.)

Expansion card An electronic assembly that can be added to a PC by slotting it into its expansion bus. Expansion cards include graphics cards, video capture cards, fax/modems, hard disk controllers and MPEG players.

Expert system *(See KBS.)*

Explorer A program which is part of Windows 95 and Windows NT, and is used to peruse files, open files, launch programs and perform file management functions. It shows file details such as their size in bytes, the date and time they were last modified, and their attributes, including whether they have read, write or read/write status. It is commonly used to move, rename, copy and delete files and even complete directories. The move, copy and delete commands work with multiple selected files, so you can copy and move batches of files without having to go through the monotony of dealing with one file at a time. Windows applications can be

run from Explorer by double-clicking them or by double-clicking files that were created with them.
(See Windows.)

Extended memory *(See XMS.)*

EyePhone An HMD (head mount display) manufactured by VPL.

E-zine An electronic magazine, which may be distributed via the Web or a digital removable medium such as CD-ROM.

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F

Failover A contingency measure which provides an alternative service provider should a failure occur.

FAQs (Frequently Asked Questions) A list of questions asked most often by users or developers.

FAT32 (File Allocation Table) A filing system used by the Windows 98 operating system; it is an enhancement of the FAT16 implementation. It is more efficient than FAT16 because it uses smaller clusters, which are used to store files. FAT32 clusters may be:

- 4 Kbyte for drive capacities between 260 Mbyte and 8 Gbyte
- 8 Kbyte for drive capacities between 8 Gbyte and 16 Gbyte
- 16 Kbyte for drive capacities between 16 Gbyte and 32 Gbyte
- 32 Kbyte for drive capacities that are greater than 32 Gbyte.

Each cluster is confined to data from a single file. The larger 32 Kbyte clusters typically used by FAT16 (on relatively small drives) are comparatively inefficient. For example, when a 34 Kbyte file is written to the hard disk, two 32 Kbyte clusters are used. The second cluster has some 30 Kbyte of unused payload. So even though the file is just 34 Kbyte, it consumes 64 Kbyte of hard disk, which equates to two of its 32 Kbyte clusters. Clearly, FAT32's dependence on 4 Kbyte clusters (on smaller drives) helps eradicate the unused data capacity of clusters. This yields considerable storage capacity gains. The disadvantage of using FAT32 is that it prevents the use of DoubleSpace when using Windows 98.

(See Hard disk.)

Fat client A system within a client/server architecture (such as that of the Web) that features:

- presentation, which is typically in the form of a Web browser
- complete application(s)

- a data cache, which is used to store information from a server-side database or back-end database.

Many systems connected to the Web may be described as thin clients. Fat clients depend heavily on client-side processing and resources, while thin clients do not. This higher demand for hardware results in higher client system costs. Generally fat clients may integrate:

- improved intelligence, because the user's interaction can be personalised through the local customisation of the application; additionally, intelligence features such as those associated with KBSes are more feasible
- additional local applications, such as industry-standard products from companies such as Microsoft, Lotus and Inprise.
- data verification prior to sending messages to the client side, thus improving system responsiveness while reducing network traffic
- security on the client-side, through password checks and restricted access to documents, data and applications.

(See Application software, Client/server, KBS, NC and Thin client.)

FDDI (Fibre Distributed Data Interface) A computer-to-computer fibre link technology and an internationally agreed ANSI standard. The topology comprises a dual multi-mode optic fibre, LED (or laser) and Token Ring network. Data rates of up to 100 Mbps are possible. Without repeaters, transmission distances up to 2 km are attainable at a data transfer rate of 40 Mbps.

(See LED and Optical fibre.)

Fibre channel A high-performance communications pathway which was introduced by the Fibre Channel Association (FCA). An open standard, it is a protocol that supports data transfer rates from 133 Mbps up to 200 Mbyte/s. Fibre channel can be used to connect sites up to 10 km apart using a 9 micrometre single mode optic fibre. The fibre channel protocol may also propagate along traditional copper-based transmission media such as miniature coax and shielded twisted pair. Typical data transfer rates, and maximum transmission distances for a 9 micrometre single-mode optic fibre are:

- 100 Mbyte/s 10 km
- 50 Mbyte/s 10 km
- 25 Mbyte/s 10 km

For a 50 micrometre multimode optic fibre:

- 100 Mbyte/s 0.5 km
- 50 Mbyte/s 1 km
- 25 Mbyte/s 2 km

For a 62.5 micrometre multimode optic fibre:

- 25 Mbyte/s 500 m
- 12.5 Mbyte/s 1 km

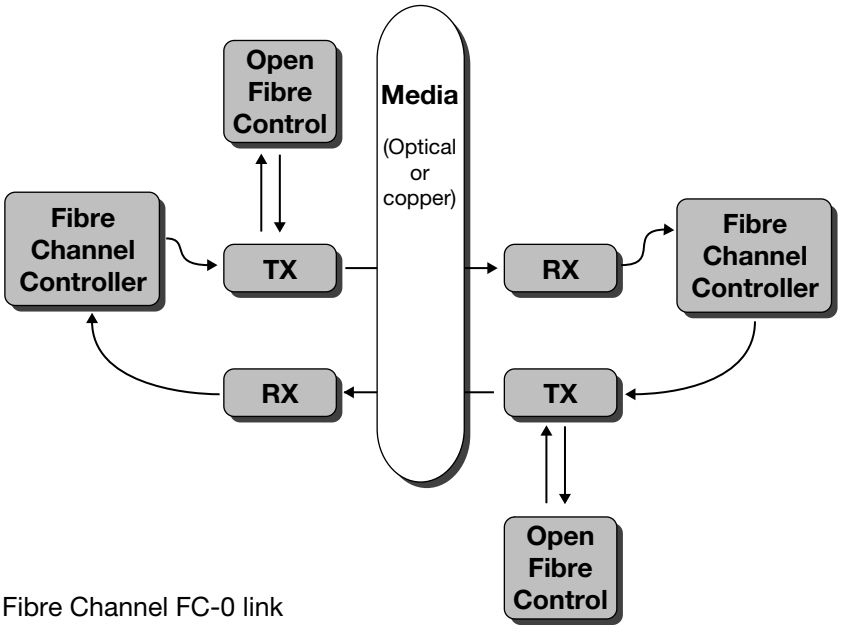
For video coax:

- 100 Mbyte/s 10 km
- 50 Mbyte/s 10 km
- 25 Mbyte/s 10 km

Applications of fibre channel include mass storage interface and control and high-speed networks. Network topologies may be point-to-point, ring or a Fibre Channel–Arbitrated Loop (FC–AL), which requires neither switches nor hubs. Frames are used to send and receive data, each having the fields:

4 bytes	24 bytes	0 to 2112 bytes (payload)		4 bytes	4 bytes
		64 bytes	2048 bytes (Maximum payload with *optional header*)		
Start of frame	Frame header	Optional header		32 bit CRC	End of frame

Fibre channel frame format



Fibre Channel FC-0 link

- start-of-frame delimiter
- frame header
- optional header
- payload, which is the user data, and may be between 0 and 2112 bytes
- 32 bit CRC error detection
- end-of-frame delimiter.

The Fibre Channel Physical (FC-PH) standard consists of the levels:

- FC-0, which covers physical media, cables connectors, LEDs, short- and long-wave lasers, transmitters and receivers
- FC-1, which covers the encoding and decoding protocol, to cater for the adopted serial transmission techniques
- FC-2, which covers the signalling protocol and defines the shown frame format (or *framing protocol*) for data transfer.

Upper FC layers include FC-3, whose common services include:

- *multicast*, for transmissions to multiple destinations
- *striping*, for transmitting to multiple N_ports concurrently, supporting multiple links
- *hunt groups*, which are a collection of N_ports, assigned an alias; frames containing the alias are routed to any non-busy N-port within the defined group.

Upper layer protocols (ULPs) are defined by FC-4, covering industry network standards, which may be transported using fibre channel. These include:

- Internet Protocol
- ATM Adaption layer
- IEEE 802.2

Channel protocols supported by FC-4 include:

- SCSI (Small Computer Systems Interface.)
- High-Performance Parallel Interface (HIPPI) framing protocol
- Intelligent Peripheral Interface (IPI)
- Single Byte Command Code Set Mapping (SBCCM).

(See Access technology, ADSL, ISDN and LED.)

Fibre optic *(See Optical fibre.)*

Field A column in a database table or a container for data entry in a form. Entries within fields are termed field values.

(See Data warehouse.)

Field value A data item in a database.

FIF (Fractal Image Format) An image compression technique.

FIFO (first in, first out) A queue whose operation hinges on regurgitating items in the order in which they were deposited. An analogy is that of a vending machine used to sell chocolate bars, which are stored in a vertical dispensing tube.

Fifth-generation language Fifth generation languages are non-procedural. They are declarative in that actions are not implemented through fixed procedures. They are also known as AI languages and include PROLOG (PROgramming LOGic).

(See AI.)

File Manager A program which forms part of Microsoft Windows 3.x and performs multiple roles, including file management and browsing and network management. Network features are available in the Windows for Workgroups version of File Manager. The Windows 95 (and later) and NT version also has network features, but the File Manager is renamed Explorer.

(See Explorer.)

Find and Replace A phrase used to describe the automated process of replacing a specified word or phrase with another. The phrases find and replace and search and replace are interchangeable.

Firewall A software/hardware implementation that partitions a network or system, so restricting access to selected users; it appropriately isolates a network. A firewall may be perceived as physically existing

- between the Web server(s) and the ISP's physical site, or
- between the network and the Internet, or
- between one or more networks.

It may perform the simple functions of checking client connections and requests and securing server-side applications and data. The firewall's collective components may intercept inbound data packets and perform a number of security checks. These may revolve around the origins of the packet, checking such packet information as its:

- source IP address
- source IP port, which identifies the originating application.

Firewalls are vital to many organisations' security strategies. Other adopted security facets include:

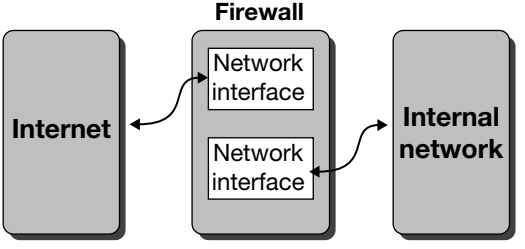
- passwords for logging on to networks
- client-side password checks for connecting to Web sites

- client-side password checks for connecting to e-mail applications and services
- password-protected compressed hard disks, made possible using Stac Electronics disk compression programs.

Firewalls may also include the ability to virus check and to screen incoming documents and executables such as ActiveX controls, plug-ins, Java applets and any other code which is downloaded and intended to be processed. Cookies may also be filtered. Firewalls may be at the network level, harnessing packet filtering techniques using routers. The routers are intelligent in that they may be programmed to behave as a selective barrier to unwanted network traffic.

Dual-homed host firewall A dual-homed host has two network interfaces, which connect with disparate networks, while a multi-homed host typically interfaces with two or more networks. The term *gateway* was used to describe the routing functions of such dual-homed hosts. Nowadays the term *gateway* has been replaced by *router*. A dual-homed host can be used to isolate a network, because it acts as a barrier to the flow of TCP/IP traffic. The implementation of a Unix dual-homed firewall requires (among other things) that:

- IP forwarding is disabled, thus yielding a protective barrier
- unrequired network services are removed
- programming tools are uninstalled.



Firewall – in the form of a dual-homed host

Bastion host A host that is critical to a network's security. This is the focus of network management and security monitoring, and is a network's principal defence against illegal use. A dual-homed host may play the role of a bastion host.

Screened subnets A subnet which restricts TCP/IP traffic from entering a secured network. The screening function may be implemented by screening routers.

Commercial firewall products include

- FireWall-1, which is a commercial gateway product, from the Internet Security Corporation, and uses:
  - application gateway
  - packet filtering

- *ANS InterLock*, which is a commercial gateway product from Advanced Network Services
- *Gauntlet*, which is a firewall product from Trusted Information Systems

(See ATM, Cookies, Encryption, Packet filtering, Risk exposure, Screening router, Security, Security gateway, SET, Stacker and Subnet.)

Firewire A high-performance interface which permits the connection of peripheral devices such as mass storage devices, modems and printers. It is otherwise known as IEEE1394, and as such it is an internationally agreed standard.

(See Fibre channel and SCSI.)

Firmware A program or data stored using a ROM variant (*see EAPROM, EPROM*, *PROM and ROM*). Firmware is thus involatile and permanent.

First-generation language First generation computer languages require the entry of code in a hexadecimal form (*see Hexadecimal*). A collection of instructions entered in 'hex' represents a first generation language, and the system upon which it runs may be described as a first generation computer. Such languages are obsolete.

Fisheye browser A browser, or feature thereof, which emphasises nodes in close proximity or of relevance.

Flatbed scanner *(See Scanner.)*

Floating-point data types A data type that may represent fractional numbers, which may be the:

- float type, which is allocated a 32 bit single-precision number
- double type, which is allocated a 64 bit double-precision number.

Such data types are implemented in C++ using statements of the form:

```
float altitude;
double angle, OpenRoad;
```

Floppy disk A magnetic storage medium typically of 3.5in or 5.25in in diameter. Standard versions store between 360 Kbyte and 1.44 Mbyte for the IBM family of computers.

Flowchart A symbolic representation of the flow of program execution. Flowcharts can also be applied to objective decision making, such as choosing a computer, sound card, monitor or anything in fact. Windows programs capable of generating flowcharts including Visio, ABC Flowchart and AllClear.

Flow control A buffering technique that can be used to enhance the DTE rate using modem-based communications.

FMFSV (Full Motion, Full-Screen Video) A term used to describe video that can be assumed to fill the entire screen, or the greater part of it, and which provides the illusion of a frame rate of not less than 25 frames per second (fps) without the use of duplicated frames. MPEG-2 or DVD video is FMFSV. 25 fps is the frame rate delivered by PAL and SECAM broadcast standards. The American NTSC broadcast standard provides 30 fps. Ideally the frame rate should be greater than 25–30 fps. The frames that make up an FMFSV can be full frames, as in the case of an M-JPEG video stream or a combination of full frames and partial frames, as is the case with MPEG video. The full frames or reference frames occur at regular intervals and dictate the number of authentic random access points provided by an encoded MPEG video sequence. The frame resolution of what can be described as FMFSV varies, but it should not fall below 720 × 360 pixels. Larger standard frame resolutions may broadly equate to 640 × 480 pixels, 800 × 600 pixels, 1024 × 768 pixels, 1240 × 1024 pixels and 1600 × 1240 pixels.

(See MPEG and Video*.)*

Folder A metaphor for a directory. Folders are used to store files, which are usually of a specific type.

Form 1. A metaphor for a paper form, used by client browsers in order to interact with programs and data that may be on the client- or server-side. Typically forms permit users to enter:

- signup details with Web sites
- contact details
- password details
- credit or debit card details for purchase from e-commerce sites.

(See MCIS.) 2. A metaphor for a paper form, used for data entry and viewing data in a database. RDBMS development tools, such as Access, DataEase for Windows or Paradox for Windows, may be used to create table-based applications. *(See Data warehouse and DBMS.)* 3. A data sector type on a CD-I disc. Like CD-ROM blocks, CDI sectors are 2352 bytes long, including headers, sync information, error detection and correction data. Like a Mode 1 block, a Form 1 sector yields 2048 bytes user data. Unlike a Mode 2 block, however, a Form 2 sector yields 2324 bytes user data. *(See Data capacity and Mode 1 and Mode 2.)*

CDI sector structure

	Form 1	Form 2
Synchronisation bytes	12 bytes	12 bytes
Header bytes	4 bytes	4 bytes
Subheader bytes	8 bytes	8 bytes
User data	2048 bytes	2324 bytes

(See CD-I.)

Fourth-generation language *(See 4GL.)*

fps (frames per second) A measure of the speed at which the frames making up a video sequence are played or captured.

FPU (Floating-Point Unit) A set of registers and instructions able to make decimal calculations.

Frame 1. A tiled area of a browser's window. A frame provides an efficient method of presenting information without using a separate Web page. For example, a frame might be used to play a video sequence or animation. A frame-enabled Web application reduces the complexity of designing multiple pages at design time, and is toured more easily by users. Frames are supported by many Web page design and Web application development tools, such as Microsoft FrontPage. *(See Microsoft FrontPage and Visual InterDev.)* 2. A single image making up a video sequence. Digital video sequences may consist predominantly of partial frames, called interframes, or full frames, called intraframes. *(See MPEG* and Video*.)* 3. A single item of transmitted data using the frame relay protocol, which is designed for modern digital networks and does not integrate the demanding error detection and correction schemes prevalent in older protocols. *(See Frame relay.)*

Frame grabber A device used for digitising still or single frames of video. Video capture cards often comprise a frame grabbing feature. For example, manual step-frame capture is equivalent to frame grabbing.

Frame relay A protocol designed for modern communications networks. Typically it may be operated at speeds between 9600 bps and 2 Mbps, though higher speeds are possible. Compared to X.25 it makes better use of network bandwidth as it does not integrate the same level of intense error detection and correction. That is not to say that frame relay is unreliable; it is simply optimised for modern networks which do not

impose the same level of error on transmitted data, which is the case with the older network technologies for which X.25 was designed. The frame relay protocol may be applied in WAN and backbone implementations, and integrated into solutions that require high data transfer speeds. Each frame consists of:

- a flag, which separates contiguous frames
- an address field, which stores the data link connection identifier (DLCI) and other information
- a control field, which contains the frame size and receiver ready (RR) and receiver not ready (RNR) information
- an information field, which contains up to 65 536 bytes
- a frame check sequence, which is a CRC for error correction.

(See CRC and X.25.)

Framework A suite of interfaces, and code, which define the behaviour of objects or components in an application. The application may be local or a client/server implementation.

Freeware A program that is not sold to users, but distributed free of charge.

(See Shareware.)

Front-end A name given to the client application or system, which may be served by a server-side or back-end application. Between the back- and front-end applications is middleware or *glues*, which exist at a number of levels. These may bind together and coordinate application logic, data and presentation distributed across the back- and front-ends.

(See Application software, Back-end, Client/server and Glue.)

FTP (File Transfer Protocol) A protocol used to transfer files between FTP servers and client systems. It is a standard method for distributing files across TCP/IP networks. Using an FTP client program, users are able to link with FTP sites and browse the remote directories and files as if they were on a local hard disk. Users can then download files from the FTP server.

(See Anonymous FTP.)

Full duplex A simultaneous bi-directional transmission of different data streams.

Full frame updates A video sequence that is composed of full frames. Any such frame can provide a valid entry point for non-linear playback or editing. Such video sequences are also known as intraframe sequences.
(See M-JPEG and MPEG.)*

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G

Garbage collection A feature found in the memory management facet of such modern programming languages as Java and Smalltalk. It reclaims the space occupied by an object when there are no references to that object.

(See C++, Java and OOP.)

Gates, Bill A co-founder of Microsoft, and currently its CEO. He is the world's best known and financially most successful computer software programmer and entrepreneur.

(See Microsoft.)*

GDI (Graphics Device Interface) A Windows device-independent graphics output interface. Inexpensive GDI printers operate via this interface. It exists as a DLL (Dynamic Link Library).

(See DLL.)

Genlock A process by which computer graphics are synchronised with video images so that they can be mixed using a 'genlock' device, or a genlock feature that is integrated into a video capture card. A practical scenario might be the coexistence of video footage and computer-generated text and/or graphics on the same screen.

GIF (Graphics Interchange Format) A standard graphics file format that produces relatively compact files.

GIF98 A file format used in animated sequences.

GIF Animator *(See Microsoft GIF Animator.)*

Gigabit Ethernet An upscaled version of the Fast Ethernet network standard. It may deliver up to 1000 Mbps access speeds, and is backwardly

compatible with 10baseT and 100baseT Ethernet standards. It may be used over the following media:

- multimode fibre optic cables over a maximum distance of 500 metres
- single- or mono-mode fibre optic cables over a maximum distance of 2 kilometres
- coaxial cable over a maximum distance of 25 metres.

(See Fibre optic.)

Global roaming A term used to describe the process of reading e-mail messages other than by using your local ISP's point-of-presence. The ability to access e-mail for subscribers to international ISPs such as Compuserve is unimportant, due to the availability of worldwide points of presence. Web-based global roaming e-mail services are available which simply provide users with a PIN. Mail may then be read using any Internet access device, such as those available in so-called Cybercafés. The term global roaming is also applicable to mobile telephony, with major digital carriers offering the ability to use services in specified countries, which can be assumed to include all first-world countries.

(See E-mail and POP3.)

Global variable A variable that may be used at any point, or by any procedure or routine of a program.

Glove An item of clothing that provides a means of interfacing a user with a virtual environment, synthesised environment or process control system. It permits user interaction to varying degrees that extend from giving simple hand signals to the user grasping and manipulating virtual objects, which can include musical instruments. Glove applications include:

- telepresence and telemanipulation
- computer-aided design
- computer games
- translating sign language into speech
- researching the effectiveness of manual or semiautomatic processes so as to refine ergonomic environments and minimize the risk of RSI (Repetitive Strain Injury).

Commercial examples include Power Glove and VPL's Data Glove.

(See Bodysuit, LED, Optical fibre and VR.)

Glue A term given to the entities that hold distributed and local applications together. In a client/server context it is an alternative name for middleware. The underlying client/server system architecture may be that

of the Web. Object-oriented glues include all the collective entities that provide the communications between distributed components. Glues in the Web architectural model include the protocols:

- TCP/IP
- HTTP
- SMTP

as well as miscellaneous low-level protocols including UDP. Glues in LANs might include Ethernet and even proprietary protocols. Aside from protocols, which are the lowest level glues in both traditional and modern OO systems, the next level is the programming model, which is of concern to systems programmers, systems architects and programmers. This dictates the method of communications between components, which include:

- remote procedure call (RPC)
- message queuing, where messages are exchanged between components normally using queues, buffers or even pipes which interface more loosely coupled components, perhaps via a WAN
- peer-to-peer, where either component can be the server (sending a message) or the client (receiving the message).

Local glue A collection of entities that unite client components, so that they may operate collectively. OLE, OpenDoc, ActiveX and JavaBeans components require local glues so that their running operations may be coordinated. These common OO component architectures use different local glues, where:

OLE uses ODL (Object Definition Language)
ActiveX uses COM
OpenDoc uses CORBA IDL (Interface Definition Language.)
JavaBeans uses a subset of the Java programming language.

(See ActiveX, JavaBeans, OLE and OpenDoc.)*

Scripting A scripting language such as VBScript or JScript may also be perceived as a glue, as may HTML.

(See JScript and VBScript.)

Distributed glues A name given to the collective entities which bind together (dynamically) running components that are on the client and on the server. As is the case with local glues, standard OO component architectures use different distributed glues.

(See ActiveX, JavaBeans, OLE and OpenDoc.)*

Gold code The final build of a program, which is released for end users. It is the final stage of development, and will have been alpha and beta tested. Programs that are sold conventionally, such as those from Microsoft, and those that are shareware or freeware, are termed gold code.

GoLive An HTML development environment for the Macintosh computer.

Gooey *(See GUI and UI builder.)*

Graphical user interface *(See GUI.)*

Graphics card An electronic assembly used to generate graphics and text. Occasionally it is referred to as a graphics engine or graphics controller. A VGA card is a graphics engine, but is more commonly referred to as a graphics adapter or card. Standard IBM graphics cards include Monochrome Display Adapter (MDA), Colour Graphics Adapter (CGA), Enhanced Graphics Adapter (EGA), Video Graphics Array (VGA), Multi-Colour Graphics Array (MCGA, used on PS/230 Model) and 8514/A. The fastest graphics controllers are of the local bus variety. These connect more directly to the processor's data bus. The graphics card specification of a PC is influential in determining the quality of digital video playback attainable. A video card comprising dedicated hardware for decoding and playing MPEG, VideoCD or Intel Indeo will generally yield improved video playback. The many areas that separate graphics cards include the following:

- the expansion bus type
- 3-D graphics capability
- ISA (Industry Standard Architecture) 16 bit
- VLB (Vesa Local Bus)
- PCI (Peripheral Component Interconnect)
- EISA (Extended Industry Standard Architecture)
- MCA (Micro-channel Architecture)
- screen resolutions supported
- screen refresh rates at each resolution; particularly important at higher resolutions and should not fall below 70 Hz
- what refresh rates are supported by the attached monitor?
- the number of colours possible
- speed of operation
- is it aimed at Windows usage?
- is it MPC-compliant?
- does it require the presence of another graphics card? If yes, what type of connector does it require? A special features connector or Vesa Media Channel connector?
- does it accelerate Video for Windows playback?
- does it scale up Video for Windows video?
- does it have the ability to play Intel Indeo video at high speed?
- does it accelerate 3-D graphics?

- does it have the ability to play video compressed according to one or more standards, which might include MPEG-1 or VideoCD?
- obvious factors that drive a graphics card's performance include the bus width of the graphics processor used, the amount of VRAM (Video RAM) it has, and its interface type.

Graphics controller An alternative name for a graphics card or for the chipsets responsible for generating graphics.

Graphics engine An alternative name for a graphics card or for the chipsets responsible for generating graphics.

Graphics format An image file may be produced and stored according to a number of different graphics file formats, which include CompuServe GIF, PCX, Windows BMP, PIC, TIFF, IMG, EPS and others. The efficiency of various image file formats in terms of the data capacity they consume tends to vary significantly.

Green Book An alternative name for the CD-I Full Functional Specification announced in June 1987, exactly one year after the first draft was issued.

(See CD-I.)

Groupware A name given to a software implementation which provides collaboration and communication across an enterprise's (business's) network solution, or even over the Web. Orfali, Harkey and Edwards define groupware as: '*Software that supports the creation, flow, and tracking of nonstructured information in direct support of collaborative group activity*.' Conventional modern groupware integrates:

- e-mail
- conferencing, such as whiteboards
- telephony, including voice mail
- scheduling
- workflow
- shared document databases
- Internet access.

The best known groupware product is Lotus Notes.

Guernica An early interactive documentary about the destruction of the Basque town of Guernica during the Spanish Civil War. Picasso's famous painting Guernica is used to promote the central theme. Authored by Robert Abel, it was first platformed on the Apple Macintosh computer.

GUI (Graphical User Interface – 'gooey') A user interface consisting of icons, usually facilitating interaction via a mouse, resulting in minimal keyboard use; sometimes referred to as the graphical front-end. The most widespread commercial examples include those of the Microsoft Windows continuum, though others exist in the form of Apple System, OS/2 Warp, and X Window System. When the Windows concept was originated at Xerox PARC (Palo Alto Research Centre), the UI was called a WIMP (Windows, Icons, Mouse and Pointer) environment.

(See GUI builder.)

GUI builder A development tool used to build a graphical user interface, or the presentation element of an application. Most modern UIs are OO. GUI builders provide a means of implementing the presentation element, together with its interaction with objects, applications and application logic. GUIs can be built using all modern multimedia authoring tools, which include Authorware, IconAuthor and ToolBook. Programming tools such as Microsoft Visual Basic and others included with Microsoft Visual Studio also have the capability to construct GUIs using visual techniques. Such development tools, including GUI builders, feature standard UI components or widgets, which include buttons, sliders, drop-down list boxes, scroll bars, dialogs and windows. Static GUI components might include fonts, colours, textures, patterns etc. The GUI will also feature containers which act as receptacles for objects or components, which might be ActiveX or OLE objects. For example, using Visual Basic, a container can be used to integrate OLE objects such as the Media Player or any compatible OLE object.

(See GUI, OOUI, Visual Basic and Windows.)

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H

H.320 A standard set of recommendations for real-time audio-visual communications in videoconferencing applications. It was initially formulated for videoconferencing over digital networks such as ISDN.

(See B-ISDN, ISDN and Videoconferencing.)

Hacking A term used to describe an individual (hacker) who endeavours to gain unauthorised and often illegal access to a computer system or network. Up until the late 1970s the term hacker (along with the term chiphead) was used to describe a person interested in computers. The controversial book, *The Hacker's Handbook,* by Hugo Cornwall (a pen name), published by Century Communications in the early 1980s, is considered the first text dealing with the subject. The controversy centred on an attempt by the British government to ban the book.

(See Encryption, Firewall and Security.)

Hand-held scanner *(See Scanner.)*

Hard disk A magnetic mass storage device consisting of fixed disks. Removable versions are available, but most are fixed. Storage capacities are increasing all the time. The usefulness of a standalone PC is greatly enhanced following the installation of a magnetic hard disk drive. This presents a practical solution to re-writable mass storage for the present, yielding data capacities many orders of magnitude greater than can be held on floppy disk. All hard disks must be paired with an appropriate controller, with which they must be 100 per cent compatible. Popular commercial variants include IDE, E-IDE or ATA-2, SCSI, SCSI-2, Fast Wide SCSI, and Ultra SCSI. There are basically three ways in which a controller can be supported. In the first, it is included on the motherboard itself. In the second, it is combined with a hard drive in the form of a hard card where the complete assembly is plugged into an expansion slot. In the third, it represents a single card which

plugs into an expansion slot. Controllers capable of accepting multiple devices provide an economical path to vast data storage capacity in the future. An inexpensive array of drives can be built up, thus lowering the considerable cost of a single high-capacity drive bought at the outset. Whereas a number of drives in an array may exhibit comparatively lengthy access times, it may be more practical to replace them with a single large disk, or several larger ones. More expensive controllers are often expandable in terms of additional daughter boards. For example, SCSI daughter boards can increase the number of drives in standard multiples of seven. Such controllers can easily yield tens of gigabytes using inexpensive drives. Some controllers are also capable of mirroring, i.e. writing the same data to two disk drives simultaneously, thus making the data more secure. Controller technology and performance have advanced considerably in recent years, giving rise to an array of commercial devices ranging from scant MFM implementations to caching variants containing on-board processors. The main thrust of advancement bases itself on the need to expand data capacities, lower access times and increase data transfer rates. In addition, the emergence of multiple device controllers reveals a secondary aim. Cache controllers speed up read/write operations by using on-board RAM as an intermediate data store between disk and system memory. High-performance cache controllers can offer access times as low as a fraction of 1 ms.

(See Cache and RAID.)

Hard disk controller A device that interfaces a hard disk with a computer. Numerous commercial variants exist including IDE, E-IDE, SCSI, SCSI-2, Fast Wide SCSI and Ultra SCSI.

(See Hard disk, RAID and SCSI.)

Hardware event queue A Windows buffer used to store keyboard and mouse events.

Hayes commands **(***See AT commands.)*

HDSL (high bit rate DSL) A data transmission line that uses two pairs of copper wire as its medium. It offers T1 data speeds of up to 1.544 Mbps.

(See ADSL.)

HDTV (high-definition television) An emerging television broadcast technology that produces superior quality images.

Help system An on-line information system that provides guidance on software usage through hypertext, hypermedia or multimedia. Such systems

are usually context-sensitive, so that information regarding a current program operation can be produced immediately. Windows Help systems are essentially hypermedia applications. They can be authored using a word processor that is able to produce standard RTF (Rich Text Format) files together with a Help compiler such as that supplied with Borland programming tools. Numerous other Help compilers exist.

Hertz A unit representing the number of cycles or pulses per second. The alternating current (AC) supply in the UK is distributed at 50 Hz or cycles per second.

Hexadecimal A base 16 counting system that is used widely in computing. Four binary digits may be represented by a single number or letter: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

Hierarchical A hypertext structure in which objects are only accessible through a parent object. Hierarchical or tree structures are well known and are normally represented using unidirectional links. Strict hierarchy demands that objects are only accessible through a parent. Compromised hierarchy, however, is less formal, permitting links to bypass children objects.

High-density CD-ROM An initial high-density CD-ROM format introduced by Philips and Sony in the mid-1990s. It was later replaced by the DVD specification.

(See DVD.)

High-level language *(See HLL.)*

High Sierra Group A standard for data storage on CD-ROM agreed at a meeting of industry representatives in 1985 at the High Sierra Hotel at Lake Tahoe, Nevada. Now part of CD-ROM folklore, the meeting resulted in the High Sierra Group (HSG) standard, which introduced compatibility for the storage of alphanumeric data. It has since been built upon to become ISO 9660.

(See CD-ROM and DVD.)

Himem The highest user memory address in a system.

`HIMEM.SYS` *(See XMS.)*

Hit 1. An event when a Web site is visited by a user. 2. In terms of processor cache memory, the hit rate is the percentage of memory requests that can be satisfied by the cache memory.

HLL (High-Level Language) A programming language consisting of easily remembered commands, constructs and statements. OOP (Object-Oriented Programming) languages and visual programming languages are highly evolved HLLs.

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

HMA (High Memory Area) A 64 Kbyte block of RAM located immediately after the 1 Mbyte address line on PCs. Originally Intel intended this to be the first 64 Kbyte of extended memory. The XMS (eXtended Memory Specification) provides a standard means for accessing many megabytes more of extended memory. This is normally achieved using `HIMEM.SYS`.

HMD (Head Mount Display) A display that is worn like a helmet or pair of spectacles. It is generally used to immerse the user in a 3-D virtual environment. Images are presented to the wearer using one of the following display technologies.

- LCDs (Liquid Crystal Displays) of the type used in pocket televisions, and first brought to market by Citizen. Current advantages of LCDs include light weight, compactness of design, low power consumption and their general cost-effectiveness. However their current disadvantages include their comparatively low resolution.
- Miniature CRTs (Cathode Ray Tubes) of the type used by Sir Clive Sinclair in the pocket television of the early 1980s. Sinclair electronics minimised the depth of the CRT by mounting the electron gun in parallel with the phosphor screen. This was achieved using mirrors.
- TFT.
- DSTN.

Current advantages of CRTs include the comparatively high pixel resolution (up to and beyond 1000×1000 pixel elements), and there is greater control of the picture in terms of brightness and contrast. Disadvantages include comparatively high power consumption, their large physical size, their high cost, particularly for high-resolution variants and their weight. Many high-specification HMDs use CRT display technology. Future HMDs will feature VRD (Virtual Retinal Display) technology where images are projected directly onto the eye's retina using low-power lasers.

(See LED, Optical fibre and VR.)

Hoare, Tony An Englishman responsible for the design of the Communicating Sequential Processes (CSP) programming model, upon which the Occam concurrent programming language is based.

(See MPP and Occam.)

Home page The highest level page in the hierarchy of Web pages at a Web site. It has a URL such as www.homepage.com. A home page may consist of a single page or a number of linked pages. It may include links to other sites, graphics, sound bites, video, an e-mail address and various forms for user feedback; it may also include a counter that records the number of hits or times it is visited.

(See ActiveX, DHTML, HTML, HTTP, Java*, Visual InterDev and Web.)*

Host-based processing An architecture where a host computer is connected to dumb terminals. Typically the terminals do not have GUIs such as Windows, but are text-based. They are sometimes termed green screens, because many earlier terminals had screens bearing green phosphor. The terminals are said to be dumb because they lack processing capabilities. They merely accept user commands, pass requests to the host and receive information from the host. Many host-based processing architectures are being renovated or migrated to client/server architectures. A coexistence strategy is also being adopted, using mainframe and client/server-based architectures to form collective IT solutions.

(See Application renovation, Client/server and Mainframe.)

Host name A name designated to a network device, which permits it to be addressed without using its full IP address. The Internet Request for Comments (RFC) No. 1178 provides guidelines for naming hosts. Using host names there is a requirement to perform translations between host names and their respective IP addresses, using a lookup file containing host names and related IP addresses, or the Domain Network Service (DNS).

(See IP address and TCP/IP.)

HotDog Pro A Web site development tool.

(See CGI, HTML and Web server.)

HotJava A Web browser produced by Sun Microsystems. It does not enjoy the popularity of Netscape Navigator or Microsoft Internet Explorer, but is nonetheless equally sophisticated.

(See Browser.)

HIPPI (High-Performance Parallel Interface) An 800 Mbps interface initially used to connect supercomputer networks; it was developed by ANSI under the name *high-speed channel.*

(See Fibre channel.)

HP-UX A Unix operating system variant.

HTML (HyperText Markup Language) A standard language consisting of formatting commands and statements that can be used to create Web pages. HTML may be used to include hyperlinks leading to Web pages, frames or sites, and many other functions including visitor counters. HTML has its roots in SGML, and is the standard language of the World Wide Web. When the Web was first introduced, almost all Web sites depended heavily on HTML. Today, however, HTML is almost a framework used to hang other components, such as:

- ActiveX controls
- Java applets
- JScript programs
- VBScript programs.

The HTML syntax is similar to old text formatting languages such as LaTeX and even that which was included in the Borland Sprint word processor. The Web browser interprets the HTML first by reading the *tags*:

```
<HTML>
<HEAD>
<BODY>

</BODY>
</HEAD>
</HTML>
```

These basic tags form the basis of all HTML listings, and encapsulate such entities as VBScript code, JScript code, ActiveX Controls and Java applets. Such components are enclosed between the `<BODY>` tags.

(See DHTML and Web.)

HTML Help An on-line Help development tool from Microsoft.

HTML template A template file that a Web server uses to display information. The information may originate from a query submitted to a database.

(See HTML.)

HTTP (HyperText Transfer Protocol) A standard protocol that allows Web browsers to communicate with Web servers. The transport protocol is provided by TCP/IP.

(See HTML, TCP and Web.)

Huffman coding An image compression process which operates in the spatial domain and forms part of the JPEG algorithm.

Hybrid CD-ROM/DVD-ROM A CD-ROM or DVD-ROM which possesses hyperlinks to Web pages, as well as having its own data and media files. For example, MPEG-2 video might be stored on the DVD-ROM for improved video quality, while text, graphics and other less dynamic content may be stored on the Web.

(See CD-ROM and DVD.)

Hyper A fashionable prefix in computer terminology that means 'more than' or 'greater than', and is particularly appropriate when considering hypertext and hypermedia.

(See Hypermedia and Hypertext.)

HyperCard A program for the Macintosh which permits the delivery and development of hypertext and hypermedia. Supplied with all Macintosh computers, it represents a milestone in the development of multimedia. (HyperCard is obtainable at a nominal fee through any Apple dealer.)

Hyperlink A link in a hypertext-based navigational scheme that permits the user to browse from one document to another, or from one Web site to the next.

Hypermedia An extension of the hypertext concept where text is combined with images. The terms hypermedia and multimedia are often regarded as interchangeable but they are *not*. In French media circles the ludicrous and ridiculously extravagant term hypermediatisation was coined in 1991. It was used to describe the immediacy with which news began to be transmitted, brought about by satellite broadcasting technology. With the time normally required by the reporter to prepare an informed report sacrificed, the concept of the resulting often confused reports became known as hypermediatisation. Available to Macintosh users through HyperCard since 1987, hypermedia is a relatively mature area of multimedia. HyperCard for the Apple Macintosh can be considered as the

earliest commercially successful hypermedia authoring tool that combined text, graphics, animated sequences and sound. It made the Macintosh an effective personal computer for multimedia. A plethora of hypermedia authoring tools has since emerged, including ToolBook for the Microsoft Windows environment on the IBM PC and compatible machines. Hypermedia applications developed using such tools can be thought of as interactive books that combine images, text and sound.

Hypertext 'It seemed so clear to me right from the very beginning that writing should not be sequential... the problems we all have in writing sequential prose derive from the fact that we are trying to make it all lie down in one long string ... if we could only break it up into different chunks that readers could choose ...' (Ted Nelson)

A term coined in the 1960s by Ted Nelson to describe the concept of linking textual information and presenting it in a non-linear fashion so that it can be navigated and browsed. The Web is synonymous with hypertext. Just as modern multimedia led to a re-evaluation of the way we communicate information in the 1980s and 1990s, hypertext had a similar impact in the 1960s. In a few cases, the birth of what is now known as hypertext also had a similar effect in the 1940s. The rationale behind the development of hypertext was a simple one: to optimise the processes of writing and storing textual information and accessing that information. It improves accessibility of stored information by eliminating the need to follow rigorous set sequences. It allows the user to reference masses of related material through the pursuit of *ad hoc* paths. The advantages of this are easily understood when considering traditional methods. A word unknown to the reader of a book first leads to the index being searched. Failing this, the reader naturally attempts to find a reference to the word in another book. The many references required to research a subject or satisfy curiosity are time-consuming. With information linked, indexed and stored on computer, hypertext expedites this process and gives users the opportunity to take regular excursions to satisfy references. It also makes information available that would not otherwise occur to the casual reader. The word 'car', for instance, might be linked to numerous options, such as: combustion engine, Henry J. Ford, Detroit, Rolls-Royce, catalytic converter and a whole host of relevant texts. Hypertext is equally useful when writing or simply arranging gathered information. An appropriate hypertext tool can be used to implant and manifest links between related items of text automatically. See the following works.

Botto, F., *Multimedia, CD-ROM and Compact Disc – a guide for users and developers* 2nd Edition, Sigma Press, 1993.

Botto, F., *PC Multimedia: An Introduction to Authoring Applications*, Butterworth-Heinemann, 1995.

Woodhead, Nigel, *Hypertext & Hypermedia,* Addison-Wesley, 1990.

(See Multimedia and Web*.)*

dictionary of multimedia and internet applications: a guide for developers and users. francis botto

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I

i750 chipset A chipset initially developed by Intel for the compression and delivery of DVI (Digital Video Interactive) video. The ActionMedia capture and playback boards for DVI video were based on the i750 chipset. Nowadays it is used to playback Intel Indeo video at high speed using such expansion cards as the ActionMedia II.

(See MMX Technology and MPEG.)*

IAP (Internet Access Provider) A company that provides users with access to the Internet; an alternative name for ISP.

(See ISP.)

IBM (International Business Machine) A major manufacturer of business computer systems and software products, including OS/2. Launched the IBM PC in early 1980s, which was to become an industry standard. Its successor, the PC AT, was downwardly compatible, and it too became an industry standard. Introduced the Personal System/2 (PS/2) in mid-1987, incorporating the Micro-channel Architecture (MCA) bus for the first time.

IBM ViaVoice *(See ViaVoice.)*

ICMP (Internet Control Message Protocol) A protocol used between an Internet gateway and hosts. It returns error messages and reports, including:

- Unreachable destination
- Echo
- Echo reply
- Parameter problem
- Redirect
- Time exceeded

- Timestamp
- Timestamp reply.

(See TCP/IP.)

Icon A graphical representation of an option, application or feature on screen. Selected by pointing and clicking with a mouse, or through other means of user interaction including voice commands.

IconAuthor A popular multimedia authoring environment; it competes with such packages as Macromedia Authorware and Asymetrix ToolBook.

(See Authorware, Lingo, OpenScript and ToolBook.)

IDA (Integrated Digital Access) A digital network pilot scheme which was introduced in 1988 by British Telecom. It was operated in Manchester and London.

IDC 1. Internet Database Connector: a Microsoft server extension, which interacts with 32 bit ODBC-compliant databases such as:

- Microsoft Access
- Microsoft SQL Server
- Microsoft FoxPro
- Oracle
- Sybase.

The IDC:

- is a DLL, and receives database requests via the Web server from the user's browser
- interacts with the database, and submits SQL queries
- receives resulting data from the database
- passes the data to the user's browser via the Web server.

IDC files may be created using Microsoft's FrontPage Database Connection Wizard. *(See FrontPage, Web* and Web server)* 2. A firm of analysts specialising in IT.

IDE (Integrated Disk Electronics) A disk controller used widely on PCs, often integrated with the motherboard. In its standard form, at least two hard disks and two floppy disk drives are supported. IDE CD-ROM controllers are also widespread.

IEEE Multimedia An arm of the Institute of Electrical and Electronics Engineers, focusing on multimedia.

IEEE1394 *(See Firewire.)*

IIS (Internet Information Server) A Microsoft Web server, which forms part of the Windows NT 4.0 Server default installation. Including FTP, HTTP and Gopher services, the IIS may be implemented to perform the standard and specialised functions of:

- downloading HTML pages to browsers
- downloading streaming audio
- downloading streaming video
- downloading streaming multimedia
- downloading files using FTP
- uploading files using FTP.

The IIS provides a migration path for the renovation of legacy systems, supporting CGI components.

(See ASP, CGI, FTP, HTTP, ISAPI and Web server.)

IMA (Interactive Multimedia Association) An organisation that provides considerable information resources and support for multimedia professionals.

Image compression A means by which pixel data can be compressed. The compression process may be lossless or lossy. Discrete Cosine Transform (DCT) features strongly in image compression. This has been adopted by numerous manufacturers and is the mainstay of the JPEG algorithm.

(See DCT, JPEG and MPEG-1/2.)

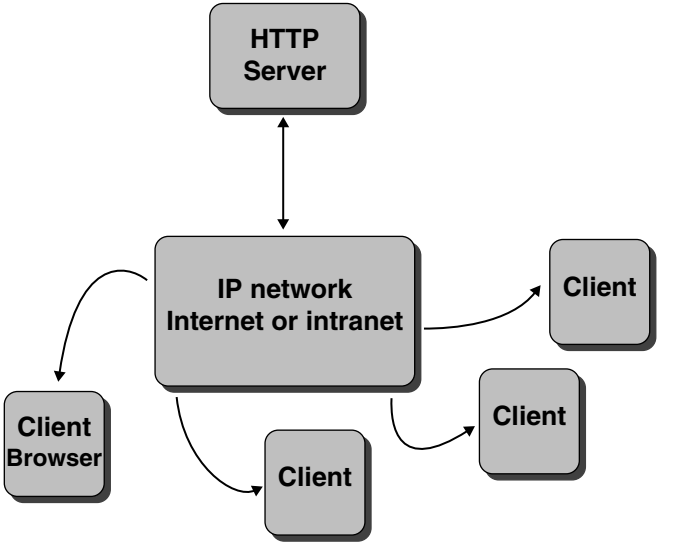
Image format Numerous image file formats exist for storing digital images, including PIC, TIFF, IMG, EPS and GIF.

Image processor A processor specifically designed for image compression purposes. Unlike a conventional processor, it is usually designed to carry out specific matrix transformations at high speed.

Immersive VR Full immersion VR places the user in a virtual world, which can be navigated and interacted with to varying degrees. Users can interact with other users. Achieving a virtual world requires the user to wear a head mount display (HMD) which normally contains miniaturised LCD screens.

(See VR.)

Inactive Web Architecture An architecture where an HTTP server is connected to HTML clients (with browsers). The connection is provided by an IP network such as the Internet or an intranet. The client functionality is restricted to information browsing and the reception of HTML documents.



Inactive Web

The information flow is unidirectional, and the client cannot edit or enter data into HTML documents. The Inactive Web model is rarely used, other than when an intranet is required for information distribution and browsing.

(See Active Web Architecture and Web.)

`include <file>` A C++ command which is implemented by the preprocessor and causes the contents of a named file to be read. Its precise syntax conforms to:

```
#include <filename>
```

(See C++.)

Information browsing A process of searching for and retrieving information which might be on the Internet or on a single CD-ROM or network. CD-ROM-based titles embody a retrieval engine, which is a piece of software that will accept search strings and logic operators, as well as permitting hypertext-style navigation and browsing. More modern navigation and browsing tools include Microsoft Internet Explorer, Netscape Navigator and HotJava. These may be used to tour the World Wide Web (WWW or W3) using the hypertext-style model for information storage and retrieval.

(See Browser.)

Inheritance An OOP methodology where a defined type inherits the characteristics of an existing type. The new type is a subclass or derived type.

(See C++, Java and OOP.)*

Inmos A chip manufacturer responsible for the innovative Transputer, a milestone in parallel processing history, and numerous other components including image compression processors and graphics chips. Once British-owned, it was bought by the European Consortium SGS-Thompson in the late 1980s.

(See Occam, MMP, NUMA and SMP.)

Inprise A software company that began life as Borland, which was founded by Philippe Kahn in order to market and sell Turbo Pascal for the PC environment. Inprise is best known for programming tools such as Delphi Turbo C++, as well as business applications. Its headquarters are in Scotts Valley, CA. Its lesser known products include the Sprint word processor. The company was founded by Philippe Kahn, and its initial rapid growth can be attributed largely to its PC programming tools, which include Turbo Pascal. Inprise (UK) International is headquartered in Twyford, and its European headquarters are in Amsterdam.

(See C++.)

Input 1. An input device provides a means for user interaction. A keyboard is an input device, as is a mouse or remote control device. Touchscreens, track balls, joy sticks and control dials are also input devices. These were referred to as user communication devices in earlier days. 2. The process of entering data into an application. Using early versions of BASIC, such as BBC BASIC, you would enter data using a statement such as:

```
200 INPUT A$
210 REM * Assign the entered keyboard characters to
    the string variable A$
```

Similarly, keyboard entries could be placed in an array using BBC BASIC with a simple loop:

```
10 DIM A$(2,10)
20 REM Create an array
30 REM
40 FOR X%=1 to 10
50 INPUT A$(1, X%)
60 NEXT X%
70 REM
```

Input device A device used to input data to and interact with an application or environment. Typical examples include a mouse, touchpad and touch screen.

InstallShield A tool used widely in the creation of installation programs. *(See www.installshield.com.)*

Instance 1. A unit object defined by a class. It may have many running copies or instances in an OO implementation, which may contain one or more programs in the form of executables and DLLs. *(See DLL.)* 2. An instance variable is the container portion of an object. This container may be used to store data. 3. A single running copy of an application. It is possible to run multiple instances of many Windows applications.

Intel A chip manufacturer founded by Gordon Moore. The world's largest manufacturer of PC processors, it makes the fifth generation Pentium and sixth generation Pentium Pro series of processors. Pentium processors are also available with MMX Technology, which is designed to accelerate multimedia performance. A modern fully specified PC should be considered as comprising a minimum of a Pentium-class processor.
(See MMX Technology.)

Intel Indeo Video A video compression standard. The resultant video can be played using software decompression or hardware decompression.
(See AVI, MPEG and Video*.)*

Interchangeability A generic term used to describe a peripheral device or storage medium able to exist within more than one system type or operating system environment.

Interface device A means of connecting peripheral devices to a computer system, consisting of hardware and software.

Interframe compression A video stream that is composed of intermittent full frames (or intraframes) that are interwoven with partial frames. The frequency of intraframes determines the frequency of random access points for non-linear playback or editing. The partial frames sandwiched between intraframes generally contain frame information that is different from that of the intraframes. MPEG is the best known intraframe compression variant that uses what were specified as Intraframes or I frames. In MPEG compressed video streams partial frames can exist as Predicted frames or Bi-directional frames. A principal disadvantage of interframe compression

is that it does not lend itself to non-linear editing. It also results in higher compression ratios than can be achieved using intraframe compression.

(See MPEG.)*

Interlaced A mode of operation in which the image on a monitor screen is generated by scanning even and odd numbered lines using two separate fields. This technique was introduced in television broadcasting specifically to optimise transmission bandwidth and reduce screen flicker. However, it can generally be assumed that a monitor operating in interlaced mode presents an image that flickers considerably more than a non-interlaced monitor.

(See CRT and Monitor.)

Internet A technical definition might be: a global network of computer networks. Conceptually, however, the Internet is much more, and it has become a universal publishing, distribution, real-time communications and broadcasting medium. It can also be used to gather information from users. The World Wide Web (or Web) is seen as a mainstay of the Internet, and it presents users with a hypertext navigation scheme. This now offers streaming multimedia playback, and may include streaming video, streaming WAV audio, graphics, photographic quality images and text. The growing number of day-to-day Internet applications include:

- e-mail
- information browsing
- downloading and uploading files to and from FTP (File Transfer Protocol) sites
- e-commerce
- distance learning
- low-cost Internet telephony
- publishing information through personal home pages
- videoconferencing
- radio broadcasting
- Web TV (television broadcasting).

Access technologies include:

- POTS
- ISDN
- Cable
- GSM.

Cyberspace is another term for the Internet. The Internet is a fast-evolving multimedia medium that is able to combine increasingly sophisticated still images, audio and video. Moreover, the Internet is cultivating an improved

real-time identity. This provides a gateway to numerous applications including telephony, videotelephony, videoconferencing, and radio and television broadcasting. Continuing evolution of the Internet will see:

- increasingly sophisticated still images, audio and video
- a growing number of Web sites used to deploy information and services, along with qualitative improvements
- improving search engine architectures that users access in order to find and retrieve Web pages
- faster access technologies. These include cable, ISDN and the increasing speed of conventional modems that offer 56.6 Kbps speeds
- improved software interfaces with the Web through better browser designs, which are programs that permit users to interact with Internet
- faster client systems such as PCs.

(See Web.)

Internet 2 A high-performance Internet implementation, which is currently the preserve of US academic establishments.

Internet 3 A high-performance Internet implementation which is currently under construction in the USA.

Internet Engineering Task Force (IETF) A publisher, originator and certifier of specifications of Internet protocols such as TCP/IP. Further information can be obtained at www.ietf.cnri.reston.va.us.

Internet Explorer A market-leading Web browser from Microsoft, which supports:

- ActiveX
- VBScript
- JScript
- Just-in-Time compiler for Java Applets
- SSL 2.0/3.0
- PCT 1.0

and runs on Windows 3.x/95/98/NT and Macintosh. Explorer records visited pages using a cache called the History folder. This optimises performance, as the cache is checked prior to connecting to remote Web sites. The period of time that Explorer maintains the pages within the History folder can be defined.

(See ActiveX, Browser, JScript, PCT, SSL and VBScript.)*

Internet Information Server (IIS) *(See IIS.)*

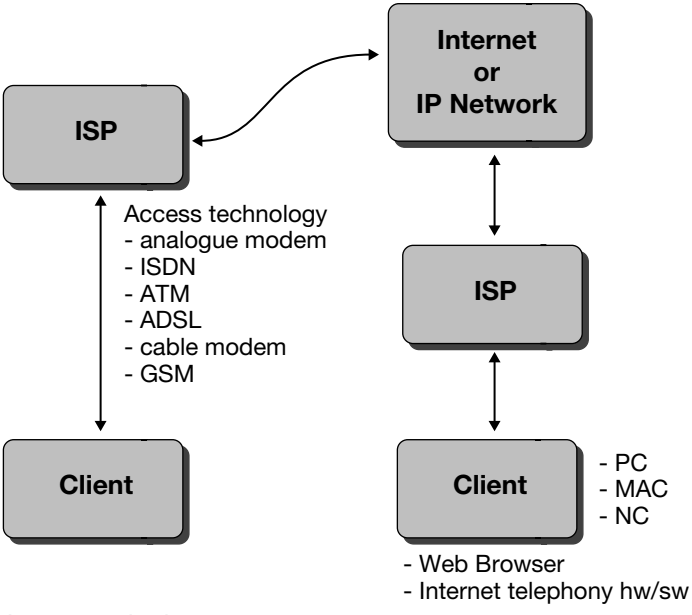
Internet Locator A Windows NT-based server which is part of the MCIS. It permits users to search a database of current visitors to a Web site, and to chat with them using Microsoft NetMeeting.

(See Chat, IRC and MCIS.)

Internet relay chat *(See IRC.)*

Internet Society A publisher of Internet statistics and market research.

Internet telephony A method of making telephone calls using packet-switched IP networks. In 1997 low-cost Internet telephony began to change the face of telcos, Internet Service Providers (ISPs) and corporations; the largely unregulated Internet became interwoven with telephony. For the first time ISPs could mine revenue-rich long-distance and international call businesses, which were once the preserve of telcos like BT and Mercury. Corporations and government departments may also 'toll bypass' the telcos by using Internet telephony over their own networks such as intranets, and significantly reduce their operating costs in the process. Similarly, since VocalTec launched the Internet Phone in 1995, growing numbers of ISP subscribers have been making long-distance and international calls for the cost of a local phone call. Internet telephony theoretically means that an ISP could become an international telco. The domestic long-distance call business presents ISPs with one opportunity to compete with telcos, as does



Internet telephony

the international call business. The technology is also being embedded into the existing switched network, where it will become transparent to the user. The successful proliferation of Internet telephony also hinges on emerging internationally agreed standards, such as H.232, which collectively will unify ISP services globally. The corporate sector will also be affected by Internet telephony, with companies like Lucent technologies and Bay Networks providing turnkey solutions that integrate into existing networks. According to an IDC report, 35 per cent of medium to large companies today already have an intranet. By 1998 that is going to increase by a further 25 per cent, and by the year 2000, 80 per cent of all companies are expected to be using an intranet. With *tour de force* Internet telephony products, Lucent Technologies is already working with numerous corporations and an undisclosed ISP in Australia. Its products are currently used by five of the seven largest banks in Australia, and the telcos MCI, GTE and France Telecom continue to evaluate its technology. One school of thought indicates that telcos have large margins in international traffic while ISPs have small margins. It follows, then, that when Internet telephony reaches critical mass, telcos will react strongly, with falling international call prices.

(See Web.)

Interpreted A computer language in which object code is generated from source code each time a program is run. Almost all inexpensive microcomputers of the 1980s included BASIC interpreters. Even the first IBM PC XT included a basic interpreter, which was stored as a firmware package. The error message 'Missing Basic Interpreter', occasionally seen on later PCs, was a legacy of its earlier inclusion.

Interpreter A program which interprets a language.

(See Interpreted.)

Intraframe A key or reference frame in an MPEG video sequence. It is a full frame and does not depend upon other frames for its data. An MPEG sequence composed entirely of intraframes is termed editable MPEG because it provides random access points. Intraframes are compressed in a similar way to JPEG images, and a comparable compression ratio is achieved.

(See MPEG.)*

Intraframe compression A video stream that can be assumed to be composed of full frames. M-JPEG is an example of intraframe compression. Its main advantage is that the resultant video files lend themselves to non-linear editing. It can also result in higher video quality than interframe compression, but compression ratios are a great deal less.

(See MPEG.)*

Intranet An IP (Internet Protocol) network based on Internet technology which is confined to selected users. Firewalls serve to partition intranets and networks from the wider Internet. Initially intranets were used for publishing internal documents in large organisations. Increasingly they are being used for transaction processing, and are displacing, and coexisting with, traditional client/server and mainframe (or legacy) systems. Intranets are based on Internet technologies, including the same protocols, client devices, server-side components etc.

(See Firewall, Security and Web.)

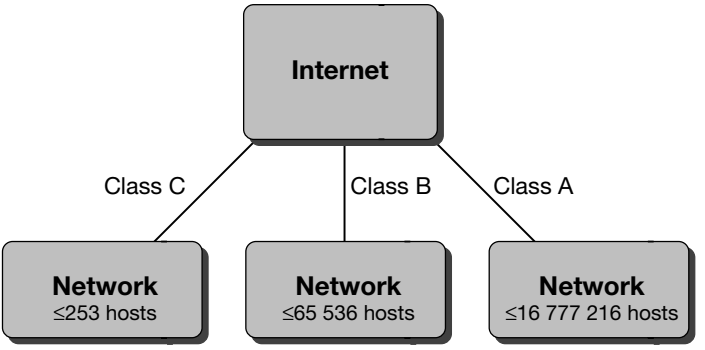
IP (Internet Protocol) 1. A collection of standard protocols used on the Internet and compliant networks. The standard IP protocols include:

TCP (Transmission Control Protocol).
ICMP (Internet Control Message Protocol).
UDP (User Datagram Protocol).

(See TCP/IP.) 2. A standard protocol initially developed to transmit TCP (Transmission Control Protocol) segments between different networks. *(See ARPANET.)*

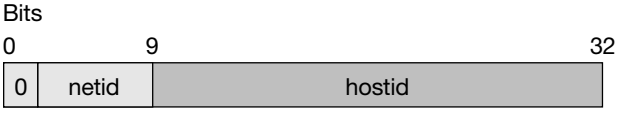
IP address A physical IP address consisting of 32 bits, which identifies a network and its connected computers. The syntax for such addresses consists of four bytes, each written in decimal form and separated by a full stop:

118.234.98.87



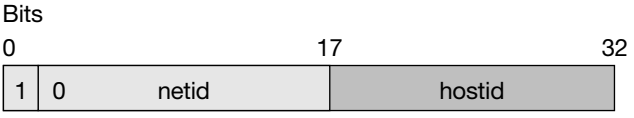
Class A, B and C addresses

IP address class A A networks may have between 2^{16} (65 536) and 2^{24} (16.7 million) hosts.



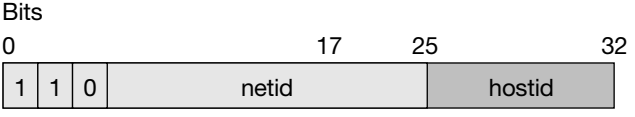
Class A address format

IP address class B B networks may have between 2^8 (256) and 2^{16} (65 536) hosts.



Class B address format

IP address class C C networks may have up to 253 hosts, and not 255 because two values are reserved.



Class C address format

The addresses consist of a network address (netID) and a host address (hostID). The leftmost digits represent the netID address. This is set to zero when addressing hosts within the network.

(See Subnet.)

IP multicast An IP addressing system, which is known as class D and was developed at Xerox PARC. A multicast packet addresses a multicast group of nodes or hosts. The first multicast tunnel was implemented at Stanford University in 1988.

(See Mbone.)

IPv6 (Internet Protocol) An advancement of the IP protocol which introduces 128 bit addressing and other improvements. The scaling of IPv4 32 bit addressing to 128 bit is intended to accommodate the future growth of the Internet in terms of the growing number of network addresses. IPv6 is also called IPng (IP Next Generation), and is specified by the Internet Engineering Task Force (IETF). IPv6 supports addressing of the types:

- multicast, which connects a host to multiple addressed hosts
- unicast, which connects a host to a single other addressed host
- anycast, which connects a host to the nearest of multiple hosts.

(See IP address.)

IRC (Internet Relay Chat) A means of communicating using text in real time across the Internet. The emergence of Internet Relay Chat or IRC in the late 1980s started a quiet revolution in the way people communicated

globally. Allowing users to chat in real time using text, it surfaced as an ideal tool for spreading news updates, particularly those about regions of war or unrest, of which the Persian Gulf is remembered as one of the first. Typical users see IRC as a way of talking to people irrespective of their geographical location, or of joining debates with IRC users that might be in different parts of the world. The debates take place in one of a number of channels, which you can change on the fly using an IRC client program. IRC clients include mIRC, TeleCafe, Mirc, PIRCH, Visual IRC96, Secure Communicator, WinTalk and NetPopup. Most popular IRC client programs are shareware or freeware, and can be downloaded from various FTP and Web sites. Modern IRC clients like mIRC offer the user easy methods of navigating through channels, connecting with selected IRC servers and talking with people in general. The many networks of IRC servers include EFnet (Eris Free net), UnderNet, DalNet, ChatNet, NewNet and IRCNet. Once connected to one of the IRC networks, you can communicate with its users through the many channels it provides. EFnet, IRCNet, UnderNet and DalNet have a global presence, and you will find their servers in many major cities. When using most IRC clients the user is required to provide a nickname, the IRC server to which to connect, an IP address, a local host name and an e-mail address if the user wishes to be contacted. An alternative nickname may also be provided, and it is used should the first nickname choice be in use on the connected network. Commercial IRC servers are rarely password protected. Many users advise reading the message of the day (MOTD), which might provide useful updates about the server. Having joined a channel, you might like to read the text messages for a while just to get the feel of things. If someone asks a question and you want to answer it, simply enter a reply and do not forget to include the person's nickname. Alternatively, you can ask a question yourself, or simply say 'hello all' or something similar, in which case you might begin talking with an IRC user that is known to you. If this leads to a one-to-one conversation, using mIRC you can double-click the person's nickname to produce a private window in which only your text appears. It is possible to set up multiple conversations like this, which is quite a good idea when you consider the lags in getting responses from users and the times when users simply stop talking to you. In regard to IRC etiquette, if you decide to be offensive in any way, and you are caught by the operator or reported by other users, the operator may eject you instantly from the channel. The channel operators' nicknames have @ signs as prefixes. Serious offences will lead to you being banned from an IRC server. When connected to IRC networks, you can use IRC commands to perform various tasks, such as joining, leaving and even creating channels. You do not have to know IRC commands, because most modern IRC clients provide such functionality through a single click. If you want to get the most out of IRC, however, it helps to be familiar

with the more common IRC commands. Equally, if you are a budding programmer and you want to write an IRC client program of your own, you will certainly need to know IRC commands. IRC commands begin with a forward slash / and range from the simple, such as `/help`, which is used to get basic help information, to the `/list #channel` command, which shows the topic and the number of users, but does not show hidden and private channels. To join a listed channel you would type `/join #channel_name`, and to leave it you would type `/part #channel_name`. The `/join` command can also be used to create your own channel by specifying a new channel name. If you create your own channel, it is a good idea to use the `/topic` command to indicate what the channel is about; you might type `/topic #genealogy`, for instance. The topic will be shown when someone lists your channel, and will help you get the channel participants you want. The `/invite` command allows you to ask specified users to join you in conversation. For example, you would type `/invite edwinstreet #hottub` if you wanted to talk to `edwinstreet` in the `hottub channel`. You can also send private messages to other such IRC users by typing `/m nickname`. To speak privately with another user, simply type `/query nickname`, following which only the named user will see what you type. The e-mail addresses of channel participants can be obtained using the `/whois` and `/whowas` commands, provided the users' e-mail addresses have been included in their IRC client program. The command `/whois #instant` will list the e-mail addresses of users on `channel #instant`, while `/who` shows the e-mail addresses of all those connected to the IRC server. You can also gain the e-mail address of a specific user with the `/whois nickname` statement, or the e-mail addresses of all users using the `/whois*` command. The `/whowas` command is used in a similar way to `/whois`, but produces the e-mail addresses of users that have recently signed off IRC.

IrDA (Infrared Data Association) A wireless interface technology, which is able to drive compatible peripheral devices such as printers. It is supported by Windows 98, and is integrated in numerous notebook systems designs. Typically, it may offer data transfer rates of up to 115.2 Kbps.

ISA (Industry Standard Architecture) A standard 16 bit expansion bus developed and introduced by IBM in the early 1980s as an integral part of its PC AT (Advanced Technology) design. Its profile is diminishing as more and more systems feature 32 bit buses and local bus slots. 32 bit buses include EISA (Extended Industry Standard Architecture) and MCA (Micro-channel Architecture). Standard local bus slots include VLB (Vesa Local Bus) and PCI (Peripheral Component Interconnect). Local bus slots

can be assumed to allow expansion cards to run at considerably higher clock speeds than those of ISA cards.

ISAPI (Internet Server Application Program Interface) An API used to create filters, which may replace CGI scripts. ISAPI filters are DLLs. They may be driven by HTTP events, and might perform such functions as data encryption. ISAPI filters improve the efficiency of server-side resources, when compared to CGI scripts, because these require separate processes. ISAPI filters require adequate testing, because their failure can render the Web server inoperable. ISAPI technology can be used for database access using the Internet Database Connector (IDC).

(See CGI.)

ISDN (Integrated Services Digital Network) An access technology that uses existing telephone lines to deliver a wider bandwidth. Introduced by the CCITT, it is able to support reasonably sophisticated video-conferencing and high-speed access to the Internet and other networks. A BRI (Basic Rate Interface) ISDN line can have two 64 Kbps B-channels that can carry video, voice or data. ISDN uses PCM for encoding data in digital form for transmission. Used in the Integrated Services Digital Network (ISDN) standard, PCM involves creating a data stream consisting of 8 bit PCM blocks. The blocks are created every 125 microseconds. By interleaving the blocks with those from other encoders, the result is time division multiplexing (TDM). In North America ISDN typically interleaves data from 24 64 Kbps sources or channels. This results in connections that provide 1.536 Mbps, although in actual fact the connection has a bandwidth of 1.544 Mbps, because each channel's frame has a marker bit 'F', adding 8 Kbyte/s. European ISDN typically interleaves 30 64 Kbps channels, giving 2048 Mbps. This and the 1.544 Mbps connection are known as primary rate multiplexes. Further interleaving of primary rate multiplexes sees:

- 6, 45, 274 Mbps in North America
- 8, 34, 139, and 560 Mbps in Europe.

(See Access technology.)

ISO (International Organization for Standardization) An organisation actively engaged in establishing standards in optics, image processing and video. It sponsors both JPEG and MPEG.

(See MPEG.)*

ISO 9660 A standard for storing data on CD-ROM. So successful was High Sierra that it was built upon by the International Organization for

Standardization, officially calling it ISO 9660. The ISO 9660 standard acted as a catalyst for CD-ROM drive manufacture.

(See CD-ROM and DVD.)

ISO CD11172 An ISO (International Organization for Standardization) official specification for the MPEG-1 algorithm, which is observed in the Video CD format.

ISP (Internet Service Provider) A company that is able to provide users with access to the Internet. Compuserve, for instance, is an ISP. Typically an ISP may offer a number of access technology options, including:

- POTS (Plain Old Telephone System), with modem access speeds of 28.8 Kbps, 33.6 Kbps or 56.6 Kbps
- Cable, providing high-speed access via cable modems
- ISDN (Integrated Services Digital Network), providing speeds of 64 Kbps or 128 Kbps, or multiples of the same.

ISPs may offer a host of other services, including virtual second lines and even Internet Telephony.

(See Access technology, Cable modem, Internet telephony, ISDN and Modem.)

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J

JARS (Java Applet Rating Service) A Web site which scores Java applets on the Internet and publishes the results.

(See www.jars.com.)

Java A general purpose high-level language (HLL) which is

- not platform or operating system sensitive, yielding 'write-once-run-anywhere' code
- object-oriented
- class-based
- concurrent.

(See MPP.) The resulting compiled bytecode can be run on Windows 3.x, Windows NT, Windows 95/98, Macintosh environments, UNIX etc. OS independence is a key characteristic of Java (Ref. 1), making it suitable for deployment of applets, where client OSes are of a heterogeneous nature. Web-based Java applets:

- are interpreted by Java-enabled browsers
- may access code libraries on the client machine
- may download class libraries from the server.

Development tools for Java include:

- the Java Development Kit (JDK)
- Microsoft J++, which is included in Microsoft Visual Studio
- VisualAge for Java
- Java Servlet Development Kit.

The Java language semantics and high-level instructions are similar to C and C++. It is considered a static programming language (Ref. 2), but is likely to be given dynamic functionality through appropriate development environments and compilers. Compilation of Java source code yields in a bytecoded instruction set and binary format (Ref. 3). James Gosling adapted Java for use in embedded consumer electronics applications.

References
1. *The Java Language Specification*, Sun Microsystems, 1996
2. *Dylan Reference Manual*, Apple Computer, 1995
3. *Java Virtual Machine Specification*, Addison-Wesley, 1996

Java applet A program created using the Java programming language, and typically deployed over the Web. It resides on the server side, and is downloaded to a Java-enabled Web browser. It is then interpreted and run. The browser must feature the Java Virtual Machine, which is a software-based processor.

Java array A matrix of entities of the same type, which may be simple or composite. The matrix or array can be multi-dimensional, and is declared using square brackets (`[]`).

```
int meters[];
char[] table;
long transform[][];
```

The size of an array is not specified when declared.

JavaBeans A standard component architecture which is similar to ActiveX technology. The resulting objects can be used to build applets, servlets and applications. The components are referred to as Beans, and compliant development tools provide access to the Beans using a toolbox. Visual programming plays an important role when architecting a Beans-based program; the developer simply selects Beans and modifies their appearance, behaviour and interactions with other Beans. JavaBeans-compatible development tools include:

- JavaSoft JavaBeans Development Kit (BDK)
- Lotus Development BeanMachine
- IBM VisualAge for Java
- SunSoft Java Workshop
- Borland JBuilder
- Asymetrix SuperCede
- Sybase PowerJ
- Symantec Visual Cafe.

JavaBeans–ActiveX Bridge A Microsoft OCX control that permits the integration of JavaBeans as if they were ActiveX controls.

(See www.splash.javasoft.com/beans/bridge/)

JavaBeans Development Kit (BDK) A JavaSoft BDK aimed at Bean and tool developers, and not applications developers.

Java Blend A database application development tool which is an environment for combining Java objects with enterprise databases. Applications can be developed by coding in Java, and the resulting objects can be mapped to databases and vice versa. It does not require knowledge of SQL. Java Blend was codeveloped by The Baan Company and Sun Microsystems.

Java blocks A segment of source code enclosed by braces: `{`and`}`.
(See Java data type.)

Java Boolean data type A data type used to store the two values *true* or *false*; it is declared by a statement of the form:

```
boolean switch;
```

Java Boolean literals A Java type that has one of two states: *true* or *false*.

Java Card A smart card implementation that uses Java technology. The Java Card specifications can also be applied to devices, which have:

- 16 Kbyte ROM
- 8 Kbyte EEPROM
- 256 bytes RAM.

Java casting types A process of converting one data type into another. Casting is often necessary when a function returns a type different from the type you need to perform an operation. The `int` returned by the standard input stream (`System.in`) is *cast* into a `char` type using the statement:

```
char k = (char)System.in.read();
```

Java character data type A data type that stores a single Unicode character. Variables of the type char are created using statements of the form:

```
char sigma, omega;
```

Java character literals A character represented by a single Unicode character. Its syntax relies on a pair of single quotation marks.

Java comments and whitespace A textual comment and whitespace consists of spaces, tabs and linefeeds.

```
/* multiple line comment */
// a single line comment
/** a multiple-line comment, which can be used with
the javadoc tool to create documentation**/
```

Java data type A means of defining a storage method for information, such as the storage of variables in memory. The following statement declares a variable, a variable type and identifier:

```
Type Identifier [, Identifier];
```

The statement:

- allocates memory to a variable type `Type`
- names the `Type` '`Identifier`'
- uses the bracketed identifier to indicate that multiple declarations of the same type may be made.

Java data types may be:

- simple, which include integer, floating-point, Boolean and character
- composite, which are based on simple types, and include strings, arrays, classes and interfaces.

Java development tool A tool/environment that allows programmers to create Java applets, Java programs, JavaBeans and possibly Java Servlets.

Java Electronic Commerce Framework A point-of-sale (POS) application framework.

Java floating-point literals A means of storing and processing fractional numbers, which are expressed in decimal notation (i.e. 200.76) or in scientific notation (2.00.76e2). Floating-point literals default to the `double` type, which is a 64 bit value. The '`f`' or '`F`' suffix harnesses the 32 bit value.

JavaHelp A software product which allows the creation of on-line Help for Java applets, applications, OSes and devices. It can also be used to deploy on-line Help over the Web and intranets. JavaHelp is:

- written using the Java language
- implemented using JFC components
- platform-independent
- browser-independent
- supported by browsers that comply with the Java Runtime Environment.

Java identifier A Java token that stores names that are applied to variables methods and classes.

Java integer data types A means of representing signed integer numbers; they include:

- `byte` (8 bit)
- `short` (16 bit)

- `int` (32 bit)
- `long` (64 bit).

Integer variables are declared thus:

```
int x;
short scale;
long lumin, light;
byte alpha, beta, gamma;
```

Java integer literals A literal may be:

- decimal (base 10)
- hexadecimal (base 16), with the '0X' prefix
- octal, with the 'O' prefix.

By default, integer literals are stored in the `int` type, which has a 32 bit value. They may be stored in the `double` type, which has a 64 bit value, using the '`l`' or '`L`' suffix.

(See Java literal.)

Java keywords A meaningful vocabulary of entities which perform specific functions and include:

```
abstract   double       int          super
boolean    else         interface    switch
break      extend       long         synchronized
byte       false        native       this
byvalue    final        new          threadsafe
case       finally      null         throw
catch      float        package      transient
char       for          private      true
class      goto         protected    try
const      if           public       void
continue   implements   return       while
default    import       short
```

Java lexical translation A process by which Java source code is converted into Java tokens. It is implemented by the lexical analyser facet of the compiler, which:

- translates Unicode escapes into Unicode characters, allowing the Java listing to be represented using ASCII characters
- generates a stream of input characters and line terminators
- generates Java input elements, or Java tokens, which are terminal symbols.

See: *The Java Language Specification*, Sun Microsystems, 1996.

Java literal An element that maintains a constant value; it may be:

- numeric
- integer
- floating point
- Boolean
- character
- string.

Character literals refer to a single Unicode character. Multiple-character strings that are implemented as objects are also literals.

JavaMail An API used to build Java-based mail and messaging applications.

Java Management API (JMAPI) A library of objects and methods used for the development of network and service management solutions targeted at heterogeneous networks.

Java Media and Communication APIs, including 2-D, 3-D, and Java Telephony A Sun Microsystems product family that allows developers to develop interactive multimedia applications for the Web.

Java Naming and Directory Interface (JNDI) A connectivity API which provides an interface with enterprise, heterogeneous naming and directory services. It is a JavaSoft API and a Java Standard Extension.

JavaOS A compact operating system dedicated to running Java programs/applets. The JavaOS family includes:

- JavaOS for Network Computers (NCs), which is described as a stand-alone Java Application Platform for NCs
- JavaOS for Appliances, which is intended for communications devices
- JavaOS for Consumers, which is aimed at consumer electronics devices.

JavaPC A software solution for migrating PCs to Java platforms. JDK 1.1 compliant Java applications can be stored locally or on a network, and can be run on DOS and Windows 3.x platforms.

JavaScript An object-orientated scripting language optimised for the Web. Using JavaScript, Web pages/HTML documents can be given:

- dynamic content such as animations
- integrated Java applets and ActiveX controls
- interactive content
- data entry forms.

Microsoft's implementation of JavaScript is JScript. The rationale behind JScript is echoed by VBScript: it is intended as a quick method of creating and tailoring applications. Unlike JScript, VBScript is not an OOP language. Like other objects, JavaScript objects have properties and methods, and include the:

- *window*, which is at the top of the HTML document's object hierarchy
- *frame*, which is a window
- *location*, which stores URL information
- *document*, which stores document characteristics such as its URL and title
- *form*, which stores form characteristics
- *text* and *textarea*, which store text information
- *checkbox*, which is a standard Windows UI object
- *radio*, which refers to a single UI radio button
- *select*, which is an array of option objects
- *button*, which stores button information
- *password*, which is a text-entry box that disguises keyboard entries using asterisks
- *navigator*, which stores a visitor's Netscape Navigator version number.
- *string*, which provides methods for string manipulation
- *date*, which is dedicated to calendar date information
- *math*, which facilitates common constants and calculations
- *image*, which indicates image information on the current page
- *array*, which is dedicated to arrays.

JavaScript listings are integrated in HTML code by enclosing them between the following tags:

```
<SCRIPT LANGUAGE="JavaScript">
</SCRIPT>
```

Development environments and applications that support JavaScript are numerous, and include the Microsoft ActiveX Control Pad, which also supports VBScript. *(See VBScript.)*

Comments Single and multiple line comments may be included using the syntax:

```
//  A single line comment
/*  Multiple lines comment
require this syntax */
```

JavaScript operators

`++`	increment
`--`	decrement
`*`	multiplication
`/`	divide
`%`	modulus
`+`	addition

- `-` subtraction
- `<<` shift left
- `>>` shift right
- `>` greater than
- `<=` less than or equal to
- `>=` greater than or equal to
- `==` equal to
- `!=` not equal to
- `&&` logical AND
- `!` logical NOT
- `||` logical OR
- `^` bitwise
- `|` bitwise OR
- `&` bitwise AND

`for` The `for` statement has three optional expressions:

```
for( initial.Expression; condition; update.Expression) {
statement
statement
statement
}
```

- `initial.Expression` initializes the `counter` variable, which can be a new variable declared with `var`
- the `condition` expression is evaluated on each pass through the loop. If the condition is true, the loop statements are executed
- `update.Expression` is used to increment the `counter` variable.

`while` A statement used to implement a conditional loop, based on a true or false validation:

```
while (condition) {
statement
statement
statement
}
```

`break` A `break` statement stops `for` or `while` loops, and diverts program execution to the line following the loop statements.

`for ... in` A for...in statement executes the statement block for each object property:

```
for (variable in object) {
statement
statement
}
```

`function` A statement which allows you to create a named JavaScript function together with parameters. The `return` statement can be used to return a value. Nested functions are not supported.

```
function name ([parameter] [...,parameter]) {
statements...
}
```

if ... else A conditional statement that offers one of two conclusions.

```
if (condition) {
statement
statement
} [else {
statement
statement
}]
```

return This is used to specify a returned value from a function.

var The `var` statement is used to declare a variable, which can be local or global.

```
var variableName [=value] [..., variableName [=value]]
```

while Repeats a loop while an expression is true.

```
while (condition) {
statements...
}
```

with Declares a default object as the focus of a set of statements.

```
with (object) {
statement
statement
}
```

(See CGI.)

Java separator A means of categorising Java source code; it directs the compiler appropriately, and includes:

```
{ } ; , :
```

Java string literals A string, or series of characters, within a pair of double quotation marks. String literals invoke an instance of the `String` class, which is assigned the character string.

Java Studio 1.0 A development environment that does not require Java coding on a line-by-line basis. It harnesses the JavaBeans object architecture, and is typically used to build Web applications. It is a product of Sun Microsystems.

Java tokens A meaningful element of a Java program when compiled. The five categories of token include:

- identifiers
- keywords
- literals
- operators
- separators.

Tokens are compiled into Java bytecode, which can be interpreted by a Java Virtual Machine.

Java Unicode The predominant character set with which Java source code is represented; it is:

- 16 bit, which gives up to 2^{16} or 65 536 possible characters
- used exclusively by Windows NT at the system level
- a worldwide standard.

In Java, three lexical translations convert a raw Unicode character stream into a sequence of Java tokens. See: *The Java Language Specification*, Sun Microsystems, 1996.

Java Virtual Machine A software solution that yields an environment for running Java applets. Browsers such as Netscape Navigator and Microsoft Internet Explorer feature Java Virtual Machines. It can be assumed that the 16 bit Java Virtual Machines of Netscape Navigator and Microsoft Internet Explorer are JDK 1.02 compliant.

(See JavaPC.)

JavaWorld An on-line magazine dedicated to Java.

(See www.javaworld.com.)

Jaz drive A removable storage device manufactured by Iomega. Jaz disks offer 1 Gbyte or 2 Gbyte data storage capacity.

JDK (Java Development Kit) Sun Microsystems development tool for creating Java applets and applications. It is freely available from JavaSoft (www.javasoft.com), and includes:

- API
- Applet Viewer
- compiler
- runtime interpreter
- debugger
- class file dissembler

- header and stub file generator
- documentation generator.

More specifically, the JDK includes the tools:

- `appletviewer` for viewing Java source code listings
- `jar` for compressing an packaging applications
- `java` for executing applications
- `javadoc` for documenting Java programs
- `javac` for compiling Java programs.

(See www.javasoft.com.)

JIT (just-in-time) compiler for Java A compiler which converts OS-independent Java bytecode and optimises it for execution on the target OS. The conversion naturally takes place on the client side.

JIT debugging A method of detecting bugs in a running program and responding by running an appropriate debugging process.

Jobs, Steve A co-founder of Apple Computer.

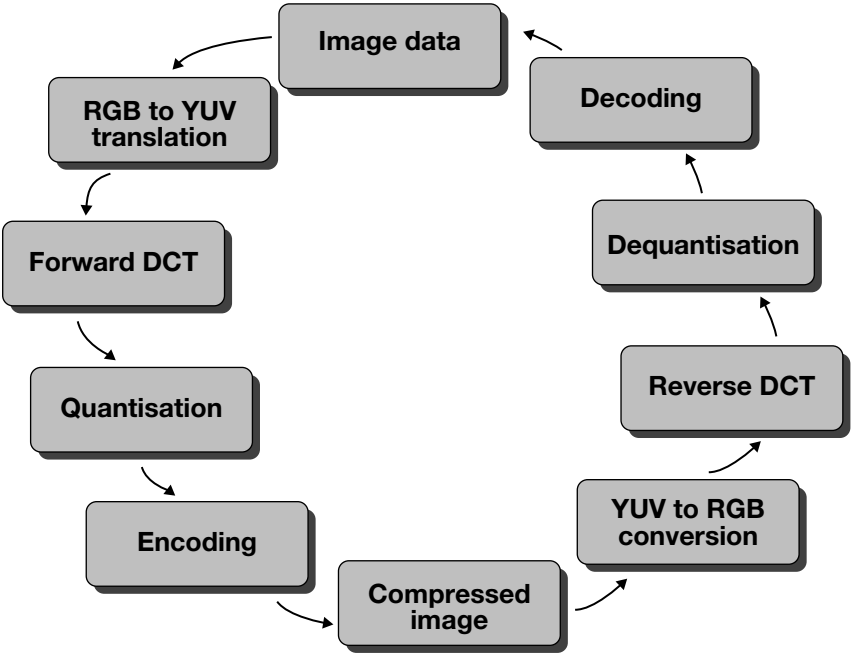
Join A process of combining records from different tables/files in a relational database management system (RDBMS).

JPEG (Joint Photographic Experts Group) An internationally agreed standard for still image compression and decompression that was devised by the JPEG, a specialist group set up by the ISO and CCITT. It is a symmetrical algorithm in that the processes required for compression mirror those of decompression. The processes include forward and reverse DCTs (Direct Cosine Transformations). It can be used to compress 8 bit, 16 bit and 24 bit graphics. Motion-JPEG (M-JPEG) video uses individual frames compressed according to the JPEG algorithm, giving full frame updates as opposed to the predominantly partial frame updates of standard MPEG video. The JPEG standard compression scheme for still photographic quality images began development in 1986. Compression and encoding techniques were evaluated during 1987 and 1988, until eventually the components of the symmetrical compression cycle were agreed, with DCT (Direct Cosine Transform) proving a central theme of the JPEG design.

(See DCT.)

.JPG An extension for JPEG files.

(See DCT and JPEG.)



JPEG algorithm – compression/decompression cycle

JScript *(See JavaScript.)*

Jump 1. A moment in a running program when execution is diverted from one point to another. The jump may be conditional, where it will occur because of a given event or variable value. An unconditional jump does not require such preconditions. 2. A graphic, or graphic fragment, which has a hotspot or hyperlink which is used to browse related information.

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K

Katakana A character set used in a Japanese phonetic alphabet.

KB *(See Kilobyte.)*

K band The range of frequencies 10–12 GHz.

Kbps (kilobits per second) A unit of data transfer, which equates to 1000 bits per second.

KBps (kilobytes per second) A unit of data transfer, which equates to 1000 bytes per second.

KBS (Knowledge-Based System) An alternative name for an expert system, which includes a knowledge base of rules or heuristics, each comprising fact(s) and conclusion(s), i.e. IF disk drive light off THEN check ribbon cable. Such conclusions and deductions may be weighted appropriately. The rule base is chained by an inference engine, which chains:

- backwards, comparing an inputted question with conclusions in the rule base, and may compare subsequently located facts with conclusions of other rules
- forwards, comparing an inputted question with facts in the rule base, and may compare subsequently located conclusions with facts of other rules.

A KBS can offer informed decision-making skills, the effectiveness of which is a function of the accuracy and comprehensiveness of its rule or knowledge base. A knowledge engineer is responsible for generating a rule base; it has proven to be a complex and arduous process. Numerous KBS applications exist, including medicine, business, stock market and maintenance. Web-based KBS solutions exist.

See: Cawsey, Alison. *The Essence of Artificial Intelligence*, Prentice Hall, 1998. (*See Neural network*)

Kbyte *(See Kilobyte.)*

Kermit A file transfer protocol, which is asynchronous.

Kernel A core component of an operating environment. The Windows kernel is responsible for a number of tasks, including memory management and dynamic linking.

`KERNEL32.DLL` A DLL included in Windows 3.1 and Windows 95.
(See DLL.)

Kernel driver A driver which interacts with an internal or external device.

Key A means of making encrypted data unique and a means of decrypting data.
(See Cryptography.)

Keyboard A physical device used for data entry and interaction with a computer. The most common variant is the standard QWERTY keyboard.

Keyboard buffer A segment of internal memory (or FIFO queue) used to store the character codes which emanate from a keyboard or comparable input device.

Key field A key field is included in a database in order to prevent the duplication of contained field values and to expedite information retrieval. Key fields are also used to link tables or files in relational databases. Where it is necessary to repeat values in a key field, additional fields are keyed. These are termed multi-field keys.

kHz (kilohertz) A unit of frequency which equates to 1000 cycles per second.

Kilobyte (or Kbyte or KB) A unit of memory which has 1024 bytes. Occasionally disk drive manufacturers equate Kbyte to 1000 bytes in accordance with the metric interpretation of kilo. It is derived from a 10 bit address bus, or 10 bit pointer register, thus giving access to 2^{10} (1024) memory locations.

Kilostream A digital service provided by BT, which requires the customer to have a Network Terminating Unit (NTU). It provides data rates of 2.4 Kbps, 4.8 Kbps, 9.6 Kbps, 48 Kbps and 64 Kbps.

Kiosk application A multimedia application intended to interface with the general public. The multimedia system may or may not be housed in a physical kiosk. Such applications might provide maps, tourist information, point-of-information, point-of-sale etc.

Kiosk mode A mode of operation which causes Netscape Navigator to start without the toolbar and menu bar.

Knowledge base 1. An information database which is accessible via a Web site. 2. A set of rules that determines the functionality of an expert system. The rules may be simple IF...THEN rules.

(See KBS.)

Knowledge engineer A person responsible for programming an expert system.

(See KBS.)

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L

LAN (Local Area Network) A number of computers connected together so that users may share directories, applications, services and resources such as printers and modems. LANs are commonly used to connect all computers in a department, while Wide Area Networks (WANs) may be used to connect multiple sites. LAN data transfer rates have approximate speeds between 10 and 1000 Mbps. There are a number of internationally agreed standards by which computers forming a LAN are connected. Network topologies include the:

- star, where computers are connected using a centralised hub
- ring, where computers are connected in a chain; this is the chosen method for small networks that are perhaps peer-to-peer configurations, which might be based on Windows 98/NT.

LAN standards include Ethernet, Token Ring and occasionally Fibre Channel (FC). The latter may be used to implement FC arbitrated loops.

(See 10base, Active Web Architecture, Client/server, Ethernet, Inactive Web Architecture, Master/slave processing and Server.)*

LAN segment A section of a LAN which is detached from the remaining network.

Lanier, Jaron A VR specialist/evangelist recognised as having invented the term virtual reality. He founded VPL, one of the earliest VR companies.

(See VR.)

Laptop computer A portable computer compact enough to be operated from a person's lap. Modern (about A4 size) versions are more often called notebook computers, or simply notebooks. Smaller than notebooks are the sub-notebooks, and smaller than these are palmtops manufactured by companies like Psion.

(See Display and Notebook.)

Large-Scale Integration (LSI) (*See LSI.*)

Laser (Light Amplification by Stimulated Emission of Radiation) A light source able to emit a coherent beam of light which is of a fixed wavelength. The device is said to 'lase' when producing such a ray of light.

(See LED and Optical fibre.)

Laser printer A printer which operates using toner deposits. Most are monochrome, though there are a few colour variants (1998). Generally, they are low-cost and provide high-speed operation, and are therefore an ideal network printer solution.

Laser Vision A standard videodisc player and disc format developed by Philips. Manufactured by Philips and other manufacturers (e.g. Pioneer), and now commonly used in IV applications as well as multimedia, it is largely a consumer product.

(See CD-ROM and DVD.)

Launch 1. The process of starting a program or application. Synonyms: Load, Open and Run. 2. A range of angles at which a ray of light must be injected into an optical fibre so that it may propagate along the cable's entire length. The angles are within the fibre's *acceptance cone*, whose size is a function of the fibre's NA or *numerical aperture*. The higher the NA, the greater the light-gathering ability of the fibre.

(See Optical fibre.)

Layer An array of functions which are defined as part of a network or communications protocol and specification. They partition functions into logical parts.

L band A section of the electromagnetic spectrum which ranges from 1.53 to 1.66 GHz and is used in satellite and microwave communications.

LCD (Liquid Crystal Display) A form of display measuring a few millimetres in depth. Available in monochrome and colour, LCDs are used in a wide variety of appliances, including pocket televisions, notebook computers, PDAs, cellular phones, calculators and portable CD-ROM readers/electronic books. Modern notebooks tend to use TFT and DSTN display technology. The former provides improved image definition.

(See LED and Notebook.)

LED (Light-Emitting Diode) A semiconductor/optoelectronic device which emits visible light when excited electrically. It may provide a basis for:

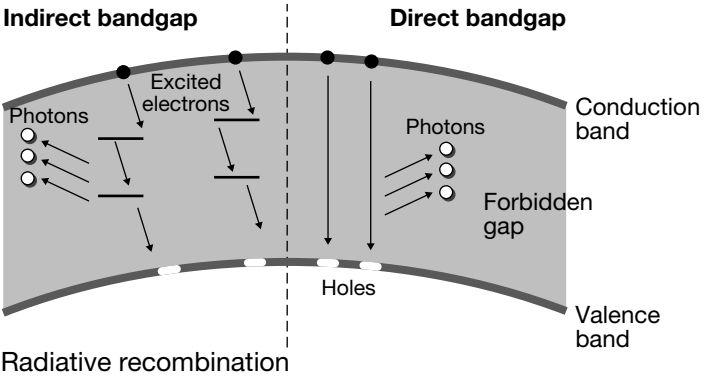
- display technology, such as that used in notebooks and consumer electronics devices such as pocket televisions
- laser light sources for fibre optic lightwave communications
- read heads for CD-ROM and DVD drives.

They are used in all types of consumer electronics and computers as power indicators and alphanumeric displays. Advantages over conventional filament bulbs include: near-infinite life span, incredible durability, reliability, physical robustness, ease of manufacture in different colours, low power consumption and cheapness. Liquid Crystal Displays (LCDs) have displaced alphanumeric (LED) and graphical displays. LEDs emit optical radiation, and the 800 nm (wavelength) emission is seen as red. Dividing the speed of light c (3×10^8 metres/second) by the wavelength (λ) of an (800 nm) LED's emission results in its frequency f:

$f = c/\lambda$
$f = (3 \times 10^8)/(8.00 \times 10^{-7})$
$f = 3.75 \times 10^{14}$ Hz

The emission from an LED is commonly defined in terms of the external stimulation of electrons. Electrons exist in bands that surround a nucleus. The outer or valence band may share its electrons with other atoms that collectively form molecules. The valence band's electrons are stimulated to a higher energy state called the conduction band. This condition occurs when electrons are:

- passed through a pn junction diode
- stimulated by a high voltage
- stimulated by light.



The difference that exists between the valence and the conduction bands is described as the forbidden gap. The type of semiconductor determines the behaviour of the bandgap, which may be:

- *indirect,* such as silicon, where electrons may occupy intermediate levels as they pass from the conduction band to the valence band
- *direct,* where electrons move directly through the forbidden gap, and provide the best results.

Photon emission takes place as electrons are displaced from the conduction band and united with holes in the valence band. The resulting emission of light from an LED might be referred to as pn junction electroluminescence or recombination radiation. The latter refers to the combination of electrons with holes. The resulting wavelength λ (in micrometres) is calculated thus:

$$\lambda = hc/E$$

where h is Planck's constant (6.63×10^{-34} joule seconds), c is the speed of light (3×10^{14} micrometres per second) and E is the energy difference between the valence and conduction bands, which may be expressed in electronvolts.

(See LCD and Display.)

Legacy A system, application or operating system (OS) that is of a past generation, usually based on mainframe technology. It may nonetheless be integrated into a modern IT implementation and coexist with modern client/server architectures.

(See Client/server.)

Lempel-Ziv A data compression algorithm.

(See Compression.)

Level 1. A defined RAID architecture. *(See RAID.)* 2. High and low levels describe macro and micro features, respectively. In terms of programming languages, low-level languages relate most closely to machine code, such as assembly languages for instance. High-level languages are those that are a considerable distance from the machine language (in terms of compilation processes), and they include C++ and Visual Basic. 3. A US-defined series of security grades. *(See Security.)*

Lexical analyser A compiler function which parses character sequences in the source code and converts them into tokens. In the case of Java it generates Java tokens from Unicode.

(See Java and Java Unicode.)*

LIFO (last in, first out) A type of queue. The order in which items are regurgitated opposes that in which they are deposited; the last item placed in the LIFO queue is the first to be retrieved. It may be used to store the return addresses when a subroutine is called. In this guise it is called a stack.

(See FIFO and Queue.)

LIM memory (Lotus, Intel, Microsoft) An alternative name for EMS (Expanded Memory Specification).

(See EMS.)

Line speed A data transmission rate over media which may be physical or wireless. The unit measurement is typically in Kbps or Mbps.

Linear medium A medium that does not permit user interaction in order to control its sequence. Conventional broadcast television is a linear medium. A non-linear medium such as the Web provides the user with the ability to control its sequence.

(See Multimedia and Web.)*

Lingo An OOP-based multimedia authoring language, which was developed by MacroMedia and is a most intuitive language even to non-programmers. It may be used in conjunction with Macromedia Director and Macromedia Authorware Professional. Lingo's functionality, syntax and structure are comparable to those of OpenScript, which is a proprietary language included with certain versions of Asymetrix ToolBook. It has become the industry's chosen language for authoring multimedia titles. Using Lingo, Director movies may be interwoven with interactivity by coding handlers that respond to events. Messages that result from such events can be defined in the program code.

Lingo events Director is driven by four key event categories, which are associated with:

- Frame
- Keyboard
- Mouse
- Movie.

Lingo program form

```
on eventOfSomeSort
go to frame 15
end
```

This simple script operates thus: if the specified event occurs, the play head is moved to frame 15.

Lingo messages Events invoke the messages:

```
mouseDown
mouseUp
-- are sent when the mouse button is either pressed or
released
keyDown
keyUp
-- are sent when is either pressed or released
enterFrame
exitFrame
-- are sent when the playback head passes over frames
startMovie
stopMovie
-- are sent when the movie either starts or stops
idle
-- is sent during dormant states
timeOut
-- is sent after a specified period following a previous
action
```

Additional messages can be defined.

Lingo `if...then` form

```
on keyDown
  if the key = ESCAPE then
    alert "Cue previous video clip"
    beep
  else
    alert "Escape?"
  end if
```

See the following works:

Roberts, Jason, *Director Demystified.* Berkeley, CA, Peachpit Press, 1995.

Thompson, John and Gottlieb, Sam, *MacroMedia Director Lingo Workshop*, Indianapolis, IN, Hayden, 1995.

Callery, Michael, *Learning Lingo, Programming with Macromedia Director*, Addison-Wesley, 1996.

(See Multimedia authoring tool, Object, OpenScript, www.asymetrix.com and www.macromedia.com.)*

Link 1. A process by which object (.OBJ) files are linked with libraries, which include functions, procedures and classes. *(See Compiler and DLL.)* 2. A means of connecting related information in a hypertext model for information storage and retrieval. Hence user interaction may be given context. Links provide the user with a means of touring non-linear paths

through information. Such links of association are taken to limits which are imposed by the design's levels of granularity. Nodes, representing text or images, are linked to provide a potentially infinite number of meaningful paths. For example, a single node representing a linear structure, such as an article, might be linked to numerous other articles and images. Links can naturally exist at a number of levels, either to link complete documents (macro features) or to reference words or phrases (microfeatures) within documents. 3. A means by which tables/files may be connected in a relational database management system (RDBMS). In the case of a multi-table form within a relational database, such links can refer to how master tables and detail tables are associated as follows:

- One-to-one: each master record is linked to only one detail record at any given time.
- One-to-many: each master record is linked to a group of detail records.
- Many-to-one: a number of master records may be linked to a single detail record.
- Many-to-many: each master record is one of a group, which can be matched to one of a group of detail records.

Such RDBMSes make possible multiple table changes and updates using a single form as a data entry interface. *(See Database, Data warehouse and Relational database.)* 4. A communications path between devices, which may be processors, as is the case in MPP designs. *(See MPP.)*

List box A windows component that provides a means of selecting files or options. Where the number of files or options exceeds a certain figure, a vertical scroll bar is provided in order to assist in the process of selection.

Literal constant A variable may be assigned a value, which is considered a literal constant. In C++, this is implemented using codes such as:

```
int yearsAfter=25;
```

A literal constant may also be used when performing arithmetic operations on variables. In the following statement, where the time variable is assigned to the product of the variable present and 10, 10 is considered a literal constant:

```
time=present*10
```

(See C++.)

Literary Machines A book written by Theodore Nelson, which put forward his hypertext concept, its methodologies, its data storage models and its applications. Theodore Nelson is also remembered for his Xanadu project, which to some is the conceptual birth of the Web. To others the

conceptual birth of the Web and of the Internet is accredited to Vannevar Bush through what he described as Memex. Both Xanadu and Memex were perceived as unified information storage architectures, which could be accessed through specific technologies.

(See Bush, Vannevar and Xanadu.)

Load balancing 1. A method of distributing the workload across processes and system resources in an effort to optimise performance. It is usually applied dynamically in OO distributed systems. *(See Distributed computing.)* 2. A method of distributing the workload in an MPP architecture, so that processors are as close to the heightened states of operation as is possible. It is carried out dynamically, and may be referred to as *dynamic load balancing*. *(See MPP, Parallel programming and Transputer.)*

Local bus A method of connecting video cards, hard disk controllers and other devices more directly to the processor's data bus, thus overcoming the data transfer bottleneck of ISA. Local bus standards have emerged, including VL-bus and Intel's PCI (Peripheral Component Interconnect). PCI generally performs better than VL-bus.

Local glue *(See ActiveX*, Glue, JavaBeans, OLE and OpenDoc.)*

LocalTalk Cabling system for Macintosh computer, supported by integral AppleTalk™. It uses the RS-422 signalling standard and twisted pair media, and provides for up to 32 connections.

Local variable A variable that is confined to a single procedure or routine in a program.

Logical client/server model A model that sees the interaction of components and programs where messages are typically used to request services and data. Software components may act as:

- servers, providing client components with data
- clients, which request data from servers
- server and clients.

Typically it is a distributed OO software architecture platformed on a physical client/sever system.

(See Client/server.)

Logical operators A term describing the notation for performing logical operations using a programming language, search engine or querying

language/tool. Using C++, for instance, logical AND, OR and NOT are implemented using the syntax '&&', '||' and '!'.

(See C++ and Search engine.)

Login and Log off The processes of connecting to and disconnecting from a computer, network, remote server, Internet service provider or Internet service. A login name is required, as might be a password.

(See Firewall and Security.)

Lomem The lowest user memory address in a system.

Look-and-feel A term which broadly describes the user interface or presentation element of an application.

(See Application software.)

Loop 1. A repetition of code in a program. The loop is normally conditional, and rarely unconditional. 2. A series of video frames which is repeated.

(See Micon.)

Loose coupling (*See Coupling*.)

Loss 1. A level of attenuation that a signal is subjected to while passing through media which may be physical or wireless. Optical fibre signal losses are caused by impurities in the silica core and by fibre couplings. 2. A measure of the number of lost telephone calls or connections due to congestion.

Lossless compression A compression technique which does not rely on the omission of pixel information from a video or image file. Authentic lossless compression should result in video or image quality that is equal to that provided by the uncompressed files. However, the attainable compression ratios are lower than those of lossy compression algorithms.

(See DCT, JPEG and MPEG.)

Lossy compression A compression technique which omits pixel information from the original uncompressed video or image file. In theory it should lead to unnoticeable loss of image quality. MPEG is a lossy compression technique.

(See DCT, JPEG and MPEG.)

Lotus Notes A Groupware implementation remembered as the first commercially successful variant. An evolving solution, it provides network

services such as e-mail and document publishing, and provides easy migration of resulting Notes applications to the Web.

(See Groupware.)

Low-level language A programming language that provides access to the low-level elements of a computer such as memory locations and processor registers. Assembly language is considered to be a low-level language. Assembly languages are indigenous to the processor type. The language consists of mnemonics, which replace, and translate into, hexadecimal processor instructions

(See Assembly language.)

LSI (Large-Scale Integration) A semiconductor chip which integrates between 100 and 1000 devices.

(See VLSI.)

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M

MacGregor, Scott A member of the ISG (Interactive Systems Group) at Microsoft assigned with the task of developing the GUI that came to be known as Windows.

Macintosh *(See Apple Macintosh.)*

Macintosh Classic Reincarnation of the Apple Macintosh computer originally launched in 1984, supplied with HyperCard, integral mono monitor, based on a Motorola 68000 running at 8 MHz, supporting 1 to 4 Mbyte RAM, containing no expansion slots as standard, but with AppleTalk network capability and SCSI controller.

Macro A short program or series of instructions. Macros are useful for automating processes, or for performing tasks that would otherwise take a great deal of time to implement. Typically macros are written when the user interface is restrictive for a given task or for particular usage habits. They are also written when there is no predefined command or option that will perform a desired task. Sometimes certain predefined macros can be improved upon or edited so as to perform different tasks. Sophisticated word processors such as Microsoft Word, WordPerfect and Word Pro have indigenous macro languages. Standard macro languages include Visual Basic for applications.

(See VBScript and Visual Basic.)

Macro level Links which exist at the macro level relate comparatively large documents or 'chunks'. They are said to exist at a high level, forming part of the chunk-based model of hypertext and hypermedia.

Macromedia Director A tool used to create interactive movies; it is produced by Macromedia. The resulting productions may include Lingo

scripts, and may be deployed over the Web using Macromedia Shockwave technology.

(See Lingo, Shockwave and Streaming.)*

Macromedia SoundEdit A wave file recorder and editor.

Macromedia xRes A graphics program that provides a number of manipulation tools.

Magazine drive A CD-ROM or DVD drive capable of reading from a number of discs. It may provide an inexpensive alternative to daisychaining.

(See CD-ROM and DVD.)

Magnetic tape A cost-effective means of storing large amounts of data where random access is not required, for example for data backup, archive purposes, and submission of CD-ROM data to replication companies. Used to back up hard disks, tape streamers offer a safety net in the event of a catastrophic system failure. Subsequent data recovery simply involves reading the tape contents back to a functioning hard disk.

(See ZIP.)

Mail bomb An e-mail message which contains a virus or other entity likely to be hostile to receiving systems, which include servers and clients.

(See Security.)

Mailing list An electronic forum using e-mail to exchange information.

`main ()` A C++ program must have a **`main ()`** function, which begins and ends with open `{` and close `}` braces. This is the first function called when the program is run, and can be used to define variable types.

(See C++.)

Mainframe A powerful computer that typically offers centralised processing, serving a number of connected dumb terminals. In terms of its positive characteristics, a modern mainframe may:

- process data at speeds beyond those attainable on desktop systems and those based on conventional 32 bit and 64 bit processors, which might be CISC or RISC
- provide long-term archiving of data
- be a massively parallel processing (MPP) architecture, where processes are run concurrently, offering efficient scalable processing
- offer industrial strength operation through robust operating systems and applications

- provide easy diagnosis of faults, as they are isolated to the network or to the mainframe itself, though the mainframe with all its electronics and mass storage remains a complex fault diagnosis domain
- provide effective migration paths to client/server architectures
- prove a more durable IT solution in terms of longevity, because mainframe technology advances more slowly than microcomputer technology.

The key disadvantages of mainframe computers revolve around the following factors:

- high initial cost
- high cost of ownership brought about by comparatively high maintenance and servicing bills
- fault tolerance is at a low threshold, because a mainframe fault may render an entire IT solution inoperable. However, the fault tolerance of the connected mass storage (which may be shared) might be high
- the dumb terminals are typically green-screen, but there is scope for renovation *(See Application renovation.)*
- mainframe languages like COBOL tend to be old-fashioned, though this is a changing situation.

(See PC.)

MAPI (Messaging Application Program Interface) A standard that permits e-mail messages to be sent from any application. Originally developed by Microsoft, it is a DLL containing C functions that allows developers to exploit Windows messaging. Calls to the DLL may allow applications to be given e-mail functions.

Marquee A Microsoft ActiveX Control which scrolls a message across the bottom of Web pages. The messages might be promotions, adverts, announcements etc.

(See ActiveX.)*

Mass storage device A device used to store data. Can be assumed to be magnetic, optical or magneto-optical.

(See CD-ROM, DVD, Hard disk and RAID.)

Master disc A glass disc from which CDs are manufactured.

Mastering system A system used to produce a glass master disc or CD master which is used in the replication of CD-ROMs and CDs.

Master/slave processing An architecture where a master computer is connected to slave (intelligent) computers, which are connected to dumb

terminals. Processing is distributed from the master computer, which can be assumed to be a mainframe, to the slave systems.

(See Client/server.)

Maximise A process by which an application or document window is enlarged to a size that might extend to that of the full screen size. Windows application and document windows contain a Maximise button near the top right-hand corner; a Maximise option also exists on the Control menu, which is invoked by clicking the Control button/icon in the top left-hand corner of the window.

(See Minimise.)

Mbone (Multicast backbone) A virtual infrastructure to deliver multicast packets over the Internet. It is composed of tunnels and provides limited bandwidth, but enough for audio/visual data. A restriction mechanism integrated in MBONE routers or mrouters drops packets over tunnels where a predefined threshold rate is exceeded. Mrouters forward multicast packets to specified destinations. The Mbone topology maps are available at www.cs.berkeley.edu.

(See IP multicast and www.cs.berkeley.edu.)

MCA (Micro-channel Architecture) A standard 32 bit PC expansion bus developed and introduced by IBM in mid-1987 as part of its PS/2 (Personal System) range of computers. The launch of the PS/2 is also remembered as providing the PC with an analogue graphics port through VGA (Video Graphics Array) and MCGA (Multi-Colour Graphics Adapter). It also marked the introduction of OS/2 1.0 with its GUI (Graphical User Interface) in the form of Presentation Manager.

(See Local bus.)

MCI (Media Control Interface) An interface commonly referred to as the Windows multimedia extensions; it is integral to the Microsoft Windows multimedia extensions built into Windows 3.1 (and higher). There is a suite of drivers together with a command set able to control connected MCI-compliant multimedia devices.

MCIS (Microsoft Commercial Internet System) An evolving suite of servers used to architect Web solutions. The servers are Windows NT-compliant, and include:

- Address Book
- Chat
- Content Replicator

- Internet Locator
- MCIS Mail
- MCIS News
- Membership
- Merchant Server
- Personalisation.

(See Address Book, Chat, Content replicator, Internet Locator, MCIS Mail, MCIS News, Membership, Merchant Server and Personalisation.)

MCIS Mail A Windows NT-based server which can be used to implement mailboxes across multiple Web sites. DPA (Distributed Password Authentication) and SSL (Secure Sockets Layer) are supported. E-mail protocol support includes:

- POP3 (Post Office Protocol)
- SMTP (Simple Mail Transfer Protocol)
- MIME (Multipurpose Internet Mail Extensions).

(See DPA, MIME, POP3, SMTP and SSL.)

MCIS News A Windows NT-based server which is part of the MCIS and supports electronic conferencing and newsgroups. It supports the NNTP (Network News Transport Protocol) together with its extensions.

(See MCIS.)

MDI (Multiple Document Interface) A user interface in which each document occupies its own window.

Media Player A Windows program able to play a variety of different media files. With the appropriate driver selected and installed using the Control Panel it can be used to play various different media types including:

- CD-DA
- Midi files
- Wave (.WAV) files
- Video files.

When launched it shows controls common to typical audio/visual appliances, including Play, Pause, Stop and Eject. Finer control over playing various media files and tracks is provided by a horizontal scroll bar.

(See Video and Wave audio.)*

Media type A conduit for communicating information. Speech, text, audio, still images, computer animations and video are media types. The balance of multimedia elements (or media types) is determined by content,

volume of multimedia material, budget, the authoring station used and the delivery systems targeted.

Megabyte (Mbyte, MB) A megabyte (Mbyte) equates to 1024 Kbyte. Sometimes it is wrongly referred to as 1000 Kbyte, as is the case when some manufacturers specify hard disk data storage capacities. Derived from 20 address lines resulting in 2^{20} (1 048 576) memory addresses.

Meiko *(See MPP and Transputer.)*

Membership A Windows NT-based server which is part of the MCIS and allows visitors to become members of your site.

(See MCIS.)

Memex An information and storage system concept which was put forward in the 1940s by the visionary Vannevar Bush, Science Advisor to President Roosevelt and administrator of the wartime Manhattan Project. He believed that all published information should be made available through access points, and clearly set out the advantages of association through links. Calling the system Memex, and describing it as a sort of private file and library, he thought that some kind of workstation would be used with user-interaction accommodated through mechanical levers. If there were errors in his vision, they were a total underestimation of the sheer quantity of information that would be published in the future, and an overestimation of the technology of the day, i.e. microfilm, facsimile and telegraph. It was Bush's misfortune to live in the era of valves. The solid state transistor had yet to be invented, and it was some thirty years before the first reasonably sophisticated microprocessor was made commercially available. As such, Memex remained in the minds of a select few.

(See As We May Think, Bush, Vannevar, Hypertext, Multimedia, Web and Xanadu.)

Merchant Server A Windows NT-based server which is part of the MCIS and permits the construction of virtual shopping sites. *(See E-commerce and MCIS.)* The server consists of a:

- Controller, which is used to define language, currency, date and other preconfigurable parameters
- Router, which is an ISAPI (Internet Service Application Programming Interface) DLL. This routes requests from the client to relevant parts of the Store Server, and routes responses to those requests back to the client browser

- Store Server, which is the system's backbone, and functions to implement tasks such as order requests and to interact with the backend database.

The Merchant Server can be used to implement sites which allow customers to:

- peruse product databases
- purchase items using a shopping cart metaphor
- receive e-mail confirmation of orders placed.

The Merchant Server permits the vendor to:

- query customer details and purchase habits
- conduct promotions
- conduct marketing campaigns
- create membership accounts using IDs and passwords
- offer membership discounts
- integrate ActiveX, OLE and COM components into the server
- use ODBC-compliant databases
- secure credit card transactions using the SET (Secure Electronics Transfer) protocol together with Verifone's vPOS application.

(See Server.)

Message A request sent from one object or component to another, commonly used in OO systems. The message will be of a standard or proprietary format, with address information and appropriate data. The messages might require an acknowledge message before the originating component may continue processing. OO client/server architectures use messages and underlying protocols as their collective glues.

(See Glue.)

Message format A template for a message, which includes headers and user data payload.

Metadata A term used to describe data that indicates the information types and subjects. The data may be stored in an information storage and retrieval system. In the context of the Web, metadata such as indexes and URLs are gathered and stored by search engine implementations. This provides clients with the ability to search and retrieve documents from the Web.

(See Search engine.)

Metaphor An emulation or representation of a process or entity. A flat file database can be a card-box metaphor, for example. Equally, a GUI can be a desktop metaphor.

Method An item of code (or procedure) attached to an object. It defines the object's behaviour in terms of how it will respond to an expected event such as a mouse click, and to other stimuli. Other events might be the reception of messages from other objects, and the underlying methods might interpret them and initiate an appropriate response. The response might be an acknowledge message or a return value such as the contents of a variable.

(See Java, OOP, OpenScript and Visual Basic.)

MHz (megahertz) A measurement that equates to one million cycles or pulses per second. It is commonly used to describe the clock speed of computers, thus providing an indication of speed of operation. A 50 MHz machine will therefore yield 50 million clock cycles per second, and a single clock cycle will have a duration of 1/50 000 000 of a second.

Micon (Motion icon) An animated icon represented by a number of frames run in a continuous loop. Invented by Hans Peter Brondmo, these manifest more clearly the purpose, feature, application or program to which options lead. Micons manifest more clearly the information, features or applications to which screen options are tagged. It is reasonable to assume that they will consolidate with the current (commercial) user interface approach, coexisting for some time with the generally accepted buttons and icons.

Microbend A bend in an optical fibre link, which increases attenuation.

Micro-channel Architecture *(See MCA.)*

Microcomputer A computer in which the circuitry making up the CPU is accommodated on a single chip.

(See Mainframe, MPP, Pentium, Processor and SMP.)

MicroJava A processor from Sun Microsystems which is optimised for the Java programming language. It is used in network devices, telecommunications hardware and consumer games.

(See Java and Sun Microelectronics.)*

Microsoft A large software producer and vendor which was founded jointly by Bill Gates and Paul Allen. Microsoft is a leading computer software company targeting mainly the PC platform. Its best known products are Windows, Microsoft Office and the MS-DOS operating system. It also produces multimedia titles, and has recently extended its operations to the Internet through the Microsoft Network (MSN) and numerous related ventures.

Microsoft ActiveX SDK An SDK dedicated to the creation of ActiveX controls, compatible with Visual C++ 4.2 (or higher).

(See ActiveX.)*

Microsoft Beethoven: The Ninth Symphony A multimedia transcription of Beethoven's famous symphony which is recorded using Red Book Audio. It embodies a detailed interactive dissection of the work as well as a biography of the composer.

Microsoft CD-ROM extensions (*See CD-ROM extensions*.)

Microsoft Cinemania A multimedia title that provides a database of mainstream movies. It embodies theme tunes, movie excerpts, movie stills, photographs of popular actors, and biographies of actors and directors.

Microsoft Commercial Internet System *(See MCIS.)*

Microsoft Design-Time Control SDK An SDK that is used to create Design-Time ActiveX Controls, which, as their name suggests, are active only during design. The resulting controls may be used with FrontPage, InterDev, Visual C++, Visual Basic etc.

(See Microsoft FrontPage, SDK and Visual InterDev.)

Microsoft DirectX SDK A toolset that is used to develop multimedia elements, which includes:

- Direct3D for three-dimensional graphics
- DirectDraw for 2-D graphics
- DirectInput for connectivity to input devices such as joysticks
- DirectSound for exploiting sound card/software capabilities
- DirectPlay for connecting to remote applications.

Microsoft Encarta A multimedia encyclopaedia.

Microsoft Forms 2.0 ActiveX Control A suite of ActiveX Controls included in Visual Basic Control Edition.

(See Visual Basic Control Edition.)

Microsoft FrontPage A Web page development package marketed and sold by Microsoft, which:

- includes Explorer, which is used to display the navigation scheme integrated in Web pages
- includes Editor, which is used to design Web pages
- includes Web Server, which is used to publish and test Web pages before their deployment over the Internet or a compatible IP network

- can be used to integrate ActiveX controls and Java applets in Web pages
- does not require programming skills
- can be used to create Web pages that interact with ODBC-compliant databases
- includes the Server Extensions, which are building blocks for driving predefined functionality gains through your Web site implementation.

FrontPage is bundled with Windows NT Server, and is also available separately.

(See PWS, ToolBook, Visual InterDev and Web Server.)

Microsoft GIF Animator A Microsoft animation program which can be used with the Microsoft Image Composer.

(See Animation and Autodesk Animator Pro.)

Microsoft Index Server A search engine which may be used to find information on a Web site. It is included with Microsoft IIS, as is the Crystal Reports reporting engine.

(See Crystal Reports and IIS.)

Microsoft Internet Client SDK A comprehensive set of tools, components and utilities for ICPs, Internet developers and Web authors.

Microsoft Internet Explorer *(See Internet Explorer.)*

Microsoft Internet News A technology which allows Web browser users to subscribe to newsgroups, submit messages and read messages. Microsoft Internet News is invoked from Internet Explorer by selecting Read News on the Go menu.

(See Internet Explorer.)

Microsoft MDK (Multimedia Developers Kit) A collection of tools that may be used to develop sophisticated multimedia titles.

Microsoft NetShow A streaming technology server which may be integrated into a Web site/application. Its inclusion results in the ability to serve client browsers with streaming audio, video and multimedia. Web site and Web application developers may integrate it into IIS-based Web application solutions.

(See ASF, IIS, Multimedia and Streaming.)*

Microsoft Office An integrated software package, which features the following applications in some or all versions of the package:

- Word word processor
- Excel spreadsheet
- Access database
- Outlook contact management program
- PowerPoint presentation program.
- Publisher desktop publishing program

(See Application software, Microsoft and Windows.)*

Microsoft Office for Developers A development solution for building and distributing Office-based business solutions.

Microsoft Proxy Server A server implementation which may be used to deliver Internet access across an enterprise. The Internet Service Manager is used to manage the Proxy Server as well as the Chat and Mail servers. The Microsoft Proxy Server:

- is compatible with Intel and Risc platforms
- uses caching algorithms to optimise access to LAN data
- includes an Auto-dial features that connects the user with the ISP if the user's requested data does not reside in the cache
- assigns users with access rights to specified Web sites.

(See Server.)

Microsoft SDK for Java A superset of the JDK, it includes Microsoft class libraries, a JIT compiler and the Microsoft Virtual Machine for Java.

(See Java.)*

Microsoft SQL Server A relational database management system (RDBMS) which provides multi- and concurrent user access to enterprise data. The Microsoft SQL Server's utilities include:

- SQL Enterprise Manager, which provides management features
- SQL Service Manager, which provides start and stop functions
- Interactive SQL for Windows, which permits sessions with multiple SQL servers
- SQL Security Manager, which provides access to security features
- SQL Setup, which can be used to upgrade MS SQL Server, as well as to change default settings
- SQL Client Configuration Utility, which is used to manage SQL Server client software configurations
- SQL Performance Monitor, which offers performance readings
- SQL Server Web Assistant, which permits the generation of Web pages that use SQL Server data
- SQL Trace, which is used to track SQL Server user habits.

(See Server.)

Microsoft Transaction Server A transaction manager. A Microsoft solution for integrating transaction processing in Web applications. Its component architecture includes:

- Transaction Server Explorer, which is used for administration and management purposes
- Transaction Server Executive, which is a DLL providing functions used by the application's server components.
- ActiveX Server Components, which is used to deploy ActiveX server components
- Server Process, which hosts the application's components
- ODBC Resource Dispenser, which manages database connectivity
- Shared Property Manager, which gives access to a Web application's properties
- Microsoft Distributed Transaction Coordinator, which coordinates transactions, and is integrated in Microsoft SQL Server 6.5

Other transaction managers include CICs and Encina.

(See ACID and Server.)

Microsoft Video for Windows (VfW) *(See Video for Windows.)*

Microsoft Visual Basic (*See Visual Basic*.)

Microsoft Web Wizard SDK A tool that can be used to create Wizards which can be used to build Web sites using tools like FrontPage and Visual InterDev. Tools created using the Design-Time Control SDK can be used with the Web Wizard.

Microsoft Windows *(See Windows.)*

Microsoft Windows CE (Compact Edition) A version of the Windows OS designed for palmtops, organisers and other small-scale systems, including those targeting the consumer market.

Microsoft Windows Sound System A business audio system and proprietary sound system standard for the Windows environment. The full implementation consists of a 16 bit sound card, microphone and a suite of Windows applications. Many sound cards and sound features offer compatibility with the Microsoft Windows Sound System standard.

(See Speech recognition and ViaVoice.)

Microwave radio Short wavelength radio waves that have a frequency above 1000 MHz (1 GHz).

Middleware 1. A software implementation or glue which exists between the client and the server. It makes the network protocols and other server workings transparent to the client. (*See Glue.*) 2. Database middleware connects client applications with back-end applications, and consists of:

- an application programming interface (API)
- network and database translators.

(See Glue.)

MIDI (Musical Instrument Digital Interface) An industry-standard file format and specification for producing and playing electronic music using computers and compatible devices such as MIDI keyboards and MIDI guitar interfaces. It covers hardware, cables, connectors, data protocols (MIDI messages) and file formats. The single most significant advantage of MIDI is the compactness of the resultant so-called MIDI song files. These consume a fraction of the data capacity required by digitised wave form audio such as .WAV files. A one-hour stereo MIDI file may consume around half a Mbyte. Even using compression techniques, an equivalent .WAV file would consume literally hundreds of Mbyte.

(See Sound card and Wave audio.)

MIDI sequencer A program used to create or edit MIDI files. Midisoft Recording Session is a popular sequencer program supplied with numerous sound cards. In many respects it is a typical sequencer offering the sorts of editing facilities commonly found in similar programs. You can cut or copy selected tracks from one recording and paste them into another. At a much lower, and detailed, level you can add, copy, cut and delete musical notes.

(See MIDI.)

MIDI studio A system consisting of hardware, software and (usually) an interfaced musical instrument, which is most often a keyboard. The first thing you need to create your own MIDI studio is an appropriate sound card. The software required to create and edit your own MIDI songs is called a sequencer. Almost all sound cards come with a MIDI sequencer. You may get the Midisoft Recording Session MIDI sequencer or CakeWalk. The final piece of hardware required is a MIDI keyboard, which provides an easy method of entering sequences for the various MIDI tracks. Companies such as Roland and Yamaha are famous for the manufacture of MIDI keyboards, and it is certain that your local music store has a range of their MIDI compliant keyboards.

(See MIDI.)

MIME (Multipurpose Internet Mail Extensions) A standard specification which permits e-mail messages to include multimedia elements. It supports:

- ASCII alternatives, such as foreign language character sets
- images
- multiple objects
- audio
- video
- PostScript.

Included in served files is a MIME code, which has a type and subtype denoting the media included. Types of media such as HTML and GIF may obviously be displayed by any browser. Others, such as MPEG video, require HELPER programs. MIME was developed by Nathaniel Bernstein of Bellcore and by Ned Freed of Innosoft.

(See E-mail.)

Mini disc A recordable audio digital distribution medium. It offers almost CD-quality sound. Physically compact, it consists of a 2.5 in diameter disc. It offers random access and is rewritable. It can be applied as a computer DSM.

Minimise A process by which a window containing an application or document is reduced to an icon or button. Windows application and document windows contain a Minimise button near the top right-hand corner; a Minimise option also exists on the Control menu, which is invoked by clicking the Control button/icon in the top left-hand corner of the window.

MIPS (Million Instructions Per Second) A unit for measuring raw computer/processing speed.

Mirroring A function of a hard disk controller that writes data to more than one disk drive simultaneously.

Mirror site An Internet site that duplicates the functionality of another site. Mirror sites help to provide an improved service for users by lowering usage demands on individual sites.

M-JPEG (Motion-Joint Photographic Experts Group) A type of video that uses individual frames compressed according to the JPEG algorithm. It gives full frame updates as opposed to the predominantly partial frame updates of MPEG-1 video. M-JPEG video therefore provides random access points and lends itself to non-linear editing. In this respect it is more

flexible on playback because applications can simply show any frozen frame of an M-JPEG sequence or play any selected frames of a sequence either backwards or forwards. Another advantage of M-JPEG is that it can be compressed into other formats, including MPEG-1/2. A principal disadvantage of M-JPEG, however, is its comparatively low overall compression ratio.

(See MPEG-1 and MPEG-2.)

MMX Technology A set of extensions (or additional instructions) that gives a processor improved multimedia performance. The Intel Pentium and Pentium II processors have MMX Technology. The addition of MMX results in dramatic performance gains in video and 3-D graphics. MPEG refused to adopt the whole of Intel's now obsolete DVI (Digital Video Interactive) technology as a video standard, allegedly causing Intel to abandon its initial plans for an Intel processor with built-in DVI functionality. Intel once announced that it would integrate the functionality of its i750 DVI chipset into a general-purpose processor design. However, the year of 1995 saw Intel unveil its MMX Technology, which is not an acronym but a trademark. MMX delivers performance gains to multimedia-, graphics- and video-related applications that range from 3-D animation programs to videoconferencing. The array of multimedia-related standards, such as those of the MPEG continuum and those that have yet to emerge, fits within the open framework that is MMX Technology. This gives ISVs the freedom to adopt current, emerging and even proprietary compression standards. MMX Technology delivers improved matrix manipulation through some 57 new instructions and gives higher levels of concurrency through Single Instruction Multiple Data (SIMD). Fred Pollack, an Intel Fellow (1997), once stated, 'Preliminary tests have shown performance benefits between 50 and 400 per cent, depending upon the application.'

(See DCT, MPEG and Pentium.)*

MNP 2-4 (Microcom Networking Protocol) A standard error correction protocol used in modem-based communications.

MNP 5 (Microcom Networking Protocol) A standard compression algorithm used in modem-based communications.

Modal A term used to describe interaction where the user moves between different modes of program operation. The multimedia authoring tool Asymetrix ToolBook is modal, in that the user switches between Read and Design modes.

(See OpenScript and ToolBook.)

Mode 1 and Mode 2 CD-ROM data block formats. Data blocks supported by all fully specified CD-ROM drives. One hour Mode 1 disc yields 527 Mbyte data capacity and Mode 2 gives 602 Mbyte data capacity. A Mode 1 data block will yield just 2048 bytes (2 Kbyte) user data, while Mode 2 offers 2.28 Kbyte user data.

(See CD-ROM and DVD.)

Modem (modulator/demodulator) A hardware device used for modulating and demodulating data normally received and transmitted over voice-grade communications systems. It may be:

- an internal modem that consists of an expansion card that plugs into the expansion bus
- an external modem connected to the serial port of a computer. It typically measures about 15 cm by 10 cm by 2.5 cm
- an external PCMCIA (Personal Computer Memory Card International Association) modem that is little bigger than a credit card.

A 56.6 Kbps standard analogue modem 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 has considered two industry standards:

- X2
- K56flex

The resulting V.90 standard was specified provisionally and finally released in 1998. (*See 56 600 and Shannon's theorem*.) Important elements of a modem include:

- a processor or CPU that is responsible for processing commands and possibly for compression also
- a PROM (Programmable Read-Only Memory) variant used to store modem software such as the AT command interpreter. The specification of certain modems can be improved by upgrading the PROM
- a quantity of RAM (Random Access Memory) which may provide the dual role of buffering and assisting in data compression. (*See Buffer*.) RAM sizes typically vary from 4 Kbyte to 16 Kbyte
- a quantity of NVRAM (Non-Volatile RAM) in order to store AT command entries and S registers.

(See Access technology and Shannon's theorem.)

Moderator A person that checks all contributions to newsgroups before posting them.

MOLAP An OLAP implementation which supports Multidimensional Database Management Systems (MDBMS), which may be assumed to use proprietary data storage techniques.

(See Data warehouse, DBMS, OLAP and RDBMS.)

Monitor A display device used with computers, multimedia and digital video playback systems. Desktop systems may be assumed to include CRT (Cathode Ray Tube) displays, but increasingly flat-screen TFT displays are being used. Notebooks and other portable systems may be assumed to integrate LCD (Liquid Crystal Displays), TFT or DSTN display technology. The principal technical factors that dictate a monitor's specification are its:

- screen size
- supported resolutions
- non-interlaced and interlaced screen refresh rates (in the case of CRT-based designs
- supported number of colours, which is irrelevant with CRT-based designs.

(See Display.)

Moore, Gordon A founder of the Intel Corporation.

Moore's Law A law stating that the number of devices that can be integrated onto a single silicon will double annually. The founder of Intel Corporation, Gordon Moore, authored his law in the 1960s.

Morphing An animation technique where one image is evolved into another. Its full name is polymorphic tweening. Numerous commercial morphing programs exist. Using such programs, the first step in the creation of a morphing animation might involve loading two bitmaps. The animation program can then be used to produce an animation which merges one of the bitmaps into the other. Modern morphing programs for Windows are able to create animations in the .AVI format, so providing full compatibility with all fully specified presentation programs and multimedia authoring tools. Morphing animation effects provide a means of enhancing the appeal of many multimedia presentations and applications.

Mosaic An early Web browser, which originated from the National Center for Supercomputing Applications (NCSA). Modern Web browsers, which support Java and its variants, include Netscape Navigator, Microsoft Internet Explorer and HotJava.

(See Browser.)

Motherboard The principal electronic assembly within a computer. It accommodates the processor, RAM (random access memory), external memory cache, expansion bus and any co-processors that might be included. It may also include additional subsystems such as a hard disk controller, video controller and even sound facility. Many designs have old-fashioned ISA (Industry Standard Architecture) expansion slots which are used to connect expansion cards such as hard disk controllers and graphics cards. ISA was introduced by IBM in the 1980s to accompany the Intel 80286 processor, which was used in the IBM PC AT. The bus is 16 lines or bits wide and runs at a relatively slow clock speed of below 10 MHz. The ISA bus was not redeveloped by IBM to run faster; instead it introduced the now obsolete MCA (Micro-channel Architecture) bus, a 32 bit variant included in the IBM PS/2 range of systems launched in mid-1987. The PS/2 launch was a milestone in the history of video in the PC environment because it marked the beginning of the VGA (Video Graphics Array) standard through which the PC finally had been given reasonably advanced colour graphics through an analogue port. The MCA bus requires compatible expansion cards, whether they be graphics cards, video capture cards, CD-ROM controllers, or hard disk controllers. Such is the inseparability of the terms MCA and PS/2 that compatible expansion cards are advertised as PS/2 cards. In the late 1980s, around the same time that MCA was launched, nine major PC manufacturers referred to as the 'gang of nine' joined forces to develop the EISA (Extended Industry Standard Architecture) bus, which is a 32 bit bus. Many high end PCs use the EISA bus, for which highly specified expansion cards exist. The real key to opening up the expansion bus and tapping into the clock speeds of the processor's external data bus, however, came through the arrival of so-called local bus slots and ancillaries. Local bus standards emerged in the early 1990s through the VESA (Video and Electronics Standards Association), and so-called VLB (Vesa Local Bus) expansion slots are now common. Usually they accompany ISA slots, but they may also accompany PCI slots. A VLB graphics card will offer better performance than a comparable ISA variant, so widening the PC video bandwidth attainable. An alternative to VLB slots has emerged through Intel's PCI (Peripheral Component Interconnect) bus, which offers slightly better performance than VLB. Generally either local bus standard will suffice to make a system faster and better equipped for video playback, capture and editing. Certain motherboards feature ISA, VLB and PCI slots. To help speed up the processor a memory cache is provided. This can be either internal, forming part of the actual processor, or external, where it is included on the motherboard. External cache memory is of a static design and does not require the cyclic refreshment that normal dynamic RAM does. External cache memory sizes typically vary between 128 Kbyte and 1 Mbyte. In future it is possible

that external memory caches might be replaced by using interleaved system memory composed of static and dynamic RAM.

Mouse A hand-held input device. By dragging it on a flat surface one has a means of moving a screen pointer/cursor in both *x* and *y* directions. It is typically connected to the serial port, but may also be wireless. It has one, two or three push buttons that are used to make selections, either by pressing a button once (single-clicking) or by pressing a button twice in succession (double-clicking). The mouse is also used for dragging (moving) objects to move them from one point to another, or for resizing windows by dragging their borders. Dragging is carried out by holding down the mouse button above an object or window border and then moving the mouse appropriately. Modern notebook systems use mechanism-free touchpads instead of the traditional mouse.

MPC-3 (Multimedia PC) A multimedia hardware standard issued by the Multimedia PC Marketing Council. The initial specification, MPC-1, has advanced to become MPC-3, which includes MPEG video playback. The base case specification, which is normally exceeded, includes:

Processor

- 75 MHz Intel Pentium processor (or equivalent).

RAM

- 8 MByte.

Mass storage

- 3.5 in floppy drive.
- 500 MByte hard disk (uncompressed user data capacity).
- An average access time less than or equal to 20.2 ms.

CD-ROM

- Audio output and volume control.
- On-board buffers for read-ahead buffering.
- The ability to read the following disc formats: Audio CD, CD-ROM, CD-ROM XA, CD-I, PhotoCD, CD Recordable and Enhanced Music CD, and VideoCD.
- Supports an average data transfer rate of at least 550 Kbyte/s, and offers an average access time of less than or equal to 250 ms.

Sound card

- The ability to record and play stereo, 8 bit and 16 bit wave audio at the following sampling frequencies: 8, 11.025, 16.0, 22.05 and 44.1 kHz.
- Offer wave table sound synthesis, featuring 16 simultaneous melody voices and six percussive voices.
- Include the OPL3 chip (or compatible device) for FM synthesis.

Graphics and video

- PCI 2.0 bus graphics controller.
- MPEG-1 video playback hardware and/or software.

Modem

- 28 800 bps modem.

Operating system

Windows 3.11 or equivalent (including Windows 95/NT).

(See MPEG and Multimedia.)*

MPEG-1 (Moving Picture Experts Group) An internationally agreed digital video compression standard. It is used widely for local playback and for streaming multimedia over the Internet and other IP and multimedia networks. *(See MPEG-2.)* The early days of digital video were plagued by the problem of how digital video data should be compressed, thus illuminating the need for international standards for the digital storage and retrieval of video data. Sponsored by the then ISO (International Organization for Standardization) and CCITT (Committée Consultatif Internationale Télégraphique et Téléphonique), the Moving Picture Experts Group (MPEG) was given the task of developing a standard coding technique for moving pictures and associated audio. The group was separated into six specialist sub-groups, including Video Group, Audio Group, Systems Group, VLSI Group, Subjective Tests Group and DSM (Digital Storage Media) Group. The first phase of MPEG work (MPEG-1) covered DSMs with up to 1.5 Mbps transfer rates, for storage and retrieval, advanced Videotex and Teletext, and telecommunications. The second phase (MPEG-2) of work addressed DSMs with up to 10 Mbps transfer rates for digital television broadcasting and telecommunications networks. This phase would cling to the existing CCIR 601 digital video resolution, with audio transfer rates up to 128 Kbps. MPEG-1 was finally agreed, developed and announced as long ago as December 1991. MPEG participants included leaders in: computer manufacture (Apple Computer, DEC, IBM, Sun and Commodore); consumer electronics; audio-visual equipment manufacture; professional equipment manufacture; telecom equipment manufacture; broadcasting; telecommunications; and VLSI manufacture. University and research establishments also played an important role. It provided a basis for the development of Video CD, which was specified publicly by Philips in late 1993. This is an interchangeable format that can be played using both PCs fitted with appropriate MPEG video cards and compatible CD-ROM drives and Philips CD-I players fitted with Digital Video cartridges. Its development is constant, so as to accommodate the increasing data transfer rates of both DSMs and other video distribution

transports. MPEG-1 compression is optimised for DSMs with data transfer rates of up to 1.5 Mbps. MPEG-2 accommodates DSMs and video distribution transports capable of supporting higher data transfer rates of up 10 Mbps. MPEG-4 video compression is designed to transmit video over standard telephone lines. An MPEG video stream generally consists of three frame types:

- intra
- predicted
- bi-directional.

Central to MPEG encoding is the use of reference or intra (I) frames, which are complete frames that exist intermittently in an MPEG video sequence. The video information sandwiched between intraframes consists of that which does not exist in the intraframes. Information that is found to exist in the intraframes is discarded or 'lossed'. Intraframes can act as key frames when editing or playing MPEG video as they consist of a complete frame. Generally, editing compressed MPEG video is difficult owing to the paucity of authentic access points. However, editable MPEG files do exist, one type of which is backed by Microsoft. Additionally an MPEG video stream composed entirely of I frames lends itself to non-linear editing. The quality of MPEG video depends on a number of factors ranging from the source video recording quality to the use of important MPEG parameters that affect the overall compression ratio achieved. Contrary to popular belief, the logical operations that provide a basis for obtaining high-quality MPEG video are by no means the preserve of expensive video production bureaux. Equipped with a reasonably specified PC and a basic understanding of MPEG video, there is nothing to stop you producing good quality White Book-compatible video on your desktop. Probably the most obvious elements that influence MPEG video quality include the analogue or digital source recording, the video source recording format and the video source device specification. It can be assumed that the higher resolution S-VHS format will provide slightly better results than VHS, but there will not be a dramatic improvement in resolution because the MPEG SIF is standardised at 352 × 288 pixels for PAL. If you are also digitising the soundtrack of the source video recording you will probably obtain the best results with camcorders and VCRs that offer hi-fi quality stereo sound. When capturing a video file so that it may eventually be compressed, it is important to choose an appropriate capture frame rate, capture frame size and image depth. The capture frame rate should be set for 25 fps for PAL and 30 fps for NTSC. Frame rates that differ from these will cause the MPEG video sequence to run at the wrong speed, and it will not be White Book-compliant. The capture frame size should correspond with the MPEG-1 SIF, which is 352 × 288 pixels for PAL and 352 × 240 pixels for NTSC.

Authentic MPEG requires a true colour image depth of 24 bits per pixel, giving a total of over 16.7 millions colours which are generated by combining 256 shades of red, green and blue. The quality of captured audio that is used as an input audio stream obviously depends upon the sample size, recording frequency and whether mono or stereo is chosen. You can assume that your wave audio recorder or video capture program will offer sampling rates of 11 KHz, 22 KHz and 44.1 KHz and sample sizes of 8 bit and 16 bit. While higher sampling rates and larger sample sizes yield improved audio quality, the resultant audio stream can consume an unacceptably large portion of the available MPEG-1 bandwidth. With regard to careful adjustment of the MPEG compression parameters there is not much you can do if the MPEG encoding software provides no control over them. If it does, then it can be assumed that a greater number of I frames can improve the quality slightly, though this will introduce an overhead in terms of lowering the compression ratio.

(See MPEG-2.)

MPEG-2 (Moving Picture Experts Group) An improved version of MPEG-1 video compression, supported by DVD technology. It was developed for media and networks able to deliver 10 Mbps data transfer rates. MPEG-1 was developed for narrow-bandwidth media, such as the original single-speed CD drive variants, which offered average data transfer rates of approximately 150 Kbyte/s or 1.2 Mbps. MPEG-2 video may contain considerably more audio and video information than MPEG-1. The most noticeable improvement is the higher playback screen resolutions that are possible, making possible D1 or CCIR 601 quality. DCT is the key to MPEG-2, as it is to MPEG-1 and JPEG (or even M-JPEG). As is the case with MPEG-1, MPEG-2 requires decoding solutions, which may be hardware-based, such as set-top boxes (STBs) or equivalent hardware implementations integrated in computers. Applications of MPEG-2 video include video on demand, multimedia videoconferencing. It may also be stored and delivered using DVD variants. MPEG-2 variables include:

- the `aspect_ratio_information` variable, which dictates pixel aspect ratios, and not that of the total frame
- `frame_rate_code`, which stores the playback frame rate
- `repeat_first_field` and `top_field_first`, which indicate to the decoder which frames may be repeated so as to maximise playback frame rate. (This was not possible with the MPEG-1 specification. However, the process of frame duplication is not new, and there have long been many graphics cards able to do this with AVI video frames.)
- `frame_rate_extension_d`, `frame_rate_extension_n` and `frame_rate_code`, which contain playback frame rate information

- `mb_height`, which determines the pictures' macroblock sizes, and permits values that are multiples of 32.

The prevalent MPEG-2 resolution is 720 × 480 pixels running at the NTSC frame rate of 30 Hz. Movie and PAL playback frame rates are possible. See: *Information Technology–Generic Coding of Moving Pictures and Associated Audio*. ISO/IEC 13818.

(See D1 and DCT.)

MPEG frames An MPEG video sequence consists of partial frames in the form of Predicted (P) frames and Bi-directional (B) frames, and full frames or Intra (I) frames. I frames are compressed in a similar way to JPEG (Joint Photographic Experts Group) images and do not rely on image data from other frames. They exist intermittently, perhaps between every ninth or thirtieth frame, and provide non-linear entry points. Increasing the frequency of I frames provides a greater number of valid entry points, but the compression ratio of the overall file diminishes proportionately. Realistically, the compression ratios achieved using MPEG can be assumed to be around 50:1. Higher compression ratios lead to an unacceptable loss of quality, and it is wise to forget the 200:1 ratio which MPEG is supposedly capable of producing. Normally this is achieved through a pretreatment process which dramatically reduces the number of frame pixels. I frames and the following P and B frames are termed Groups of Pictures (GOPs), and the occurrence of each frame may be predefined through the careful adjustment of MPEG parameters prior to encoding. However, this fine level of control over compression parameters may not be provided by low-cost MPEG encoding programs.

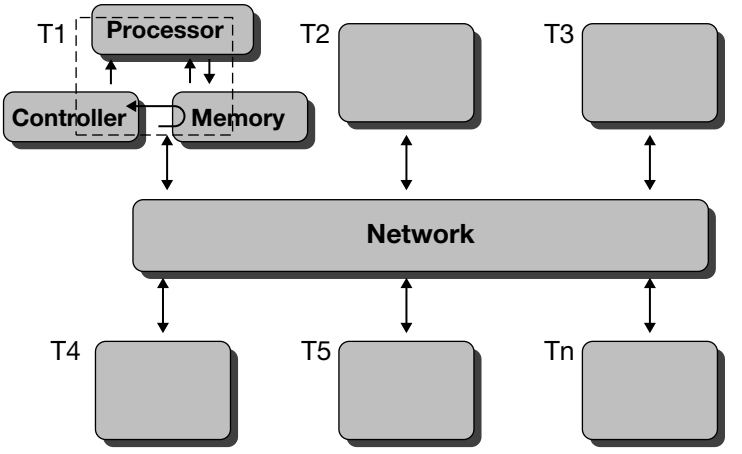
MPEG video production The process of creating MPEG video. As expected, MPEG-1 video production has also become increasingly popular, using comparatively inexpensive video capture hardware and encoding software. These provide a gateway to producing Video CD or White Book-compatible MPEG-1 video that can be integrated into multimedia productions, embedded into applications in the form of OLE objects, or used as non-interactive pop videos, movies and documentaries. Using a White Book-compatible CD-R recorder you can produce a Video CD with over 70 minutes of linear MPEG-1 video. This is a bridge format that can be played on a variety of different systems and appliances, including appropriately specified PCs and Macintoshes, Multimedia PC-3s, CD-I players fitted with DV (Digital Video) cartridges, Karaoke players and 3DO players fitted with MPEG decoders. An alternative to such video production is to use the services of a fully equipped bureau. The decision as to whether the services of a bureau should be used is driven by a number of obvious key factors that

include the amount of encoding you require, for which you will be charged on a per-minute basis. Other factors include the person-hours and hardware/software costs required to encode the MPEG-1 video yourself, and the resultant video quality, which will relate not only to the way in which the MPEG-1 encoding parameters are applied, but to the video source recording, the video source format and captured digital video file. It comes as a surprise to many to learn that bureaux are not bound to produce noticeably superior MPEG-1 video than that produced using low-cost MPEG encoding software. Their use of expensive real-time MPEG encoder cards is driven by the need to produce MPEG video as quickly as possible, as opposed to achieving optimum quality. Generally, however, it can be assumed that a reputable bureau will produce Video CD-compatible MPEG-1 video that is of an acceptably high quality and will certainly meet commercial standards. The production of MPEG-1 video using encoding software begins with the capture of a video sequence from a source recording, which might be in the VHS or S-VHS formats. Film studios and production companies might rely upon professional and broadcast quality formats such as Digital Betacam or D1 for their source recordings. (*See D1*.) The capture process can be carried out using an appropriate video capture card such as Spea's Crunch It used in conjunction with a video capture program. You can use almost any Windows video capture software, including Asymetrix Digital Video Producer, Microsoft Video for Windows VidCap or the VideoMaestro Video Capture program. These provide adequate control over capture parameters, allowing you to a set a capture frame rate of 25 fps, a true colour image depth of 24 bits providing 16.7 million colours per captured pixel, and an acceptable frame resolution of 352 × 288 pixels. This resolution equates to the MPEG Source Input Format (SIF) which is achieved by omitting odd or even lines from a standard interlaced PAL (Phase Alternating Line) signal. This is an exceptionally 'lossy' procedure, omitting a great deal of picture information and losing video quality. It is this single operation that limits the quality of video that can be achieved using MPEG-1, though it has to be implemented in order to confine the video stream to the narrow bandwidth of about 1.5 Mbps. If you are unable to capture video at 25 fps, you can increase the frame rate following video capture using Video for Windows VidEdit or an equivalent digital video editing program. The increased frame rate is achieved merely by duplicating frames, but it does mean that the finally encoded MPEG video stream will at least be an authentic one. If you capture video with a soundtrack, it is necessary to separate the video and audio components into different files. Using VidEdit this can be achieved by first making the audio track active and then selecting the whole video sequence using Selection from the Edit menu. Then by selecting Extract from the File menu, the soundtrack can be saved as a Windows wave file or

in any other format that is compatible with the MPEG encoding software. If necessary, delete the audio soundtrack and then save the video sequence. This general sequence of events is echoed using other digital video editing programs. An alternative to capturing audio and video simultaneously is to record them separately. A wave audio soundtrack can be recorded using a video capture program or a Windows wave audio recorder/editor such as Creative Wave Studio. This may result in higher quality video capture than might otherwise be possible, though it will probably lead to video and soundtracks that have different play times. Consequently, when mixing or 'multiplexing' them together using MPEG encoding software, the audio and video information will not be synchronised correctly, which will be most noticeable with sequences that are lip-synched or during 'hits', where sounds and visual events correspond. This may be remedied by opening the video file using a video editor such as VidEdit and then inserting the wave audio file as its soundtrack. A video editing program can be used to synchronise audio and video streams, usually by introducing a time offset for the audio track. By then separating the file into video and wave audio files, once again using the video editing program, the play times should become equal. This will help ensure that they are synchronised after multiplexing using the MPEG encoding software. Although some MPEG encoders will automatically alter the length of the input audio file so that it matches the length of the input video file, this does not guarantee that the audio and video material is synchronised correctly when multiplexed. It should be added that the synchronisation of audio and video information can also be carried out at the decoding stage. Having obtained audio and video input files in an appropriate format, they can be compressed or encoded separately into MPEG audio and MPEG video streams. Using MPEG encoding software this may take some time, particularly when creating the MPEG video stream. It is therefore advantageous to have a Pentium-class system, which may reduce the encoding time to around two to three times the period required for real-time MPEG encoding. The final stage of encoding is to mix or multiplex the MPEG audio and video streams into an MPEG system stream. Using PixelShrink, encoding and multiplexing jobs can be implemented in batches, so relieving you of a degree of tedium. To test and evaluate the quality of the compressed system stream you will need a fully specified MPEG player. You can use software-only players, but these will not allow you to evaluate the video adequately, as they may play video only, and are more likely to play the file at an incorrect speed, which is usually too slow.

(See MPEG-2.)

MPP (Massively Parallel Processing) Computing using multiple processors, which may operate independently and concurrently as well as



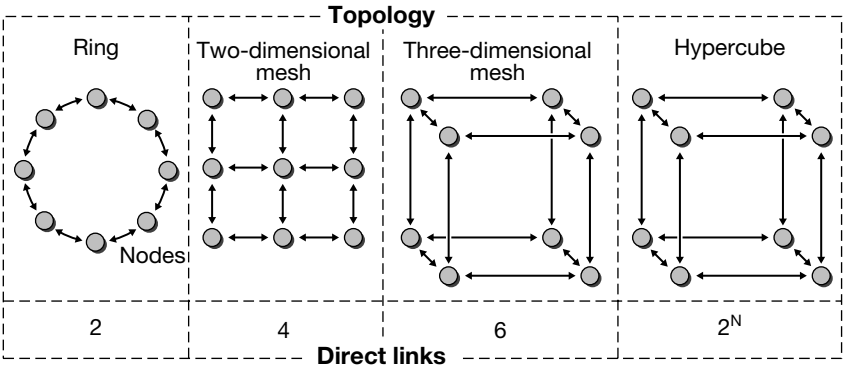
MPP DM-MIMD architecture

interacting with one another through interprocess communications. The strict definition of MPP is a system which offers scalability, where resulting processor gains increase in multiples that equate to the processing power of a single unit processor. For example, the collective processing power of an MPP system with *n* processors should increase by *x* MIPs per added processor(s). The processors may have their own memory and I/O capabilities, and may constitute complete computers or use shared memory. The processors also exhibit channels of interconnection between other processors. These connections constitute the network, and its bandwidth naturally influences the collective processor power of the system. The network is not to be confused with external, industry-standard networks such as IP and Ethernet. An MPP network is internal, with the rationale of optimising system performance by permitting the processors to communicate as quickly as possible. Typical network topologies include *ring*, *two-dimensional mesh*, *three-dimensional mesh* and *hypercube*. The resulting MPP interconnection network may be specified in terms of its:

- link bandwidth, or the rate at which data may be sent via a direct link, which is a function of clock speed and data bus width
- switching latency, which might be defined as the period between a processor data request and the reception of that request; this is a function of clock speed, network topology and the physical location of the serving processor in the network; the farther away it is, the more extended the switching latency.

The processing power of an MPP may be measured in:

- millions of floating point operations per second (MFLOPs)



- billions of FLOPS (Giga FLOPs or GFLOPs)
- trillions of FLOPS (Tera FLOPs or TFLOPs) – in future
- millions of instructions per second (MIPs)
- SPECmarks.

The optimum processing yield depends on distributing processes evenly across the processor array, matrix or network. Program algorithms may perform this function of *dynamic load balancing*, which is carried out in real time. A common denominator in current networks is that not all processors are connected directly. MPP architectures are divided between:

- Multiple Instruction Multiple Data (MIMD)
- Single Instruction Multiple Data (SIMD).

MIMD architectures feature memory, which may be:

- distributed
- shared.

The SIMD architecture has a single controller driving multiple slave processors, each with independent storage. The distributed memory DM MIMD architecture has a multiplicity of such processors and controllers. An MPP architecture variant may be explained in terms of its electronic storage, controller(s) and processor(s). Leading MPP manufacturers include Cray, Thinking Machines, Intel and nCube. Concurrent programming languages include Occam, which has its origins in Inmos (UK) where it was developed as part of the Transputer parallel processor. Java is the first mainstream programming language which supports the parallel programming model. Languages that are optimised for parallel processing systems offer authentic concurrency. One of the earliest transputer-based supercomputers was developed by Meiko though the Computing Surface. This was used in the development of DVI, and modern transputer-based implementations are used as video on demand servers. Among the advantages of such parallel processing systems is scalability, where for example

growing numbers of subscribers to a Vod service may be accommodated through additional processors, and even complete servers.

(See NUMA, Parallel programming, SMP and Transputer.)

MSCDEX (*See CD-ROM extensions*.)

MSDN (Microsoft Developer Network) A Web site targeting developers using Microsoft tools and technologies. Hyperlinks to the site are also included on hybrid CD-ROMs included with the Microsoft Visual Studio.

(See www.msdn.com.)

MS-DOS (Microsoft Disc Operating System) A PC operating system that was the successor to Digital Research's CP/M (Control Program for Microprocessors). It achieved the status of worldwide standard because of its inclusion in the IBM PC XT. The operating system evolved into numerous versions, including DR-DOS by Digital Research and PC-DOS by IBM. The complete MS-DOS implementation included numerous utility programs, including `MSCDEX`, which is the program name of the Microsoft CD-ROM Extensions, and enables DOS to address the full data capacity of a CD-ROM, as well as providing developers with a command set that can be used to write CD-ROM device drivers. Other utilities include `FDISK`, which is used to create and delete primary DOS partitions and extended partitions on hard disks; `DOSSHELL`, which can be used to manage files, edit files and run programs; `FORMAT`, which can be used to format hard and floppy disks; and `BACKUP`, which can be used to backup files. MS-DOS embodies many other programs and utilities.

MSN (Microsoft Network) A superset of the Web, providing additional services that are comparable to those of CompuServe.

MTBF (Mean time between failures) An average period time that indicates the frequency at which a device, component, subsystem or complete system will fail.

(See MTTR and Reliability.)

MTTR (Mean time to restore) The average period required to return a failed system to its fully operational state.

(See MTBF and Reliability.)

Multi-field key (*See Key field*.)

Multimedia A broad term which may be applied to a system or process which embodies and combines various different media. Modern (digital)

multimedia may comprise computer animations, text, still images, digital audio, synthesised sound, digital video and interactivity. Unlike linear non-interactive media such as broadcast television, it provides users with a choice of numerous meaningful paths. The underlying technology has spawned offshoots, of which the most notable will be video-telecommunications and videoconferencing. Distribution media disc-based multimedia include Compact Disc – Read Only Memory (CD-ROM). Other less well-known distribution media include Compact Disc Interactive (CD-I) and CD-ROM XA (Extended Architecture) discs. The 12 cm diameter CD-ROM and CD-I discs typically support up to about 660 Mbyte data storage capacity. A single-sided, single-layer DVD-ROM disc supports 4.7 Gbyte, and supports MPEG-2 video playback. Increasingly, however, multimedia networks are being used, and the most significant of these is the ubiquitous Internet.

(See Hypertext and Web.)

Multimedia authoring tool A software tool intended for the development of multimedia. Many such tools require no programming skills.

(See Authorware, IconAuthor and ToolBook.)

Multimedia delivery A phrase occasionally used to describe the process of delivering or deploying multimedia locally, over a multimedia network or over the Internet.

Multimedia delivery system (*See Multimedia system/appliance*.)

Multimedia design team A team given the task of designing and developing a multimedia application. It may consist of experts in all disciplines required to generate the multimedia title, including:

- a producer/director to enforce an appropriate degree of creative control and oversee the amalgamation of media types
- a project manager to ensure that the budget and schedule are observed and adhered to
- high-level language programmers to design the retrieval system or to write other routines
- a multimedia author to implement the interactive design
- content provider/advisors who possess expertise in the material/information to be communicated
- an associate producer
- a project planner
- an interface designer
- an animation director

- a writer
- an art director
- a lead programmer
- a quality Assurance (QA) manager
- a sound designer
- an audio visual (A-V) designer
- a 3-D modeller
- a video editor
- graphic designers/computer graphics artists, to produce original artwork
- sound engineers for recording etc.
- studio technician(s)
- various production staff
- Web site/Internet developer(s).

How many of the aforementioned experts should be included depends upon the complexity of the material and what percentage, if any, of the production process is contracted out.

Multimedia development (*See Authoring.*)

Multimedia origins The origins of multimedia are frequently connected with the emergence of the term 'hypertext', and with an earlier means of information storage and retrieval devised in the 1940s. Not until the late 1980s did the technology for truly interactive multimedia emerge. The term 'multimedia' was first used in the 1960s to describe simple tape-and-slide presentations. The first breakthrough in optical storage was Philips' LaserVision, a videodisc system capable of storing still video, motion video and audio data (each in analogue form). Launched in 1978 (and in Europe in 1982) as a consumer product for playing video films, LaserVision quickly led to IV. This yielded the first taste of video in a computer environment. The real significance of LaserVision was that it provided a basis for the development of Compact Disc–Digital Audio (CD-DA) (1982), which in turn led to the announcement of CD-ROM and later to CD-I. Philips issued the first provisional CD-I specification in June 1986, making it commercially available for the consumer in 1991 (USA) and 1992 (Europe). 1986 also saw the launch of CUBIC-CT by Creative Labs, Inc. (Santa Clara). This system delivered music, had voice input and output and enhanced graphics, and used an electronic mass storage device. It was not a success, and Creative Labs now attribute its commercial failure to a lack of software. It is reasonable to state that CUBIC-CT was the world's first digital multimedia system. In July 1987 Compact Disc–Video (CD-V) was launched. This provides a means of storing digital audio and digital video. In response to CD-I, Intel made available an equivalent technology for the PC. Called DVI, it was initially demonstrated by RCA and General Electric at the

Microsoft CD-ROM conference of 1987. (DVI was originally pioneered for video distribution.) The DVI chipset was accommodated on two boards in 1990 and 1991, one for motion video delivery and another for video and audio capture. Philips' response to DVI was to instigate the development of CD-ROM XA (Extended Architecture). Like DVI this was initially intended to open up the PC market. Announced by Philips, Sony and Microsoft in August 1988, it currently permits (near) CD-I delivery in the PC environment. It is important to note that CD-ROM XA is not 100 per cent downwardly compatible with CD-I. Microcomputer graphics was technically immature for much of the 1980s. The Apple computer supported colour graphics, but like all other machines of the early 1980s it was slow and limited regarding pixel resolution and numbers of colours. More powerful computer graphics systems, such as the Cromenco SDI existed but were prohibitively expensive. PC computer graphics matured as late as mid-1987 when IBM released the Video Graphics Array (VGA) standard, which included an analogue monitor port. Initially launched as part of the Personal System/2 (PS/2) range, it raised the standing of PC computer graphics. In advance of the PC, the Macintosh included an analogue monitor port approximately three years earlier; and in 1987 Apple launched HyperCard, the most successful and best-known microcomputer hypermedia product. It is logical to conclude that the collective technology we now call digital multimedia was first realised by Creative Labs in 1986 through CUBIC-CT. HyperCard became the first major hypermedia product from a leading producer. In terms of the consumer market, multimedia technology came of age in April 1991 (USA) with the launch of the Commodore CDTV.

(See Multimedia.)*

Multimedia presentation A multimedia-based presentation that might combine audio, MIDI, video, text, animation and graphics. It might be presented on a desktop or even notebook computer using their attached display, or it might be presented using an LCD projector. Popular multimedia presentation programs include Microsoft PowerPoint, which is included with Microsoft Office. Multimedia authoring tools such as ToolBook, IconAuthor and Authorware may also be used, but these are not dedicated to the production of presentations.

Authoring an interactive multimedia presentation When creating a multimedia presentation the aim of the author is to communicate information as effectively as possible. The media types required to do this depend upon the intended audience. It is true to say that a presentation to customers in a bank may be more effective if interesting animations, video and soundtracks are included. A multimedia presentation to financiers and investors, on the other hand, may require a greater proportion of text and charts giving factual information. However, it could be

argued that multimedia with video, animations and effects is a persuasive medium, irrespective of the audience. You must have heard or read that overused statement that people remember 10 per cent of what they read, 20 per cent of what they hear, 30 per cent of what they see and 70 per cent of what they see and hear. There is disagreement generally about the factual accuracy of this much repeated statement, although that people do, in fact, remember a great deal more that they see and hear is widely agreed. Your job as a multimedia author is to create a presentation that will be memorable for the right reasons, and leave the audience with a clear understanding of the information you are conveying. But you have to be subtle; you cannot hammer home important points by repeating salient points over and over. Remember: you are not briefing a platoon or detachment of soldiers for an important mission. Do not author a presentation that is an obvious attempt to brainwash people. Equally, do not fall for that elementary error of turning up the volume too high. Ear-piercing wave audio or MIDI music is unlikely to have the desired effect. And be sure not to arrange loudspeakers so as to be right next to certain people in the audience. Keep all loudspeakers at least five metres away from members of the audience. This raises the matter of seating arrangements. Ensure that you leave the name of each member of your audience in an appropriate seating position. For example, important members should be seated more centrally, and closer forward, so that they have a direct view of the screen and yourself, and where they may benefit from a good stereophonic and perhaps surround sound effect. Less important members should be seated at the periphery of the room or auditorium. Returning to the content of the actual presentation, it is important to create an appropriate blend of media types. Achieving the right balance should not be too difficult if you simply bear in mind that too much of any one may cloud the messages and information you are trying to put across. The opposite to overworking certain media types can also have a negative effect. A dull presentation without animation, video or interesting music might bore people and make them desperate to leave, making the whole presentation an instantly forgettable experience.

Text in presentations Almost all Windows presentation programs use TrueType fonts. There are a wide variety of these available and you can normally buy inexpensive collections of them. Choosing appropriate fonts to use in your presentation does not require the expertise of a print designer but simple common sense, in most instances. The fonts you choose should be legible and suit the nature of the presentation. Straightforward legibility is obtained by choosing the correct font and point size. Fonts that resemble ornate writing styles with fancy serifs should be avoided; although you may find that you can get away with using them for the first letter of a word, or as a drop capital. Generally fonts with a symmetrical geometric appearance are more legible than others. Particularly good examples include families of Arial, Helvetica, Futura or Futurist. With regard to type styles used, you might find it useful to embolden or italicise certain portions of text purely to highlight salient points. Take care with italics, as this can reduce legibility. In terms of the suitability of the fonts used, common sense should tell you which ones to use. For example, a traditional Times Roman is a

font with credibility and should be used perhaps for more formal presentations, possibly to an audience of investors or board members. Generally you can mix different fonts on the same screen, but do bear in mind that there are limits, if you are conventional that is. If you are unconventional, you can mix as many fonts as you please, though we are not recommending that you do this. Text foreground and background colours are also important and should be chosen in terms of suitability. A closer investigation into colour will indicate the reactions that different colours evoke in people. However, once again common sense may play an important role in your choice of colours.

Graphics The numerous different methods of obtaining digital images include:

- scanning photographs and illustrations
- using a digital camera
- using a still video camera
- using a video frame grabber
- using photographs processed onto Photo CD
- using royalty-free collections of clip art and clip photos
- drawing them using a graphics program
- capturing a frame from a captured video sequence
- capturing charts from databases, spreadsheets and graphing programs
- photographic library.

The graphics you include may simply improve the look of your presentation or perform a function, such as a chart to illustrate sales figures. With regard to using photographic images, these should be relevant and not included simply because you found a good one in a royalty-free collection that vaguely relates to the subject of your presentation. The cheapest method of obtaining original photographs is to use Photo CD, although how good an image you achieve rather depends on how good a photographer you are, as well as on camera quality. A compact camera will not give the same results as a professional medium format camera like a Hasselblad. If you require a good quality photograph and your budget does not run to hiring a professional photographer, consider hiring an automated medium format camera; this will give excellent results and will be almost as easy to use as an automatic 35 mm camera.

Graphics in presentations Graphics files come in numerous different formats, including PCX, Compuserve GIF, Windows BMP and so. Some of these are more efficient than others, offering a more compact means of storing pictures. Perhaps the best known image file format for storing compressed still images is JPEG (Joint Photographic Experts Group). Which image file formats you use may depend upon the graphic import filters in you presentation program. For example if it will not import JPEG files then you will have to work in another file format. Numerous software programs are available that convert image file formats, including the shareware program PaintShop Pro and the conventionally marketed program HiJaak Pro. Ideally you should choose an image file format that requires comparatively small file sizes and short loading times. The image depth you choose can be a function of your presentation platform, which must have the

appropriate graphics card. Many authors find an image depth of 8 bits per pixel and the resultant 256 colour graphic images perfectly acceptable. Which image depth is used can also depend on the graphics themselves; if they are cartoon-like images, then there may be little point in opting for an image depth greater than 8 bits. Photographic images, on the other hand, are different, and to obtain realistic images you may need 16 bit 65K colour images, or even 24 bit 16.7 million colour images. Needless to say, file sizes grow in proportion to the image depth chosen; a 16 bit file of an image will be twice the size of the same image stored with an 8 bit depth. When including a number of different images in a presentation, you may have to create a common optimum palette using the presentation program itself or another graphics program. This is to avoid any problems you might encounter with palette switching.

Sound choice Sound, in the form of dialogue, music and effects, can mean the difference between a good and bad presentation. Music is not to be underestimated; its mood-changing characteristics can be persuasive with even the hardest business people. The sound you include may take the form of MIDI songs, wave audio or CD audio. Wave audio is ideal for recording dialogue. Its technical quality is important, and 8 bit wave audio recorded at a low sampling rate will be inferior to 16 bit CD-quality audio recorded at 44.1 kHz. The quality of script and spoken voice are not be overlooked either. MIDI is useful for music only. The single most significant advantage of MIDI is the compactness of the MIDI song files. These consume a fraction of the data capacity required by digitised waveform audio such as .WAV files. However, the .WAV file representation file is authentic: it is not composed from a rigidly defined set of sounds as you would find in MIDI files. For example, a MIDI representation of a recital of Beethoven's Ninth Symphony would be basic and noticeably synthetic, though sound cards that use actual samples of musical instruments are a great improvement on those that use synthesiser chips only. A wave file, on the other hand, could be used to record the actual performance of, say, the London Philharmonic playing Beethoven's Ninth. Using 16 bit samples at a rate of 44.1 kHz, a wave file can produce a CD-quality recording. However, MIDI files can be edited using various MIDI applications. Also, you can speed up or slow down MIDI files to sync them with animations. For many multimedia authors, the process of composing a MIDI sequence is something best left to MIDI professionals. MIDI song producers will compose original soundtracks to suit your multimedia title or presentation. Though this approach will lead to professional quality MIDI songs, the cost can be high, and it is hardly something you would do if authoring an in-house multimedia title. A cheaper alternative is provided by collections of clip music MIDI files that are in the public domain and can be used without payment of royalties to their owners. The many companies that produce collections of such clip music include large companies like Voyetra and Twelve Tone Systems. There are many other companies that produce clip music collections. Check with computer magazines such as *Windows Sources* (McGraw-Hill) and with CD-ROM dealers for information about clip music. CD audio may be used if you find an interesting royalty-free clip music track. Using many presentation programs you can play CD tracks or even a section of a track using MCI commands. There

are numerous other media devices that can be controlled using MCI commands. Such MCI-compatible devices may well provide an alternative to using CD.

Animations and effects Produced correctly, animations and effects can make a presentation more interesting. The animations can be aesthetic or functional, perhaps adding motion to a graph or chart. Popular programs that allow you to generate animation include Autodesk Animator and 3D Studio. The resultant .FLI or .FLC files can be imported into most presentation programs, and if you have Video for Windows you can convert them into the .AVI format. Actually producing an animation can be time-consuming, depending upon the type of animation you want. Bear in mind that in most cities you will find animation production companies, though you will need an appropriate budget to cover the cost of such production.

Video Easily the most persuasive of all the multimedia types, video can transform a presentation into an infinitely more engaging communication medium. Although PMPSV might be adequate for some presentations, you may prefer to use FMFSV, such as MPEG-1 and MPEG-2 video.
(See MPEG.)*

Video in presentations Often video is stored on hard disk, usually in the .AVI format. .AVI files can be created using Video for Windows together with an appropriate video capture board. All full-featured modern PC multimedia presentation programs can integrate .AVI files. Storing video in this manner can make presenting your multimedia production easier because there is a need for nothing more than an MPC-2 for playback. *(See MPEG*.)* Video quality is a function of the:

- compression techniques, where MPEG-2 can be assumed to deliver the best results
- quality of the analogue/digital video source
- quality of the analogue/digital video source device
- video capture board
- graphics card used in the presentation platform
- video capture technique: step-frame capture can result in better video quality than real-time video capture
- hard disk speed
- depth of video data
- processor speed
- size of external cache,

The second method is to use something like an MCI-compatible videodisc player and a video overlay card.

The script The script you write should convey all the messages you want to put across. A good approach is to begin by writing down the text you wish to display in each frame of your presentation. Remember, if your audience is to read the text it must be displayed using an appropriate font size. Although it probably goes

without saying, you should reinforce the text messages by repeating them verbally. Again this can be done by you or the presenter, or using recorded wave audio. The script you write is the gateway to completing your complete presentation. It will provide you with ideas as to where and when various different media types need to be included. More importantly, it provides the general sequence of events and gives you the basis for a storyboard. Say, for example, that we wanted to create a presentation advertising a special price holiday package to Australia that you might want to target at members of the public. It is a holiday package aimed at young professionals in the 18–30 age group. Because of this it needs to be upmarket while including features that may turn on young people. These features might include pop music of various sorts, lots of synthesiser sounds, punchy dialogue and interesting video and animations. The script, if appropriate, can be distributed among your audience as hand-out notes.

(See Multimedia.)*

Multimedia producer An individual given the task of captaining the production of multimedia applications/titles. Typically he/she will:

- liase with investors, if he/she is not the sole investor in the project
- often have control over the hiring of personnel, ranging from directors to programmers and multimedia production staff, who might include camera operators and even sound engineers
- be responsible for optimising the application of a given budget
- be responsible for originating marketable project ideas
- understand the technical issues that control the quality of a multimedia application
- direct personnel effectively, perhaps toward the use of contracted services and sources of multimedia or Web content
- receive praise or criticism for the complete project.

Multimedia production The process of gathering media files for inclusion in a multimedia application. Multimedia production embodies the implementation of all tasks necessary to attain (in appropriate format) audio and visual materials required. The following components are typical of the production process. The end result should be a collection of usable digital files that can be included in an application. It may involve the following processes.

- Capturing video using an appropriate video capture program and capture card.
- Editing digital video using a video editing program such as Adobe Premiere or Microsoft VidEdit supplied with Microsoft Video for Windows.
- Editing 8 bit video/graphics colour using a palette editor.
- Compressing video according to preselected parameters that are appropriate to the bandwidth of the target platform.

- Recording digital wave audio using a sound card/sound feature together with wave audio recording software.
- Editing wave audio files.
- Compressing wave audio files.
- Obtaining still images by scanning, using a still video camera or using Photo CD.
- Compressing graphics files and/or converting them into the appropriate file formats.
- Digitising text using a scanner.
- Marking up text files using a language such as HTML (HyperText Markup Language).
- Creating Web pages.
- Creating Java applets.

(See ActiveX, Multimedia, Multimedia authoring, OOP, Java, JScript, VBScript and Visual Basic.)*

Multimedia streaming Real-time delivery and playback of multimedia, which may be local or remote. Typically, it takes place over the Web or Internet, and requires a server and a client. Web applications include real-time monitoring or surveillance of remote locations, WebTV and video playback.

(See ASF, Multimedia, Streaming and Video*.)*

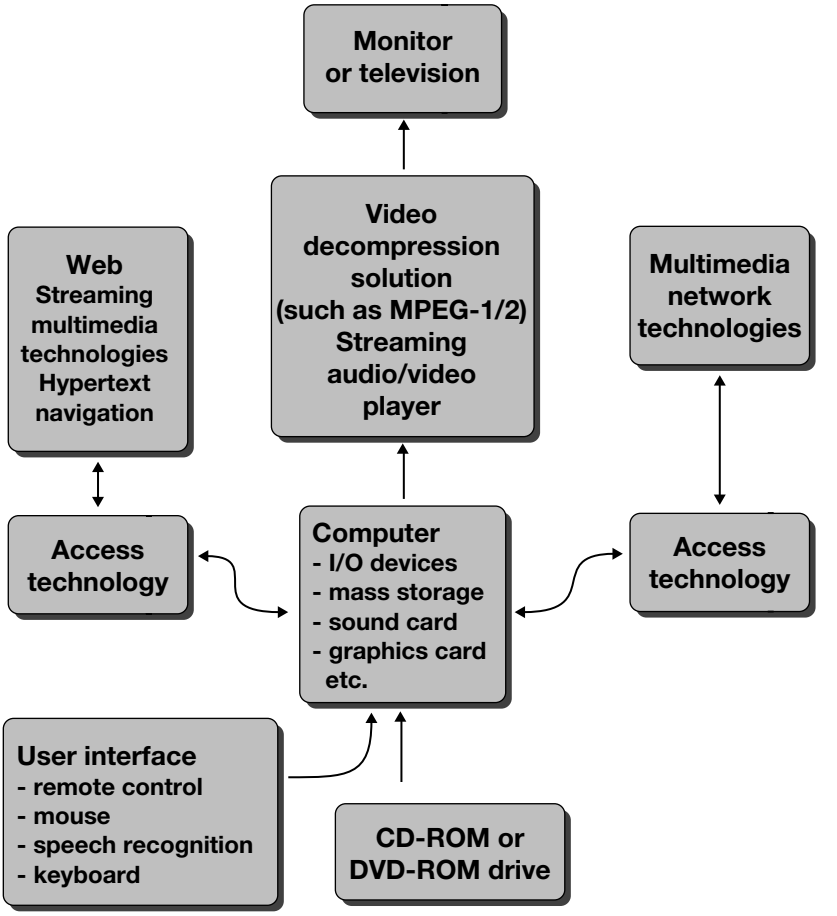
Multimedia system/appliance (See Figure on page 230). A device capable of playing multimedia titles. Examples include MPC-3, DVD-ROM-based PCs and Apple Macintosh computers. A multimedia appliance includes:

- a modem and Web browser
- an operating system, such as Windows 95/98/NT, Modular Windows, OS/2 or Mac OS
- a CD drive variant such as a CD-ROM or DVD-ROM drive
- a sound card that is at least MPC-2 compliant, able to play and record wave audio with a sampling rate of 44.1 kHz
- a stereo amplifier with accompanying speakers, or self-powered speakers, or simply a pair of headphones
- a video decoder

(See MPC-3.)

Multiple inheritance A concept where subclasses inherit methods and data from more than one superclass. It defines a class of objects, which inherit attributes and behaviour from multiple superclasses.

(See C++, Inheritance and OOP.)



Multimedia system/appliance

Multiplexing 1. A process by which an MPEG video stream is mixed with an MPEG audio stream to form an MPEG system stream. (*See MPEG* and Video capture*.) 2. A process by which multiple signals may be communicated along a single transmission path, which may be serial or parallel. The Integrated Services Digital Network (ISDN) standard uses multiplexing, which involves creating a data stream consisting of 8 bit PCM blocks. The blocks are created every 125 microseconds. By interleaving the blocks with those from other encoders, the result is time division multiplexing (TDM). In North America ISDN typically interleaves data from 24 64 Kbs sources or channels. This results in connections that provide 1.536 Mbps, although in actual fact the connection has a bandwidth

of 1.544 Mbps, because each channel's frame has a marker bit 'F', adding 8 Kbyte/s. Europe sees ISDN that typically interleaves 30 64 Kbps channels, giving 2.048 Mbps. This and the 1.544 Mbps connection are known as primary rate multiplexes. Further interleaving of primary rate multiplexes sees:

- 6, 45 and 274 Mbps in North America
- 8, 34, 139 and 560 Mbps in Europe.

PCM was conceived in 1937 by Alec Reeves, but was not applied widely for many years.

Multisync monitor A monitor that may synchronise itself with various incoming signals. There are many technical implementations of the 'multisync monitor', the simplest of which will automatically synchronise with perhaps two or three vertical frequencies. The term multisync was coined and registered by NEC. Professional versions are able to synchronise automatically with a range of horizontal and vertical frequencies. This is called the scanning range, and the greater it is, the greater the number of acceptable signal sources. Yet higher specification monitors economise on scan range, thus concentrating on the narrow band of professional graphic, controllers, beginning with VGA. Such monitors can be considered non-proprietary.

Multithreading A process by which multiple processes within the same application are executed concurrently, or what is perceived to be concurrently.

(See Parallel programming.)

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N

Nanometre A billionth of a metre.

Nanosecond A billionth of a second.

Navigating The process of moving between points via links in hypertext-based material such as Web applications. Originally navigating was a macro-level activity, in that it was a search for material by passing to and from high-level components. These include entries in indexes, lists of contents, and libraries of video clips, programs, graphics etc. Browsing was considered to be the process of moving to and from microfeatures in a hypertext-based information model. Today both operations are considered *browsing*.

(See Browse and Browser.)

NC (Network Computer) A computer designed for connection to the Internet or to an IP network. The subsequent rationalisation of hardware results in low system costs and reduced costs of ownership. Apple, IBM, Netscape, Oracle and Sun have issued the Network Computer (NC) Reference Profile. Base case NCs are not fully specified standalone multimedia devices. They do, however, offer streaming multimedia functionality that plug-ins and ActiveX controls may provide to the client. The NC Reference Profile guidelines below are general requirements and capabilities, many of which are supported involuntarily by all PC makers.

Support for popular IP protocols TCP (Transmission Control Protocol). Optional security is provided by the Secure Sockets Layer (SSL). FTP (File Transfer Protocol) for file exchange over the Internet. Telnet client/server protocol for optional character-based console access to remote hosts. NFS (Network File System) support for NCs that feature distributed file systems. UDP (User Datagram Protocol) for application-specific communications. SNMP (Simple Network Management Protocol)

System overview VGA screen resolution of 640 × 480 pixels. *X-Y* pointing device. Text input device (keyboard). Audio output. Local mass storage is not required.

Boot and configuration options DHCP (Dynamic Host Configuration Protocol) so that NCs can boot over a network and obtain IP addresses. Bootp enables an NC to boot over the network.

World Wide Web standards HTML (HyperText Markup Language) and CGI (Common Gateway Interface). HTTP (HyperText Transfer Protocol). Java Application Environment.

E-mail protocols SMTP (Simple-mail Transfer Protocol). IMAP4 (Internet Message Access Protocol Version 4). POP3 (Post Office Protocol Version 3).

Multimedia file formats JPEG graphics format. GIF graphics format. WAV wave audio format. AU.
(See MIME.)

NDIS (Network Driver Interface Specification) A standard specification for network interface cards (NICs). It provides functions, collectively referred to as a wrapper, which may be used by TCP/IP protocol drivers. It was developed by Microsoft and 3-COM. Its implementations for Windows may be assumed to be proprietary.
(See Network interface card.)

Nelson, Theodore The inventor of the term hypertext, and a dedicated hypertext evangelist. He also began project Xanadu, which paralleled the functionality of the Web.
(See Hypertext and Xanadu.)

Nested 1. *Nested transaction*: a technique which sees the integration of subtransactions within transactions. The subtransactions are said to be nested. (*See Server and Transaction*.) 2. *Nested loop*: a loop in a computer program that is encapsulated within another.
(See Java.)*

Net An alternative shorthand name for the Internet or The Net.
(See Internet and Web.)

NetBEUI An industry-standard network protocol.

NetBIOS (Network Basic Input Output System) A network protocol.
(See Protocol.)

NetMeeting A Microsoft technology which permits a multiplicity of communication and information exchange types over the Internet and over compatible IP networks such as intranets. The communications types supported include:

- Internet telephony
- Whiteboards
- Application sharing
- File transfer
- Chat
- Multiple participant conferences.

(See IRC, Whiteboard and Videoconferencing.)

NetMeeting SDK (Software Development Kit) An ActiveX control and suite of Win32 APIs that can be used to integrate conferencing features into applications. The NetMeeting SDK is freeware.

(See API.)

Netscape A company founded by Marc Andreessen, who developed its initial flagship product, the Netscape Navigator Web browser. The company continues to produce Internet software for users and for developers, including Netscape Communicator.

Netscape Navigator A Web browser produced by Netscape. Its functionality is improved through the addition of plug-ins. Plug-ins for streaming audio and video are available. Like many other browsers, Navigator can be used to send e-mail messages, but it is not an e-mail application. A bookmark menu assists users to list and revisit Web sites that are of interest. Images that are shown in the client area can be saved to disk by right-clicking on them.

(See Browser and Web.)

NetWare *(See Novell NetWare.)*

Network 1. A physical entity that unites computer systems. (*See Client/server, Internet, LAN and Web*.) 2. A physical entity which interconnects processors in an MPP. (*See MPP.*) 3. An interconnecting scheme for neural networks. (*See Neural network*.)

Network computing A broad term denoting the use of systems that are connected to physical networks.

(See Internet, LAN and NC.)

Network interface card A device used to connect a system to a network. It may be one (or even more) of a number of standard and proprietary variants, including:

- Ethernet
- Token Ring
- ISDN interface
- Fibre channel interface (arbitrated loop)
- Modem (such as an analogue or cable variant).

(See Ethernet)

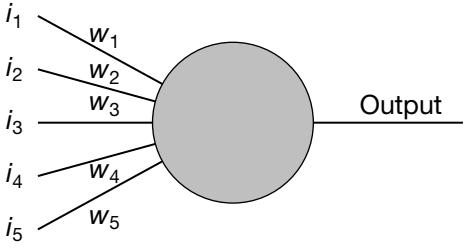
Network OLE A glue developed by Microsoft for distributing OLE component architectures. It has since been replaced by the Distributed Component Object Model (DCOM), which may be applied as a glue for ActiveX controls distributed across LANs, WANs, intranets and the Internet.

(See ActiveX, Glue and OLE.)*

Neural network A network of neurons, which function as processing units. Part of the field of artificial intelligence (AI), their implementation is an attempt to reconstruct the operation of the human brain, which has some ten thousand million neurons. The neuron connections have weights, which determine network behaviour. Given an example, the weights may be learned by the network. Neural network variants include the:

- perceptron
- multilayer perceptron.

The perceptron neuron was proposed in 1962 by Frank Rosenblatt, a significant figure in the development of synthetic neural networks. A computational neuron has input connections, each of which may have a different weight. The neuron is preprogrammed with a threshold value which, if equalled or exceed by the total weight of inputs, will respond accordingly. Typically the response is to output a specific value. Neurons differ from



Computational neuron

multiple input logic gates (such as AND, NAND, OR or NOR) in that the inputs may not be one of two logical values. The inputs *i* are assigned the weights *w*, and a positive output is yielded should a predefined threshold *t* be exceeded:

```
if i1w1 + i2w2 + 13w3... +inwn > t,
then output =1
  else
output =0
```

See: Cawsey, Alison, *The Essence of Artificial Intelligence*, Prentice Hall, 1998.

(See KBS.)

NeXT A company founded by Steve Jobs, the co-founder of Apple Computer. Its products include high-performance NeXT workstations and an advanced proprietary OS.

NeXTStep A GUI and operating system based on Unix and developed by NeXT, a company founded by Steve Jobs shortly after leaving Apple Computer.

Nintendo A consumer electronics company and maker of games consoles.

NNTP (Network News Transfer Protocol) A protocol for transferring Usenet news between servers, clients and a central server.

Non-interlaced A mode of CRT-based monitor/display operation in which the screen image is generated by scanning all lines in a single scan field. The rate at which all lines are scanned is termed the refresh rate or the vertical scan rate. The frequency at which lines are scanned is termed the horizontal frequency.

Non-linear medium A non-linear medium provides the user with the ability to control its sequence. The Web, for instance, presents the user with a non-linear medium.

(See Multimedia and Web.)*

Non-preemptive multitasking A type of multitasking in which the operating system does not interrupt applications. It is less seamless than preemptive multitasking in that a reasonable degree of concurrency is not achieved. Windows 3.1 (and earlier) and Windows for Workgroups 3.1x offer non-preemptive multitasking.

Notebook A portable computer with a footprint about the size of an A4 page. A sub-notebook is slightly smaller.

Novell A corporation which markets and sells Internetworking products. Its flagship product is NetWare.
(See Novell NetWare.)

Novell NetWare A network operating system which is optimised for serving information to a large number of users. It caches data read from servers in RAM.

NSFNET (National Science Foundation NETwork) A network created by the National Science Federation (NSF) in 1984, and originally platformed on five computers that were then categorised as supercomputers. The rationale behind the construction of NFSNET was not only to provide the US academic community with access to a repository of information, but also to provide access to leading edge supercomputers. The ARPANET was considered to be technically underspecified for this purpose. 1987 saw a major upgrading of NFSNET through faster computers and a higher backbone speed of 56 Kbps. Then in 1989 the NSFNET backbone was given T1 status, capable of transferring 1.544 Mbps.

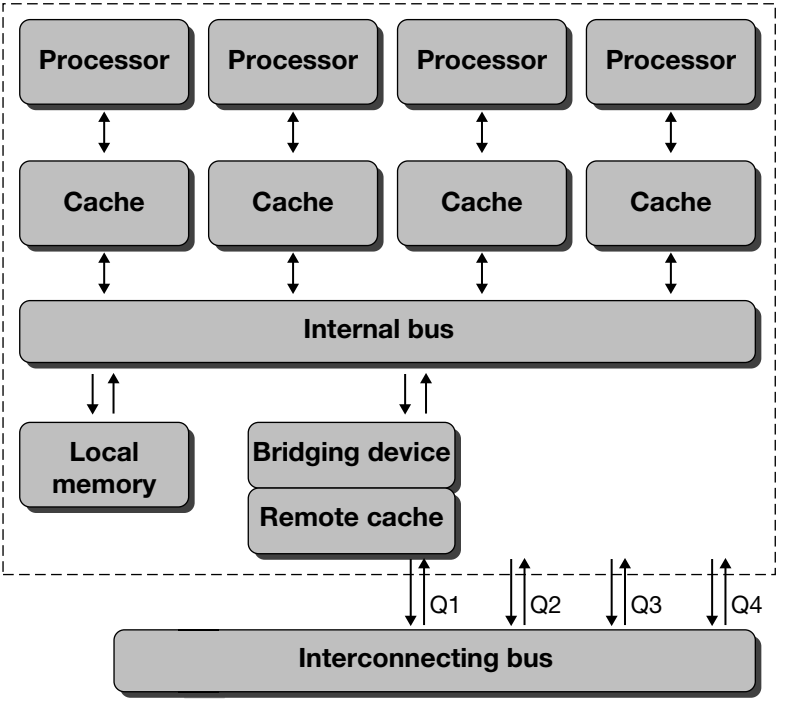
NT (New Technology) A 32 bit version of Windows, which features an extra layer to prevent general protection faults and unrecoverable application errors.

***n*-tier client/server architecture** A client/server architecture which sees multiple divisions of application logic and data. The divisions are distributed across four or more systems, which represents the number of tiers (*n*).
(See Application software and Client/server.)

NTSC (National Television Standards Committee) An American video/broadcast standard at 60 fields/30 frames per second on the 525 line system.

NUMA (Non-Uniform Memory Architecture) A variation of the SMP system architecture, NUMA attempts to solve the bottleneck of using a single shared bus to interconnect processors. Instead a number of internal buses are introduced, thus promoting processor scalability. NUMA systems have modules called quads, which include processors, memory and I/O devices that share an internal bus. Quads interconnect via a main bus. The NUMA architecture permits processors to access

- local and external caches
- local and external memory.



NUMA 'Quad-based architecture'

Its *non-uniform* characteristic hinges on the varying access time between local and remote memory access. Though NUMA is architecturally superior to SMP, it is not classifiable as an MPP system.

(See MPP and SMP.)

NVRAM (Non-Volatile Random Access Memory) A rewritable electronic memory device which preserves stored information following interruption of the power supply. It is useful for calendars and other alterable information which must be preserved after a system is switched off.

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O

Object An entity within an OO program or system which has methods (or internal code) that determines its behaviour in response to stimuli such as events and messages. Objects are the currency of OO systems.
(See C++, Java and OOP.)

Object-based (*See C++, Java* and OOP.*)

Object factory A term sometimes used to describe software publishers, who offer objects such as ActiveX controls, Java applets, JavaBeans, Plug-ins or OLE objects.
(See ActiveX, Java*, Plug-in and OLE.)*

Object implementation A coded solution which dictates an object's behaviour and response to events. The code represents the object's methods.
(See OOP.)

Object interface An object's outer conceptual layer, which intercepts messages and directs them appropriately. The layer is sometimes referred to as a shell. It is the first entity which an inbound message meets. The message may then be processed internally by the object's methods.
(See Object and OO*.)*

Object-oriented (*See C++, Java* and OOP.*)

Object-Oriented Database Management System (*See OODBC.*)

Object-oriented language (*See C++, Java* and OOP.*)

Object-oriented programming (*See C++, Java* and OOP.*)

Object-oriented programming language (*See C++, Java* and OOP.*)

Object-oriented UI (*See OO user interface.*)

Object schema A structure that defines the interactions and relationship of objects in an OO system.

(See OO.)*

Object scraping A method of mapping data from a server to objects. The objects are used to perform transactions or other types of processing. It may be applied in an application renovation solution.

(See Application renovation and Screen scraping.)

Occam 1. A programming language intended for developing software targeted at parallel systems such as supercomputers. It is closely aligned with the Transputer model for parallel processing. Named after William of Occam (circa 1300 to circa 1349), Occam is based on Co-operating Sequential Processes (CSP), which were originated by Tony Hoare. CSP puts forward the *monitor* concept, which coordinates tasks. Put simply, executing tasks are placed in monitors which are then locked, thus preventing other tasks from entering them. When the task is complete the monitor is unlocked, and may be entered by other tasks. Java is the first mainstream programming language to feature such concurrent programming features. Java objects have monitors, whose state is determined by the keyword synchronised. This is one of Java's key attributes, but is rarely publicised. When synchronised, other threads cannot execute Java object methods that have begun executing as the result of a thread. In order to run such methods, threads must be able to obtain the object's monitor lock. (*See Java and MPP.*) 2. An ancient philosophical principle that states we should not presume more to exist than is absolutely necessary. In the guise of Occam's razor it loosely translates to: if you have two or more possible paths, then select the easiest. However, the convenient route in the short term often proves the most difficult later on.

OCR (Optical Character Recognition) A process that converts scanned images of text into text files.

Octet A term used to describe eight consecutive bits.

OCX A control or object which was a forerunner to ActiveX. OCX controls can be integrated into compatible applications, yielding functionality gains that may take the form of complete applications such as grammar checkers. OCX controls can be written using Visual C++.

(See ActiveX, C++ and Visual Basic.)*

ODBC (Open Database Connectivity) An internationally agreed standard, covering database connectivity. Most modern databases offer ODBC compliance.

(See DBMS.)

ODBC 3.0 SDK A set of tools, libraries and headers which can be used to integrate ODBC 3.0 connectivity access in Web sites.

(See Data warehouse and ODBC.)

OLAP (On-Line Analytical Processing) A data analysis technique used predominantly in the client/server computing environment. It is a decision-making support technique, which may be applied to interrogate data from disparate sources. The resulting data may also be analysed. OLAP implementations can be assumed to embody multidimensional data analysis techniques, and to integrate:

- an OLAP GUI for user communication
- OLAP analytical processing logic
- OLAP data processing logic.

OLAP empowers users to generate query data in order to answer complex questions based on what-if scanarios or on current and historical data. It is an advancement of the primitive querying techniques harnessed in RDBMS designs. These include Borland (now Inprise) QBE and even query languages such as the industry standard SQL.

(See Data warehouse, MOLAP and ROLAP.)

OLE1 and OLE2 (Object Linking and Embedding) An object architecture. It is a method by which one application may be linked with or embedded into another. An OLE server application is the underlying source of an OLE client application. Objects may be video, wave audio, speech synthesis, MIDI files, graphics or text. The objects may be shown in the client OLE document or application as an icon, and can be launched by double clicking that icon. OLE can be used to embed Windows Media Player into client applications to add voice or video annotations to documents. Using OLE1-compliant applications the process of embedding an object is more intensive than that associated with OLE2 applications. Object embedding is made easier using OLE2-compliant applications, because objects can simply be dragged from one application to another. An increasing number of Window applications are OLE2-compliant.

(See ActiveX.)*

OLE client (Object Linking and Embedding client) An application which has an embedded object or application from an OLE server application.

(See Object and Visual Basic.)*

OLE DB SDK A Microsoft database access specification which bases itself on OLE and COM object architectures. It complies with SQL and non-SQL databases.

(See Database, ODBC and ODBC 3.0 SDK.)

OLE server (Object Linking and Embedding server) An application which provides an object for an OLE client application, providing a means of running that object from within the client application.

(See Object and Visual Basic.)*

Online state A state in which a computer or peripheral can perform its intended purpose. For example, a printer may print when it is online, and it is possible to communicate with a remote computer when it is online.

OO (Object-Orientated) A prefix used in object-oriented systems, software and development tools.

(See ActiveX, C++, Java, JavaBeans, Object and OOP.)*

OODBMS (Object-Oriented Database Management System.) A database used to store and to retrieve complete objects, including their code and their data. Stored objects may be categorised and stored in compound structures or objects. OODBMSes are characterised by their ability to:

- store complex objects
- be renovated or updated without radical renovation of data table structures associated with RDBMS implementations
- be extensible, providing a means of defining new data types
- support OO methodologies and concepts, including encapsulation, where objects' inner workings are hidden, and inheritance, where objects may be granted the methods and data of other objects. Multiple inheritance may also be supported where subclasses inherit methods and data from more than one superclass.

(See Data warehouse, DBMS, OO and OOP.)

OODL (Object-Orientated Dynamic Language) A programming language that is both object-orientated and dynamic, of which Dylan is a commercial example.

(See Dylan, Dynamic and OOP.)

OOL (Object-Oriented Language) A programming language which adheres to the object-oriented programming model.

(See C++, Java and OOP.)

OOP (object-oriented programming) A modular programming approach that depends upon reusable objects. OOP programming tools include Inprise Delphi, Optima++ and PowerSoft PowerBuilder. OOP languages include C++, Java and Visual Basic. In the real world we unconsciously place objects in classes. We know, for example, that cars, holiday chalets and computers are from different classes, but each time we see a car we don't ask ourselves: which class does a car belong to? Or why is it different from a holiday chalet? We know that it is a member of the class of vehicles because we have learned how it behaves, and that behaviour, with all its methods, is in our mind. We do not have to learn or consider an object's behaviour each time we come in contact with it. For example, you know that you cannot drive the holiday chalet because of its behaviour and the class to which it belongs. You know these things without having to repeatedly decide that a holiday chalet cannot be driven because it has no wheels, no axle, no engine and so on. Object-oriented programs are much the same. Classes of objects are carefully defined. If the class `HolidayChalet` were defined appropriately, we could not drive it by using, for example, the following command:

```
HolidayChalet.drive()
```

Only the correctly defined class, `Car`, could be made to drive using the command:

```
Car.drive()
```

Hierarchies form another important part of classes where, once again, as in the real world, classes are subdivided into further classes. This helps distinguish between, say, a sports car and a jeep. The jeep would be a member of the class `OffRoadVehicles`, which is a member of the class `Cars`, which in turn is a member of the class `Vehicles`. This additional information tells us that a sports car cannot be driven up a steep muddy slope etc. Everything in the real world is a member of a class, of which there are an infinite number. Some Windows databases come with a number of in-built methods to choose from. These cover standard activities such as opening tables and forms and even opening the Help window. This type of database building is achieved through a so-called 'pick and build' interface. The OOP model embraces:

- data hiding
- encapsulation
- reuse
- polymorphism.

OOP languages include:

- Java
- C++
- Smalltalk
- Visual Basic.

(See C++, Data hiding, Dylan, Encapsulation, Java, Parallel programming and Polymorphism and Smalltalk.)

OOUI (Object-oriented user interface) (*See OO user interface*.)

OO user interface A user interface which uses the object model as its underlying interface components. They are typically graphical user interfaces (GUIs or 'gooeys'). The Apple Macintosh is remembered as one of the first systems to feature a commercially successful OO UI, followed by NeXTStep, which was founded by Apple Computer's co-founder Steve Jobs. This was followed by the Microsoft Windows and IBM OS/2 OSes, which featured OO user interfaces.

(See ActiveX, C++, Java*, Object*, OO*, UI builder and Windows.)*

OpenDoc A standard object or component architecture initially aimed at the creation of compound documents. It is not as widespread as OLE or Microsoft ActiveX component technology.

(See ActiveX, Compound document, JavaBeans and OLE.)*

OpenGL A 3-D graphics language. OpenGL is remembered as having started life in the 1980s as IRIS GL, a graphics programming interface for Silicon Graphics workstations. It provides foundation components for the development of applications that base themselves largely upon 3-D graphics. It contains 120 functions to draw 2-D and 3-D images. Among other things, OpenGL provides developers with the necessary high-level programming components to shade polygons, texture-map or colour polygons with bitmaps, light scenes, create animations, perform atmospheric effects, and to depth cue or dim distant objects.

(See VRML.)

Open Inventor A 3-D developer's toolkit based upon OpenGL. It provides a library of C++ objects and methods, including geometric primitives, routines that interface objects with data entry devices, and tangible elements for lighting. Open Inventor is licensed to several companies including Template Graphics Software and Portable Graphics. Open Inventor has an ASCII file format.

(See VRML.)

OpenScript A programming language included in many versions of Asymetrix ToolBook. It fits into the same programming language category as Lingo, but is dedicated to the ToolBook environment and is not used as widely.

Coding a ToolBook presentation using OpenScript ToolBook applications are based on the metaphor of a book. Books are applications, and are divided into pages which are displayed in windows called viewers. Pages can have objects such as fields, buttons and graphics. Such objects can be shared among pages by placing them in a background that may be common to two or more pages. Usually each page is used for each screen in your application. For example, each definition in an encyclopaedia might be shown on an individual page. Equally, each record in a form-based database application may be confined to a single page. An authentic object-oriented environment, the buttons, fields, graphics, pages and backgrounds that make up a book are all objects. The properties of an object determine both its appearance and its response to events such as a mouse click. There is an array of ready-made objects in the tool palette. The tool palette lets you implant a variety of different objects including buttons, fields, lines, rectangles, polygons and ellipses. ToolBook operates in two basic modes: Author level and Reader level. The Author level mode provides access to ToolBook's drawing and programming tools. It lets you create books, create and modify page objects, and program in OpenScript. The Reader level mode provides all necessary features to run ToolBook applications, but does not provide access to the development tools. It lets users:

- navigate through pages and add pages
- type, edit and format text in fields
- print
- run OpenScript programs.

To prevent users changing ToolBook applications you can use the runtime version of ToolBook. While authoring an application you can switch between Author level and Reader level instantly in order to test applications under development. You toggle between Reader and Author levels either by selecting Reader or Author from the Edit menu or by pressing F3.

Scripts A typical OpenScript is shown below. It plays a MIDI file and shows a page of a video file in a stage. Take for example the script for page 1, which is shown below:

```
to handle enterPage
mmOpen clip 'intro'
mmShow clip 'intro' in stage 'intro'
mmPlay clip 'music'
end
```

Like all the scripts associated with page objects this event handler is activated by simply opening, or moving to, the page number. The second line simply opens the video clip stored as `intro` in the Clip Manager. With the `intro` clip open the third line shows the first page, or a current page, of the `intro` video file. Finally, the fourth line plays a MIDI file clip stored as `music` in the Clip Manager. All the

page scripts operate in the same way, except they have extra statements to close MIDI file clips. The button script below simply closes a MIDI file clip that is played by the page script and plays the video file in the stage. This requires just two lines of code using the `mmClose` and `mmPlay` commands:

```
to handle buttonClick
mmClose clip 'music'
mmPlay clip 'intro' in stage 'intro'
end
```

The script below illustrates a Pause button. It requires an additional `if…then` structure to determine whether or not the video clip is playing. This has to be included because an attempt to pause a clip that is not playing causes an application to crash.

```
to handle buttonClick
if mmStatus of clip 'intro' = 'playing' then
mmPause clip 'intro'
end if
end
```

The status of any clip can be obtained by using the `mmStatus` command.

(See Authorware Professional, IconAuthor, Lingo and ToolBook.)

Operating system (OS) A generic term used to describe the software elements that manage system resources and so provide an interface between the user and the system, as well as between software and the system. The shell, user interface or front-end is sensitive to a number of user commands. Popular operating systems include Windows 95/98/NT, OS/2 Warp, MS-DOS, DR-DOS, OS/2 and Unix.

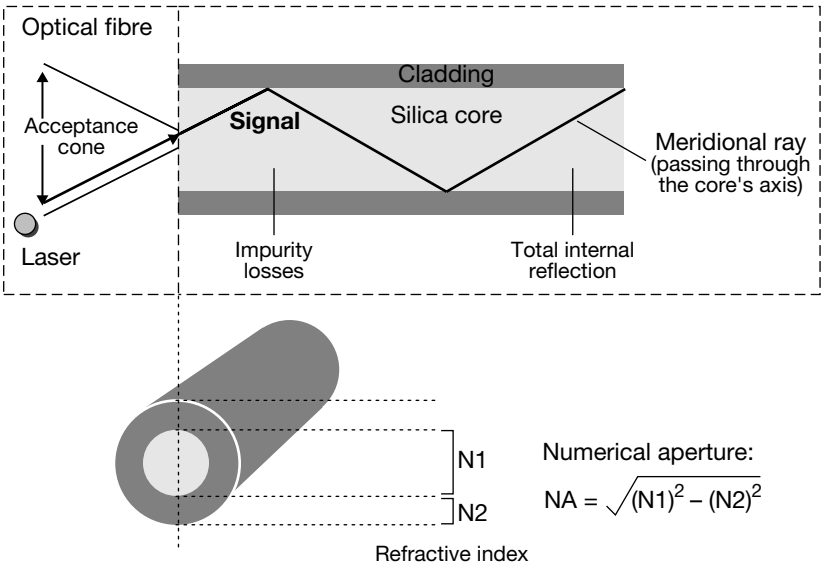
(See Windows.)

OPIE (One Time Passwords in Everything) (*See OTP.*)

Optical fibre A silica-based fibre that can propagate a light signal while inducing minimal losses. Light propagation is driven by total internal reflection. This is made possible using a core fibre and surrounding cladding of different refractive indexes. The light source must emit light into the cable at the critical angle in order to achieve total internal reflection. Applications include:

- lightwave communications
- flex sensing in gloves and bodysuits, which are used in VR.

Numerous different types of optical fibre exist, including graded and step-index. A step index is one in which the core silica is of one refractive index and its coating silica is of another index. A graded fibre consists of a core fibre that is coated with a number of grades of silica of differing refractive index. The advantages of optical fibre include:



Optical fibre – *monomode/single mode*

- low weight and ease of installation.
- immunity to electrical and reasonable levels of electromagnetic interference
- exceptionally wide bandwidth when compared to electrical conductors
- cost-effectiveness

The operation relies upon total internal reflection, given by reflecting injected rays in the cladding. The core and the cladding, therefore, have a different refractive index. The angle at which rays are injected into a fibre is critical in order to achieve total internal reflection and to propagate the ray appropriately. The numerical aperture (NA) of a fibre is a measure of the size of its acceptance cone or the range of angles at which rays must be injected. Propagated rays may be:

- meridional, which repeatedly intersect the core's axis
- skew, which spiral through the core without ever intersecting the axis. Their launch angle tends to be greater than that of meridional rays.

The light source must be an LED or laser device which lases at an appropriate wavelength. A multimode step-index fibre may have a core diameter of $\geqslant$50 micrometres and an NA of the order of 0.15 to 0.4. They are able to propagate a substantial amount of emitted light from an LED. Injected light is dispersed into many thousands of paths called modes. A monomode step-index fibre has a smaller core and an equally low NA (which is typically 0.1).

(See LED.)

Optical medium A generic term used to describe a medium which is read using an optical read head. CD variants are optical media, and include Audio CD, Philips CD-I discs, CD-ROM, CD-V, CD-ROM XA, Photo CD, Video CD and DVD. Other optical media include LaserVision and Sony Mini disc.

(See CD-ROM and DVD.)

Oracle A database development environment produced by the company of the same name.

Oracle Media Objects An object-based multimedia authoring tool.

Orange Book A set of security standards developed by the United States Department of Defense, and formally named the Trusted Computer Standards Evaluation Criteria.

(See Security.)

OS/2 (Operating System/2) A PC operating system. Launched in mid-1987 to coincide with the release of the IBM PS/2 family of computers, it is a multitasking operating system able to run applications simultaneously, and is downwardly compatible with DOS. OS/2 is used in conjunction with Presentation Manager, a GUI. Relaunched in 1992 by IBM under the name OS/2 2.0, it is now a relatively successful 32 bit operating system. It is also able to run Microsoft Windows applications in either real or standard modes. The release of OS/2 2.1 in mid-1993 saw the inclusion of multimedia extensions, which compare with those of Windows.

OS/9 (Operating System/9) An operating system originally developed for the Motorola 6809 processor in the late 1970s, and used widely on micro-computers based on the 6809 and subsequent processors of the Motorola family. The Tandy Colour Computer, Atari ST and Dragon 32/64 were all able to run OS/9. Because CD-I is based on a Motorola processor, OS/9 was adopted and modified for Philips' purposes, calling it CD-RTOS (Compact Disc–Real-Time Operating System).

OSI (Open System Interconnection) A seven-layer industry-standard reference model which is applied extensively to client/server architectures and was introduced in 1984 by the ISO (International Organization for Standardization). It provides a standard infrastructure for the applications, glues and communications required of modern client/server implementations. The seven layers include the following.

- *Application*, which encompasses client- and server-side programs, such as e-mail clients and browsers at the front end.

- *Presentation*, which is the formatting layer, delivering such operations as protocol conversion and compression. A typical application sees clients' SQL requests converted to a format that complies with the SQL server.
- *Session*, which permits a conversation between programs, objects or processes.
- *Transport*, which provides error detection and correction operations for communicated data, and adds a transport layer ID.
- *Network*, which operates to break down transmitted data into packets (with sequence numbers), and to reassemble them into a readable message on reception. It may be assumed to route packets to an appropriate node.
- *Data-link*, which receives packets from the network layer and adds control information to their headers and trailing regions. The resulting frames are passed to the physical layer when appropriate access is detected.
- *Physical*, which converts frames into binary data so that it may be transmitted, and returns this data to frames upon reception at its intended destination.

(See Application, Client/server and Glue.)*

OSPF (Open Shortest Path First) A protocol used in routers.

OTP (One-Time Password) A password protection security policy to prevent illegal access. In many instances it does not prevent hackers from monitoring the network and gaining access to information. OTP variants include:

- Wietse Venema's LogDaemon
- Bellcore's S/KEY Version 1.0
- BellCore's Commercial S/KEY Version 2.0
- United States Research Laboratory's (NRL) One Time Passwords in Everything (OPIE).

(See Encryption.)

Overlay A screen image laid on top of another. It often applies to mixing computer-generated images with video.

OzEmail An Australian ISP that also operates as an international telecommunications company using Internet Telephony, which it calls *OzEmail Phone*.

(See Internet telephony.)

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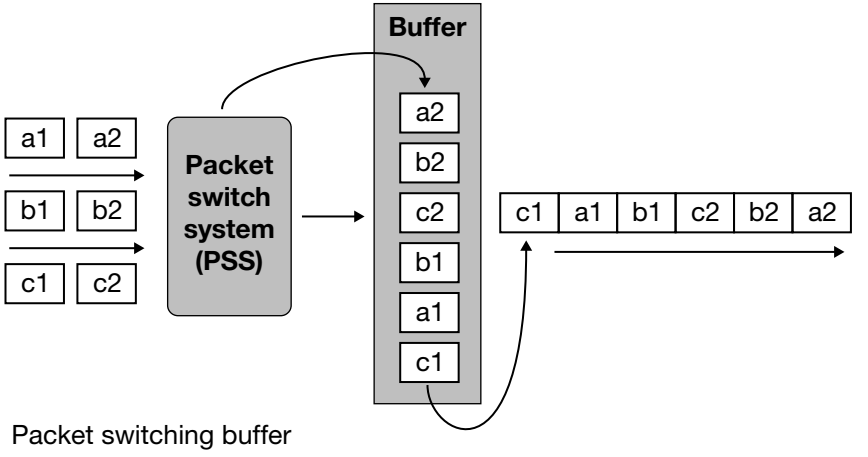
P

Packet filtering A method used to promote network security, where packets are filtered according to predefined criteria. Packet filtering is possible using screening routers and security gateways.

(See Screening router and Security gateway.)

Packet-switched network A data transmission and reception technique where data streams are divided into packets coded with origination and destination information. The packets may be interleaved with different data transmissions. For instance, packets that may be providing a two-way audio communication link in IP telephony might be interleaved with other streams such as videoconferencing data. Packets may follow dissimilar routes over a network, and are directed over what are perceived as the quickest and least congested routes. If available routes or logical channels are congested, then packets are buffered before transmission. The buffer is a FIFO (first in, first out) storage, where the first packet placed in the buffer



Packet switching buffer

is the first to be retrieved and transmitted when the appropriate virtual channel is available. The X.25 protocol standard dictates that a packet may contain between three and 4100 octets or bytes. *(See X.25.)* Up to 4095 logical channels may be accommodated on a single physical link (1997). The logical channel followed by a packet is determined by its header information. There is also error correction, where the receiver might request that a particular packet is re-transmitted. The original packet switching standard for public data networks is CCITT X.25. This is a multi-tiered recommendation embodying everything from physical connectors to data formatting and code conversion. Packet switching is rather like the logistics involved in shipping a motor car part by part. The disassembled parts are sent and then assembled at the factory of destination. Equally, if a part is damaged, the factory will request that it is sent again. The packets may have one of two identities:

- multicast packets (or items of transmitted information) can be delivered to more than one destination
- unicast packets have one destination only.

Packet-switched networks (that use IP) are currently displacing switched networks in the telecommunications industry, and drive the growing use of IP telephony or Internet telephony. The comparative advantages of IP telephony include reduced costs and reduced cost of ownership for telcos and corporations running IP-compatible networks such as intranets. The reduced costs are largely brought by the fact that IP and Internet traffic is unregulated. Corporations and government departments may experience savings in the cost of voice traffic that might reach as much as 80 per cent. Flexibility is also an advantage. IP telephony makes better use of bandwidth. For example, Australian telecommunications giant Telstra introduced the virtual second line in the late 1990s. This allows subscribers to its ISP (Telstra Big Pond) to receive incoming calls while connected to the Internet. *(See Internet telephony.)*

Paintbrush A Windows application used for editing and drawing.

PaintShop Pro A popular graphics capture, and editing program. It has numerous special effects.

PAL (Phase Alternating Line) A video standard developed in West Germany, delivering 50 fields/25 frames per second on the 625 line system. Used in the UK, much of Europe, Africa, Australia and South America.

PalEdit An 8 bit colour palette editing program supplied with Video for Windows and other programs that include Asymetrix ToolBook 3.0.

Palette An item of colour information accompanying 8 bit digital video sequences and images.

Palette editor A program used to edit the palette of 8 bit graphics or video. Palette editors such as Microsoft PalEdit are used to alter the colour characteristics of 8 bit video sequences. They are also useful for building palettes that work with a number of different 8 bit video files. The importance of this relates to switching between two or more different 8 bit sequences on screen that contain different palettes, which can result in flicker. The degree to which the flicker occurs depends upon the difference that separates the palettes, as well as upon the general video and graphics speed of the playback system. Building a common palette is easiest if you run multiple instances of the palette editor, provided the program has this capability, or where it is possible to open multiple palettes.

Palette switching An instant when a colour palette is switched from one to another. Palette switching occurs most often when 8 bit video is cut from one sequence to another which has a different colour palette, or when one 8 bit still image is cut to another which has a different palette. Palette switching can result in a brief screen flicker. The screen flicker can be eliminated using a common palette for all bitmaps (images) and video clips. A common palette can easily be achieved using a palette optimiser or by using an editing program such as PalEdit.

Paradigm A workable and (to many) conceivably optimum model that defines the manner in which an activity should be implemented. Multimedia and the Internet may be considered as paradigms for communicating information.

Parallel programming (or concurrent programming) A genre of programming where the target system is an MPP architecture. Parallel or concurrent languages include Java and Occam. Named after William of Occam (circa 1300 to circa 1349), Occam is based on the idea of Co-operating Sequential Processes (CSP), which was originated by Tony Hoare. CSP puts forward the *monitor* concept, which coordinates tasks.

(See Java, MPP and Occam.)

PARC (Palo Alto Research Center) A research establishment founded in 1970 by Xerox. It is the birthplace of many multimedia-associated technologies and concepts, including laser printing, local area networks, the graphical user interface (GUI) and object-orientated programming (OOP). The GUI system integrated into the Apple Macintosh, launched in 1984,

was a direct result of Apple's Steve Jobs visiting PARC. During his visit he saw a GUI platformed on PARC's Alto system.

(See Windows.)

Parity bit A bit used in data storage and electronic memory to indicate whether an item of data should contain an odd or even number of positive bits. A parity bit is used in 9 bit electronic memory devices such as 9 bit SIMMs.

Parser A function of a compiler, interpreter, or translator that attaches semantics to tokens, which are generated by the lexical analyser.

(See Java.)

Partial frame updates A video frame that is not a full frame. Compressed video is often composed predominantly of partial frames which cannot be displayed in isolation because they do not contain the necessary frame information. Partial frames rely on preceding frames to provide adequate frame information. MPEG contains such partial frames in the form of Bi-directional (B) frames.

(See MPEG.)*

Pascal A high-level general purpose programming language that is used in Inprise Delphi. The original implementation was developed in the mid 1960s by Prof. Niklaus Wirth of Eidgenössische Technische Hochschüle, Zurich. A structured language, it was one of the main advancements in computer programming languages to follow Algol 60. The most popular and successful implementation of Pascal was Turbo Pascal from Borland (now called Inprise).

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

Password A series of alphanumeric characters used to protect a system against unauthorised access. Using TCP/IP, the password file is used to prevent unauthorised access.

(See Security.)

Path/trail A path through a series of links in hypertext, hypermedia or multimedia material.

PC A generally standard architecture for desktop and notebook computers. In terms of specification PCs vary dramatically. The standard was introduced by IBM when it launched the PC XT in the early 1980s. This

was a text-based system, featuring an Intel 8086 processor and an 8 bit expansion bus.

PC Card (*See PCMCIA.*)

PCI (Peripheral Component Interconnect) A local bus implementation which permits the addition of expansion cards to a system. Such cards typically include graphics controllers, internal modems and sound cards. Local bus technology provides high performance communications between such devices and the system processor and memory. It does this by providing a data path width and operating clock speed that is more closely matched to the internal and external data bus of the processor. While PCI has become the industry's chosen local bus standard, Vesa Local Bus (VLB) is also used. Non-local variants include:

- IBM's 8 bit XT bus
- IBM's 16 bit ISA (Industry Standard Architecture) or AT (Advanced Technology) bus
- IBM's MCA (Micro-channel Architecture)
- EISA (Enhanced Industry Standard Architecture).

(See AGP.)

PCM (Pulse Code Modulation) A method of encoding data in digital form for transmission over a network or for storage on DSM. Used in the Integrated Services Digital Network (ISDN) standard, multiplexing involves creating a data stream consisting of 8 bit PCM blocks. The blocks are created every 125 microseconds. By interleaving the blocks with those from other encoders, the result is time division multiplexing (TDM). In North America ISDN typically interleaves data from 24 64 Kbps sources or channels. This results in connections that provide 1.536 Mbps. In fact the connection has a bandwidth of 1.544 Mbps, because each channel's frame has a marker bit 'F', adding 8 Kbyte/s. Europe sees ISDN that typically interleave 30 64 Kbps channels, giving 2.048 Mbps. This and the 1.544 Mbits/s connection are known as primary rate multiplexes. Further interleaving of primary rate multiplexes sees:

- 6, 45 and 274 Mbps in North America
- 8, 34, 139 and 560 Mbps in Europe.

PCM was conceived in 1937 by Alec Reeves, but was not applied widely for many years.

Sampling Using ISDN, a 3.4 kHz analogue signal is sampled at 8 kHz. The sampling rate is less than twice the bandwidth of the analogue signal, in accordance

with Nyquist's sampling theorem, and prevents aliasing. A sampling frequency of a multiple of 4 kHz was used because the existing networks used 4 kHz carriers, and would cause audible interference in the form of whistles.

Coding The amplitude of each sample is measured and encoded using 12 bit values, which give ± 2048 possible values.

Compression The 12 bit samples are reduced to eight bits using logarithmic compression, which may be:

- 'mu-law' in North America
- A-law in Europe.

Compression standards permit the system to be embedded anywhere in an analogue network. See: *CCITT Recommendation G.711. Pulse Code Modulation (PCM) of voice frequencies.*

(See ATM, ISDN and T1.)

PCMCIA (Personal Computer Memory Card International Association) A slot which connects with almost credit card-size peripheral devices. The exact dimensions of a PCMCIA card are 8.5 cm × 5.5 cm, and their thickness may be 3.3 mm, 5 mm or 10.5 mm. Memory cards are 3.3 mm thick, I/O devices are 5 mm thick and hard disks are 10.5 mm thick. The original PCMCIA was designed for memory cartridges only, but in September 1991 the PCMCIA Type II (PCMCIA 2.0) specification was launched, facilitating hard disks and modem/facsimile devices. However, though the PCMCIA laid down a hardware specification for slots and cards it did not specify a software interface, so some PCMCIA cards are proprietary. To solve this Intel introduced a standard interchangeable card aimed at Intel-based machines. Called Exchangeable Card Architecture (ExCA), third-party manufacturers are free to use the logo provided their cards are ExCA-compliant.

PCX A bitmap file format developed by ZSoft, featuring RLE compression.

PDA (Personal Digital Assistant) A pocket-size appliance which provides data entry using a stylus or pen and can be used to support computer-related applications. Apple is remembered for having introduced the first commercial PDA in the Newton. PDAs exist at a number of different levels. The most basic are mere personal organisers, while highly specified versions feature cellular communications able to send faxes and communicate with remote systems and connect to the Internet. The PDA vision is that of a mobile communications device that embodies a mobile video phone, a means to access the Internet and a remote personal computer.

Peer-to-peer network A network that permits each network user to access the directories and the peripheral devices associated with any connected computer. When computers are linked together so that they can share the resources of one or more computers, a network is formed. You can build a peer-to-peer network using Windows 95/98, simply by adding Ethernet cards to connected systems. Another type of local area network (LAN) is the server-based variant, which permits users to access and share information stored on a powerful computer, commonly termed a server.

Pentium A fifth-generation Intel processor, and successor to the 486DX family of processors. Currently the Pentium with MMX Technology is the *de facto* Intel fifth-generation processor. MMX Technology is the registered trade name for Intel's additional instructions that lend themselves to multimedia. They drive performance gains through such applications as speech recognition, video and 3-D graphics. The clock speed of the Intel Pentium processor has increased steadily, and currently there are 200 MHz, 233 MHz and 266 MHz versions. The more modern Intel Pentium II processor offers yet higher performance.

(See MMX Technology and Pentium II.)

Pentium II An Intel processor which integrates MMX Technology as standard.

(See MMX Technology and Pentium.)

Pentium Pro A sixth-generation Intel PC processor which integrates SMP design features. It used for servers and for workstation class PCs.

(See Pentium and SMP.)

Perl (Practical Extraction and Report Language) A programming language for processing text. It was developed by Larry Wall who once joked that Perl stood for 'Pathologically Eclectic Rubbish Lister'. He describes Perl as: '…an interpreted language optimized for scanning arbitrary text files, extracting information from those text files, and printing reports based on that information. It's also a good language for many system management tasks. The language is intended to be practical (easy to use, efficient, complete) rather than beautiful (tiny, elegant, minimal). It combines (in the author's opinion, anyway) some of the best features of C, sed, awk, and sh, so people familiar with those languages should have little difficulty with it. (Language historians will also note some vestiges of csh, Pascal, and even BASIC-PLUS.) Expression syntax corresponds quite closely to C expression syntax …'

Perl variables Scalar variables are assigned single data values, which may be integer, floating-point or string:

```
$transform=25;
$response="You did not enter the correct patient
symptoms.";
```

Numeric variables are incremented using the syntax:

```
$transform=$transform+1;
```

or

```
$transform++;
```

Numeric variables are decremented using the syntax:

```
$transform—;
```

Subroutines are named using the sytax:

```
&subroutine;
```

Perl arrays An array of scalars is defined using the syntax:

```
@trans(2,4,5);
@forward (7,8,9);
```

The number '4' in the defined three-element array is addressed thus:

```
$tate=@trans(1);
```

Arrays may be combined using the syntax:

```
@combine=(@trans, @forward);
```

The definition of array variables is accompanied by the generation of scalar variables (of the same name), which have the `@#` prefix. These store the array size, or more precisely the sequence number of their final element. The array size need not be defined, and it is legal to insert elements into an array at whatever point, thus:

```
@transform = (10,25,35,55);
$tranform[25] = 7;
```

An associative array of scalars may be assigned to a variable (with the `%` prefix) thus:

```
%transform = ("x",100, "y",20, "z", 20);
```

This equates transform to the element strings `x`, `y` and `z`, whose values are 100, 20 and 20.

Subroutines Subroutines begin with the word `sub` and the code or block is contained within opening and closing braces:

```
sub transformt_every {
  $tate=@trans(1);
}
```

(See CGI.)

Personalisation A Windows NT-based server which is part of the MCIS suite of servers. It functions to allow Web developers to deliver specific dynamic content to individual visitors.

(See MCIS.)

Personal Web Server (*See PWS*.)

PhotoCD A CD variant developed by Kodak in conjunction with Philips, and launched in 1992. PhotoCD permits the processing of photographic negatives into digital form on PhotoCD disc. Kodak continues to license high-street photographic finishers to develop conventional film reels into images on PhotoCD using a CD-R drive. Additional films can be processed and added to the same PhotoCD on up to 99 different occasions (99 being the maximum number of tracks supported). Following the addition of the second batch of images, it becomes a multisession CD.

PhotoShop *(See Adobe PhotoShop.)*

PicoJava A chipset from Sun Microelectronics which is optimised for the Java programming language. It is used in cellular phones and computer peripherals.

(See Java and Sun Microelectronics.)*

Ping A name for ICMP (Internet Control Message Protocol) Reply/Echo. It is also used to describe programs that use ICMP. ICMP is used to test the reliability and connection speed to a remote host. The reply to such a test is called a pong.

Pipe A network communication channel, which provides a means of transferring packets between *local* or *wide* destinations. Pipes have addressable names and can be used to send and receive data (which is typically assembled into packets) to and from a central computer over a WAN.

Pixel A dot on screen, or stored in memory, that is represented using a number of bits. On CRTs, pixels physically consist of red, green and blue phosphor deposits. The term is derived from the phrase 'picture element'.

Plug-in A module that adds functionality to an application. In the case of a browser, a plug-in might take the form of a video playback feature. Numerous plug-ins are available for the Netscape Navigator browser. An alternative technology to Microsoft's ActiveX Controls, plug-ins tend to be

a feature of browsers. ActiveX Controls are applied more broadly and cut through boundaries that separate many different software sectors, including client-side and server-side component architectures. The plug-in architecture adds processing capabilities to the client browser and displaces logic from the server side.

(See Active Desktop, Active document, Active server, ActiveX and Netscape Navigator.)*

PMPSV (Part Motion, Part Screen Video) A video sequence that runs at a rate noticeably slower than 25 frames per second, and has a frame resolution that fills only a portion of the available screen.

PnP (Plug and Play) A hardware specification that ensures easier installation using Windows 95/98/NT. PnP hardware devices can be detected and installed automatically by these versions of Windows.

POI (Point Of Information) A means of exhibiting products electronically through the Internet or other medium such as CD-ROM or DVD-ROM. Traditionally, consumer education has consisted of publishing product brochures, advertising, allowing the potential customer to peruse in a shop or showroom and product demonstrations. These generally accepted ways in which the consumer chooses an appropriate product can be aided or replaced using multimedia in a point of information (POI) guise. POI terminals present the customer with the ability to browse through product ranges, or experience just those items that fit a user-defined profile. POI can be a powerful marketing and advertising tool, providing the means to display products. The benefits are clear: it gives an opportunity to promote products in a medium that cannot be rivalled by (current) television advertising. It also allows small and medium-sized companies to promote products on terms that only large companies and corporations could previously afford. Furthermore, if products can be demonstrated adequately through multimedia, the need to exhibit them physically becomes unnecessary, so floor space can be saved. Research also indicates that users of POI terminals spend more money than those shoppers using conventional means. Finally, the possibility of fewer sales staff is raised. With the growing number of multimedia systems in the home and with the falling price of disc replication, POI may be distributed free, like junk mail. In the computer industry, there is also the possibility of distributing short advertisements/demonstrations containing video sequences on floppy disk. Museums of various kinds throughout the world have installed POI terminals. These give visitors the opportunity to follow user-defined guided tours. Such an approach also allows visitors to experience interesting items which might otherwise be catalogued and hidden away from public view. Many other

areas, such as careers advice, geographic information systems and surrogate travel (brochures) are also possible through POI.

Polymorphism An object-oriented concept where an entity has many forms. For example, a function call can be used to apply an object in different ways. The object might be a button, whose various forms include different methods which determine its response to mouse clicks. Polymorphism allows messages to stimulate context-sensitive processing. For instance, the message might be interpreted by one of a number of methods in a single object.

(See C++, Java and OOP.)

POP3 (Post Office Protocol) A protocol for sending and receiving e-mail. Compliant e-mail applications are called POP3 agents.

Port 1. A channel through which a computer communicates/drives a peripheral device. Standard PCs include Centronics parallel ports and serial ports (which are often referred to as COM ports). Typically parallel ports are used to connect with such peripherals as printers, mass storage devices and scanners. Serial ports are often used to connect with external modems. Other ports include FireWire and USB (Universal Serial Bus). 2. A method of translating a program from one platform to another, or from one language into another.

POS (Point Of Sale) A method of selling products or services from e-commerce Web sites, or even multimedia booths. It is a rarely used term, with *e-commerce* being the preferred label.

PostScript A standard formatting language used to store and print documents. Many commercial printers and reprographics bureaux are able to accept files in the PostScript format, from which they are able to print or produce film. The language itself is the property of Adobe. PostScript printers are more expensive than others, mainly because Adobe require licence fees.

PowerBook A range of notebooks manufactured by Apple Computer. Such notebooks may operate as DOS, Windows and Windows NT systems using emulation software.

PowerPC A processor architecture designed for Microsoft and Apple OS compatibility. The technology is integrated in Apple desktop and notebook systems.

PowerPoint A presentation program that is marketed and sold by Microsoft. It may also be used as a drawing package, and is included in the Microsoft Office integrated package.

PowerPoint Animation Player A Microsoft animation player, which may be added to Web pages.

(See ActiveX control.)

PPP (Point-to-Point Protocol) A standard protocol used with standard access technologies such as POTS and ISDN. Such connections to ISPs see it used with the IP protocol.

(See SLIP.)

PPTP (Point-to-Point Tunneling Protocol) An evolution of the Point-to-Point Protocol (PPP) which may be applied to the construction of VPNs (Virtual Private Networks).

(See VPN.)

Precedence In C++, arithmetic operators have a precedence value. These indicate the order in which such operators are implemented, which is significant with expressions such as:

```
dev = xx + yy* zz + yy;
```

Control over such arithmetic operations is obtained by using parentheses, i.e.:

```
dev = (xx + yy)* zz;
```

Parentheses can be nested.

(See C++.)

Preemptive multitasking A type of multitasking in which the operating system interrupts applications running concurrently. It is more seamless than non-preemptive multitasking in that a higher degree of concurrency is achieved. Windows 95 and OS/2 Warp embody preemptive multitasking.

Principal A user or software component or object which uses services.

Private key encryption An encryption model that requires the sender and the receiver of encrypted matter to use a single password key. The size of the key (in bits, such as 56 bit) is a function of the encryption techniques harnessed.

(See Cryptography and Encryption.)

Process flow A diagram which shows the processes included in a system architecture. It shows how the processes, and their leaf processes, inter-relate and interact with entities that might be data or program modules.

Processing power A measure of a system's processing performance, it may be measured in:

- millions of floating point operations per second (MFLOPs)
- gigaFLOPs or billions of FLOPs (GFLOPs)
- teraFLOPS or trillions of FLOPs (TFLOPs)
- the rate at which instructions are executed in millions of instructions per second (MIPs)
- SPECmarks
- whetstones
- dhrystones.

(See Dhrystone and Whetstone.)

Processor A device that embodies the functionality of a CPU (Central Processing Unit). The familiar Intel PC processor continuum broadly equates to: 4004, 8088, 80286, 80386DX, 80836SX, 80486DX, 80486SX, 80486DX2, Pentium, Pentium Pro, Pentium II. The generic PC processor continuum is a little more complex, with companies such as AMD (Advanced Micro Devices) and Cyrix producing reverse-engineered, and often enhanced, Intel-compatible processors.

Production The process of marrying media files with hypertext-based structure on a multimedia application. At this point in development, the application can be tested. Easily remedied bugs of various kinds warrant a return to the application development stage for fine-tuning. More serious problems, such as inappropriate paths, indicate inadequate testing at the storyboard (design) stage, and can necessitate significant modification. Testing (in the form of a CD simulation) requires the building of a precise disk image, which reflects the actual data content of a required CD-ROM or CD-I disc. For simpler applications, testing can often be carried out from within the authoring environment.

Program Manager A desktop metaphor used in pre-Windows 95 versions of the Windows operating system. It provides double-click access to all the different applications that can be run using Windows. It consists of group windows that contain different categories of application. The Main program group, for instance, consists of important Windows utility programs, including the File Manager and Control Panel. The release of Windows 95 saw the inclusion of an alternative to the Program Manager in the form of

the Start button, which provides access to applications via a menu system. The menu system can be browsed and navigated by dragging the mouse. Menu items include programs and sub-menus which replace group windows. Menu items are invoked using a single mouse click. The group windows making up the Program Manager can be moved, resized, maximised and minimised. The Window menu on the Program Manager allows group windows to be tiled or cascaded (stacked diagonally).

(See Explorer.)

Programmer A broad term used to describe a person engaged in developing computer programs. Programmers tend to specialise. For example, applications programmers might specialise in the development of financial systems, RDBMSes (Relational Database Management Systems) or client/server applications. RDBMS programmers might use programs/development tools such as Paradox for Windows, dBase, FoxPro, Microsoft SQL Server, DataEase for Windows and Compsoft Equinox. High-level language (HLL) programmers might specialise in C++, Java or Visual Basic. Low-level language (LLL) programmers, or machine code programmers or software engineers, work at the machine code level. They generally program using assembly languages that are indigenous to different processors.

(See C++, Java and Object*.)*

Project planning The process of organising a project so that its component parts are completed on time. The compilation of a design, development and production schedule is essential for the efficient use of studio time or for providing a completion date. As with costing, estimation may play a role, the accuracy of which will increase with greater experience. A reasonable starting point for accurate scheduling is a design network, within which the frequency of targets or milestones depends upon fineness of granularity. A low-level approach will yield a more accurate basis upon which to build a precise schedule, where each stage can be allocated a precise period of time. The real function of a design network, however, is to illuminate a critical path, highlighting those stages whose target dates, will, if exceeded, set back the entire project. Equally, less important stages manifest themselves. For example, it might be found that certain production processes running in parallel with application development can overshoot target dates without setting back the completion date.

PROM (Programmable Read-Only Memory) A type of read-only electronic memory that is used to store firmware such as BIOS (Basic Input Output System) software.

(See BIOS.)

Protocol A format used to transmit and to receive data. Examples of industry standard protocols include IP, Ethernet, SMTP and HTTP. Each protocol is optimised for the information it is intended to carry and for the network over which it is to be used. A protocol often consists of:

- an information field for data
- the destination address
- error detection and correction codes
- originating address

All of this information is held together in a single unit, which might be a *packet*, *cell* or *frame*. In IP networks, such as the Internet and intranets, they are called packets, but it is just a new term; really they are all the same thing. The packets are assembled at the point of transmission, and sent over various different paths to their destination. Once received they are checked for errors and then appropriately assembled. Network protocols are analogous to the Royal Mail: the packets are comparable to envelopes, and they have destination and originating addresses etc.

(See TCP/IP.)

Prototyping The process of developing an initial working model of a multimedia application. Often it will consist of the hypertext structure only, and in some instances it may be little more than an electronic storyboard authored using either an authoring tool or presentation program. It might include some media, such as MIDI files, wave audio files, graphics, animations and video sequences, depending on their availability. Navigation, or retrieval system design, is often verified through an electronic storyboard emulation. Hypermedia authoring tools such as HyperCard provide a prototyping environment where nodes or objects can be created and linked at the required levels. This permits thorough testing and fine-tuning of meaningful paths at an early stage. The number of person-hours consumed during this stage of design, verification and testing is a function of title complexity in terms of user interaction. This will be related to the number of links implanted and to the levels at which they occur. A children's title, for instance, is likely to include a greater percentage of links at the macro level. A leisure title such as a jukebox simulation might be equally simple. Electronic storyboards or hypermedia applications also help convey to clients, publishers or even investors what can reasonably be expected from the final product in terms of functionality.

Pseudo-conversational communication A communication regime between two software components or objects that exists only for the duration of interaction.

PSTN (Public Switched Telephone Network) A voice-grade public telephone network.

Public Key (*See Cryptography.*)

Public key encryption An encryption technique which requires both private and public keys. A public key is used to encrypt sent data.

(See Encryption.)

Publishing medium A medium that can be used to publish information. The Internet, CD-ROM and DVD-ROM are publishing media.

Push technology A technology with which a user is served requested Web-sourced information. It is sometimes referred to as the push model.

(See Webcasting.)

PWS (Personal Web Server) A downsized implementation of IIS, bundled with Microsoft FrontPage. It can be used to:

- test Web applications
- build intranets.

(See IIS.)

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Q

QA (Quality Assurance) A testing phase in the development life cycle, which is implemented through the testing of beta copies.

(See Alpha and Beta copy.)

QBE (Query By Example) A proprietary database querying method introduced by Borland through the Paradox RDBMS. It involves completing forms and using arithmetic operators to interrogate tables. It offers users the basic functionality of SQL, but is not a language.

(See SQL.)

Q-Media for Windows A multimedia authoring tool.

QoS (Quality of Service) 'A set of quality requirements on the collective behaviour of one or more objects' *(International Telecommunications Union)*. Generalised criteria used to describe Internet-related technologies. It may be considered as providing thresholds which help to guarantee quality levels.

Quad A processor module incorporated in a *Non-Uniform Memory Architecture* (NUMA).

(See NUMA.)

Quantum A company engaged in the manufacture of mass storage devices.

QuarkXPress A desktop publishing program which is used throughout the world. It competes with such packages as Adobe PageMaker.

Quattro Pro A spreadsheet program first introduced (as Quattro) by Borland in the late 1980s. Early DOS versions permitted users to use the then industry-standard Lotus 1-2-3 commands. After porting the spreadsheet to Windows, the product soon became Quattro Pro. Current standard spreadsheet programs include Microsoft Excel, which is part of Microsoft Office.

(See Microsoft Office.)

Query An SQL script, or database submission created using QBE or similar, which requests specified data from a database. The query may be used to list customers that live in, for example, London, and who have purchased certain products during a specified period.

(See SQL.)

Quest A multimedia authoring environment produced by Allen Communications.

Queue A contiguous series of memory locations utilised as a temporary storage area. It is a FIFO (first in, first out) system in that the order in which items are dispensed is the same as that in which they were deposited.

QuickDraw 3D A set of 3-D extensions initially developed for the standard Mac operating system (OS). These are now integrated into the PowerPC-based Mac OS. QuickDraw includes elements for the creation of numerous geometries ranging in sophistication from polygons to NURBS (Non Uniform Rational B Splines).

(See 3-D.)

Quick Recorder An OLE 2.0-compliant wave audio recorder supplied with Microsoft Windows Sound System.

QuickSite A Web site development tool produced by DeltaPoint. Competing products include Adobe's PageMill.

QuickTime A video compression standard. It appeared in advance of the Microsoft Video for Windows (AVI) video standard. QuickTime files may be converted into Video for Windows (VfW) format using a utility supplied with VfW.

(See AVI.)

QuickTime VR A VR development tool for the Macintosh that supports 8 bit, 16 bit and 24 bit video.

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R

RAD tool (Rapid Application Development tool) A development tool that expedites application development. Its identity hinges on a number of identifying features, which may include:

- authentic object-oriented programming (OOP)
- visual programming methodologies
- industry-standard component architectures such as ActiveX or JavaBeans
- useful program libraries
- features that are appropriate to the collaborative team development environment. These may include security features that can be used to provide team members with access rights to objects so that they may be developed.

(See ActiveX, C++, Java* and Visual Basic.)*

Radio button A series of buttons in which only one may be selected at a time.

RAID (Redundant Array of Independent Disks) A mass storage device that has many individual disks. Identifying features of RAID may include:

- high levels of fault tolerance
- scalability through the addition of hard disks
- hot-swappable disks, meaning they may be removed and replaced without the need to power down the RAID
- redundant power supplies for improved fault tolerance
- shared mass storage, serving disparate computers/networks
- heterogeneous characteristics, where they may be integrated into environments comprising multiple OSes
- high speed interfaces such as Fibre Channel and Ultra SCSI.

The original RAID specification originated in UC Berkeley in 1987, and

was named Redundant Array of 'Inexpensive' Disks. The aims of the Berkeley group were threefold:

- improve fault tolerance of mass storage
- reduce mass storage costs
- improve mass storage performance.

Realising the inescapable fact that no single mass storage system could be optimised in all three of the aforementioned areas, the group defined what were to become a number of industry-standard solutions. Achieving its objectives to varying degrees, the Berkeley group defines a series of RAID levels employing several tried and tested data storage techniques. One of these was mirroring, where data is written to, and read from, pairs of disks concurrently in order to deliver fault tolerance. Modern RAID systems may be specified in terms of:

- maximum data storage capacity, which is typically in the Gbyte range for a single RAID unit and in the Tbyte range for multiple connected units
- average access time measured in milliseconds (ms)
- average and burst data transfer rates
- cache size
- interface type
- multiplicity of host types that may be connected
- OS compatibility.

RAID performance has obvious effects, and high performance echoes performance gains that are felt locally and remotely. The five levels of RAID defined by the Berkeley group include the following.

- Level 0, which stripes data across multiple disks but provides no error correction or redundancy.
- Level 1, which uses duplexing or mirroring, where data is written concurrently to pairs of independent disks, promoting a high degree of fault tolerance.
- Level 2, which stores and reads data by dividing it into bits and storing them on different drives, *otherwise known as striping*. It also stores ECC codes on dedicated disks.
- Level 3, which divides data into blocks, storing them on different independent disks. One additional disk contains parity data.
- Level 4, which stripes data blocks across multiple disks. One additional disk contains parity data.
- Level 5, which stripes data blocks across multiple disks, while parity data is stored on multiple disks.

Other RAID configurations include Level 6 and Level 7, neither of which were devised by the Berkeley group. Level 7 offers improved fault tolerance, and is patented by Storage Computer Corporation.

(See Hard disk.)

RAM (Random Access Memory) A volatile form of electronic memory which loses its contents when electrically isolated or powered down. It is a *readable* and *writable* memory store. It is the most common type of electronic memory. Its name derives from the constant access time taken to read data, irrespective of where it is held in the cell array. As this is also a feature of read-only memory (ROM), the name RAM is a misnomer, and tells little of the key properties of RAM, i.e. it is readable and writable.

RAS (Remote Access Services) A RAS feature/program permits you to dial in to remote networks and to ISPs. Windows NT features RAS compliance.

RDBMS (Relational Database Management System) (*See DBMS.*)

RealAudio A streaming audio technology for deploying real-time audio over the Web.

(See Streaming.)*

Real time 1. A program or system that responds to user interaction, instantly. 2. A program or system which captures and/or compresses data at the rate it actually occurs. For example, a live satellite broadcast link is in real time.

Real-time compression A technique where an uncompressed video stream is compressed while it is played at full speed.

Real-time video capture A video capture technique where a source video recording is digitised and stored as it is played at full speed.

Record A row in a database table, or a collection of fields that contain field values.

Recursion A property of a programming language which enables procedures to be called by their own code. Such compliant languages are termed recursive.

(See C++.)

Red Book Audio An industry term used to describe the official Compact Disc-Digital Audio (CD-DA) specification that defines the common or garden audio CD.

Reflective light system An optical storage device that operates by reading encoded data using a reflected laser beam. CD-ROM is a reflective light

system, where a laser beam is shone against turns of track which are encoded with digital data using pits and areas of land. Pits scatter the laser light, while areas of land produce reflected light. Reflected light is diverted to a photodetector that produces a series of electrical pulses corresponding to encoded data. The underlying technology of CD-ROM is markedly similar to that used in Philips' first optical video disc system, demonstrated in Eindhoven as early as 1972. This research and development led to LaserVision.

(See CD-ROM and LED.)

Refresh rate A measurement of the rate at which all lines on a CRT-based monitor are scanned. It is quoted in Hz.

(See Monitor.)

Relational database An information storage and retrieval application. Using a relational database, information is stored in records that are divided into fields of different types including text, numeric, date, graphic, and even BLOB (Binary Large OBject). The records are stored in tables or files. Records from one file can be linked to records stored in a separate file or table. Codd's standard text about relational databases published in the 1960s specified different types of relational links. Types of link include one-to-one, one-to-many and many-to-many. There are many commercial examples of the relational database that base their design on the original writings of Codd. Relational databases are formally referred to as RDBMSes (Relational Database Management Systems), whereas flat-file databases are termed simply DBMSes (Database Management Systems). Commercial examples of software products that permit the development of RDBMSes include Borland Paradox for Windows, dBase, Microsoft Access, Ingres, and Compsoft Equinox. All fully specified RDBMS development tools include an indigenous programming language. For instance, Paradox for Windows has ObjectPAL (Paradox Application Language) which is a visual programming language. Important relational database features include:

- ODBC1 or 2 (Open Database Connectivity) compliance
- Maximum table or file size
- Speed of operation.

BLOB (Binary Large OBject) support permits the storage of field values that include executables and digital video files.

(See Data warehouse, DBMS and OODBMS.)

Reliability A measure of the period of down-time which a system will endure. It may be expressed as a percentage value, indicating the portion of

time that the system will be fully or even partially operational. Such a measure of *availability* (A) may be applied to devices, components, subsystems, systems, networks etc. Availability may be calculated using the:

- MTTR (Mean time to restore), which is the average time period required to return a failed system to its fully operational state
- MTBF (Mean time between failures), which is the average time period that indicates the frequency at which a device, component, subsystem or complete system will fail.

```
Availability (A) = MTBF/(MTBF + MTTR)
```

Collective Availability (Ac) of a complete system is equated to the product of the availability for each individual component. For example:

```
Availability (Ac) = Clients (Au) * Server (As) *
Network (An) * ...* Router (Ar)
```

Removable medium A storage medium that can be removed from the computer. Examples include floppy disks, CD-ROM disc, DVD disc and Iomega Zip disks.

(See CD-ROM and DVD.)

Resolution A measurement of the concentration of dots or pixels in a digital image. In display technology, resolution is specified in terms of screen dimensions expressed in pixels and the dot pitch expressed as the distance between displayable pixels. Typical display resolutions of commercially available monitor include 640 × 480 pixels, 800 × 600 pixels, 1024 × 768 pixels, 1280 × 1024 pixels and 1600 × 1200 pixels. In terms of printer technology, resolution is expressed in terms of the number of dots per inch (dpi). Generally, low-cost laser printers produce output composed of 300 dpi. More expensive variants offer 600 dpi and 1200 dpi resolutions. Inkjet printers typically offer resolutions between 300 × 300 dpi and 1200 × 1200 dpi. Another popular resolution (for inkjets) includes 1440 × 780 dpi, which is offered by Epson versions.

(See Monitor.)

Restore A method by which a maximised or minimised application or document window is returned to its previous size and position.

RGB (Red Green Blue) A computer monitor output where each colour component, red, green and blue, is represented by an individual signal. The range of colours which can be generated depends upon how many bits are used to represent each (primary) colour component.

RGB (5:5:5) (Red Green Blue 5:5:5) A technique used in CD-I giving 5 bit RGB, where each colour component may be excited to produce one of 32 shades, giving a total of 32 768 ($32 \times 32 \times 32$) colours.

Rhapsody An operating system built around OpenStep technology, which was developed by NeXT Software.

(See NeXTStep.)

Risk exposure (RE) A product of risk probability (RP) and risk cost (RC):

```
RE=RP* RC
```

- RP is the probability of attempted attacks on a system leading to a security breach
- RC is the estimated cost of a particular (or average) security breach.

(See Firewall and Security.)

RLC (Run Length Coding) A lossless compression process. It may be used in conjunction with DCT and forms part of the JPEG algorithm.

(See DCT and JPEG.)

ROLAP (Relational On-line Analytical Processing) A data analysis environment using RDBMS data structures and query language implementations and techniques.

(See Data warehouse and OLAP.)

ROM (Read-Only Memory) An electronic memory device from which it is only possible to read data.

Root directory A top (or highest level) directory in a storage medium. All other subdirectories originate from the root directory.

Rosenblatt, Frank A computer scientist who put forward the idea of the perceptron neuron.

(See KBS and Neural network.)

Route 1. *Noun*: A path taken by a packet or message which leads from a sending device to a receiving device. The path might involve interaction with software components, which may form part of an OO distributed system. 2. *Verb*: An action taken in order to send or forward a packet or message to a receiving device or software component.

(See Screening router.)

Router A device which receives and routes messages between network systems or between complete networks. The messages may be packets, cells or frames, depending on the protocol used.

(See Frame relay, Packet-switched network, Protocol and Screening router.)

Routing An action which sees a packet, cell or frame allocated a path.

(See Frame relay, Packet-switched network, Protocol, Router and Screening router.)

RS232 A standard from the Electronic Industries Association (EIA) for the serial transmission of data over relatively short distances, but greater than those internal to most computer systems. Standard representation of digital data, using TTL for example, is limited in terms of transmission distance. To overcome this, signal strength is broadly increased. RS232 represents an industry standard for achieving this, so as to increase transmission distance and give interchangeability of computer peripherals.

RSA (Rivest, Shamir and Adleman) Encryption An encryption technique that uses public and private keys. RSA is integrated into numerous protocols, including: SSL (Secure Sockets Layer) and S-HTTP (Secure HTTP).

(See Cryptography and SSL.)

RTP (Real-time Transport Protocol) A protocol which supports real-time audio/video communications.

(See ASF.)

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SAA (Systems Application Architecture) A strategy initiated by IBM for enterprise computing, which defines the three layers:

- Common User Access
- Common Programming Interface
- Common Communications Support.

Sample A digital value derived from an analogue source.

(See ADC and ISDN.)

Sampling rate (or frequency) The frequency at which an incoming analogue signal is digitised. The sampling rate of an ADC influences the effectiveness of conversion.

SAP R/3 A client/server development environment, which is the successor to SAP R/2. The transition was a response to the shift from the two-tier client/server model to the three-tier client/server model. The product is used globally, and came to prominence through its application in German industry, notably the automotive sector.

(See Client/server, Three-tier client/server and Two-tier client/server.)

Satellite system A medium or communications technique which uses orbiting satellites fitted with microwave antennas. These provide line-of sight communications with microwave antennas at earth stations. Applications are used extensively in telecommunications and in television broadcasting. Geostationary satellites orbit above the equator, revolving in unison with the earth; hence they are stationary relative to the earth's rotation. The concept was originated by science-fiction writer Arthur C. Clark.

Scanner A device used to digitise printed material such as photographs. With optical character recognition (OCR) software, a scanner can be used

to convert text into machine-readable form. Types of scanner include the following.

- Hand-held scanners typically offer a scanning width of around 10 cm. Operation involves passing the scanner over images to be digitised.
- Flat-bed scanners are the most popular. Paper handling is comparable to that of a photocopier. Flat-bed variants can allow complete A4 or A3 pages to be scanned, and are ideal for digitising manuscripts, together with illustrations. If digitisation of a significant amount of material forms part of the development process, then a flat-bed scanner is essential. Conversion of text into a computer-readable format requires optical character recognition (OCR) software.
- Sheet-fed scanners are easier to use than hand-held scanners. Paper handling approximates that of a fax machine, where motorised rollers simply pass sheets over the scanning array. A principal disadvantage is that bound publication pages have to be removed before they may be scanned.
- Drum scanners are very highly specified and tend to be used by commercial printers and bureaux. They offer very high resolutions that provide true photographic quality images.
- Slide scanners enable the production of images using 35 mm slides alone.

Scanners may be greyscale or colour. The simplest greyscale variants will produce 8 bit images, so generating images with 256 (2^8) shades of grey. More sophisticated colour versions may generate colour images using 24 bits per pixel, so producing 16.7 million (2^{24}) colours. Image depths of 30 bits, 32 bits or 36 bits may also be supported. Most scanners come complete with scanning software, picture editing programs and OCR (Optical Character Recognition) software. Such software can be essential in the production stage of multimedia, and also in electronic publishing when transcribing older texts into digital form. Drivers supplied with a scanner do much for compatibility with various software packages. For example, a standard Twain driver will allow the scanner to be used with Twain-compliant programs like HiJaak Pro. Equally, HP Scanjet drivers allow the device to understand HP protocols.

Screened subnets A subnet which restricts TCP/IP traffic from entering a secured network. The screening function may be implemented by screening routers.

(See Firewall, Screening router and Security gateway.)

Screening router A router variant able to screen packets which match pre-defined criteria, including the:

- source address
- destination address
- protocol type.

(See Firewall, Packet filtering and Security.)

Screen refresh rate (*See Refresh rate.*)

Screen scraper A client/server software component or function, which removes or 'scrapes' display information from requested data and formats it so that it may be displayed by the client system. It may also do the same for outgoing traffic from the terminal or client system.

(See Client/server.)

Script A series of instructions that can be interpreted by a program, sometimes referred to as macros. Scripts can sometimes be generated through menu selections or by writing code.

(See Perl and VBScript.)

Script-based authoring tool A multimedia authoring system/environment which requires coded program sequences or scripts. They are generally difficult to use for non-programmers.

Scripting A scripting language such as VBScript or JScript may also be perceived as a glue, as may HTML.

(See VBScript.)

Scroll bar A user interface component that is used to scroll an image of item of text that is too large to be shown in the display area. Horizontal and vertical scroll bars are available.

SCSI (Small Computer System Interface) A universal and internationally agreed interface standard backed by ANSI (American National Standards Institute), intended to provide interchangeability between peripherals and computer systems from different manufacturers. Apple Computer has long realised the importance of SCSI, fitting Macintosh machines with appropriate controllers. The SCSI continuum approximates:

- SCSI-1
- SCSI-2
- Wide SCSI
- Fast Wide SCSI
- Ultra SCSI.

(See Firewire.)

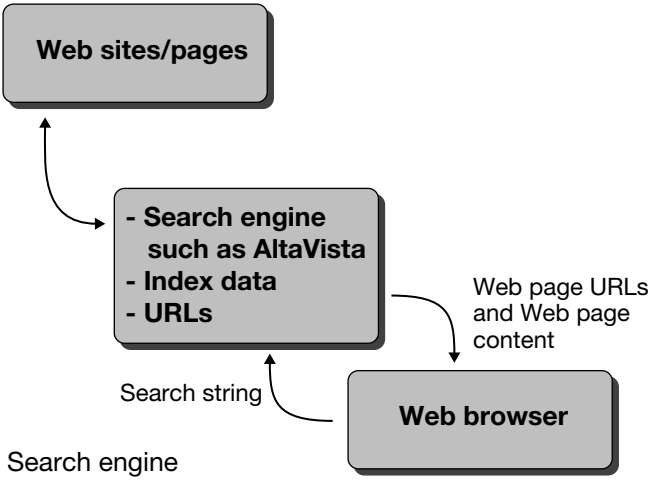
SDK (Software Development Kit) A library of functions that may be used to implement specific solutions. Microsoft SDKs are numerous, and include those associated with:

- ActiveX
- Java
- NetMeeting
- Design-Time Control
- Active Template Library
- OLE DB.

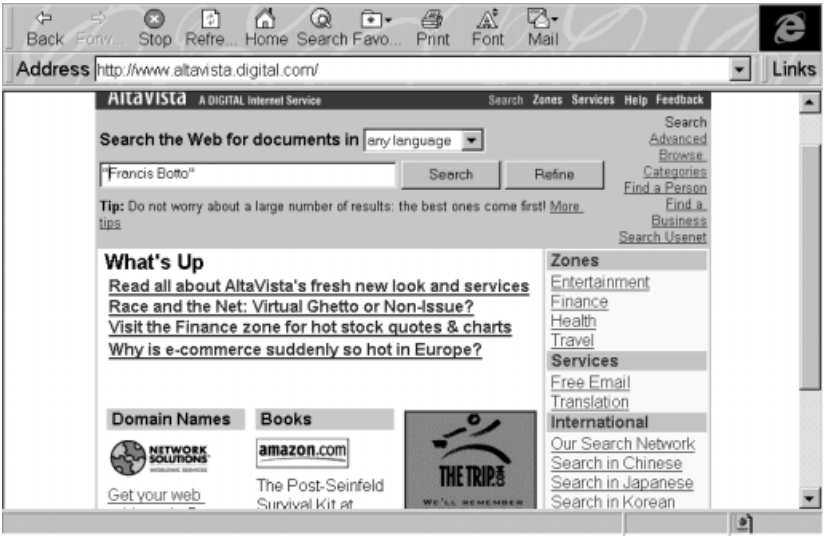
SDRAM (Static Dynamic RAM) A type of random access memory (RAM) which offers a comparatively short access time. Such access time is measured in nanoseconds (nS), or billionths of a second.

(See EDO.)

Search engine A program used to search indexed words and phrases that exist in documents on the Internet. The search engine retrieves the documents in which specified words or phrases are found. Popular search engines include AltaVista (at www.altavista.digital.com) and HotBot (at www.hotbot.com). Crawler programs may be deployed to gather metadata (such as indexes) from Web sites.



Search string A single word, phrase or sentence (or a number of words, phrases or sentences) for which a document or number of documents are searched. A search engine or retrieval system retrieves documents (or document details) based on the search string. Search engines and retrieval



systems support wildcards and logical operators. For instance, if it were necessary to find documents containing the name Van Gogh along with the city Amsterdam, using logical operators you would use the phrase Van Gogh AND Amsterdam.

(See Search engine.)

SECAM (Système Electronique Couleur Avec Mémoire) A broadcast television standard developed in France, and used in many parts of Eastern Europe. Like PAL, it runs at 25 frames/50 fields per second.

Second-generation language A programming language where instructions are represented by concise mnemonics. Such 'assembly languages' are indigenous to processors. Often the terms *assembly language* and *machine code* are used interchangeably.

Secret key *(See Cryptography.)*

Security A method of restricting access to applications, data and systems to their intended users. The term may include automated virus checks on incoming documents and on executable code such as Java applets and ActiveX controls using security gateways. *(See Security gateway.)* Firewall technology is vital to Web security, as are data encryption and password protection. Security is paramount to organisations deploying corporate data, and for companies running e-commerce Web sites (such as Amazon,

for example). Security standards include those developed by the United States Department of Defense, and named the Trusted Computer Standards Evaluation Criteria, which are otherwise known as the Orange Book. This was introduced in 1985, and was originally aimed at mainframe and mini-computers for many years. It is also applicable to databases and to networks, through the Trusted Database Interpretation and the Trusted Network Interpretation. The Orange Book is a multi-tier set of guidelines, including:

- Level D1, which is the lowest level of security, rendering the system untrusted.
- Level C1, which is a discretionary security protection system, requiring a login name and password, and in which access rights are allocated.
- Level C2, which includes Level D1 and Level C1 security and integrates additional security features. For instance, this level requires that the system's relevant events be audited.
- Level B1, or Labelled Security Protection, which provides tiered security. Compliance sees object permissions that may not be changed by file owners.
- Level B2, or Structured Protection, requires the labelling of all objects.
- Level B3, or Security Domains level, which requires terminal connections via a trusted path.
- Level A, or Verified Design level, is the highest Orange Book security level.

(See Encryption, Firewall, Packet filtering, Risk exposure, Screening router, Security gateway, SET and Web security.)

Security boundary Also known as security perimeters, such boundaries encapsulate systems, software, objects etc. They may be implemented in software, in hardware using firewalls, in passwords, by encryption or by the assignment of dongles to users. Boundaries exist at a number of different levels, including:

- Physical, which covers tangible resources such as systems
- Application, which covers access rights to applications
- Data, which covers access and editing rights to data
- System, which dictates who may log on to a network or system.

(See Firewall.)

Security gateway A security layer which fortifies a network against hostile virus attacks by screening incoming executables and data. The executables might be Java applets, ActiveX controls or plug-ins. Each of these represents a potential threat, not just in terms of viruses but in terms of what they may do to client-side documents, files and even system files, such as those

concerned with the initialisation of Windows variants. For instance, an ActiveX control might take control of a client's Word documents, performing operations on them, such as converting them to HTML, and then possibly abstracting them, for display or even processing on a remote Web site. For many security managers, this is unacceptable behaviour. Additionally, the unregulated Internet means that virtually anyone can deploy applications, which may potentially damage clients. It is desirable, therefore, to attempt to check and possibly screen such inbound traffic. Such a comparative centralisation of the anti-virus security layer makes redundant the need for standalone variants on clients, though these may still be employed, particularly if removable media are being used for file transfer. Such a security gateway may:

- provide multiple OS support, such as Windows, DOS or NetWare, though many are confined to Windows NT
- support ActiveX, Java, cookies, plug-ins, JavaScript, JScript, VBScript and various executables
- check all Java classes on downloaded applets
- provide intelligent filtering features.

(See Firewall, Security and Solomon, Alan.)

Security proxy A Web proxy that integrates security features, which are used to authenticate connections to servers.

(See Firewall, Security and Web proxy.)

Sega A manufacturer of games consoles and their accompanying software titles.

Semaphore A communications method involving physical signalling which was invented by the French in 1792. Even today the semaphore principle is applied in programming, where flags may be used to relay certain states and events. In computer terms, semaphore may be applied to coordinate processes.

Sequential prose A continuous stream of linear text.

(See Hypertext and Nelson, Ted.)

Serial port An input/output port through which data is transmitted and received sequentially. RS232 is a standard serial port used to transmit serial digital information over modest distances so as to connect communication devices and other serial peripherals to computers. The PC COM (COMmunications) ports are serial ports.

(See Firewire and USB.)

Server 1. A transaction server is allocated the task of transaction processing (TP), and it often invokes the application logic necessary to perform database interactions and manipulations. The process(es) invoked directly or indirectly by the client are collectively referred to as the transaction. Transaction servers may include UI logic, driving the client UI, relegating the client device to little more than a dumb terminal. Typically, mainframe-based transaction systems might adhere to this model. Alternatively, the UI logic or presentation may be distributed to the client. The server consists of a TP monitor, which performs transaction management and resource management. Transaction management ensures the so-called ACID properties of transactions. These include *Atomicity*, *Consistency*, *Isolation* and *Durability*. ACID property compliance is achieved through the two-phase commit protocol. *(See ACID and Two-phase commit.)* Resource management is intended to optimise the use of resources, which include memory, mass storage and processing. It may also be involved with load-balancing between resources and between the software processes, which may be threads. *(See MPP.)* 2. An entity that serves clients. The services provided might include the implementation of processes and the distribution of data, and may be categorised as follows.

- Fax, where the server provides fax reception and transmission facilities for connected client systems.
- Database, in the client/server configuration, in which SQL requests from the clients perform the necessary data requests.
- Communications, which enable client systems to make remote connections to external networks and servers.
- Print, where the server is dedicated to printing locally or remotely.
- File, where a centralised server, perhaps connected to RAID storage devices, is utilised by clients to provide high-volume data storage and high-performance disk access and data transfer rates.
- Transaction, where the server updates data, which may form part of simple client/server two-dimensional database or warehouse data that may be multidimensional (in data cubes) or even hypercubes. *(See Data warehouse and entries listed below.)* 3. A Web server is the hardware platform that supports one or Web sites. Traditionally Web servers have been based on the Unix or Windows NT OSes. 4. A Web server may also be considered as the software implementation which serves HTML pages etc. *(See Web.)* 5. An intranet server may considered in the same terms as a Web server, but with a security perimeter to prevent public access. 6. A peer-to-peer server is a system on a network in which the resources of any connected system may be shared. While any system on a peer-to-peer network might be a server, typically the most highly specified system performs as a server. 7. A file server provides centralised

resources for network users. 8. A database server provides centralised data storage. 9. An object or application that serves an application or object with embedded or linked data. The server might be OLE 2.0-compliant, or may conform to another component architecture. *(See ActiveX, Object* and OLE.)* 10. A CD-ROM server dynamically distributes requested information from CD-ROM drives to LAN users. If the maximum number of drives per server is exceeded, additional servers are added. The incorporation of additional servers, prior to reaching the network maximum of drives per server, leads to a better service for users. There are several commercially available CD-ROM network packages, many of which are software orientated. 11. A video server is a hardware solution which provides the basis for a video on demand (VoD) service. It may be implemented using MPP. The advantage of such parallel processing systems is scalability, where, for example, growing numbers of subscribers to a VoD service may be accommodated through additional processors and even complete servers. *(See MPP.)* 12. A video, audio or multimedia server which serves client systems with streaming media.

(See ASF and Streaming.)*

SET (Secure Electronic Transaction) An internationally agreed standard for securing electronic funds transactions using e-commerce on the Web/Internet. Encryption is a key technology of SET.

(See Encryption, Firewall, RSA and SSL.)

Set-top box A television decoder that permits the reception of an encoded analogue or digital signal. It may also provide a means of interaction. MPEG-2 decoders permit the reception of high-quality digital video/television broadcasts. MPEG-2 was initially aimed at digital video distribution via networks, satellite, wireless and digital storage media that could sustain an average data transfer rate of up to 10 Mbps.

SGML (Standard Generalized Markup Language) An internationally agreed language intended for the implantation of formatting information in documents.

(See HTML.)

Shannon's theorem A theorem that may be applied to give the maximum data transfer limit over a given medium such as an access technology:

$I=F \log_2 (1 + S/N)$
F=bandwidth,
S/N=signal-to-noise ratio.

(See 56 600, Access technology and Modem.)

Shareware A method of distributing software, which allows the user to try it without paying a fee to the software's legal owner. If the user continues to use the software, he/she is required to register it for a fee. In some instances a registered copy may include additional features, along with technical support and documentation.

Shell 1. A means of entering commands using Unix and other similar operating systems. A Unix shell can be considered as performing a similar task to the command line interpreter associated with DOS. 2. A term used to describe the framework of an expert system. The shell is occupied by a knowledge base that consists of IF … THEN rules that are used to solve entered problems. The knowledge (or rule) base is interpreted by an inference engine.

Shockwave A streaming multimedia technology which uses AfterBurner compression. Its producers, Macromedia, also produce the popular Director and Authorware programs. Essentially, the technology is used to deploy Director movies over the Web, and can also be applied to the same to applications that depend on the Lingo multimedia authoring language. Web browsers may be enabled using a Shockwave plug-in.

(See Lingo and Streaming.)*

S-HTTP A means of seamlessly integrating encryption into HTTP. It was developed by Enterprise Integration Technologies and supports RSA, DES, triple DES and DESX.

(See Encryption.)

SIF (Source Input Format) An MPEG-1 frame resolution of 352 × 288 pixels. This resolution equates to the MPEG Source Input File (SIF), which is achieved by omitting odd or even lines from a standard interlaced PAL (Phase Alternating Line) signal. This is an exceptionally 'lossy' procedure, omitting a great deal of picture information and losing video quality. It is this single operation that limits the quality of video that can be achieved using MPEG-1, though it has to be implemented in order to confine the video stream to the narrow bandwidth of about 1.5 Mbps. The MPEG claim that this is VHS quality is an area of debate.

(See MPEG.)*

SIMM (Single In-line Memory Module) A standard electronic assembly used to accommodate electronic memory in the form of RAM. Standard SIMM sizes include 4 Mbyte, 8 Mbyte, 16 Mbyte and 32 Mbyte. SIMMs may include parity checking (*See Parity bit*). EDO (Enhanced Data Out) offers improved performance.

SIMNET A US network used to distribute military simulations. Financed by ARPA it was originated and developed in the Institute of Simulation and Training, University of Central Florida. It is used for training US army personnel. Its existence came to prominence when it was revealed that it had been used to train foot soldiers for Operation Desert Storm (the Gulf War). Satellite information can be used to generate complex landscapes bearing important military installations, communication installations and the distribution of enemy forces to varying degrees of accuracy. Effective military simulations require a near real-time link between gathered satellite information and the simulated environment to achieve real-time imaging.

Simulation An interactive environment that duplicates a real-world operation such as flying a passenger aircraft or driving a car. Simulators are used widely in the military sector. Displays that may be used in simulators include conventional CRT, projected images, LCD projected images and HMDs (Head Mount Displays).

Sinclair, Sir Clive An English technologist and entrepreneur. Notable Sinclair products include the first commercial pocket calculator and the first pocket television. Unlike the LED-based pocket TV from Citizen, Sinclair's was CRT-based and was bulky and heavy. Sinclair's work on miniature CRT manufacture was valid, with such assemblies used in many highly specified HMDs (Head Mount Displays) today. Currently their specification in terms of speed and resolution outperforms comparable LED technology. Sinclair also introduced a range of home computers in the late 1970s and early 1980s. The earliest computer was the ZX80 which was available ready-built or in kit form. His most successful computer was the Spectrum. Later Sinclair computers include the QL (Quantum Leap), which was not a success. Other Sinclair interests include chip manufacture (wafer-scale technology) and transport, through the C5 electric car and the electric bicycle called the Zyke.

Site Server A Microsoft solution for enhancing, deploying and managing e-commerce Web sites.

SK8 (Skate) A multimedia authoring tool/environment developed by Apple Computer.

SLIP (Serial Line Internet Protocol) A protocol often used for serial data transmission over media which include access technologies such as POTs.

(See PPP.)

Smalltalk An OO programming language.

(See OOP.)

SMIL (Synchronised Multimedia Integration Language) A language intended for the deployment of interactive multimedia applications over the World Wide Web, and over networks that offer a comparable narrow-bandwidth. Pronounced 'smile', it is similar to HTML, but is designed specifically for multimedia, which includes text, audio, video, animations, graphics and interactivity. It may be perceived as a glue which enables the developer to choreograph multimedia elements. Offering the timeline metaphor, SMIL permits the coordination of multiple streaming multi-media entities, which combine to form an application. SMIL does not require the merging of media streams into container files; rather, users may simply edit the listing to alter the coordination of such multimedia elements. SMIL is an open standard and supports among other things:

- AVI
- ASF container format
- RealMedia
- QuickTime
- AAF
- WAV
- MOV
- MIDI
- Shockwave Flash.

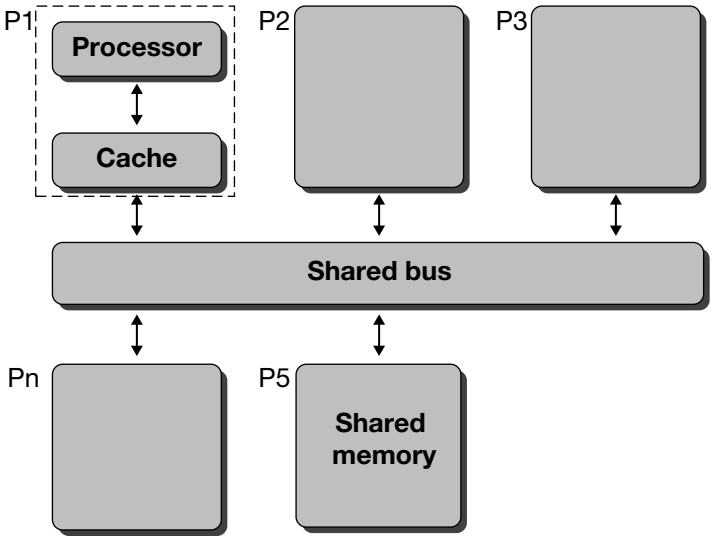
The World Wide Web Consortium (W3C) is responsible for the SMIL specification, and participants in the SMIL Working Group include:

- Microsoft
- Philips
- Netscape
- Digital Equipment
- Lucent
- RealNetworks.

(See ActiveX, ASF, DHTML, HTML and XML.)*

SMP (Symmetric Multiprocessing) A system that has two or more processors which do not operate independently with their own connected memory and I/O capabilities. Systems find application as servers, and such processor designs as the Intel Pentium Pro were optimised for SMP. SMP systems offer processor scalability, but not in the precise processing increments associated with MPP systems. Unlike MPP systems, limitless scalability is prohibited by the interconnecting bus bandwidth, which is shared.

(See MPP and NUMA.)



SMP – simple architecture

SMTP (Simple Mail Transport Protocol) A protocol used to transmit e-mail messages over the Internet and across other compatible IP networks.

(See TCP/IP.)

Sniffing A term used to describe the use of a *sniffer* program to monitor data traffic to a network or server in order to gain access information. For instance, it may be applied to gather illegal passwords and IDs for ISP accounts, passwords to mail accounts and passwords to remote systems.

(See Firewall.)

SOCKS A security-related technology which may be used to allow hosts within a firewall perimeter to access the Internet. The hosts do not require IP addresses; rather they use an intermediate server. This server acts as a bridge or interface which offers a connection between the firewall's hosts and external Internet sites. It was designed for multi-homed firewalls.

(See Firewall and Security.)

Software distribution A method of delivering software to users. Software distribution may be by downloading from the Internet. Other distribution media include floppy disk, CD-ROM and DVD-ROM. The first commercial CD-ROM software distribution disc from a major producer was Microsoft Office. Farallon Computing released lesser known programs on

CD-ROM prior to this, as did Microsoft itself. PC Sig released the world's first shareware compilation on CD-ROM in the USA. Used as a distribution medium, DVD-ROM presents vendors with new opportunities; spare storage space may be used for program demonstrations, program documentation, training material and advertising using DVD (MPEG-2) video. Currently most leading software producers distribute their programs on CD-ROM, but a swing to DVD-ROM is imminent.

(See CD-ROM and DVD.)

Software key A method for unlocking encrypted data. It allows the customer to unlock the products purchased contained on a CD-ROM.

Software training A process through which users are trained to use software applications. The continual introduction of Information Technology, and its pace of change, have given rise to a thriving software training industry. This bears testimony to the fact that current commercial software and computers are simply too difficult to use. Evidence of this is seen when a new program is introduced into an office environment: the need for training or retraining emerges instantly. Equally, new employees often have to be trained to use word processors, databases, spreadsheets, integrated packages and so forth.

Solomon, Alan The founder of Dr Solomon's anti-virus software: computer programmer, entrepreneur and accomplished writer. His anti-virus products have won him deserved fame and wealth.

SoundBlaster A range of sound cards produced by Creative Labs.

Sound card A plug-in card which permits wave audio recording, multivoice sound synthesis and speech synthesis. Questions that should be asked about sound cards include the following.

- Is it SoundBlaster-compliant?
- Is it an 8 bit or 16 bit variant? A 16 bit card will normally offer CD-quality sound.
- Does it use wave table synthesis? MPC-3 compliant cards support wave table sound. They include sampled sounds that make MIDI file playback more authentic. Commercial examples include the Creative Labs SoundBlaster AWE.
- If the sound card does not include a wave table, can it be upgraded to include one? The SoundBlaster 16 ADSP can be upgraded to include the WaveBlaster daughter board.
- What CD-ROM interface does it have? If it has a proprietary interface you must naturally ensure that it is compatible with your CD-ROM

drive, or the CD-ROM drive you intend buying. Ideally you should look for a sound card with a SCSI-2 controller which will give greater flexibility in terms of CD-ROM drives and peripherals that can be controlled.

- Does it come with business audio software? Text-to-speech convertors such as Monologue for Windows and ProofReader (supplied with Windows Sound System 2.0) can prove useful. Programs that permit you to control Windows and Windows applications using voice commands are also useful. Examples include Creative Voice Assist and Microsoft Voice Pilot.
- Does it come with useful Windows applets? The card should include a decent wave audio recorder and editor, mixer and MIDI sequencer.
- What wave audio compression schemes does it use? These can result in greatly reduced wave audio file sizes. Compression schemes to look for include IMA ADPCM for recording music, True Speech for recording dialogue, CCITT A-Law and u-Law.

With suitable software, sound cards can be used for such purposes as sampling, playing synthesised polyphonic sequences, speech synthesis and MIDIs (Musical Instrument Digital Interfaces). The latter application, however, often requires additional hardware which can usually be assumed to be a MIDI connector box or similar, to which MIDI keyboards and other compatible devices can then be connected. Most sound cards also operate in full stereo, and on more expensive variants you can expect features such as reverb, thus giving multimedia developers the ability to emulate various acoustic conditions. Sampling permits you to digitise and store, in memory or on disk, live sounds from an analogue source. For example, it is possible to sample a short sequence from a CD player using a microphone or the direct output from a player's headphone socket or that which is connected to an amplifier. The duration of sequences is often restricted by memory capacity, and the overall sound quality of different cards varies according to individual specification. Occasionally, sampled sequences can be compressed by a modest degree, thus saving disk space. Popular low-cost 8 bit sound cards include Ad Lib and SoundBlaster Pro (from Creative Technology).

(See Wave audio.)

Sound Recorder A Windows recording, playing and editing tool for waveform audio files (.WAV). It is not the most sophisticated .WAV file recorder, and it is almost certain that you will have a better one already bundled with your sound card. SoundBlaster 16 ASP, for example, comes with WaveStudio, and the Microsoft Windows Sound System has Quick Recorder. Sound Recorder has standard controls that include Rewind, Fast

Forward, Play, Stop and Record. Like almost all other such programs it illustrates the wave shape of loaded .WAV files. It has an Effects menu that can be used to increase and decrease the volume of recorded .WAV files. The same menu has options to alter the speed of a .WAV file, to add echo, and to reverse the recording. Accompanying its effects features is an Edit menu. This allows you to delete the start and end sections of WAV files. More interesting items on the Edit menu include Insert File and Mix with File. The former allows you to insert a .WAV file at a specific point in a loaded .WAV file. You can define the exact point at which the file is inserted using the horizontal bar. The latter lets you blend one .WAV file with another. For instance, a chime sound can be blended with a bell.

Sound rendering An audio reproduction technique which indicates the position of moving or stationary sound sources. A 3-D sound rendering system emulates the complexity of the sensation of sound in three-dimensional space. For example, if you approached a person playing a guitar the volume of the guitar would increase.

(See VR.)

Spam 1. A form of unsolicited e-mail; the Internet equivalent of junk mail. The originators of such e-mail are termed spammers, and messages from known spammers may be filtered using appropriate software. 2. The practice of posting the same message simultaneously to a large number of USENET newsgroups.

Speech recognition A technique by which a computer is able to recognise speech and perform tasks. Modestly specified speech recognition programs recognise a modest number of words. Commercial examples include Creative VoiceAssist and Microsoft VoicePilot (included in Microsoft Windows Sound System), both of which provide a means for operating Windows and Windows applications using voice commands. More advanced speech recognition systems are voice-independent dictation systems, such as IBM ViaVoice and competing products from Dragon Systems.

(See ViaVoice.)

Speech synthesis The process of generating recognisable speech using digital data. Currently most speech synthesis programs operate by combining a predefined set of phonemes. Such programs are sometimes called text-to-speech convertors. Commercial examples include Creative TextAssist, which reads text, and ProofReader (supplied with Microsoft Windows Sound System) that read monetary and numeric data. TextAssist

is useful for proofreading long documents in Windows applications. ProofReader is aimed at reading data entered in real-time. Both tools serve to increase productivity. Other commercial speech synthesis programs include Texto'LE, which can be embedded into documents as an OLE object. Occasionally the vocabulary of speech synthesis programs can be increased using a predefined set of phonemes, or sometimes it is necessary to add wave audio files.

Sprite A screen image confined to a limited number of pixels, often used as a 'character' in computer games and a pointer in GUIs. Highly mobile, they may be defined by hardware or software.

SPX/IPX A network protocol.

SQL (Structured Query Language) A non-procedural language that is used to manipulate data stored in a relational DBMS. Like other procedural languages, including Prolog, it does not have a rigidly defined series of operations to perform a function. Some thirty commands are included in the SQL specification, of which a recent version is SQL-92. However, third parties have extended it to semi-proprietary variants. The language permits:

- the creation of table structures
- the entry, correction and deletion of data
- databases to be queried, to satisfy perhaps data requests.

The SQL syntax is easily learnt and understood, as it depends heavily on English words and phrases. For example, creating a database requires the statement:

```
CREATE DATABASE datawarehouse
```

See: Date, C. J., *A Guide to the SQL Standard*, Addison-Wesley, 1987. This text describes the original SQL standard.

(See C++, Data warehouse, Dylan, Java and OOP.)

SRAM (Static Random Access Memory) A volatile form of electronic memory which is not constantly refreshed. It therefore consumes less power.

SSL A means of encrypting data transparently when sent using TCP/IP. A security protocol, it was developed by Netscape and uses the RSA public key encryption technique.

(See Encryption.)

Stack A contiguous series of memory locations utilised as a storage area. It is a LIFO (last in, first out) system, in that the order in which items are

dispensed opposes that in which they were deposited. A stack is sometimes called a push-down store. It can be used to store the return addresses from subroutines.

Stacker A real-time disk compression utility. It increases the data capacities of hard disks and of removable magnetic media by around two-fold. Produced by Stac Electronics, it is available as a hardware or software product. Its makers won global fame, and media exposure, when they served Microsoft with a $100 000 000 lawsuit for patent infringements and duly won. The compression ratio attained using Stacker is a variable, and:

- increases with data files that are largely uncompressed, such as BMP and text files
- diminishes with pre-compressed files, such as JPEG and ZIP.

Start button A button that provides single-click access to the main menu system in Windows 95/98/NT. By default it appears at the bottom left of the screen and is anchored to the Taskbar which underlines all applications. The menus that result from the Start button can be navigated by moving the mouse, and highlighted menu items can be run by clicking them once. The Start button and Taskbar were introduced into the Windows 95 design in order to replace the Program Manager of Windows 3.x.

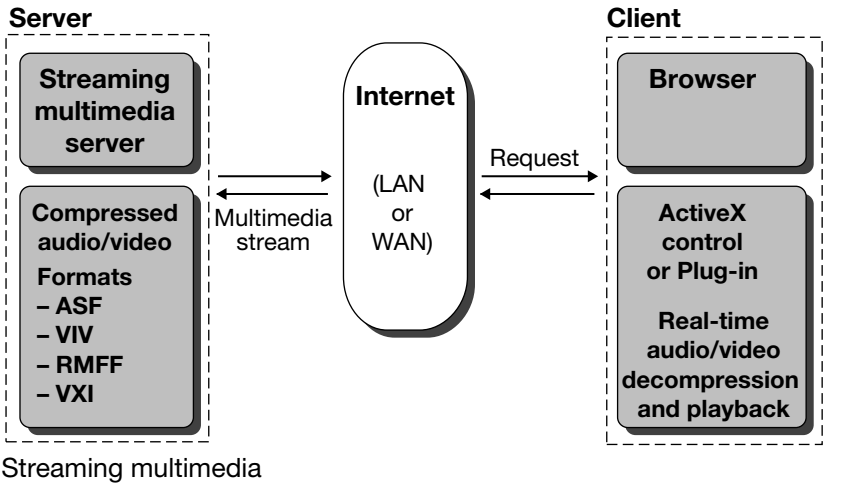
Static processor A processor that requires a lower level of cyclic electrical refreshment than most widely used designs. Such devices consume less power than dynamic designs such as the Intel Pentium. Commercial examples of static designs include Intel processors with the SL suffix.

Stereoscopic A term used to describe the process of communicating the depth of an image by stimulating each eye with a slightly different image. The earliest device used to communicate such images was the stereoscopic viewer, a hand-held device that provided a stereo view of normal photographs. In 3-D computer graphics a transformation matrix is used to present a stereographic view of images stored using the homogeneous vector representation of 3-D coordinates.

Still video camera (*See SVC.*)

Streaming audio A method of playing audio while the audio stream is being downloaded. Streaming audio plug-ins are available for popular browsers such as Netscape Navigator. Such plug-ins are useful for tuning into radio broadcasting services on the Web.

Streaming video A method of playing video while the video stream is being downloaded. Streaming video plug-ins are available for Netscape



Streaming multimedia

Navigator, while equivalent ActiveX controls operate with Microsoft Internet Explorer.

(See ASF and Microsoft NetShow.)

Structured programming A programming model which consists of procedures or subroutines and has no `GOTO` commands in order to direct program execution unconditionally. All modern high-level languages can be assumed to comply with structured programming. One of the first implementations was structured BASIC, which was launched in 1982 by Acorn Computer. It was integrated into its Acorn BBC microcomputer design in the form of a ROM-based BASIC interpreter. One of the earliest structured programming languages was Algol, which was evolved into Pascal.

(See BBC BASIC.)

Stylus A pen input device used to interact with, and write to, a computer or appliance. The first stylus was the light pen, which was yielded by the US Defense SAGE project, an early warning radar system based upon digital graphics technology. A stylus might be used as a pen with a graphics tablet or bit pad. The stylus is used widely in pen computing with everything from notebook computers to PDAs. In pen computing the user simply writes directly on the screen, and data entry using normal longhand is valid.

Subnet A method of using an IP address so that a greater number of networks may be addressed. IP addresses are designed to accommodate networks which may have between 253 and several million hosts. In many

instances, organisations wish to address a number of networks using a class C address. By creating subnets using their IP address, they may link the separate networks using a router. Subnets are created by dividing the last octet of an IP address. The division involves reserving the most significant bits of the octet so as to provide addressing information for subnets. This may yield one of the following configurations:

2 subnets, each with 62 hosts
6 subnets, each with 30 hosts
14 subnets, each with 14 hosts
30 subnets, each with 6 hosts
62 subnets, each with 2 hosts.

(See IP address.)

Subnotebook A portable computer that is smaller and lighter than conventional A4 size notebook computers.

(See Notebook.)

Subsystem A physical element of a PC. Subsystems include graphics cards, video capture cards, hard disks and sound cards.

(See Graphics card, Hard disk and Sound card.)

Sun Microelectronics A division of Sun Microsystems, and manufacturer of chips that are optimised for the Java programming language, including:

- the PicoJava chipset, which is used in cellular phones and computer peripherals
- the MicroJava processor, which is used in network devices, telecommunications hardware and consumer games
- UltraJava, which is optimised for use in 3-D graphics and multimedia-related computing, much like Intel's MMX Technology.

(See Java and MMX Technology.)*

Super Beta An enhanced Beta videotape variant, using ½″ tape.

Superclass A class of objects that has subclasses, which may inherit its attributes and behaviour.

(See Inheritance.)

Supercomputer An MPP architecture that is based on a network of parallel processors.

(See MPP.)

SuperVGA monitor A typical SuperVGA monitor can be driven at resolutions of at least 640 × 480 pixels. All fully specified PC monitors can be considered as being SuperVGA-compliant. The number of colours produced is a function of the video card you have fitted to your machine. All VGA monitors have analogue inputs and can therefore support an infinite number of colours. The resolution achieved, however, depends upon both the video card and the monitor.

Surf An alternative and popular term for browsing the Internet.

Surround sound A sound reproduction technique where the sounds that emerge from the rear of an auditorium are reproduced using surround speakers placed to the rear of the listener. It was once termed quadraphonic. An accessible worldwide standard is Dolby Pro-Logic. Other more expensive surround sound technologies exist, but are confined mainly to cinemas. The complete Dolby Pro-Logic effect requires stereo speakers either side of the screen and a shielded centre speaker mounted beneath the screen to accompany a pair of surround speakers to the rear. These are becoming increasingly popular under the name 'home movie system'. However, the full Dolby Pro-Logic effect requires a little more than this. In fact, two pairs of speakers are required for the rear surround speakers, including a pair of centre speakers to accompany the front speakers mounted either side of the screen. There are two basic ways of decoding Dolby Pro-Logic sound. The first of these is the use of a dedicated Pro-Logic decoder that plugs into a standard stereo amplifier using its tape loop capability. The other method of decoding is to use a Dolby Pro-Logic receiver, which consists of a decoder and an amplifier. The number of outputs supported is variable, as is its ability to support the full Dolby effect.

Sutherland, Ivan A founding father of a field that has come to be known as virtual reality. In 1968 he built the first Head Mount Display (HMD), providing a means of interfacing a user with what was then described as artificial reality or a synthetic/synthesised environment.

SVC (Still Video Camera) A still video camera may operate by writing images in analogue form to a two inch diameter magnetic (video) floppy disk that can store up to 50 exposures. Using a still video player exposures can be digitised using a frame grabber or video capture board.

SVGA *(See SuperVGA monitor.)*

S-VHS (Super-VHS) An enhanced version of the VHS videotape standard. *(See Video*.)*

Switched network A telecommunications network that uses switches to route calls from one telephone to the next. A switch matrix can be used to allow intercommunication between connected terminals.

Symbolic constant A symbolic constant has a name, and is assigned an unchanging value. It can be used just like an integer constant. Symbolic constants improve program maintenance and updating; a single change may be made to a symbolic constant, which might be used throughout a program. A symbolic constant multiplier can be assigned the value 10 using the C++ code:

```
#define multiplier 10
```

or

```
const unsigned short int multiplier = 10
```

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T

T1 An AT&T designation for a digital link with a bandwidth of 1.544 Mbps.
(See ATM, Frame relay and ISDN.)

T2 An AT&T designation for a digital link with a bandwidth of 6.312 Mbps.
(See ATM, Frame relay and ISDN.)

T3 An AT&T designation for a digital link with a bandwidth of 44.736 Mbps.

T50 An ITU-T designation for ASCII.

T90 An ITU-T designation for image coding, which is used by Group 4 facsimile. This uses an ISDN 64 Kbps bearer channel.
(See ASCII.)

Tactile feedback A method of addressing the tactile senses of an interfaced user in a computer or virtual environment. The interfacing device can generally be assumed to be lycra-based clothing such as a body suit, partial suit, or even gloves fitted with inflatable bladders usually at strategic points.

Taos ('Dowse') An operating system for parallel systems. Taos's most unusual feature is that it incorporates an instruction set for a virtual processor. Code written for it may therefore be run using a number of different processor architectures.
(See MPP, Occam and Parallel programming.)

Tape streamer A magnetic tape storage device used to back up hard disk data as a contingency measure against data loss or data corruption resulting from system failure or an interruption of the power supply. Data recovery

simply involves copying the contents of the tape streamer to a functioning hard disk.

TAPI (Telephony Application Programming Interface) A standard representation of a system's communications hardware. It yields broad compliance between different applications.

Target system A system for which a multimedia application or title has been developed. In terms of Web applications, the target system is any connected client system which has an appropriate browser. Generally it can be assumed that such systems feature modern Java-compliant browsers, which are able to deliver streaming media. They may also be assumed to possess at least 256 colour graphics and a 640 × 480 pixels screen resolution, and a SoundBlaster Pro sound facility. Deciding which system should be targeted depends upon a number of factors, foremost among which are the size and demographic breakdown of the user base. The technical specification of the target system also plays an important role, and it is imperative that it is able to deliver the sound quality required. You can assume that all CD-based systems are able to play standard audio CDs or Red Book Audio tracks. The sophistication and playback quality of MIDI files are driven by the level of polyphony and whether FM (Frequency Modulation) synthesis or wave table synthesis is used on the target system. FM synthesis is the most common and gives relatively crude renditions of musical instruments, whereas wave table synthesis is infinitely more realistic because PCM recordings of actual musical instruments are played. An important technical factor when considering which target system should be addressed is the sophistication of video that can be supported. Also, the video standard that can be delivered is important. For instance, can it support MPEG-1 or MPEG-2 video? The overall video bandwidth supported by any CD-based system can be assumed to be a combination of the CD data transfer rate and the graphics capability.

(See browser, CD-ROM, DVD, MPEG and Streaming*.)*

Taskbar A status bar used in Windows 98/NT that underlines all applications. It shows the Start button and illustrates all open applications, which may be minimised or maximised. By default the Taskbar also illustrates the time of day. The Windows 95/98/NT user interface centres around the Taskbar, which provides buttons to select open applications and anchors the Start button, which invokes the Start menu. The Start menu bears options that lead to programs as well as to submenus. Once invoked, the menu system can be navigated by moving the mouse rather than by clicking on its menu items. Programs are opened through a single mouse click.

(See Windows.)

TCP/IP (Transmission Control Protocol/Internet Protocol) A standard set of protocols used in packet-switched networks. It consists also of standard and non-standard files, utilities and daemons. It interprets a standard set of commands. TCP/IP originated from DARPA and ARPANET, and is one of the most established internationally agreed standard protocols. Occasionally, however, it includes proprietary files and programs through specific implementations, which include that of Santa Cruz Operation (SCO). *(See ATM and Frame relay.)*

TCP/IP Daemons A daemon is a program or process dedicated to performing what is usually a singular given function, such as sending mail. TCP/IP daemons include those added by third parties including SCO. The daemons include:

- DNS (Domain Name Server), which is used to provide IP addresses for given host names
- SYSLOG (System Logger), which stores messages pertaining to various operational events including status, detected errors, and debugging
- SNMP, which is an implementation of the Simple Network Management Protocol, and is capable of receiving information from such compatible agents
- INETD (Super Server), which monitors TCP/IP ports for incoming messages
- BOOTP, which implements an Internet Boot Protocol server
- ROUTE, which manages Internet routing tables, and is invoked when booted; the netstat command is used to print the routing tables; among other details, the resulting listing shows gateways to networks
- RARP (Reverse Address Resolution Protocol), which is able to provide a 32 bit IP address in response to a 48 bit Ethernet address
- LINE PRINTER, which accepts incoming print jobs and queues them for remote printing
- SLINK, which links STREAMS modules and is included within Unix implementations that use STREAMS-TCP/IP
- LDSOCKET, which initialises the System V STREAMS TCP/IP Berkeley interface.

Configuration Interfaced devices are configured in terms of IP address, netmask and operational status using the command:

```
ifconfig
```

Configuration files include:

- `/ETC/HOSTS`, which provides a lookup table for finding IP addresses for host names
- `/ETC/ETHERS`, which provides a means of converting IP addresses into Ethernet hardware addresses; an alternative conversion method is provided by ARP (Address Resolution Protocol)
- `/ETC/NETWORKS`, which provides a lookup table for IP addresses and their respective network names
- `/ETC/PROTOCOLS`, which provides a list of DARPA Internet protocols

- `/ETC/SERVICES`, which lists services that are currently available to the host
- `/ETC/INETD.CONF`, which monitors a specified port, and invokes daemons when required.

Network access files

Access files include:

- `/ETC/HOSTS.EQUIV`, which contains a list of trusted hosts, and is significant to system security; each entry is trusted in that users access their accounts without a password
- `RHOSTS`, which lists system and user names; users are permitted to log in using any name in the file `/ETC/PASSWORD`.

(See ARPANET, DARPA, IP address and Security.)

TDM (Time Division Multiplexing) A technique by which several different signals may be transmitted concurrently over the same physical link.

Teleoperation The process of operating a remote robot or device.

Telepresence A process by which 3-D movements, manipulations and other variables can be communicated to a remote device. It is believed that the term was invented by Marvin Minsky.

(See VR.)

Telnet A connectivity mechanism which permits a client system with Internet access to operate a remote computer. The screen images shown on the remote system are also seen on the remote user's client system.

Telstra A large Australian telecommunications company.

Telstra Big Pond An Australian ISP.

Terminal A computer which is interfaced with a system (such as a mainframe computer). Typically it is dumb, meaning that it has no application logic or data, only the mere presentation element of an application.

Thin client A system within a client/server architecture (such as that of the Web) that features:

- presentation, which is typically in the form of a Web browser
- a portion of the application logic.

Many systems connected to the Web may be described as thin clients. Thin clients require less hardware resources, and are therefore cheaper to deploy than fat clients.

(See Application, Client/server, Fat client and NC.)

Third-generation language A high-level language such as Java, Pascal, BASIC, C and C++.

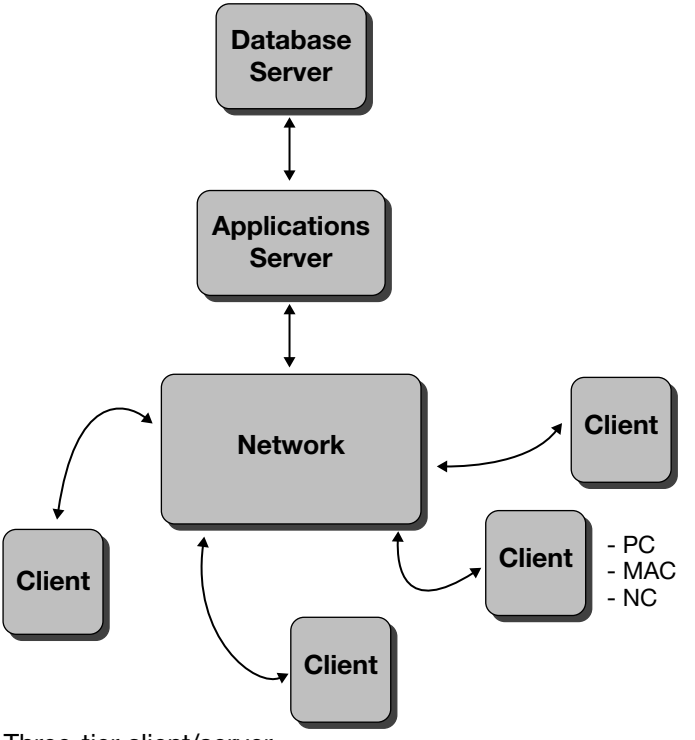
(See C++, Java and Visual Basic.)

Three-dimensional (*See 3-D.*)

Three-tier client/server A tiered architecture where the elements presentation, application logic and data may be perceived as existing on different platforms. Essentially, the three tiers are separate and independent, and interact via appropriate glues or middleware. The tiers are:

- presentation, which is the front-end
- application logic, which is the middle-tier
- data, which is the back-end.

The partition which separates these three entities in terms of those that reside on the client and those which reside on the server is a function of the client/server implementation. The clients might be PCs, Macintosh computers or NCs. The three-tier architecture offers:



Three-tier client/server

- effective scalability paths
- wider distribution of processing than the two-tier model
- low cost of ownership
- industry standard applications and operating systems
- isolation of hardware/software faults, while prospective areas of failure increase in comparison to two-tier architectures

(See Application, Client/server, Distributed computing, Fat client, Glue, Thin client and Two-tier client/server.)

Throughput A measure of work implemented as a function of time. It may be measured in floating-point operations per second (FLOPs), instructions per second (MIPs) or another unit for measuring processing performance.

(See MPP, Processor and SMP.)

TIFF (Tagged Image File Format) An image file format maintained by the Adobe Developers Association (ADA).

Time line A method of helping users to navigate information by allowing them to click on a line that bears dates. Generally it is in graphical form and accompanied by relevant images for various named periods of time. Microsoft Encarta Encyclopedia features a time line, as does Software Toolworks' History of Science and Innovation, which also features a graph of the economic cycle derived by Schumpeter. The peaks and troughs of the graph illustrate periods of economic prosperity and recessions/depressions, respectively.

TMA (Telecommunications Managers Association) A body whose membership is composed largely of telecommunications managers. Each year there is a TMA convention featuring state-of-the-art communications systems, techniques and standards.

Token Ring An IBM-developed network protocol and specification, officially named IEEE802.5.

(See LAN.)

ToolBook A multimedia authoring tool for the PC, produced by Asymetrix Corporation. Recognised as the brainchild of Microsoft's co-founder Paul Allen, and as one of the first generic multimedia authoring tools, ToolBook is one of those products that has earned a much-deserved place in contemporary computing history. Its early implementations were used to create some of the first multimedia CD-ROM titles, which include Microsoft's Multimedia Beethoven: The Ninth Symphony. Since these

memorable beginnings Asymetrix's ToolBook has evolved into a formidable family of products aimed at the creation of CBT (computer-based training) courses, of which ToolBook II Assistant is the latest addition. Other members of the product range include ToolBook II Instructor, ToolBook II Librarian, and Designer's Edge for ToolBook II. ToolBook II Assistant version 6.0 may be used to create multimedia programs that can be distributed using CD-ROM, floppy disk, intranets and the Internet. Aimed squarely at trainers, teachers, instructional designers and other similar professionals, it requires not even rudimentary programming skills. It does not possess the Asymetrix OpenScript programming language that has become synonymous with ToolBook. This is a welcome departure for Asymetrix and allows ToolBook to compete with tools like Authorware Professional, which has long been regarded as an environment that does not require programming. Those with programming skills might be better served by ToolBook II Instructor, which also includes the OpenScript programming language. This gives programmers better control over the resulting ToolBook applications by allowing them to define the behaviour of objects more accurately. ToolBook II Librarian is designed to help manage courseware deployed over the Internet and on corporate Intranets by providing administrators with feedback regarding student progress. Designer's Edge for ToolBook II is a productivity tool used in the pre-authoring stages of development, and provides a walkthrough environment for developers, taking them from analysis to evaluation during the instructional design process. Turning to the subject of this review, ToolBook II Assistant uses the familiar book metaphor for authoring and running resulting applications, which can contain multiple books. Each page of a ToolBook application has a foreground and background upon which can be placed objects such as questions, buttons, graphics and stages for video. The source for most of the objects is the ToolBook II Assistant Catalog. This can be extended to include your own objects, such as custom backdrops, buttons and graphics. To help developers create ToolBook applications there is a Book Specialist, which walks users through the process of creating a book structure, and gives control over various basic properties. The many properties that can be specified using the Book Specialist include the page size, position of navigation buttons, backdrops, your e-mail address, whether to record scoring information that can be sent by e-mail to the student, and whether student results are e-mailed to the administrator. You can also choose from one of three methods for distributing your program, which includes a Windows application on hard disk, on a CD-ROM or on a LAN. You can also choose Asymetrix Neuron so that your application can be played using Netscape Navigator or Microsoft Explorer. This method of application delivery requires that users have the Asymetrix Neuron plug-in or ActiveX Control installed on the browser. You can also choose to

distribute your applications as HTML files and Java applets over the Web. Having created a basic application framework using the Book Specialist, you can proceed to authoring the application at the Author level. While authoring you can test and play your application at any time by selecting the Reader level. You can toggle between Author and Reader levels using the Edit menu or by pressing F3. At the Author level multimedia production processes can be completed, including the addition of graphics, video, animations and text. The many aspects of the authoring process can be addressed, including the addition of a navigation scheme through the inclusion of hyperlinks. Page sequences of ToolBook applications can be viewed and edited using Book View on the View menu. The resulting window lists the hyperlink objects of selected pages, and can be used to rearrange pages simply by dragging thumbnail sketches of them. A vast library of objects is made available by the ToolBook II Assistant Catalog, which provides numerous categories of objects aimed at the development of courses as well as generic multimedia and interactive titles. These include questions, media players, clip art, video clips, animations, backdrops and user interface components such as buttons and hyperlinks. Many of the contained objects are not documented in the manual, so when familiarising yourself with ToolBook, browsing the Catalog should probably be on your list of starting points. Navigating through the various categories in the Catalog window reveals literally every component you could possibly need to build effective CBT courses. If you want to give your ToolBook applications a more original look, you might consider adding your own objects. The appearance and functionality of objects can be altered using the Properties dialog box, which can be invoked by right-clicking objects or by selecting the Properties button. Typically the Properties dialog box is used to alter fonts, change colours, establish object names and generally change the appearance of objects. The properties that can be altered depends on the selected object. In the case of a stage object that is used to accommodate video footage or an animation you can set the object so that it is transparent. Additional control over the behavior of objects is provided by the Extended Properties dialog box, which can be invoked by right-clicking the object or by selecting the Extended Properties button. As is the case with the Properties dialog box, the control that the Extended Properties dialog box gives over an object is a function of the selected object type. For instance, when using a video player object its extended properties include the video clip that it plays, as well as other properties of the playback sequence. Equally the Extended Properties of a selected question object will allow you to specify the correct answer, feedback for a wrong answer, and perhaps the score for the correct answer. In terms of adding multimedia content, the Catalog contains numerous media players, which include a number of video players with different controls. Video clips

are added to video players by right-clicking them in order to produce the Extended Properties dialog box. Similarly, the characteristics of stages can be changed through the Properties dialog box. The Catalog also has a category of buttons which Asymetrix has chosen to call Actions. Basically these are simply buttons with predefined behaviours that can be used to start and reset various actions. For example, they can be used to set the volume of wave audio and MIDI sequences, or to start media sequences which might be wave audio, MIDI, animations or video. You can trigger such actions using events other than mouse clicks, such as turning to a new page. A typical example of using Actions might be a simple path animation, where an object is moved from one point to the next. An Action trigger object would be used to move the object or sprite to a destination, and a Reset Trigger object would be used to return to the object or sprite to its starting point. As you would expect, the Catalog is also a rich source of question objects, which are among the most important components for course applications. Question types include selections of multiple choice buttons, where students simply click a button that is generally located to the left of text, and multiple choice fields where student can select buttons that show possible answers. Fill-in-the-blank and match-item question objects are also available in the Catalog. The former allows you to create questions where students are required to enter an answer, while the latter requires the student to match objects, perhaps by dragging an object onto an appropriate text item. Other question types include drop-target, which can be set up so that the student has to select one of a number objects and drag it onto an appropriate target object. And there is a question object which can be used to present lines of text, which the student must arrange in the correct sequence. A score-quiz object can calculate students' scores, which can be displayed in a feedback field. Using the Book Properties dialog box, it is possible to send student scores to specified e-mail addresses. Also included in the Navigation category in the Assistant Catalog is a Jump to URL button that will allow users to download ToolBook II Neuron from the Asymetrix Web site. There is also a button that allows users to download Java classes from the Asymetrix Web site. Some of the objects in the ToolBook II Assistant Catalog are Java-enabled, and their properties can be modified at Reader Level in the same way as any other object. Examples of Java-enabled objects include buttons in the so-called Course Action category and several of the objects in the Navigation category. When books are packaged for the Web, such objects become Java applets. Deploying a ToolBook course over the Web first involves selecting Export for Web on the File menu. It is then necessary to upload the application's exported HTML file and media files to the Web server, and an FTP utility is provided to carry out this operation. Having completed these operations you need only create a link to your application on a Web page. If the application

contains Java class objects it is necessary to upload a special file that contains Java code to the server. Additional applications provided include Microsoft's Bitmap Editor and Palette Editor, which have been around for some time, and Asymetrix's newer Palette Optimiser. Not much can be said about the Bitmap Editor other than it provides rudimentary editing features. The Palette Editor can be used to alter the colour information of video clips and graphics. It can also be used to generate common colour palettes, though this is best done with Palette Optimiser. A common colour palette ensures that the colours of video footage and graphics displayed together are reproduced accurately, and it also reduces so-called palette switching, which appears as screen flicker when switching between graphics and video clips.

(See Lingo and OpenScript.)

Top-down analysis A design approach which begins at a high-level and progresses to low-level component parts.

(See Bottom-up analysis.)

Touchpad An *x-y* input device consisting of a small touch-sensitive pad or surface. It is the chosen device for notebook systems.

Touch screen A screen which is responsive to touch, and provides a means of establishing interaction between the user and a running application or environment. It can be described as an input device or a user communication device. Touch screens are used widely for kiosk applications, where a multimedia title might be interfaced with the general public, for example. They can be assumed to make applications more intuitive.

TP-heavy server A server that runs TP monitors.

(See Server.)

TP-lite server A server that provides a portion of all the action required by full transaction processing (TP) monitors. Typically it will be able to commit changes to, and roll back changes made to, operational data, which is stored in an appropriate database variant. It may be devoid of:

- transaction coordination of multiple programs
- resource management.

(See Server and Transaction.)

TP (Transaction Processing) monitor (*See Server.*)

Trackball An input device that is integrated in older notebook and subnotebook designs. Physically it is a ball joint. The ball can be rotated using fingers, so providing a means of manipulating a screen pointer or cursor in the *X* and *Y* directions.

(See Touchpad.)

Transaction A term used to describe the data exchange and data changes which occur as the result of an interaction. The interaction might be the submission of an order form using a client browser. A transaction server is allocated the task of transaction processing (TP), and it often invokes the application logic necessary to perform database interactions and manipulations. The process(es) invoked directly or indirectly by the client are collectively referred to as the transaction. Transaction servers may include UI logic driving the client UI, relegating the client device to little more than a dumb terminal. Typically mainframe-based transaction systems might adhere to this model. Alternatively, the UI logic or presentation may be distributed to the client. The server consists of a TP monitor, which performs transaction management and resource management. Transaction management ensures the so-called ACID properties of transactions. These are Atomicity, Consistency, Isolation and Durability. ACID property compliance is achieved through the two-phase commit protocol. (*See ACID and Two-phase commit.*) Resource management is intended to optimise the use of resources, which include memory, mass storage and processing. It may also be involved with load balancing between resources and between the software processes, which may be threads.

(See MPP and Server.)

Transaction coordinator (*See Two-phase commit.*)

Transaction management (*See Server.*)

Transaction server A server allocated the task of transaction processing (TP).

(See MPP and Transaction.)

Transputer A processor designed for the construction of parallel processing systems or personal supercomputers. It is a complete microcomputer on a single chip, including a processor, memory and input/output devices in the form of communication links that can be used to interface one transputer with another. Initially it was developed by Inmos (Bristol, UK) using state funding, but it has been evolved into its current state using private investment. Inmos is currently owned by the SGS-Thomson group. Early

transputer designs include the 16 bit IMS 212 processor, which provided 10 MIPS, and the 32 bit IMS 414. The language of the transputer is considered to be Occam. Meiko (Bristol, UK) was among the first companies to develop transputer-based computers, most notably the Computing Surface. This system was used in the development of DVI (Digital Video Interactive) to research and implement digital video compression at the David Sarnoff Research Centre, New Jersey.

(See MPP, Occam and SMP.)

Triple DES An encryption technique based on a variation of the DES encryption technique. One variation sees three DES encryptions using three different keys.

(See DES.)

TTL (Transistor–Transistor Logic) A standard representation used in logic devices and in systems, denoting digital data.

Turnkey system A system which is installed and made fully operational on site.

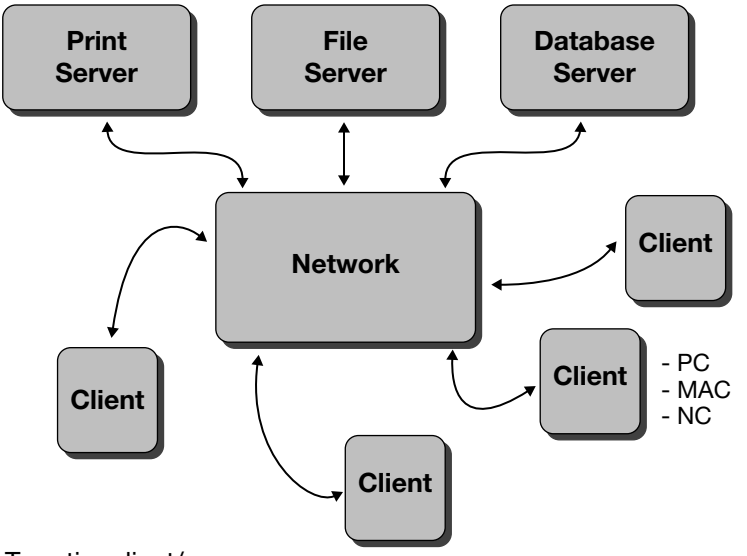
Twain A standard interface for scanners. Such compliant devices may be used directly with many graphics-oriented programs.

(*See Scanner.*)

Two-phase commit A method used in transaction processing which ensures ACID properties. It coordinates the changes made to system resources which result from transactions. It tests for their successful implementation, in which case they are committed. If not, and any one fails, they are all rolled back. The transaction coordinator is key to the two-phase commit protocol. This queries all subordinates to verify that they are ready to commit. If the subordinates have other subordinates, these must also be queried. When all subordinates are ready to commit, the transaction coordinator records the information to protect it against any interruption that might be caused by a system failure. Having received information about the readiness to commit, the transaction coordinator sends a commit command to its subordinates, and they do the same. Once the transaction coordinator has received confirmations from all subordinates, the client may be sent a transaction complete message.

(See Server and ACID.)

Two-tier client/server An architecture where application elements are distributed across two tiers of hardware. Physically logic and presentation elements may reside on intelligent client systems, and the data element may



Two-tier client/server

be on a back-end server or mainframe system. Client systems might be PCs, Macintosh computers or NCs, while the server might be based on one or more of the latest generation of Intel processors and running the Windows NT Server OS. Equally, the server might be a powerful RISC platform running the Unix operating system. File servers, print servers and database servers may also be integrated in the design architecture so as to distribute processing and optimise performance. The connection or access technology between servers and clients is provided by a LAN variant.

(See Application software, Client/server and Three-tier client/server.)

`typedef` A C++ command, which permits mnemonics to be assigned to the statements used to define variables. The following statement assigns the word `xxxx` to the `unsigned short int` statement:

```
#include <filename>
typedef unsigned short int xxxx;

int main ()
{
   xxxx coordinate;
   // define coordinate as an unsigned short integer
   variable
}
```

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U

U A chrominance component in a video signal that comprises colour information.

UART (Universal Asynchronous Receive Transmit) An electronic device used for serial communications.

UDP (User Datagram Protocol.) A protocol which is used widely in streaming audio and video. Macromedia Shockwave Director 6.0 is among a number of leading streaming server technologies which use UDP. It does not feature the reliability of TCP, and is therefore appropriate for streaming media where intensive error detection and correction is less important. Dropped packets, which are those that do not reach their destination, are acceptable in streaming media. UDP therefore optimises performance and makes better use of available bandwidth because it does not insist on the retransmission of erroneous packets.

(See Streaming and ASF)*

UI (user interface) A software module or program through which users interact with one or more applications.

(See GUI, OOUI and Windows.)

UI builder A development tool used to build user interfaces. Most modern UIs are OO. The resulting UIs may be text-based or graphical, as is common today. The latter naturally require the use of GUI builders, which provide a means of implementing the presentation element, together with its interaction with objects, applications and application logic. GUIs can be built using all modern multimedia authoring tools, which include Authorware, IconAuthor and ToolBook. Programming tools such as Microsoft Visual Basic, and others included with Microsoft Visual Studio, also have the capability to construct GUIs using visual techniques. Such development

tools, including GUI builders, feature standard UI components or widgets, which include buttons, sliders, drop-down list boxes, scroll bars and dialog windows. Static GUI components might include fonts, colours, textures and patterns. The GUI will also contain containers which act as receptacles for objects or components, which might be ActiveX or OLE objects. For example, using Visual Basic a container can be used to integrate OLE objects such as the Media Player or any compatible OLE object.

(See GUI, OOUI, Visual Basic and Windows.)

ULSI (Ultra Large-Scale Integration) A packaged semiconductor chip which integrates over 10 000 electronic devices. All processors are ULSI. The packaged component may contain more than one semiconductor chip, as is the case with the Intel Pentium Pro, which has two.

(See VLSI.)

UltraJava A chipset from Sun Microsystems which is optimised for the Java programming language. Like Intel MMX Technology, it is application-specific, thus optimised for 3-D graphics and multimedia-related computing, including MPEG video playback. UltraJava is licensed to NEC, Samsung Electronics, LG Semicon and Mitsubishi.

(See Java, MMX Technology and Sun Microelectronics.)*

Undo A feature provided by almost all fully specified programs. It simply cancels the last editing operation.

Uniform resource locator (*See URL.*)

Uniprocessor system A system design based on a single processor. Such serial systems might be referred to as von Neumann implementations.

(See MPP, NUMA and SMP.)

Unix A multi-tasking, multi-user operating system originally developed at Bell Laboratories for the creation of interdepartmental reports. It has since evolved into numerous commercial variants, including XENIX. Typically Unix OS variants feature the X Window system GUI.

(See X Window System.)

Uploading The process of transferring files from a client system to a server. Usually the transfer takes place using the FTP protocol.

UPS (Uninterruptible Power Supply) A device which prevents data loss following power supply failure or deviation by providing an instantly available alternative power supply.

URL (Uniform Resource Locator) The address of a service or Web site or Web page, which can be used by the Web browser to open specific sites and pages. For, example, the Web page www.altavista.digital.com is a URL which can be opened to show the Altavista search engine home page. Additionally, the browser permits such URLs to be stored in a directory, which might be called Favorites or something similar. The user may then open frequently visited sites and pages through one or two mouse clicks, depending on the browser used. The underlying HTTP protocol implements a client/server connection for each URL which is opened by the client browser. It transmits and receives data and carries the subsequent contents of an opened URL. Typically, when a URL is opened the first procedure involves finding the requested site or page on the Web. Having made an appropriate connection, the browser waits for a reply and then downloads the ensuing page data. Eventually, the HTTP breaks the connection with the remote server where the requested site or page resides. This break may be carried out manually by selecting the Stop button or a similarly named button.

(See HTTP and IP address.)

USB (Universal Serial Bus) A serial interface for connecting peripheral devices.

User authentication A process of identifying the user of a system or program.

- The most common user authentication technique is based on tokens, such as ID names, passwords and PINs.
- User authentication can also be implemented using biometric data, which may be a fingerprint, thumbprint or retina image.

(See Encryption, Firewall and Security.)

User block data A CD-ROM Mode 1 block contains 2048 bytes of user data.

(See CD-ROM.)

User communication A rarely used term which describes the user's interaction with a system or application.

User communication device A rarely used term which describes an input device such as mouse, touchpad, trackball or touch screen.

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V

V.1 A standard covering power levels for telephone networks.

V.21 A standard modem speed capable of transmitting and receiving data at 300 bps.

V.22 A standard modem speed capable of transmitting and receiving data at 1200 bps.

V.22bis A standard modem speed capable of transmitting and receiving data at 2400 bps.

V.32 A standard modem speed capable of transmitting and receiving data at 9600 bps.

V.32bis A standard modem speed capable of transmitting and receiving data at 14 400 bps.

V.32terbo An upgrade to the V.32bis standard introduced by AT&T.

V.34 A CCITT standard modem speed capable of transmitting and receiving data at 28 800 bps.

V.42 An international error correction standard for modem-based communications. MNP2-4 (Microcom Networking Protocol) and LAPM (Link Access Procedure M) provide error correction.

V42bis A standard for compressing asynchronous data. It uses LZW compression.

V.90 An official designation for the 56.6 Kbps modem standard. 56.6 Kbps = 56 600 bps.

(See Modem.)

Vapourware An intangible software product featured in a misleading software announcement. For instance, company X might announce an upgrade to a software product that features exceptional features, when in actual fact there is unlikely to be such a product.

Variable An entity which is not constant, and which may change in terms of its value and type. An integer variable stored using a byte (eight bits) may vary from 0 to 256. Its type could change from being numeric to being a character string or string variable.

(See C++ and Java.)

VBScript A scripting language that is a subset of Visual Basic and which may be used to deliver functionality gains to applications. VBScript may be used to enhance Web pages through the addition of:

- event-driven objects
- ActiveX controls
- interactive content
- Java applets.

VBScript does not harness:

OOP methodologies (1998)
DLL calls (1998)

The VBScript syntax is similar to that of Visual Basic, and includes statements for loops, events, procedures, functions etc.

VBScript `For . . . Next` loop A means of repeating statements based on a true or false condition

```
For pointer = first To last [Step step]
' statements
' statements
Next
```

VBScript `While...Wend` loop

```
While condition
'statements
'statements
Wend
```

VBScript procedures VBScript has `Sub` and `Function` procedures; the latter should be used to return values (in accordance with definition of a function).

VBScript The `Sub` procedure has the following form:

```
Sub Subroutine_Name([parameter])
   'statements
End Sub
```

VBScript function A `Function` procedure is of the form:

```
Function FunctionName([parameter])
   'statements;
End Function
```

(See Visual Basic.)

VBXtras An object factory which specialises in Visual Basic controls and add-ons.

(See Object factory and www.vbxtras.com.)

Vertical market A specialist or niche market. Until the late 1980s multimedia was considered a vertical market.

Very Large-Scale Integration (*See VLSI*)

VESA Media Channel connector A connection standard backed by VESA (the Video and Electronics Standards Association). The VESA Media (VM) Channel connector is an alternative to the VGA feature connector. It is bus- and processor-independent, so even the simplest system can accommodate 16 bit and 32 bit devices. A cost-effective gateway to upgradability, a VM Channel-based graphics card can be connected to MPEG decoders, Video CD cards, video capture cards, videoconferencing adapters and any other motion video decoders/decompressors as and when they emerge. Compatible with VRAM and DRAM display memory, it can be implemented using VL bus, PCI, MCA, EISA and ISA systems. It works using a packet-scheduling system that allows up to 15 real-time video and audio streams to share the same VM channel simultaneously.

(See Local bus.)

VGA (Video Graphics Array) An IBM PC graphics controller standard released in mid-1987 by IBM as part of its PS/2 range. Like all add-ins for PCs, graphic controllers (adapter cards) plug directly into expansion slots.

(See Graphics card.)

VHS (Video Home System) A standard ½″ video cassette developed by Matsushita and JVC. It was successful in forcing the BetaMax standard out of VCR market.

ViaVoice An IBM speech recognition program for desktop computers. Speech recognition has been high on IBM's agenda for over 25 years, and is part of an on-going multi-million dollar research and development program that yielded the VoiceType family of products. This high level of interest

indicates that speech recognition is an application with great potential. IBM's research program has also led indirectly to some impressive offshoots, including the DragonDictate program from speech recognition specialists Dragon Systems, which was founded by husband and wife James and Janet Baker, whose combined experience includes research at IBM. DragonDictate competes directly with the VoiceType packages and with IBM's latest offering and the subject of this entry, ViaVoice. The mentioned speech recognition programs differ from voice-dependent programs like the Microsoft Windows Sound System, which requires the user to train it to recognise each and every word. The process of training ViaVoice does not involve recording an acoustic model for every word or phrase; rather it is a process of teaching it to understand your voice characteristics. The training also teaches users to speak in a manner likely to be understood by ViaVoice, which means speaking clearly and leaving a noticeable pause between words. If we were dealing with the interpretation of musical notation, we would mean staccato and not legato; staccato means that each note ends suddenly and is detached from the next, while legato joins notes together using smooth phrases. The first port of call following installation of ViaVoice is the Dictation Trainer, whose Basic section must be completed in order to prime the program for use with Microsoft Word 95 or 97, ViaVoice's SpeakPad and other word processors via the clipboard. An additional Dictation section requires you to dictate a number of sentences and also has a useful demo, which includes information about correcting errors. Single-word errors are corrected by double-clicking them and then typing an alternative word, or by selecting one from a list. ViaVoice learns from such usage habits, because entered words that are not in the 30000 word dictionary are added to your personalised vocabulary, which cancontain up to 34000 words. Selected phrases are corrected in much thesame way, except that it is necessary to click on the Correct Error button. Itis advisable to then run the Enrolment program, which improves the recognition accuracy, which IBM broadly claims to be around 95%. Enrolment requires you to dictate one hundred sentences, and if you have a strong regional accent, or if your system hardware is less than that recommended, it is advisable to dictate all 473 sentences. Rather than being expanded through corrections, the personalised vocabulary can also be expanded using the Vocabulary Expander. To use this you first load a document, enter text using the keyboard or paste text into it using the clipboard. ViaVoice then analyses the text and lists unknown words, which can be selected and added to the personalised vocabulary. Apart from customising ViaVoice through the extension of the personalised vocabulary, it is also possible to add macros in order to automate the dictation of perhaps frequently used phrases and even complete paragraphs. The programming of macros takes place in the Dictation Macro Editor, which

requires you to add the text as it should look when dictated and add an appropriate description. ViaVoice then searches its vocabulary to see if the entered dictated text is already available. If it is not, then you are required to train the entry by recording an appropriate voice command. ViaVoice can be set up for a number of different users, who will each have their personalised copy according to the enrolment, user vocabulary and any macros they may have added. User names can be added during installation or immediately before the enrolment process, and are shown in various places including on the status bar of the SpeakPad. At a basic level of operation, users need to familiarise themselves with a number of voice commands, such as Stop Dictation to leave dictation mode, and Begin Spell and Begin Numbers to enter Spell and Numbers modes, respectively. While using Spell mode it is necessary to use the phonetic alphabet in order to enter words on a letter by letter basis.

VidCap A video capture program supplied with Video for Windows. *(See Video*.)*

VideoBlaster A low-cost video capture card series of products manufactured by Creative Labs.

Video capture The process of acquiring video in appropriate digital form, which might be compressed or uncompressed. The video source recording might be analogue or digital. The latter requires the video capture card to incorporate an appropriate input. The three general types of video capture include the following.

- The real-time video capture technique involves digitising the incoming video source signal immediately, and the video source device is not stopped or paused at any moment during capture.
- Automatic step-frame capture requires that the source device is stopped, paused and even rewound to digitise a greater amount of the source recording. It offers certain advantages; namely it is possible to achieve a greater number of colours (or greater image depth), higher capture frame rates, and larger capture frame resolutions than would normally be possible using the same video capture hardware and software configuration to record video in real time.
- Manual step-frame capture usually depends upon the operator clicking a button on screen in order to capture selected video frames.

Before video capture can begin it is necessary to prime the capture program by choosing a number of different options that include colour depth, video capture frame rate, frame dimensions, audio sample frequency and audio sample size. If you are capturing video using an eight bit colour depth (or

256 colours), and you wish to use a colour palette (which is a predefined set of colours), you also have to paste an appropriate palette into the video capture program or open an appropriate palette file. This, however, is a comparatively rare requirement. A capture file has to be set up to optimise the rate at which digitised video can be written to hard disk, so improving video capture performance. If necessary, the target hard disk should be defragmented so that video data is written to a contiguous series of blocks, optimising the target hard disk performance. Available colour depths using fully specified video capture card and capture program partnerships include 8 bit, 16 bit and 24 bit. The 8 bit format gives a maximum of 256 colours stored in the form of a colour palette that can be edited using programs such as PalEdit. 16 bit and 24 bit formats are described as true colour, giving a maximum of 65K (2^{16}) and 16 777 216 (2^{24}) colours, respectively, and when using appropriately specified video capture hardware and software they can produce impressive results. Using many video capture systems the data throughput required to capture 16 bit and particularly 24 bit video in real time limits both the capture frame rate and frame size. One solution to this problem is automatic step-frame capture, where an MCI video source device is operated automatically. The frame dimensions chosen hinge largely on the specification of the capture card, though the image depth chosen and the capture frame rate are also influential. Though the video frame dimensions can be scaled using video editing programs and even multimedia authoring tools, enlargement can result in a blocking effect as the individual pixels are enlarged. However, certain graphics cards, particularly those that enlarge Video for Windows video sequences, will apply a smoothing algorithm during playback in an attempt to minimise the blocking effect. Video editing techniques can also be used to increase the playback frame rate (through frame duplication). Other digital video editing techniques and hardware/software features of the playback system can help improve the quality of video playback. However, capturing and compressing optimum quality digital video relevant to the intended playback platform remains the most important process. There are limitations in what can be achieved through digital video editing and through playback hardware that enhances digital video playback. The original video sequence may be enhanced, even enlarged, through duplication, but it cannot be used to play video information present in the source recording that it simply does not contain. Even though numerous algorithms can enhance digital video, and numerous others will emerge, it is reasonable to assume that if the video file does not contain a particular frame then that frame cannot be played. The quality levels available using wave audio recorders together with mainstream sound cards can also be achieved through fully specified Windows video capture programs. 8 bit or 16 bit sample sizes are available, recorded at frequencies of 11.025 kHz, 22.05 kHz and 44.1 kHz in mono or

in stereo. The size of the sound track, which increases in relation to the recording quality chosen, can be monitored by selecting the Statistics command (or something similar on many video editing programs) using VidEdit.

Video capture card A card that can be used to capture and sometimes compress motion video, converting it into digital form. The majority of video capture cards sold are aimed at the production of video for the Windows environment, and are often supplied with the full implementation of Video for Windows. Manufacturers of mainstream video capture cards include Creative Labs, Fast Electronics, Intel, VideoLogic and Spea. Increasingly, as MPEG is entering into mainstream computing, video capture packages are able to capture and compress video according to MPEG. Important points to consider when purchasing a video capture card include the following.

- The image depths supported. All fully specified versions should support 8 bit, 16 bit and 24 bit colour depths.
- The maximum capture frame rate and capture frame resolution supported at a given image depth.
- The video editing tool supplied with the package; examples include VidEdit, Adobe Premiere and Asymetrix Digital Video Producer.
- The video capture program supplied; this will normally be Microsoft VidCap, though other variants are available.
- Video sources supported; it can be assumed that all modern implementations will support both PAL and NTSC.
- The video formats and compression schemes supported; these include Intel Indeo, M-JPEG and MPEG.
- The sound feature capabilities; with the exception of Video Spigot all video capture cards feature a built-in sound facility that is able to record sound tracks of audio qualities that are equivalent to those available using an MPC-2 compliant sound card.
- The presence of a VL channel connector indicates that the card can be connected to graphics cards that also feature a VL channel connector. Occasionally such cards can be slightly less expensive, as well as being expandable to incorporate additional functionality such as an M-JPEG video capture facility.

Video capture file A capture file is set up prior to video capture to optimise the rate at which digitised video can be written to hard disk. This improves the quality level of captured video. If necessary, the target hard disk should be defragmented so that video data is written to a contiguous series of blocks, thus optimising the target hard disk performance. The specified size of the capture file should be large enough to accommodate the video sequence that is to be captured and stored. Though the capture

program will usually enlarge it automatically, the possibility of complete frames being omitted or dropped during video capture is increased, as is the possibility that the capture file will become fragmented.

(See Video capture.)

Video CD (or White Book) A standard for storing MPEG-1 video on single density CD variants. It can be assumed to store approximately 74 minutes of MPEG-1 video. Discs are interchangeable between appropriately specified PCs and appliances. It can be assumed that a Video CD or a White Book disc can be used to store around 74 minutes of MPEG-1 video, the quality of which can be equated to an analogue VHS video recording. A key advantage of Video CD over analogue VHS video cassette is that there is no incompatibility between PAL and NTSC recordings, thus eradicating the need for separate NTSC and PAL versions, as is currently the case with VHS cassette video distribution.

(See MPEG.)*

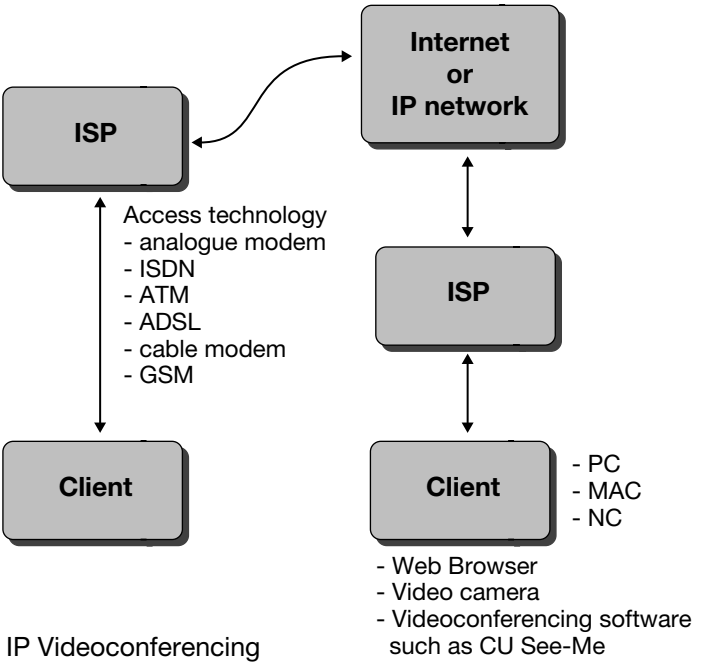
Videoconferencing A process by which users in remote locations communicate in real time both visually and verbally. Systems may be divided into the categories of:

- desktop videoconferencing using conventional desktop or notebook computers
- conference room videoconferencing, which typically include appropriately large displays.

Desktop videoconferencing systems include a camera, microphone, video compression/decompression hardware/software and an interface device that connects the system to an access technology. The interface device might be:

- a conventional modem used to connect with an ISP or intranet server, thereafter using an Internet-based videoconferencing solution such as CU-See Me
- a cable modem that might provide high-speed Internet access via cable
- an ISDN interface, which provides a connection to the Internet or appropriate IP network
- a Network Interface Card (NIC) which connects to a LAN
- a wireless interface which provides connection over GSM or another mobile communications network.

Access technologies for videoconferencing include PSTN, ISDN, ADSL, cable, GSM, ATM, T1 frame relay and proprietary wireless technologies. Point-to-point videoconferencing involves communication between two sites, while multi-point videoconferencing involves interaction between more than two sites. The latter might require a chairperson to conduct



IP Videoconferencing

proceedings. Also, the collective system might be voice activated, switching sites into a broadcasting state when the respective participant begins speaking. Vendors of videoconferencing solutions include Intel, PictureTel, Insoft and Creative Technology. Internationally agreed standards relating to videoconferencing include H.320 and T.120. The former was introduced in 1990 and provides guidelines to vendors and implementers that yield appropriate levels of compatibility.

(See ATM, Cable, Cable modem, ISDN, ISP, T1 and Video.)*

Videodisc A disc used to store video images. Popular videodiscs include DVD, LaserVision and Video CD.

Video editing The process of editing a video file. Digital video files can be edited using programs such as VidEdit, Adobe Premiere, and Asymetrix Digital Video Producer. Typical video editing operations include:

- Copying frames from one point to another in a sequence.
- Moving/cutting frames from one point to another in a sequence.
- Copying frames from one sequence to another.
- Moving frames from one sequence to another.
- Deleting unwanted frames from a video sequence.

- Titling video sequences.
- Cropping video frames.
- Altering the playback speed in terms of frames per second.
- Fading colours.
- Tinting colours.
- Changing colours.

The frame rate of a video sequence may be increased or decreased using many video editors without loss of synchronisation between the video and audio track. An increase in the frame rate results in the duplication of existing captured frames. For instance, increasing a frame rate from, say, 9 to 12 frames per second results in the duplication of the third, sixth, and ninth frames, while lowering the frame rate from 12 to 9 frames per second results in the removal of the fourth, eighth and twelfth frames. The capture frame dimensions also may be altered by cropping or resizing, though when enlarging or stretching a frame the resultant resolution can become poor, as the pixels are each expanded. ToolBook and other multimedia authoring tools can themselves be used to resize video sequences, so there is no need to do so at the video editing stage. A video editing program will also permit you to paste various different media files into a sequence, and depending upon its sophistication you may have a choice of fades as one video clip is merged into another. When cutting/copying and pasting between video sequences, video editors that are able to open multiple video sequences or tracks can prove more convenient than using multiple instances of a program such as VidEdit. Using all modern video editing programs you can edit the audio and video tracks independently, perhaps in order to paste a wave audio file over an existing substandard or unrequired sound track. Audio and video data tracks making up a video sequence may drift out of synchronisation, particularly when editing them individually. The synchronisation of video and audio can even go adrift at the video capture stage. For video footage where the sound track is a continuous musical sequence which does not tie in exactly with video images a lack of synchronisation may make little difference. This is not the case, however, where spoken dialogue is lip-synched or where cuts to different scenes result in different passages of music or sound tracks. In order to synchronise data tracks, the editing program will normally permit the adjustment of the video frame rate, or offset the audio track using an appropriate positive or negative value. Both audio and video formats can be altered following capture using a fully specified modern video editing program. The audio data track can be altered in terms of the number of channels, sample size, and sampling frequency. The video format depth can also be changed, perhaps to reduce a 16 bit and 24 bit sequence to an 8 bit video sequence. More complex editors also make titling possible, where text can be super-

imposed over video sequences, perhaps to add captions or credits. Control is given over the font, type style and size and colour, as well as the position of the title or text which exists for a predetermined range of frames. Some editors, such as Digital Video Producer and Adobe Premiere permit 'film strip editing', where frames of a sequence are shown on screen in horizontal or vertical strips. Often users find that these provide a better overview of sequences and help in the editing process. Video editing programs may also accommodate multiple open video sequences, so that video data can be copied/moved from one to another more easily. Without this ability it is often necessary to run multiple copies of the editing program. See: Botto, F., *Video for Multimedia PCs*, Computer Step, 1995.

(See MPEG.)*

Video for Windows A video standard. Video for Windows (VfW) permits video playback, capture and editing. Microsoft Video for Windows which includes the VidCap video capture program, VidEdit video editing program, BitEdit 8 bit graphics editor and PalEdit 8 bit colour palette editor. VidEdit provides a gateway to several video compression schemes, the variety of which depends upon the video card you have. Compression algorithms such as Intel Indeo, Microsoft RLE (Run Length Encoding) and Microsoft Video 1 can help reduce video file sizes by varying amounts. The size and quality of the video files can be controlled using compressors through the adjustment of compression settings. The resultant video can be added to applications through OLE (Object Linking and Embedding). It supports the AVI (Audio Video Interleave) format and features a number of compressors, including Microsoft 1, Microsoft RLE and Intel Indeo. See: Botto, F., *Video for Multimedia PCs*, Computer Step, 1995.

(See JPEG and MPEG.)

Video overlay A process by which video is combined with computer graphics or text. The hardware feature that provides the facility is called a genlock, and it can be found on many video capture cards.

Videotex A service used to publish text and graphics over the PSTN. It emerged from the BT Research Laboratories in 1970s, and was launched in the form of Prestel in 1979. Videotex uses alpha-mosaic text and graphics. The display is based on character blocks, which require 7 or 8 bits, and is produced from a look-up table or from a character generator. A videotex frame consists of a matrix of such characters, consisting of 24 rows of 40 characters. Typically the frame requires 960 bytes, and may be transmitted in around 6.5 seconds over PSTN. Using faster ISDN access technology, the transmission time is reduced.

ISDN D channel
Transmission time =(960 × 8)/16 000
=480 mS

ISDN B channel
Transmission time =(960 × 8)/64 000
=120 mS

(See DCT and MPEG.)*

Virtual private networking (*See VPN.*)

Virtual processor A processor which is implemented in software. It may sometimes be referred to as a virtual machine. It is a design approach used by such programming languages as Java, so that they may be system- and OS-independent. They may, therefore, be applied as applets in heterogeneous environments such as the Web.

Virtual reality (*See VR.*)

Virtual Web server A Web server that is not physically implemented; rather it may exist with a number of other such virtual Web servers on the same site. Virtual Web Servers may be created using Microsoft IIS, and they may have a:

- domain
- TCP/IP address
- root directory.

Whether or not a Web server is virtual is transparent to the user.

(See IIS, TCP/IP and Web server.)

Virus A program which propagates itself from computer to computer and which has a detrimental effect on the operation of software or hardware. Viruses may be assumed to be programs that often cling to applications and perform occasionally catastrophic procedures such as the erasure of files or even formatting of disks. Known viruses are said to be 'in the wild', and include Michelangelo, which alters the size of the DOS `COMMAND.COM` file and attempts to make a system unbootable. Such known viruses may be removed from a system or DSM using commercially available anti-virus programs. These include Dr Solomon's Anti-Virus Toolkit, and other comparable products from companies like IBM and Symantec. Typically viruses are spread via removable media like floppy disks and e-mail attachments. Appropriate anti-virus programs may alert the user to the presence of such unwanted software components. Certain applications are more susceptible to viruses than others. The Microsoft Word program may be subjected to

the unwanted effects of so-called macro viruses. The Concept virus is one such common example, which alters Word templates.

(See Firewall and Security.)*

Visual Basic A programming language which offers OOP and visual programming features. The most popular implementation is the Microsoft Visual Basic programming tool, which can be used to tackle a variety of different programming projects, including the development of:

- ActiveX controls
- client/server applications
- mainstream business applications
- utilities
- multimedia-related programs such as media players
- leisure programs.

Microsoft Visual Basic forms part of its Visual Studio package, and is also available in standalone form. 1998 editions of Microsoft Visual Basic are:

- The Standard Edition, which can be used to build 16 bit and 32 bit applications. The standard edition does not support ODBC databases or Visual SourceSafe.
- The Professional Edition, which adds to the Standard Edition's facilities through such features as ODBC compliance.
- The Enterprise Edition, which includes the features of the Standard and Professional Editions, and also integrates Visual SourceSafe.
- The Control Edition, which is intended for building ActiveX Controls.

(See ODBC and Visual SourceSafe.) The following paragraphs show how Microsoft Visual Basic can be used to develop a video player application which uses an OLE container along with standard Windows UI objects. Drawing the program's controls is one of the first stages of program development when using MS Visual Basic. Consider an instance where we wanted to develop the media player shown here.

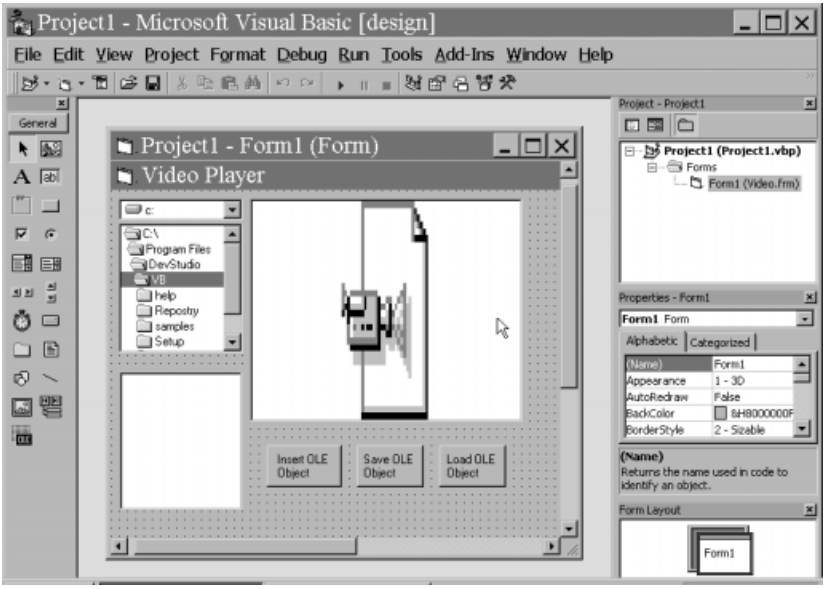
1. It is necessary to draw:

- a directory list box
- a files list box
- a drive list box
- an OLE container.

2. Go to the *media type* property box and select *Video Clip* as the media type.

3. Modify the properties of the page, by typing the name *Video Player* alongside Caption.

4. In the *File list* properties box, type *.AVI to ensure that only Windows AVI compatible video files are listed.



5. Modify the OLE1 object properties so that AutoActivate is set to Manual, its Class is 'avifile' and its SizeMode is 1 'Stretch'.
6. The final and most important stage of the program is the addition of code to the controls. The following lines should be added to the form to be executed when the application is loaded through the `Form_Load` event.

```
Private Sub Form_Load()
  Drive1.Drive = App.Path
  Dir1.Path = App.Path
End Sub
```

The code segment merely ensures that the drive and pathname default have the same directory and drive as the VideoPlayer. So if the video player application was in `C:\WINDOWS` the program would start to look for AVI files on the C drive in the `\WINDOWS` directory. To make sure that the drive, directory and file list boxes all refer to the same locations, add the following code segments to the `Dir1` and `Drive1` controls.

```
Private Sub Dir1_Change()
  File1.Path = Dir1.Path
End Sub

Private Sub Drive1_Change()
  Dir1.Path = Drive1.Drive
End Sub
```

This ensures that a change made in the drive list box is reflected in the directory list box, and changes made therein are echoed by the file list box. Shown below is the code segment assigned to the file list box activated by a double-click event. It first declares a string variable in which to store the selected path and filename using the statement `Dim Video As String`.

```
Private Sub File1_DblClick()
  Dim Video As String
  If Right(File1.Path, 1) = "\" Then
    Video = File1.Path + File1
  Else
    Video = File1.Path + "\" + File1
  End If
  OLE1.CreateEmbed (Video)
  OLE1.DoVerb
End Sub
```

The second thing that it does is to determine whether or not the selected file is in the root directory or in a named directory. It does this by using the statement that begins with the `Right` function. This returns the right-most character of the pathname. If this is not a backslash '\', then the selected file is identified as residing in a directory, in which case the statement `Video=File1.Path+"\"+File1.filename` is implemented. This ensures that a backslash is inserted between the path and the filename. It also assigns the complete path and filename to the string variable `Video`. If the rightmost character of the pathname is found to be a backslash, the statement `Video=File1.Path + File1.filename` is executed, which assigns the filename to the string variable `Video`. The contents of the string variable `Video` are then used as a source document and embedded in the OLE1 container control using the statement `OLE1.CreateEmbed Video`. Finally the `DoVerb` method activates the embedded object in order to play the selected video file. The OLE container control does not require coding, but it is important to adjust its properties as previously described. It is important that you set its `Class` property to `avifile` and its `SizeMode` property to `1 Stretch`. The application can be run by pressing F5 by using the menus or the appropriate toolbar icon. After testing and debugging, the program can be saved as an executable file by clicking Save as EXE file on the File menu. OLE provides a quick method of including wave audio, MIDI files, animations and video, and helps to shorten the software development life cycle. There are many instances when program users need to include their own media files through OLE2 at runtime. Users may harness it to add voice or video annotations, documents, etc. This can be achieved by including Paste Special or Insert Object dialog boxes in the program. The Paste Special dialog box is produced using the PasteSpecialDlg

method. The Insert Object dialog box is produced using the InsertObjectDlg method. This allows the user to choose a compatible application or file type to insert in an OLE container control. Whether an object is linked or embedded depends on the `OLETypeAllowed` property of the OLE container control. When an object is linked, the `OLETypeAllowed` property equates to `0-Linked`, while it is set to `1-Embedded` when an object is embedded. The listing below shows how a button can be used to open the Insert Object dialog box and allow the user to place an object in an OLE container control called `OLE1`.

```
Private Sub Command1_Click()
  OLE1.InsertObjDlg
    'Produce the Insert Object dialogue box
End Sub
```

Embedded or linked objects in an OLE container control can be saved using the `SaveToFile` method, which causes the placeholder and link to be saved. Changes made to the linked object can be saved using the OLE server application. When applied to embedded objects, the data is saved in its entirety. The `SaveToFile` method can be used to write OLE 2.0 object data to files, while the `SaveToOle1File` method saves objects in the OLE1.0 file format. The listing below can be used to save embedded or linked object data.

```
Private Sub_Command2_Click()
  FileOLE=FreeFile 'Assign a free file number to
    'FileOLE
  Open "ONE.OLE" For Binary As #FileOLE
    'Open the file
  OLE1.SaveToFile FileOLE
    'Save the object data in OLE
  Close #FileOLE      'Close file
End Sub
```

The subroutine first determines a free file number. Then it opens that file, writes the object data to it and closes the file. The opening statement `FileOLE=FreeFile` returns a legal file number that can be used by the `Open` statement. It ensures that the `FileOLE` variable is assigned a file number that is not currently in use. An argument can be added to `Freefile` in the form of a suffix. The default argument '0' used in this case returns a file number from 1 to 255. A '1' argument returns a file number from 256 to 511. `Freefile` can be used to specify the number of the file to be opened with the `ReadFromFile` method or saved using `SaveToFile` or `SaveToOleFile` methods. It is dormant at design time, and returns no value. The second statement `Open "ONE.OLE" For Binary As #FileOLE` opens the file that is defined by the file number assigned to the

FileOLE variable. The statement OLE1.SaveToFile FileOLE writes the data within the OLE1 container control to the file specified by the contents of the FileOLE variable. Finally, with the object data saved, the file is closed using the statement Close #FileOLE. As you would expect, the code required to retrieve saved OLE data is markedly similar to that required to write it. The listing below illustrates this:

```
Private Sub Command3_Click()
  FileOLE=FreeFile    'Assign a free file number
  Open "ONE.OLE" For Binary As #FileOLE
    'Open the file
  OLE1.ReadFromFile FileOLE
    'Read the object data from
    'the file
  Close #FileOLE
    'Close the file
End Sub
```

The statement OLE1.ReadFromFile FileOLE reads object data from the file and writes it into the OLE1 container control. Like the SaveToFile method, the ReadFromFile method requires the file number of an open binary file to read object data.

Visual Basic Control Edition A version of Microsoft Visual Basic aimed at the development of ActiveX Controls.

(See Visual Basic.)

Visual Basic Standard Edition A version of Microsoft Visual Basic which can be used to build 16 bit and 32 bit applications. It does not support ODBC databases or Visual SourceSafe.

(See Visual Basic.)

Visual C++ A Microsoft C++ programming environment which can be used to create

- DLLs
- ActiveX controls
- 16 bit and 32 bit applications

(See C++.)

Visual FoxPro A Microsoft OOP database management system for creating enterprise solutions. It is supplied with the Microsoft Visual Studio.

Visual InterDev A Microsoft development tool which is used to create Web and intranet applications. It can be used to:

- access ODBC databases
- script client and server Web pages
- edit content files
- manage multiuser Web projects.

The files of an InterDev application are stored on the Web server. Files are accessed with Visual InterDev, using a local *project* file that points to the server and to the relevant Web. InterDev lends itself to the team collaboration environment because multiple developers can work simultaneously with files (on the Web server or in a Web). The Web project includes the Web files on the server and, on the client-side, the local project files. A Web Project File is available for the creation of project files that point to relevant Webs and Web servers. Visual InterDev is also supplied with the multimedia production tools:

- Image Composer, which offers a sprite-based drawing environment. Each imported image becomes a sprite. A number of effects and filters are available. Support is provided for plug-ins from Adobe and Kai. It supports BMP, GIF and TIF formats.
- Music Producer is used to create MIDI sequences.
- Media Manager empowers Windows Explorer to view media files.

(See MIDI, Multimedia production and Wave audio.)

Visualisation A process which transcribes often empirical data into a more readily understandable form. It can accelerate the interpretation, communication and understanding of complex data sets. Visualisation takes place on a computer platform or in a VR environment. Visualisation tools have many applications, ranging from molecular biology to architectural design.

Visual Java++ A Microsoft development environment for writing, compiling and debugging Java applications and applets. Visual J++ can be used to integrate JDK packages into Java programs, and to create multithreaded Internet and intranet applications. InterDev is included in Microsoft VisualStudio 97.

(See Java, JDK and JScript.)

Visual programming A programming technique where the programmer simply draws usually standard components on screen and then attaches code to them. The code segments may be written in a line-by-line fashion or selected from a library. Many multimedia authoring tools and modern development tools employ visual programming techniques at various levels.

(See Visual Basic.)

Visual SourceSafe A Microsoft solution which lends itself to the team collaboration environment. Once installed, this restricts editable files to individual authorised developers.

Visual Studio (Enterprise Edition) A comprehensive suite of Microsoft development tools, which includes:

Visual J++
Visual C++
Visual Basic
Visual InterDev
Visual FoxPro.

It also includes numerous tools, extensive documentation and the Microsoft Developer Network (MSDN) on CD-ROM.

(See ActiveX, C++, Java* and Visual Basic.)*

VLAN (Virtual Local Area Network) A network where computers may not be connected to the same physical LAN; rather, they are connected on different networks, and in remote locations. They may be configured using software, and are immune to the physical location of the networked systems.

(See Ethernet, LAN and VPN.)

VLB (VESA Local Bus) A standard local bus, which supports compatible peripherals such as hard disk controllers, I/O cards and graphics cards. It is internationally agreed and backed by VESA (Video and Electronics Standards Association). It is used widely on PC designs, and gives better performance than IBM's original ISA (Industry Standard Architecture) expansion bus developed for the PC AT (Advanced Technology) in the early 1980s.

VLSI (Very Large-Scale Integration) A semiconductor chip (or die) which integrates between 1000 and 10 000 devices. The packed assembly may contain more than one chip, such as the Intel Pentium Pro.

(See ULSI.)

VOC A wave audio file format introduced by Creative Labs as part of its SoundBlaster range of sound cards.

(See Wave audio.)

VoiceAssist A program that permits Windows to be operated using voice commands. It is comparable to Microsoft Voice Pilot.

Voice Pilot A basic voice recognition system supplied with Microsoft Windows Sound System, which permits the operation of Windows and Windows applications using voice commands. It works by storing acoustic models of your voice. For example, when you train it to understand the way you say 'File' it will implement this voice command by opening the File menu. It is not intelligent. For instance when training Voice Pilot, and you are asked to say 'Maximise' you could just as easily say 'big'. Voice commands are implemented using simple macro recordings which are shown in the Detail window.

(See ViaVoice.)

Voice recognition *(See Speech recognition and ViaVoice.)*

VPL Inc. (Virtual Programming Language Inc.) A company founded in 1985 by Jaron Lanier with the purpose of serving the VR market. Its products include the DataGlove and the EyePhone HMD. Other early products include RB1 (Reality Built for 1), a single-user VR system. Its specification was raised to RB2 (Reality Built for 2), which could interface two users.

(See VR.)

VPN (Virtual Private Network) A network which may be built using Internet technologies, as opposed to private lines. VPNs may be LAN-to-LAN, or even extranets, which include remote users that may be business partners or even customers.

VPN tunnelling A method of connecting to VPNs via an ISP. The ISP must have a Network Access Server (NAS). For many enterprises, VPNs form part of an IT solution for teleworking.

(See VPN.)

VR (Virtual Reality) A non-linear medium that can extend to the concurrent communication of interactive 3-D images, sound and numerous different variables that include 3-D movements and manipulations. Its key property is that of a theoretically infinite bandwidth. Users' extracted movements typically include body, limb and digit movements, but can range from intricate muscular contractions to intimate vessel expansions and retractions, and from surface movements of the skin to eye movements. Trends point to a yet more sensitive interface able to read every movement down to the blink of an eye, the enlarging of a pupil, and even the displacement of a human hair. A verbatim image of the interfaced user is foreseeable. Jaron Lanier lays claim to having coined the term. Users

themselves may also be the recipients of 3-D movements, most notably in simulation applications. Subtler manipulations may also be experienced. Variables that are unidirectional include user coordinates, pulse rate, heart beat rate, blood pressure and capacity. Variables that may be bi-directional in nature include temperature and moisture. Other more specialised variables include pressure, flow, air flow, acidity, luminance, potential, mass, velocity/speed, acceleration and directionality. Computer-generated 3-D images comprise full or partial virtual environments, as well as perhaps complete or partial replications of interfaced users. The attainable sophistication of the overall graphical environment is a function of the driving graphics engine, the software and particularly transformation algorithms. Features which determine complex virtual environments include requirements for high-speed graphic transformations, large sets of coordinates, high-resolution images, large numbers of independent 3-D graphic objects, complex 3-D objects with changeable behaviours and high levels of chrominance. Voice commands can replace and/or complement tangible and even virtual mechanisms for interaction and navigation. 3-D sound rendering also may be included to maintain the perspectives of virtual sound sources. The tangible VR platform provides the necessary mechanisms for navigation, browsing, interaction, stimulation of sensory channels and monitoring variables. At the core of a standalone VR system is at least one appropriately specified computer that might typically range from a single-processor-based variant to a multiple microprocessor-based system based on a single shared data bus or a complex supercomputer architecture including multiple processors (such as the Transputers used by Division (Bristol, UK)) working in concurrence. The graphics performance of the collective virtual engine and accompanying graphics engine/controller is the key to determining overall complexity and effectiveness of supported applications. Obvious VR applications can be revealed, or discovered, by considering instances when interactive 3-D graphics/environments have to be communicated and experienced. The experience may be intimate, vague or detached, where the user need not be fully immersed, in which case the HMD may be exchanged for something less intimate, or even a two-dimensional display. Current applications include architectural visualisation, scientific and engineering visualisation, civil and military simulators, surrogate travel, surgery (telepresence), point-of-information using realistic computer-generated images or video overlay. Distant future applications include virtual conferencing, three-dimensional multimedia authoring tools, and the simulation of ergonomically effective working environments, yielding the virtual desktop. The visualisation tool market for desktop computers has mushroomed in recent years, giving professionals of various different kinds the ability to experience and experiment with structures in three dimensions. The resultant acceleration of

understanding renders visualisation a useful instrument for learning. The absorption of 3-D movements at various different levels and their replication in remote, and even multiple, sites is termed telepresence. Related applications include instances where human operatives may be subject to hostile elements in the remote environment; human operatives cannot physically exist due to the large or small scale of the remote environment; the cost of physically implanting human operatives in the remote environment is reduced through telepresence; a single human operative must have a concurrent presence in multiple remote environments; or the presence of human operatives must be shifted quickly between different multiple remote environments. Current real-world applications include remote surgery and keyhole surgery, while a plethora of others wait in the wings, ranging from deep-sea diving to the remote realisation of military roles. Conceivably telepresence will one day extend to VR-conferencing, providing full interaction between participating users; conference members or even a complete workforce could be congregated from multiple locations. An almost mandatory stage in the development of a multimedia application is the development of a storyboard, which may also include the various implanted links that support its non-linear paths. This preliminary design stage can be carried out using the multimedia authoring tool itself, which is the case with Asymetrix ToolBook and many other tools. This stage provides a prototype structure for testing the partial or complete interactive design. Multimedia based on a complex hypertext model that features a fine level of granularity can be difficult to storyboard in two dimensions; a single page, window or screen that forms part of a frame-based multimedia application may contain a number of micro features that provide navigational controls. The micro features may include active words/phrases, image fragments or micons (motion icons), all of which will require the implantation of links. Modern authoring tools offer visual programming techniques where you first draw screen objects such as buttons and then attach program scripts to them, so defining their behaviour. Modern tools also provide a number of commonly used ready-made scripts that can be used to handle events such as mouse clicks. Even if the authoring tool provides a means of drawing the links using a graphical model of the application, the underlying hypertext structure can remain difficult to overview. This is largely because the conventional computer monitor is restrictive and fuels a tunnel vision that significantly lengthens the design stage. Now consider a 3-D multimedia authoring tool: a virtual environment ergonomically designed as a receptacle for the components of a multimedia application. It could be a room of any shape or size, a sphere, or simply a free space without visible boundaries. Documents/frames with multiple media types could be pasted on virtual walls and surfaces, or suspended in free space. Mixed media documents could be cascaded or tiled as required, while the

all-important links could be implanted graphically. Multimedia, hypermedia and hypertext authors familiar with two-dimensional environments will appreciate fully the advantages of a third dimension: both the storyboard and interactive design are implemented and overviewed more easily; while testing the interactive design and debugging is made easier. See the following works.

Sutherland, Ivan, *A Head-Mounted Three-Dimensional Display*, Harvard Computation Laboratory, *Proceedings Fall Joint Computer Conference*, Thompson Books, 1968.
Larijani Casey, L., *The Virtual Reality Primer*, McGraw-Hill, 1993.

VRML ('Vermul') (Virtual Reality Modeling Language) A file format and a language for creating and describing objects or nodes and their behaviour. VRML extended the Open Inventor specification to include cone, cube and cylinder primitives, along with methods for embedding hyperlinks. Applications of VRML include:

- multimedia presentations and titles
- leisure software
- virtual reality
- Web pages.

Objects may be:

- static 3-D images
- static 2-D images
- audio
- multimedia
- embedded with hyperlinks.

VRML authoring tools or generators are widely available.

VRML nodes Node properties have:

- a *name*, which is dedicated to the class
- *parameters*, which offer an object's definition and have fields that contain dimensions etc.

VRML events The nodes are event driven, and receive and send messages such as:

`eventIn`

which typically changes a property of the node, or

`eventOut`

which sends a message from an object that might have undergone change due to an interaction with a message. Nodes interact using messages passed via `ROUTE`, which interconnects `eventOut` and `eventIn` processes.

VRML ISO/IEC 14772 An official designation for the internationally agreed VRML specification.

V standards A set of recommendations that covers voice and data telephony. Popular V standards cover the following full-duplex modem speeds:

V.21	300 bps
V.22	1200 bps
V.22 bis	2400 bps
V.32	9600 bps
V.32 bis	14 400 bps
V.34	28 800 bps
V.90	56 600 bps

(See Access technology and Modem.)

Vulnerabilities A listing of comparative flaws in a network's defences against illegal access.

(See Firewall and Security.)

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W

W3C *(See World Wide Web Consortium.)*

Waldo A term used to describe a remotely controlled robot or machine.

WAN (Wide Area Network) A network of computers and interconnected LANs. Typically a WAN is spread over a greater area than a LAN.

WAV A Microsoft standard file format for storing wave audio data. It can be used to store 8 bit and 16 bit wave audio at sample rates of 11.025 kHz, 22.050 kHz and 44.1 kHz. WAV files are compatible with all fully specified multimedia presentation programs and multimedia authoring tools. They are also compatible with all modern Windows wave audio recorders and editors, including Sound Recorder, Creative Wave Studio and QuickRecorder.
(See ASF, MPEG, Streaming* and Wave audio.)*

Wave audio A term often used to describe digital audio recordings, usually made using an analogue signal provided by a source device. Such wave audio may be distributed in real time over the Internet using streaming server technologies, or it may be distributed using CD- and DVD-based variants. It may provide content for CD-ROM, DVD or Web applications. Generally it can be distributed and played back using any medium that is capable of sustaining an average data transfer rate that is appropriate to the recorded wave audio quality level. The principal parameters which drive the quality of wave audio recorded using PCM (Pulse Code Modulation) include the sampling frequency and the sample size. The wave audio quality levels that can be achieved are functions of the wave audio recording software and the sound facility on the recording system. MPC-2/3-compliant sound cards may be used to record and play wave audio in mono or stereo at sampling rates of 11.025 kHz, 22.05 kHz and 44.1 kHz, using 8 bit or 16 bit samples. Used with appropriate software, highly specified sound cards offer higher sampling frequencies and larger sample sizes. They may make DAT-quality wave

audio possible, which equates to 16 bit samples recorded at a frequency of 48 kHz. There are many programs able to record and edit wave audio, including Windows Sound Recorder, Creative Wave Studio and QuickRecorder (supplied with Microsoft Windows Sound System). All of these may record CD-quality wave audio, which equates to a sampling frequency of 44.1 kHz and a 16 bit sample size. Wave audio files may also be produced using modern video capture software such as VidCap (supplied with Video for Windows) or Asymetrix Digital Video Producer. Apart from the odd exception, almost all video capture cards have a built-in sound feature that can record wave audio of the same quality levels accommodated by MPC-2/3 cards. Simple calculations imply that one minute of uncompressed CD-quality wave audio, which amounts to 10.08 Mbyte (10321.92 Kbyte), requires a DSM capable of providing an average data transfer rate of around 172.032 Kbyte/s. Approximate file sizes when recording one minute of 8 bit stereo wave audio at different sampling rates are as follows:

11.025 kHz	1.25 Mb
22.050 kHz	2.52 Mb
44.1 kHz	5.04 Mb
48 kHz	5.49 Mb

Approximate file sizes when recording one minute of 16 bit stereo wave audio at different sampling rates are as follows:

11.025 kHz	2.52 Mb
22.050 kHz	5.04 Mb
44.1 kHz	10.08 Mb
48 kHz	10.98 Mb

The memory capacity consumed by a sequence is a function of quality. If it is necessary to calculate the exact memory/data capacity consumed, then the following simple formula can be applied:

```
Memory capacity required (bits) = Sequence duration
(secs) × Sampling rate (Hz) × bits per sample
```

For example, if an 8 bit sound digitiser with a sample rate of 11 kHz were used to digitise a 15 second sequence, then:

```
Data capacity required (bits)
  = 15 × 11 000 × 8
  = 1 320 000 bits
  = 165 000 bytes
  = 161.13 Kbyte
```

Memory or disk data capacity required naturally increases linearly with increased sample rates.

(See MPC-3 and Streaming audio.)

Web A global hypertext-based structure that may be navigated and browsed (shorthand for World Wide Web). It provides links to information sources and services, which are termed Web sites. Tim Berners-Lee is credited with the Web's invention, and is currently the Director of W3C (World Wide Web Consortium). The initial work was carried out by Berners-Lee when he was a computer scientist at the Centre for Nuclear Research (CERN) in Switzerland. A key facet of the Internet, the Web is based on the hypertext model for information storage and retrieval. URLs are the key to permitting the implantation of hypertext links and navigation schemes on the Web. It can support mixed media, including video. It was released in 1992 by CERN. Its origins are in hypertext, hypermedia and multimedia models and concepts.

(See Berners-Lee, Tim, Web and World Wide Web Consortium.)*

Web-based company A company that uses the Web as its marketing and selling channel. Historically, such e-commerce Web sites require CGI scripts and programs in order to implement processing logic. Typically forms posted from the browser are validated in terms of credit card details and so on, and if accepted the customer's order is placed in the database and processed by the vendor at an appropriate point in operations.

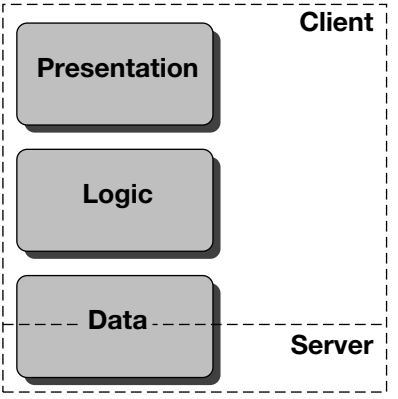
(See ASP, CGI, Perl and Transaction.)

WebBot A name given to components included with Microsoft FrontPage. They each have a specific functionality:

- *Comment* is used to at Web documentation, which is only visible at design time
- *Confirmation* echoes entered user data
- *Include* replaces the contents of a Web page with another
- *Scheduled Include* echoes the Include WebBot functionality, except it may be scheduled for a future date
- *Scheduled Image* echoes the functionality of the Scheduled Include WebBot, except it includes an image rather than Web page contents
- *Search Component* provides Web site search facilities
- *Table of Contents* generates a Web's outline, together with its hyperlinks.
- *TimeStamp* is used to display the date and time the Web page was last updated.

(See ActiveX, Java, Microsoft FrontPage and Plug-in.)

Webcasting A process by which a Web server serves clients or users with specific data or files. The user merely specifies what is required. Webcasting



Webcasting client/server model

software includes Intermind Communicator and PointCast. Such a process exists within the *push* model. (See Figure).

(See Application software and Client/server.)

Webmaster An individual that manages and maintains a Web site. His/her duties are numerous, including updating Web pages, adding new content, removing old content and overlooking integrated security features and policies.

Web page A page which may be accessed via the Web. A Web page may include links to other pages, 2-D and 3-D graphics, sound bites, video, an e-mail address and various forms for user feedback. Its underlying code or glue is HTML, which may be used for formatting as well as for holding together such components as ActiveX controls.

(See ActiveX and Web*.)*

Web phone *(See Internet telephony.)*

Web proxy An agent which may be perceived as existing between the browser and the Internet or intranet. Typically they are used for caching Web pages in order to improve performance, hence the term 'caching proxy'.

(See Security proxy.)

Web security A method of securing Web applications and their associated data from illegal unauthorised use. Securing Web applications and their data typically involves:

- implementing a firewall, which restricts access to selected Web applications and data

- using client-side security features of Windows NT and its variants, and security programs like Virtual Key
- restricting access to server-side data and components, which might include CGI scripts and ISAPI filters
- monitoring system logs
- restricting a user's rights to upload files to server-side directories, to minimise the possibility of virus infections
- adhering to SET guidelines
- designing a security regime where users require membership of the complete site or selected components
- requiring site members to change their passwords
- granting users guest rights, where they may be able to peruse demo Web applications and data.

(See Encryption, Firewall, Security and SET.)

Web server An architecture which maintains the connection between the server-side processing and data with that of the client-side. The mainstay of one or more Web applications, the Web server may also implement interactions between users and server-side databases. User interaction via the browser might be processed on the client-side or on the server-side. ActiveX controls might form a basis for such client-side processing. The Web server interprets user requests and implements specified tasks, such as:

- serving HTML pages, which are interpreted by the browser
- downloading files
- downloading streaming audio, video or multimedia
- downloading Java applets
- downloading ActiveX controls
- interacting with server-side databases

Web servers include the Microsoft Personal Web Server, which can be used for prototyping and for proving conceptual designs. With Microsoft IIS, Windows NT is used as the Web server's operating system.

(See IIS and MCIS.)

Web site 1. A physical server (or collection of such servers) and software that supports the server-side applications and data of Web applications. Users may connect with the physical or virtual Web servers contained therein, using Web addresses such as www.server.com.au. Server-side components of Web applications are numerous, including:

- software server components
- ActiveX controls
- Java applets
- Perl scripts

2. A software solution which serves clients with a Web application. The application contains a page, or number of pages, and has a Web address (e.g. www.testsite.com.). Such sites can be created with numerous software packages. Microsoft Publisher 98, for instance, has numerous useful wizards which guide you through the design of Web sites. The site's interactive and media content will reside physically on the Web server, and be distributed across:

- HTML code
- Scripting languages such as JScript and VBScript
- ActiveX controls
- Java applets.

(See Active server, Active Desktop, Server, Virtual Web server and Web server.)

Web TV 1. A technology integrated into Windows 98 which permits TV reception using an appropriate tuner card. 2. An Internet access appliance which connects with a television. It may take the form of an STB (set-top box.)

(See Streaming video and Video.)*

What-if A term commonly applied to hypothesising in a computer environment. Using fully specified relational databases, it is possible to play What-if by querying stored information. The querying process involves using either standard SQL such as ANSI-92 SQL, OQL (Object-oriented Query Language) or a proprietary querying language or feature such as Borland's QBE (Query By Example). Querying may be used to set up hypothetical situations such as increasing a product price, for instance. The consequences can be viewed almost immediately.

(See Data warehouse and OLAP.)

Wheatstone system A five-wire telegraph system, invented in 1837 by Cooke and Wheatstone, now consigned to the pages of history.

Whetstone A standard benchmark for measuring floating-point computations, which are the binary equivalent of decimal arithmetic. A high rating makes the machine under test suited to arithmetic intensive operations, such as CAD (Computer-Aided Design) or computer graphics, that depend upon matrix transformations. Performing such a test does not require a specialised laboratory testbed but a commercially available diagnostics program. One such program is CheckIt. More sophisticated programs include PC Bench (Ziff-Davis).

White Book *(See Video CD.)*

Wildcard A shorthand for search strings. For example, Van Gogh AND Amsterdam can be exchanged for Van*gh AND ?msterdam where * represents any series of characters and ? replaces any single character.

WIMP (Windows, Icons, Menus and Pointers) A traditional term for GUI environments such as OS/2 Warp and Windows.

Windows An industry-standard graphical user interface (GUI) and OS for the PC platform. Currently we have Windows 95, Windows 98, Windows NT Workstation and Windows NT Server. Its origins are embedded in work carried out at Xerox PARC (Palo Alto Research Center). In the mid-1980s Microsoft set up the Interactive Systems Group (ISG), a team assigned the task of developing a GUI for the PC. Ex-PARC researcher Scott MacGregor was a member of the Microsoft ISG. The founding father of the Windows concept, however, is deemed to be Douglas Engelbart, who is also credited with the invention of the mouse. Windows 1.01 was launched in November 1985. It was a success, but nothing like that of the Apple Macintosh GUI launched over a year earlier. Windows 2.x was launched in September 1987. Not until May 1990, when Microsoft began selling version 3.0, did Windows become a widespread success.
(See Microsoft.)*

Windows Explorer *(See Explorer.)*

Windows Help system A Windows Help system which uses hypertext-based navigation.

Windows Media Player *(See Media Player and Visual Basic.)*

Windows NT Registry A configurable set of parameters which allow Windows NT to optimise resources for applications. The *regsvr32* program is used to register components such as:

- ActiveX
- OLE
- DCOM
- COM.

Windows NT Server A Microsoft 32 bit operating system which includes the functionality of Windows NT Workstation and an additional array of server-orientated features. *(Refer to the Microsoft Web site.)*

Windows NT Workstation A Microsoft 32 bit operating system which has a graphical front-end. It features a HAL (Hardware Abstraction Layer), which helps provide crash protection. Windows NT Workstation is a complex OS and suite of integrated applications, and includes:

- Windows Explorer, which is used to browse local and remote files, open files and launch programs
- the Start menu, which permits applications to be launched
- the Desktop, upon which icons reside
- Notepad, which is a simple word processor
- Network connectivity functions
- Internet connectivity functions
- e-mail functions

Windows Sound Recorder *(See Sound Recorder.)*

Winsock A Windows Application Programming Interface (API), which provides input/output operations for Web applications. Its implementation takes the form of a DLL (Dynamic Link Library), and it is an evolution of the Berkeley Unix sockets, which provide interprocess communications both locally and over networks.

Wizard A software feature that guides the users through the steps required to perform a specific task. The task might be the addition of computer hardware or programs.

Workflow management A broad term used to define the coordination of processes necessary to implement a given task, or given set of tasks.

World Wide Web (WWW) *(See Web.)*

World Wide Web Consortium (W3C) The publisher, originator and certifier of specifications of Web technologies that include HTTP, HTML and CGI. Further information can be obtained at www.w3c.org.

WORM drive (Write Once, Read Many) A device to which data may be written but not erased or overwritten.

Wozniak, Steve A co-founder of Apple Computer and designer of the early Apple computers.

Wrappering A process used to migrate a conventional program structure to that of an object. The program is renovated in terms of the addition of an object interface. Thereafter it may be stimulated as any other object.
(See Object.)*

WWW *(See Web.)*

WYSIWYG (What-you-see-is-what-you-get) A term applied to a program which is capable of generating on screen exactly what will be printed.

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X

X25 A device which permits communications between non-X.25 compliant devices.

X.25 A standard set of protocols for packet-switched networks which was introduced by the CCITT, but now comes under ITU-T. It covers the protocols between DTE (data terminal equipment) and DCE (data circuit terminating equipment). X.25 was developed in the 1970s, when data transfer rate requirements were slow in comparison with today's. High-speed data transmission using the X.25 protocol is possible, but increasingly modern communications networks integrate frame relay. The X.25 error correction is accommodated using a scalable acknowledgement window, which may typically include seven packets. This means that the sending device must wait for an acknowledgement for each group of seven packets. The maximum packet size is defined as 256 bytes, so the transmitting device may send $n \times 256$ bytes of data before receiving an acknowledgement, which verifies data reception. The error correction that is integrated into X.25 is robust because earlier networks were unreliable. Today's digital networks are much more reliable; thus there is an opportunity to develop more efficient protocols. These need not include the intensive error detection and correction of previous packet switched protocols. Frame relay is one such relatively contemporary protocol designed for modern communications networks.

(See ATM, Frame relay and ISDN.)

XA 1. A standard protocol which is used to coordinate transactions. 2. A shorthand term for CD-ROM XA (Compact Disc – Read-Only Memory eXtended Architecture). Published by Microsoft, Philips and Sony in March 1988, XA permits a near-CD-I title to be delivered using a conventional desktop computer with installed CD-ROM drive and XA decoder. Initially it appeared for the PC and was seen as a response to Intel's DVI (Digital

Video Interactive) digital video compression. It brought CD-I level B and level C audio quality to the PC. Level B audio is equivalent to a high-quality stereo FM broadcast transmitted under optimum conditions. An entire CD-I disc gives a maximum of four hours B-Level stereo playback. Technically level B audio is an 8 bit recording digitised at a sampling frequency of 37.7 kHz. Level C audio equates to an AM radio broadcast transmitted under optimum conditions. A whole disc could yield over 16 hours of playing time. It is also termed mid-fi quality. It equates to a 4 bit ADPCM wave audio recording sampled at 37.7 kHz.

(See CD-ROM and DVD.)

Xanadu A unified repository of literature and information, invented by Theodore Nelson. It was conceived before the Web and abstracts much of the thinking embedded in the work of Vannevar Bush and his momentous article 'As We May Think.' Conceptually, Xanadu was the Web. If Vannevar Bush and Ted Nelson were responsible for putting forward the concept of the Web, then Tim Berners-Lee must be considered its architect.

(See Web.)*

XENIX A Unix variant, which was developed by Microsoft.

Xeon A shorthand term for the Pentium II Xeon processor, originally aimed at Workstations and servers.

(See Pentium II.)

Xerox PARC (Palo Alto Research Center) *(See PARC.)*

XingCD A software product from Xing (Arroyo Grande, USA) capable of compressing video according to the MPEG-1 compression algorithm. Used without an MPEG-1 player it is able to play MPEG video without sound.

(See MPEG.)*

XingSound A software product from Xing (Arroyo Grande, USA) useful for compressing wave audio according to the MPEG-1 audio compression standard. It can record and compress audio from an analogue source in real time. It can also be used to perform standard editing operations on MPEG-1 wave audio files, including cut, copy and paste.

Xing Technology Corporation A company engaged in the development of MPEG encoding and editing products, and audio and video compression in general. Its headquarters are in Arroyo Grande, USA. Products include the

XingCD, which can be used to compress video according to the MPEG-1 compression algorithm, and XingSound, which can be used to produce and edit MPEG-1 audio streams.

(See MPEG, Streaming video and Video.)*

XML (eXtended Markup Language) A language designed to overcome certain shortcomings of HTML; it is used to deploy information over the Web. It may be perceived as a glue that may be used to deploy SGML information. An application of SGML (Standard Generalized Markup Language), it was designed by a group sponsored by the World Wide Web Consortium (W3C). Its structure approximates that of HTML.

(See HTML.)

XMS (eXtended Memory Specification) A software specification that provides access beyond the 1 Mbyte boundary of PC-architecture machines. Access to extended memory is provided by an appropriate driver in the `CONFIG.SYS` file, which can be assumed to be `HIMEM.SYS`.

XNET An interprocessor communications scheme used by the MasPar MP-1 SIMD processor. It addresses processors as a two-dimensional network topology.

(See MPP.)

X/OS A Unix variant developed by Olivetti.

X standards A series of evolving recommendations covering data networks. Among the most significant X standard is X.25.

(See X.25.)

XT A shorthand term used to describe the IBM PC XT, an early desktop computer design produced in the very early 1980s. Its specification is now defunct.

(See PC.)

X Window A GUI System used with almost all Unix OSes and developed at the Massachusetts Institute of Technology (MIT), which surrendered it to the public domain. X Window System implementations include Motif and OpenLook.

(See Unix.)

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Y

Y 1. A horizontal dimension of a coordinate in a two- or three-dimensional vector coordinate representation. The value may be absolute, measured from the origin [0, 0] or relative such as $[X_0+X_1, Y_0+Y_1]$. 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. A luminance component of video signal.

Y2K (year 2000) A term used to describe the year 2000. The lead up to the end of the millennium sees numerous IT systems being renovated to accommodate the need for date stamping using the year 2000 and its increments. Many non-compliant Y2K IT systems were created decades ago, when little consideration was given to the future.

Yamaha A large company engaged in consumer electronics, computers, music and more.

***Y*-axis** A horizontal axis on a graph or drawing.

***Y*-dimension** A horizontal measurement that might be absolute or relative, in a 2-D or 3-D coordinate.

(See 2-D and 3-D.)

Yellow Alarm An alarm state which forms part of the T1 circuit specification. *(See T1.)* The Yellow Alarm is activated by:

- the receipt of a Red Alarm signal
- severe burst traffic.

Yellow Book An alternative name for the CD-ROM physical format created by Philips and Sony. Later, standard file structures came about as a result of industry cooperation in 1985 by way of the High Sierra Group (HSG) standard. This was built upon by ISO to become ISO 9660. A universal distribution medium based on Compact Disc, CD-ROM was the first viable multimedia distribution medium.

(See CD-ROM, CD-ROM data block and DVD.)

YMODEM A protocol that supports data transfer using 1024 byte blocks, also referred to as XMODEM 1K.

YMODEM G A protocol which transmits a complete file before an acknowledge signal is received. It is intended for modem devices that have built-in error detection and correction.

YUV A collective name given to the luminance (Y) and chrominance components of a video signal.

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Z

Z 1. A dimension of depth in a 3-D image or animation. *(See 3-D.)* 2. A measurement of impedance. Connected electronic devices typically have an input and output impedance. By matching these using the *maximum power transfer* theorem, an optimum electronic/electrical connection may be made. 3. The dimension (*n*) in which a processor exists in an MPP network configured as a cube or hypercube.

ZAP The process of eradicating data or applications from a system.

Zero beat A state where two frequencies are the same.

Ziff-Davis A large corporation engaged in the computer book and magazine publishing sectors.

ZIF socket (Zero Insertion Force socket) A type of socket commonly found on motherboards that permits the safe and easy removal and replacement of processors. The socket is fitted with a lever which is used to lock the processor in place and to release it. ZIF sockets are also available for DIL (Dual In-Line) devices such as ROM (Read-Only Memory) chips.

ZIP 1. A file format from PKWare that is used for batch file compression. WinZip is an application that can be used to zip and unzip such compressed files. 2. A removable storage device manufactured by Iomega. Its removable disks store 100 Mbyte of data.

ZOG A hypertext system developed at Carnegie-Mellon University in the 1970s. Among other applications it was used for teleconferencing and CBT. It is best known for its role on the *USS Carl Vinson*, where it is used as a shipwide information and management system. Incorporating graphics, the Knowledge Management System (KMS) became the commercial face of ZOG.

Zoom A feature on many graphics and video editing programs that permits the user to enlarge a frame or image. All Windows applications feature such a control, which may typically be invoked from the View menu. The user may be presented with zoom-in values, such as 75%, 100%, 125% or 150%, or a value may be specified. Alternatively, scale ratios may be selected, such as 2:1, 3:1, 4:1 etc., which may be used to zoom in and out.