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 imple-ment 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 down-stream 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 inter-active 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 poly-carbonate 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.
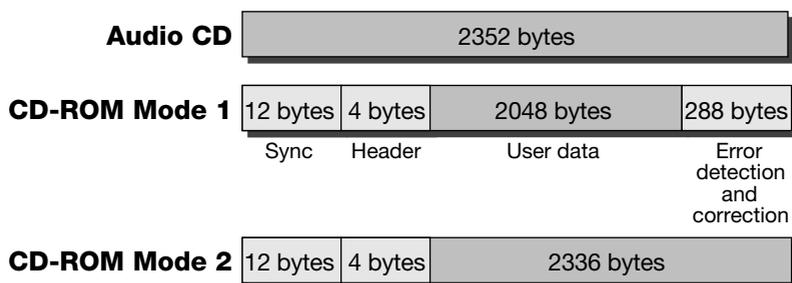
CD-ROM/CD block

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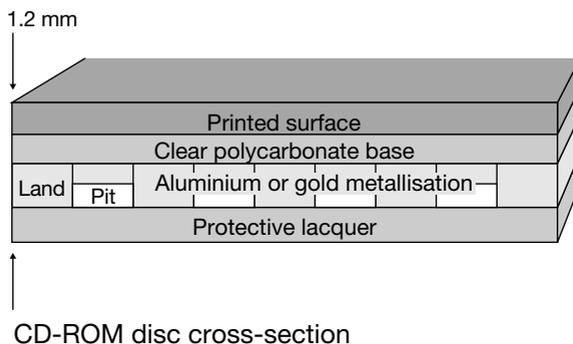
A Mode 1 data block will yield just 2048 bytes (2 Kbyte) user data, while Mode 2 holds 2.28 Kbyte user data.

(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, negoti-ating 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 Archi-tecture)   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 con-ventional 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.
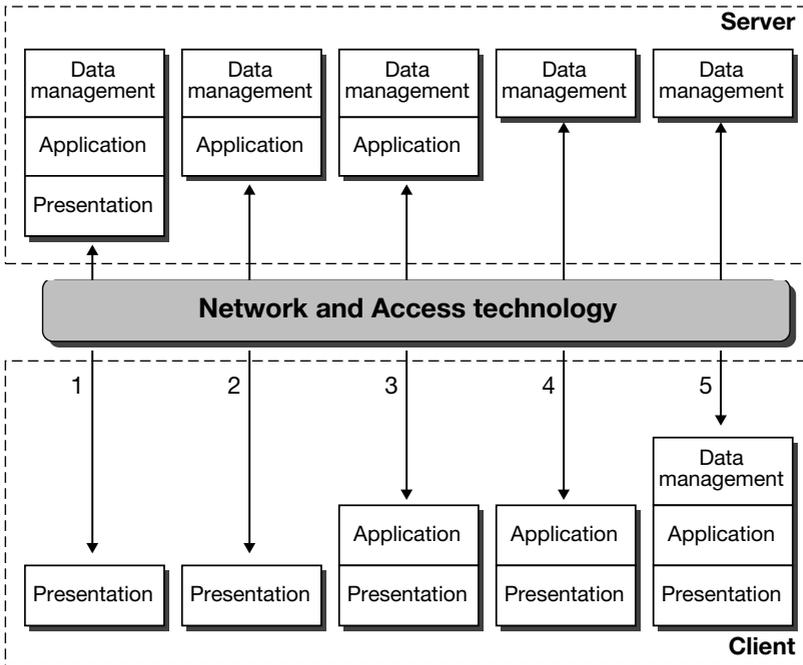
Client/server logical topologies as once defined by the Gartner Group
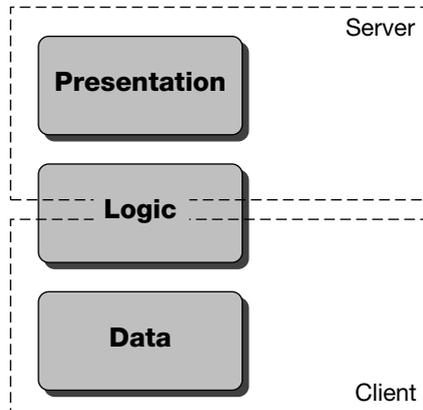
Web client/server model with
Java applets/ActiveX
controls or plug-ins

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 be-tween network hardware and software components. *Tight* coupling between two network components indicates comparatively high-speed communica-tion 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 stand-ard. 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.