Fast Track to

TECH JARGON

Core Hardware
Storage
Peripherals And Other Components
Sight And Sound
Portable Gadgets
Software
The Network
Everything Else

YOUR HANDY GUIDE TO EVERYDAY TECHNOLOGY
Credits

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January 2008
Free with Digit. Not to be sold separately. If you have paid separately for this book, please e-mail the editor at editor@thinkdigit.com along with details of location of purchase, for appropriate action.
Behind The Word-Screen

You’ve doubtless noticed that of late, tech phrases, terms, and names float about freely, intermingled with regular speech. We know you know half those terms (or a little more, or a little less), and those that you do, there’s a good chance you’re not sure, or you “know” wrong, or you know half of what’s to be known. If you deal with technology in any way—and you do, since you’re reading Digit—you’d be happy knowing all those words that float around. That’s our (simple) purpose here: to demystify everyday tech terms.

We’ll extend that a bit and say that we’re not just demystifying things; we’re also explaining things where it is warranted. The following can be read cover to cover if you’d like, if you need a basic education of sorts, or it can be used as a reference for when you come across a new term—even, for example, in Digit.

We’ve covered pretty much everything you’d need to know in an everyday sense—the basic hardware of a computer, storage, peripherals (things like printers), the devices that deliver multimedia, portable gadgets, software, and network terminology.

We’d encourage you to flip through these pages even if you think you’re familiar with most terms—for the reason that some of the terms we’ve covered go into somewhat in-depth explanations, which can be useful, and also because a term might not actually refer to what you think it does!

In the end, it’s about being aware. So allow us to rip off the tagline of a popular technology site, modify it just a little bit, and state that as the raison d’être for this book: It feels good to know.
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If we're going to talk about terms, definitions, and jargon, the best place to begin would probably be where it all starts - namely, at the CPU and motherboard. Let's also not forget the RAM!
1.1 The Motherboard

1.1.1 Audio sockets
A set of sockets that allowed speakers and a microphone to be connected, usually three in number. With multi-channel audio becoming common, the number of sockets has risen to six. The function of each of these sockets is configurable from the audio driver.

1.1.2 AGP
The Accelerated Graphics Port is present only in very few new motherboards; it is being phased out. This was a slot dedicated to enhance the graphics capabilities of the system by allowing a high-speed direct bus to the RAM, unlike PCI, the other prevalent bus. (A bus refers to a channel that is used to transfer data.) It operated at 66 MHz and had a 32-bit width. The AGP specifications have passed through three revisions (AGP 1, 2, and 3). The original AGP specification, now referred to as AGP 1, specified only 1X and 2X speeds. It also mandated an AGP slot that provided 3.3 V. AGP2 extended support to the 4X mode of operation. It also specified an AGP slot that provided 1.5 V, but AGP2 cards could work in the older AGP1 slots. To maintain backward compatibility to AGP1 cards, a Universal AGP Slot allowed cards of both versions to be run in it. AGP3 supported speeds up to 8X and would only work in slots that operated at 1.5 V.

The AGP slots differed in the construction, so that 3.3 V and 1.5 V slots and cards were not compatible: the 3.3 V AGP slot has a par-
tition towards the left, while the 1.5 V slot has a partition towards the right. Each of these slots also had a Pro version that extended the slot a bit to the right. The AGP Pro slot was for those cards that needed additional power (which was supplied by the Pro extension). The cards were also similarly-notched. Maximum data transfer speeds offered were: AGP 1X: 266 Megabytes per second; AGP 2X: 533 Megabytes per second; AGP 4X: 1066 Megabytes per second; AGP 8X: 2133 Megabytes/second.

1.1.3 BIOS / CMOS

Though often interchangeably used, the two terms refer to different things. BIOS (Basic Input Output System) refers to a set of instructions that are critical for the functioning of the system. These instructions include information about the components connected to the motherboard, like the hard disk, RAM, and the configuration of the many onboard subsystems. CMOS (Complementary Metal Oxide Semiconductor) refers to the chip on which the BIOS instructions are stored. CMOS is the name of the technology behind the chip that stores the BIOS. Present-day CMOS is technically called EEPROM for Electronically Erasable Programmable Read-only Memory. These can be rewritten to, and this allows the BIOS instructions of a motherboard to be updated when required.
The process of updating the BIOS instructions is called Flashing.

1.1.4 Chipset
Refers to a set, usually a pair, of microprocessors that are present on the motherboard, and which controls the communication between every component of the system - the CPU, the RAM, the expansion cards, and other peripherals plugged into the system.

The CPU has garnered all the attention among computer users, but the system’s performance is just as much determined by the much-ignored Chipset. The Chipset usually comprises the Northbridge and the Southbridge. The names are derived from the relative position of the microprocessors with respect to the CPU. The chip closer to the CPU is called the Northbridge, and the one placed further away is referred to as the Southbridge. The Northbridge has traditionally controlled the communication of the CPU with the rest of the system, namely the memory, the graphics subsystem (either onboard graphics or the graphic card(s)), and the Southbridge. The Southbridge is traditionally involved with controlling the communication between the Northbridge and the peripherals, namely expansion cards not plugged into the graphics slot like the sound card and internal modem, storage devices like the hard disks and optical drives, and the ports - COM, USB, etc.

Exceptions to the traditional roles exist in the form of the chipsets for the AMD Athlon 64 series of processors, since the RAM
controller has been included in the CPU itself; the Northbridge is no longer burdened with this task.

1.1.5 Display port
The 15-pin, mini DB 15 port, also called the VGA / Display port is used to connect an analogue monitor. With LCD monitors becoming popular, the DVI (Digital Video Interface) port is also frequently seen.

1.1.6 Expansion slots
Earlier motherboards rarely offered additional functionality besides offering a place for the CPU and RAM to be plugged in. The capability of the system had to be "expanded" with the use of external cards that carried the additional circuitry to fulfil the function. Additional circuitry usually included hard disk controllers, display adapters, sound system, etc., all of which are nowadays present "onboard" - referring to the inclusion of all this circuitry on the motherboard. Today, expansion slots on motherboards are mostly PCI, PCIE, and AGP. A couple of rarely-used slots are CNR (Communications and Networking Riser) and AMR (Audio Modem Riser). These special slots were designed to incorporate the interfaces for networking and audio devices; they did not contain the processing circuitry, and merely acted as a channel. The processing was done by the host CPU.

1.1.7 FireWire port
FireWire ports are not as common as USB, but do make an occasional appearance on the
back panel. FireWire exists in two versions: FireWire 400, which offers a maximum data transfer rate of 400 Mbps, and FireWire 800, which offers double that.

**1.1.8 Form Factor**

This is a name to denote the specifications of a motherboard - like dimensions, power supply type, location of mounting holes, number of ports on the back panel, etc. The most commonly-used motherboards are of the ATX or Micro ATX form factor, which are used for Desktop systems. An ATX (Advanced Technology Extended) motherboard is 12" x 9.6" in size, and supports the most number of expansion slots. Micro ATX is shorter than ATX, at 9.6" x 9.6", and was created to reduce total cost. The original ATX specifications have been updated to include technological improvements and reconcile the requirements of later PCs. For example, the latest ATX form factor specification includes the 24-pin power connector, which the original did not. There are many other form factors that cater to different PC designs: BTX, ITX, mini ITX, FTX, and more. VIA, a computer component manufacturer that focuses on power efficiency, has been creating mini ITX motherboards, which include all the functionality of the larger motherboards. With all important functions - video, audio, USB, and LAN - on board the motherboard, there is need for only one PCI slot and a RAM slot, besides a socket for the CPU, usually a VIA processor that consumes less than 5 watts. Such systems are ideal for use in situations where the workload is low and where the systems need to be left running - like downloading very large files.
1.1.9 Jumpers
These refer to the open contacts on the motherboard that can be used to configure different settings of the board. With time, the number of jumpers has come down, with most of its functionality shifted to the CMOS / BIOS. Still, many motherboards today do have one set of jumpers, which is used to reset the BIOS settings.

1.1.10 LAN port
RJ-45, or the LAN port, allows the PC to be connected to a network, whether to a LAN or to the Internet via a broadband modem.

1.1.11 Parallel port
The DB 25 or Parallel port is the traditional port for older printers. These are rarely seen today.

1.1.12 PCB (Printed Circuit Board)
The foundation of every electronic device is the board on which every component is connected. The PCB consists of minute conductors, usually of copper, seen as fine lines criss-crossing the surface, mounted on an insulated substrate. The minute pathways actually carry data signals or power between the various components that are eventually soldered on the PCB. PCBs come in various sizes and shapes, and besides the motherboard, are also seen in expansion cards (sound cards, graphics cards, etc.) and RAM modules.

1.1.13 PCI
Peripheral Component Interconnect is still widely seen in motherboards, though it is older than AGP. The wide availability of PCI
cards is one reason for this. This bus is 32 bits wide and operates at 33 MHz, and has a maximum data transfer speed of 132 Megabytes per second. This bandwidth is divided between all slots and also the storage devices, like the hard disks.

1.1.14 PCIE (PCI-Express)

PCI-Express is the latest type of expansion slot. Unlike the AGP and PCI buses which transfer data in a parallel fashion, PCIE offers serial data transfer. It is designed to be a point-to-point bus, and so it is not shared by other components. The bus is implemented as a pair, with two lanes per bus. So it can act in full duplex mode, meaning that data can be simultaneously sent and received over different lanes at full speed. It is also modular, in that the number of PCIE lanes can be increased or decreased based on the need of the device. So a PCIE x16 slot that has 16 lanes (8 lanes each for carrying data in one direction) can be used for graphics cards, while a slower PCIE x2 slot can be used for less demanding components like modems and sound cards. Each PCI-Express lane can transfer 2 Gigabits of data per second, which translates to 250 Megabytes per second.

1.1.15 Ports

Every motherboard offers a plethora of ports on its back panel. The most commonly seen ports on today's PCs are PS2, USB, VGA, LAN, Serial, and Audio Sockets.

1.1.16 PS2 port

The PS2 port is used to connect PS2-compatible keyboard and mouse. The violet-coloured port is usually for the keyboard, and the green one is for the mouse.

1.1.17 RAM slots

These refer to the interface to connect RAM modules. Memory is organised in the form of banks, with one or more slots constituting a bank. Each bank has a dedicated channel to the memory controller. Many motherboards, thanks to their Northbridges, implement a dual-channel RAM mode, wherein the effective bandwidth
of the bus is doubled. To use the memory in dual-channel mode, one slot in each bank needs to be fitted with RAM modules that are similar in all respects.

### 1.1.18 Serial port

DB 9 or Serial port is a 9-pin port that transfers data serially. It is increasingly being left out from the back panel in favour of faster ports like USB. It is used today mostly for external modems.

### 1.1.19 Socket

The motherboard carries the interface to connect the CPU. This is referred to as a Socket. There are many socket types, with no clear naming scheme, though most are named after the number of pin sockets they contain. The latest Intel CPUs require a Socket 775 interface, while the latest AMD processors require a Socket AM2 interface. Some older CPUs like the Pentium 2 used a slot-like interface, called Slot 1.

### 1.1.20 USB ports

USB ports are ubiquitous, with many newer motherboards offering up to 10 USB connections. USB is available in two common versions - version 1.1, which has a maximum data transfer rate of 12 Megabits per second, and version 2, which tops out at 480 Megabits per second. Besides speed, USB also allows up to 116 compatible devices to be connected in a daisy-chain into a single port, and it also supports hot-swapping (the system would detect the newly-connected device without requiring a restart).
1.2 RAM

RAM is short for Random Access Memory. In common parlance, RAM refers to system memory, the temporary storage area that holds all the data that the CPU is working on. All data that requires processing by the CPU and the results of the processing are first stored in the system memory.

RAM, per se, refers to the type of storage medium that allows any data stored within to be directly accessed without having to access the preceding data (the latter mode being called sequential access).

System memory is volatile, which means that the stored data is lost when the device is powered down.

1.2.1 CAS

To be able to access data from a particular storage area in RAM, the RAS and CAS procedures are needed to provide the address of the storage area. The RAM is organised as an array of storage areas. Each storage area can therefore be uniquely identified by the number of the row and the number of the column that intersect at that position. Row Access Strobe (RAS) is the process of identifying the row from which data needs to be read. This step precedes CAS. Column Access Strobe is the process of identifying the column from which data is to be accessed.

1.2.2 CAS Latency

Refers to the delay between the CAS and the arrival of the data from the RAM. It is an indicator of the speed of the memory, and is expressed in the number of clock cycles: a CAS Latency of 3 means that three clock cycles are needed after the CAS for data to be produced by the RAM.

1.2.3 DDR SDRAM

Double Data Rate SDRAM was an evolutionary improvement over SDRAM. It allowed data to be transferred twice during every cycle.
This effectively doubled the frequency of the memory; DDR 266 memory actually works at 133 MHz. It is important to note that the term is "DDR 266" and not "DDR 266 MHz." Another mode of notation is by referring to the peak data transfer speeds. So a DDR 266 module is also referred to as PC 2100, since it can transfer 2100 Megabytes per second. DDR modules have 184 contacts, and are not backward-compatible.

### 1.2.4 DDR2 SDRAM

An evolution of DDR SDRAM, DDR2 allows four data transfers per clock cycle, by clocking the internal bus at twice the speed of the memory clock. Therefore the effective frequency of the memory becomes 4 times its actual frequency. A DDR2 800 module operates at 200 MHz. As in the case of DDR SDRAM, the alternate notation relying on the maximum data transfer speeds is also used. PC2 3200 refers to DDR2 400. A DDR2 module has 240 contacts, and is not backward-compatible.

### 1.2.5 DDR3 SDRAM

This is the latest iteration of SDRAM, and increases the internal bus speed to 8 times the memory clock, effectively operating at 8 times the frequency. DDR3 800 operates at 100 MHz and is also referred to as PC3 6400. DDR3 is still a cutting-edge technology, and is supported by very few motherboards and CPUs. DDR3 modules also have 240 pins, but they are keyed differently, so they cannot be inserted into a DDR2 slot.
1.2.6 DIMM
Dual Inline Memory Module refers to the package in which RAM is available. Unlike the earlier and now obsolete SIMM (Single Inline Memory Module), a DIMM has contacts on both sides of the module.

1.2.7 DRAM
Dynamic RAM refers to volatile RAM that is constantly refreshed to prevent stored contents from being lost. All modern RAM is of this type, though there have been improvements. Data is stored in the form of rows and columns, with each storage area in RAM having a unique address that is a combination of the row and column number. DRAM was available in different types like SDRAM, EDO (Extended Data Out) RAM, FP (Fast Paging) RAM, and more, all of which are now obsolete except for SDRAM.

1.2.8 ECC RAM
An Error Correction Code (ECC) RAM module is a special type of module that includes additional components to verify the integrity of data stored in or transferred by system RAM. This is needed in critical systems that require high levels of data integrity, like servers.

1.2.9 RAS to CAS delay
This is the number of clock cycles that intervene between the identification of the row with the RAS and the start of launching the CAS. This is displayed as "tRCD" in the BIOS.

1.2.10 RAS Precharge Time
This is the number of cycles that are needed to refresh the RAS after the previous access before it can be used for a new access.

1.2.11 RDRAM
RAMBUS Direct RAM was based on a technology developed by RAMBUS. Unlike SDRAM, it used a serial mode of data transfer, and though the technology was considered superior to DDR SDRAM, its expensiveness made it unpopular. RDRAM modules are called RIMMs.
1.2.12 Registered RAM / Buffered RAM
This type of RAM module had additional storage areas - called buffers or registers - where the data is stored temporarily and checked for data integrity before being transferred. Similar in use to ECC RAM, though using a different method, this type of RAM is needed in servers, which require high levels of data integrity.

1.2.13 SD RAM
Synchronous Dynamic RAM was an improved version of DRAM that synchronised all its functions to a single frequency, usually the system's FSB frequency. The frequency refers to the rate at which the RAM would perform an action, namely refreshing, reading, or storing. SD RAM is available in various frequencies, with the fastest modules capable of running at 266 MHz (high performance modules, targeted at enthusiasts, which perform at higher frequencies, are also available). SD RAM modules have 168 contacts. After the release of DDR SDRAM, the original SDRAM began to be referred to as SDR SDRAM (Single Data Rate SDRAM).

1.3 Processor

1.3.1 32-bit / 64-bit CPU
"32/64-bit" refers to the width of the address bus and registers used by the CPU core. A 64-bit CPU has a 64-bit wide address bus and 64-bit wide registers. CPUs access data in the RAM by using the address bus. The breadth of the bus influences the amount of RAM that can be addressed. A 32-bit bus allows a maximum of 4 GB of RAM to be accessed. A 64-bit CPU, obviously, allows for more RAM to be used - about 16 exabytes (1 exabyte = 1,000,000,000 gigabytes, approximately). A 64-bit register can store 64 bits of data simultaneously. To fully utilise a 64-bit CPU, the operating system and application need to support the 64-bit mode of operation.

1.3.2 BGA
A Ball Grid Array (BGA) package is similar to a PGA package, except that the role of the pins is taken over by small balls of conductive
material. The advantage is that unlike pins, the conductors are not easily bent. Unfortunately, BGA CPUs are soldered right onto the motherboard, and users cannot replace them. This form of packaging is seen in some embedded CPUs like those from VIA.

1.3.3 Cache memory
All CPUs presently made have two components in their die - the processing core and some memory. The memory is used to store frequently-used data so that the CPU doesn’t have to wait for the data to be fetched from other, slower storage areas like the system RAM or hard disk. This temporary storage is referred to as the cache. Unlike system RAM, cache is made of more expensive Static RAM, which does not require refreshing. There can be multiple caches per CPU. The cache that is closest to the CPU core is called the Level 1 cache, and is most frequently accessed by the CPU. The subordinate cache, called the Level 2 cache, is approached only if the data is not available in the L1 cache. Some high-end CPUs also sport a Level 3 cache. Cache sizes tend to increase with their Levels, with L1 caches being smaller than L2. In current CPUs, the L1 cache tops out at 128 KB per core, while the L2 cache tops out at 8 MB per core.

1.3.4 Cool 'n' Quiet / Speed Step
These refer to the power management schemes used by AMD and Intel respectively. This allows the CPU to conserve energy by altering its speed according to the processing load. At slower speeds, the power consumption is decreased.

1.3.5 Die size
A Die refers to the block of silica that contains the core logic of a
CPU. The die size is affected by the fabrication process and the number of transistors included within.

1.3.6 Fabrication process
This term is used to refer to the smallest distance between two components in the CPU. All CPUs contain miniature circuits etched on a silicon chip. The latest Intel CPUs use a 45-nanometre process.

1.3.7 FPU
Floating Point Unit; a sub-unit of the CPU core. The CPU is made up of different functional sub-units. There is the ALU (Arithmetic and Logical Unit), the FPU, Registers (temporary storage areas), and the caches. The CPU Core refers to all components of the CPU except the caches; it forms the area that is responsible for the actual computation.

1.3.8 FSB
The Front Side Bus is the data channel between the CPU and the system RAM. In turn, the Back Side Bus refers to the link between the CPU and the cache memory within the CPU die itself. The FSB frequency is the speed at which the bus operates, and is an indicator of the number of times the CPU interacts with the rest of the system. Usually, the CPU itself works much faster than the FSB (see Multiplier).

1.3.9 LGA
A Land Grid Array package is the latest form of packaging, seen in Intel’s latest CPUs. This form of package does away with pins or other projections, and offers sockets only. The pins are present on the socket in the motherboard.

1.3.10 Multi-core CPUs
Many present CPUs are multi-core, meaning that there exist more than one computational unit on the same CPU. This allows for better performance when dealing with several jobs simultaneously. Both the major manufacturers offer quad-core CPUs.
1.3.11 Multiplier
Originally, all the components on a system operated at the same frequency. But with improvements in technology, the rest of the system became a bottleneck to the CPU achieving its full potential. This problem was solved by allowing the CPU to operate multiple cycles for every cycle that the system operated. This factor is called the Multiplier. Earlier it was possible for the user to set the multiplier using switches on the motherboard, but now, except for the high-end CPUs, most CPUs come with a set multiplier.

1.3.12 Package types
Every CPU is packaged to ensure that its core components are protected, while allowing connection with the motherboard. Package types seen in current CPUs include PGA, BGA, and LGA.

1.3.13 PGA
Short for Pin Grid Array, this type of packaging has a grid of conducting pins projecting from the package, which connect into the socket. PGA is available in different formats like FC PGA for Flipped Chip PGA, mPGA for micro PGA, and OPGA or organic PGA. AMD CPUs use this form of package.

1.3.14 Pipelining
This refers to the internal data processing pathways of a CPU. The CPU processes data through different stages, like Fetch, Decode, Execute, and Store. By Pipelining, it becomes possible to perform these stages independently and on different bits of data. This allows for more efficient use of CPU cycles.

Modern CPUs have increased the number of stages in the pipeline, and also use advanced techniques like branch prediction, which is used to estimate the possible outcome of an if/else condition, to ensure that every stage of the pipeline is utilised.

The performance of the CPU is greatly influenced by the way it implements pipelining.
1.3.15 HSF
Short for Heat Sink Fan unit, this refers to the aluminium block and fan unit placed over the CPU to aid in dissipation of heat. While most stock HSF units are made of aluminium and use a fan, fancier cooling solutions made of copper and using liquid coolants are also available.

1.3.16 Overclocking
Overclocking refers to the art of making a computer component perform at levels exceeding those set by the manufacturer. Components like the CPU, RAM, and graphics cards can be overclocked.

1.3.17 HyperThreading
This was a technology used by Intel to improve CPU utilisation by splitting a processing workload into parallel threads. Thanks to HyperThreading, the CPU appeared to the OS as multi-core. To make use of this feature, it was essential that the OS and motherboard supported it.

1.3.18 TDP
Thermal Design Profile refers to the average energy (expressed in watts) in the form of heat that the HSF has to dissipate from the CPU. This can be taken as a rule-of-thumb measure of the energy consumed by the CPU.

1.3.19 Transistor count
This refers to the number of transistors included in the CPU core. The transistor count is influenced not just by the complexity of the core, but also the size of the on-die cache. The transistor count of a Intel Core 2 Duo CPU with a 2 MB cache is 151.6 million.
1.4 Code-names

CPU manufacturers use a code-name for a CPU during its development. Once the product is launched, it gets a formal name, which is the name of the current product family. Usually, a new code-name points to improvements in the core, so even if all CPUs in the product family carry the same name, a knowledge of their code names can help identify internal differences. For example, Intel Core 2 Duo CPUs have different internal properties corresponding to different code-names.

The following table lists some dual-core CPU code-names and their specifications.

<table>
<thead>
<tr>
<th>Mfr.</th>
<th>CPU Family</th>
<th>Code-name</th>
<th>Process Size</th>
<th>L2 Cache Size</th>
<th>FSB</th>
<th>Socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel</td>
<td>Core 2 Duo</td>
<td>Conroe</td>
<td>65 nm</td>
<td>2 MB or 4 MB</td>
<td>1066 or 1333</td>
<td>Socket 775</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allendale</td>
<td>65 nm</td>
<td>2 MB</td>
<td>800 or 1066</td>
<td>Socket 775</td>
</tr>
<tr>
<td>Pentium Dual Core</td>
<td>Allendale (Same core as used in Core 2 Duo, but with half the cache disabled.)</td>
<td>65 nm</td>
<td>1 MB</td>
<td>800</td>
<td>Socket 775</td>
<td></td>
</tr>
<tr>
<td>Pentium D</td>
<td>Smithfield</td>
<td>90 nm</td>
<td>1MB per core</td>
<td>533 or 800 MHz</td>
<td>Socket 775</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presler</td>
<td>65 nm</td>
<td>2 MB per Core</td>
<td>800</td>
<td>Socket 775</td>
</tr>
<tr>
<td>AMD</td>
<td>Athlon 64 X2</td>
<td>Manchester</td>
<td>90</td>
<td>256 MB or 512 KB per core</td>
<td>1000 MHz*</td>
<td>Socket 939</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toledo</td>
<td>90</td>
<td>512 KB or 1 MB per core</td>
<td>1000 MHz*</td>
<td>Socket 939</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Windsor</td>
<td>90</td>
<td>512 KB or 1 MB per core</td>
<td>1000 MHz*</td>
<td>Socket AM2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brisbane</td>
<td>65</td>
<td>512 KB per core</td>
<td>1000 MHz</td>
<td>Socket AM2</td>
</tr>
</tbody>
</table>
1.4.1 In The Pipeline
A few innovations expected in 2008

1. AMD's quad-core processor for the Desktop, Phenom (not "Athlon X4"), was released towards the end of 2007. One can expect to see larger number of these CPUs entering the market.

2. Intel's "true" quad-core processor for the Desktop market, presently code-named Penryn, featuring four cores on the same die, is expected in 2008. (Intel's present Core 2 Quad processors are not native quad-core; rather, they fuse two Core 2 Duo processors.) Penryn is also the first CPU to use the 45nm fabrication process, the smallest in the industry. Penryn-based CPUs have already been released for the server market, under the Xeon label.

3. DDR 3 SDRAM, presently marketed only by a few high-end memory manufacturers, and supported only by Intel's P35 chipset, can be expected to gain broader market acceptance.
Here we talk about hard disks, optical drives and disks, and Flash storage—things you interact with on a daily basis. You’ll therefore notice that most of the following terms are at least somewhat familiar.
2.1 The Hard Disk

2.1.1 Access Time
Reading data from or writing data to a hard disk involves the rotation of the spindle to bring the required sector under the read/write head, and the motion of the read/write head to the desired track on the platter. The access time is the sum of the time taken for these.

2.1.2 Active Partition
This is the partition that has been marked in the Master Partition Table as containing the boot information. Only one partition can be marked as active, though more than one can contain the boot information.

2.1.3 ATA / IDE
The ATA (Advanced Technology Attachment) specification deals with the interface between the motherboard and hard disks that have integrated circuitry. This standard is also referred to as IDE (or Integrated Drive Electronics). Earlier, the hard disk controller had to be separately plugged into an expansion slot, with cables running to the hard disk from the controller. ATA has many versions, which have increasingly improved the features and speeds of the connection. ATA 2 is also called Extended IDE (EIDE) because it introduced support for large drives by using the LBA naming scheme. ATA 6 is the last version of ATA, and is also referred to as ATA/133, which denotes the maximum data rate for the interface—133 Megabytes per second.

2.1.4 ATAPI
Advanced Technology Attachment Packet Interface is a protocol that allows optical drives to be connected through PATA cables to IDE controllers. This forms part of the ATA version 4 specifications.

2.1.5 Bad Sector
Bad sectors are areas on a hard disk that are physically damaged. The data present in these areas cannot be read with normal soft-
ware, and no data can be stored there. All hard disks, including new ones, have bad sectors, which are a normal occurrence during the manufacturing process. The locations of the bad sectors are recorded by the hard disk circuitry, ensuring that they are avoided. However, bad sectors can also form during use, either as a result of improper shutdowns—causing the read / write head to physically scratch the recording surface—or due to normal wear and tear. Newly-developed bad sectors can also be recorded to ensure that they are not accessed the next time. This can be done by performing a “thorough” format of the drive.

### 2.1.6 Boot Sector

Every partition in a hard disk contains critical data in the first sector, carrying information about loading the operating system. This first sector is called the boot sector. Any partition containing relevant information in the boot sector is termed bootable, and is called the Boot Partition.

### 2.1.7 BPI

Bits Per Inch refers to the number of bits stored per linear inch of a track.

### 2.1.8 Cache

Cache is the memory incorporated in the hard disk that stores frequently-accessed data. This saves use of the read/write head, thus extending its life, besides, obviously, improving performance. A 2 MB cache is common in most hard drives, with the highest being 16 MB in the latest, large-capacity drives. The maximum transfer speeds of the interface that is mentioned in the drive specifications refers to the time it takes for the cache to send the data.

### 2.1.9 CHS

Cylinder Head Sector is a naming scheme used to uniquely address every storage area or sector in a hard disk. Each sector can be uniquely identified, based on the number of the Cylinder, the read / write head operating on that platter, and the number of that sector in that cylinder.
2.1.10 Cluster
A cluster refers to the group of sectors that are manipulated as a unit. Depending on the filesystem and the size of the partition, the number of sectors that form a cluster changes. From the operating system’s point of view, the cluster is the smallest storage unit.

2.1.11 Cylinders
A platter is made up of concentric tracks along which the read / write head stores data. The tracks are numbered. A cylinder refers to the same-numbered tracks of all the platters, since, theoretically, they form a cylinder.

2.1.12 DMA/UDMA
Direct Memory Access / Ultra Direct Memory Access refers to a technology that allows a hard disk to manage data transfer without the aid of the CPU. This speeds up data transfers, while also leaving the CPU to perform other tasks. DMA / UDMA have gone through many iterations, the latest being UDMA 6, which offers transfer speeds of 133 Megabytes per second. DMA / UDMA modes are specified in the ATA standard. To achieve speeds above 33 Megabytes per second, as envisaged in UDMA3, a special 80-pin conductor cable is needed to reduce the interference that occurs between two data-carrying channels. Though the data is transferred using only 40 pins, the remaining pins are needed to ground interference created during the data transfer.

2.1.13 eSATA
External SATA is an interface that allows standalone SATA drives to be connected from outside the system. Since the SATA speeds extend to eSATA devices, eSATA offers the highest data transfer rates among all interfaces—namely, USB 2.0 and FireWire—at 3 Gigabits per second (in case of SATA 2).
2.1.14 Extended Partition
An Extended Partition refers to the entry in the Master Partition Table that points to the location of the Extended Partition table. The Extended Partition is not assigned any letter.

2.1.15 Form Factor
Hard disks come in different sizes to match the systems they are intended to be used in. The 3.5-inch hard disk is what is used in all Desktop PCs. The 2.5-inch hard disk is used in laptops. Some consumer electronics products like the iPod use a 1.8-inch internal hard disk.

2.1.16 Formatting
Formatting is of two types—low-level and high-level. Low-level formatting creates the tracks and sectors that are used to store data. High-level formatting involves preparing the filesystem and creating a record of avoidable bad sectors in the partitions. All present hard disks are low-level-formatted by the manufacturer, and the user only performs a high-level format. A high-level format can be performed in two ways: a Quick Format, which erases the existing file index and creates the desired file system, and a Thorough Format, which in addition also performs a bad sector scan.

2.1.17 GMR
Giant Magneto Resistance is the phenomenon behind the technology used by the read heads in modern drives to read the data stored on disk platters. The GMR effect is a property of thin films of certain materials that experience large changes in resistance as a result of very small changes in magnetic field. This effect allows the information about changes in magnetic fields to be deciphered by detecting changes in resistance. And since even minute changes in magnetic field can be detected, these magnetised spots can be more closely packed, leading to greater storage area on a platter of the same size. The 2007 Nobel Prize for Physics was awarded to the discoverers of this effect—Albert Fert and Peter Grünberg.
2.1.18 Heads
Read / write heads refer to the main reading and writing apparatus in a hard disk. The Read head contains thin films that display the GMR effect. The Write head is usually made of an electromagnetic substance that gets magnetised when electricity is passed to it, thus magnetising the spot below it.

2.1.19 Hybrid Drives
These are hard drives that include both rotating disks as well as Flash memory based storage. This is an attempt to combine the benefits of the two types of storage media: the inexpensiveness of rotating platters and the non-volatility of Flash memory. The Flash memory component in a hybrid drive is merely a temporary storage area; the data is finally written onto the disk. Like the cache in regular hard drives, the Flash memory improves performance, and since unlike cache memory the data is not lost when powered down, startup time is reduced since there is no longer the need to wait for the disks to rev up.

2.1.20 Landing Zone
During normal operation, the read/write heads levitate over the platter surface thanks to the air cushion created by the rotation. When powered down, the heads are brought to rest over an area on the platter where data is not stored. This is the landing zone.

2.1.21 LBA
Logical Block Addressing refers to the scheme used by modern hard disks to overcome the bottlenecks presented by older BIOS limitations that do not detect large-capacity hard disks. LBA allocates a unique number to each sector. The hard disk circuitry translates this into the respective CHS values, which is comprehended by the BIOS.

2.1.22 Logical Drives
This refers to the partitions created in an Extended Partition. A maximum of 24 logical drives can be created, since each drive needs to be lettered, and letters A and B are reserved for floppy disks.
2.1.23 Master / Slave
Since a PATA controller allows two devices to be connected to the same channel, one has to be designated the “Master” and the other the “Slave” to avoid data being wrongly routed. This is just a convention—the drives could as well be termed “first” and “second.”

2.1.24 MBR
The Master Boot Record resides in the first sector of the hard disk. This contains critical information like the Master Partition Table and the information about the active partition.

2.1.25 MTBF
Mean Time Before Failure is the average life of the hard disk expressed in hours of usage.

2.1.26 NCQ
Native Command Queuing is a feature of SATA hard drives. This allows read / write requests made to the hard disk to be re-ordered to use the movements of the internal components more efficiently, leading to lower waiting periods.

2.1.27 Partition Table
A Partition is a logical subdivision of a hard disk into smaller chunks. The partition table is the record of the partitions on a hard disk. There are two types of partition tables. The Master Partition Table forms part of the MBR, and can carry details of only four partitions. The need for more than four partitions was met by allowing the creation of an Extended Partition Table, which could contain an unlimited number of partition entries (though the letters in the alphabet limits this number to 24). The Master Partition Table contains a reference to the Extended Partition Table.

2.1.28 PATA
The original ATA standard had to be called PATA (for Parallel ATA) after the advent of Serial ATA for sake of differentiation. PATA refers to an interface used for connecting hard disk and optical drives to the system. It used the parallel mode of data transfer,
which peaked at 133 Megabytes per second. Due to the proximity of the data carrying wires, interference was a major bottleneck to greater speeds. Each PATA channel can support two devices in a Master / Slave configuration.

2.1.29 PIO
Programmed Input Output mode of data transfer is the mode of data transfer that requires the CPU’s intervention (in contrast to DMA and UDMA). Older optical drives still use this mode. There are many versions of PIO mode, with the latest being version 4, which offers a maximum speed of 16.7 Megabytes per second.

2.1.30 Platter
The surface on which data is stored in the form of magnetised and non-magnetised regions is usually a glass or aluminium disk coated with a magnetic substance. This disk is called a platter.

2.1.31 PMR
Perpendicular Magnetic Recording is an improved method for storing data on platters, allowing for greater areal density. Unlike the present method, also called Longitudinal Magnetic Recording, where the magnetised areas are laid out end to end, in PMR, the areas are arranged vertically, side by side, thus reducing the space they occupy.

2.1.32 Primary Partition
This refers to the partition whose details are included in the Master Partition table in the MBR. A maximum of four primary partitions can exist in a hard disk.

2.1.33 RAID
Redundant Array of Independent (mistakenly called Inexpensive sometimes) Disks is a scheme that allows multiple hard disks to be used to create a single unit with features better than what would be attained if they were not a unit. A “RAID controller” contains the circuitry to manage the disks as a single unit. There are different RAID schemes. The most popular ones are RAID 0, 1, 0+1 and 5.
RAID 0 allows Striping, a scheme where alternate blocks of data is written to different disks. This results in a direct doubling of the write / read speeds. The flip side is that if one of the disks fails, the entire data becomes inaccessible.

RAID 1 offers data redundancy by mirroring the data. In this scheme, the same data is written to both disks. While there is no improvement in performance, from the security standpoint, failure in one disk will not result in downtime, since the same data is mirrored on the other disk(s). Both the above-mentioned schemes require at least two hard disks to function.

RAID 0 + 1 brings together the benefits of both the schemes, and obviously requires a minimum of four hard disks to function. RAID 5 allows striping, but also stores the parity information of every operation, which can be used to recover data in case of failure. This scheme requires a minimum of three drives.

2.1.34 Rotation Speed
This refers to the speed with which the spindle rotates. Naturally, the faster the disk rotates, the faster the data can be accessed and written or read. The fastest hard disks have a speed of 15000 rpm. Regular hard disks are available at 7200 rpm and 5400 rpm, with laptop hard disks also available at 3500 rpm.

2.1.35 SATA
Serial Advanced Technology Attachment refers to the latest form of connection for storage devices like hard disks and optical drives. Data is transferred serially though the interface. The SATA standard has two versions: SATA 1, which offers a maximum data transfer of 1.5 Gigabits per second, and the later SATA 2, which offers data transfer speeds of up to 3 Gigabits per second. Unlike PATA, each SATA channel can connect to only one device.

2.1.1 SCSI
Small Computer System Interface is a high-performance interface mostly used in server systems. It offers better data transfer
speeds than PATA, and other advantages like “hot swappability,” which refers to the capacity to plug in additional storage devices without the need to restart the computer to get it detected, and the ability to connect up to 15 devices to a single channel. SCSI technology has improved over the years; the latest iteration is called Ultra 160 SCSI, which offers a maximum data transfer rate of 160 Megabytes per second.

2.1.36 Sectors
A Sector is the smallest logical division of a track. It is usually 512 bytes in size.

2.1.37 SMART
Self Monitoring Analysis and Reporting Technology is a feature of all modern hard disks that allows a disk to predict its own failure by monitoring various operating parameters. For example, an increase in operating temperature is indicative of increased friction, which could lead to failure of the drives. In such cases, a SMART drive will report a warning diagnostic message to the user at boot time.

2.1.38 Spindle
A hard disk is organised as one or many platters rotating on a central axis. This arrangement is the spindle.

2.1.39 SSD
Solid State Drives refer to the new-generation drives that are built using Flash memory technology. These offer better power economy and data transfer speeds.
and due to the absence of moving parts, are more sturdy and silent. Since they are much more expensive than disk-based storage media, they are still niche products. The current maximum capacity of an SSD is 64 GB, with larger disks coming soon.

**2.1.40 TPI**
Tracks per inch refers to the number of tracks present per radial inch of a platter.

**2.1.41 Tracks**
Data is stored in concentric paths on a platter; the concentric paths are called tracks.
2.2 Optical Drives

2.2.1 Blu-ray Disc
Blu-ray Disc (BD) is a next-generation optical storage medium developed by Sony and others. It uses a blue-violet laser with 405 nanometre wavelength, and offers 25 GB (single layer) 50 GB (dual layer) storage capacity. Blu-ray discs appear as BD-ROM (read-only, pre-manufactured), BD-R (recordable once), and BD-RE (recordable and erasable). The 1X data transfer speed for a Blu-ray drive is 4.5 Megabytes per second. The Blu-ray Disc format is not compatible with the other next-generation optical storage medium, HD-DVD.

2.2.2 Bootable Disc
Optical discs that can be used to start a system are termed bootable. Technically, these discs follow the El Torito extension of the ISO 9660 file format; any motherboard that is compatible with this standard recognises optical drives as a bootable device, and can pass on control to the optical drive to boot the system. Today, bootable optical disks are the norm; you won’t find bootable floppy disks except in a few rare cases.

2.2.3 Buffer
Buffer refers to the internal memory present in the drive where data is stored before being written to disc. A 2 MB buffer is common in all drives.

2.2.4 Buffer Underrun Protection
If the buffer becomes depleted midway during a writing session, the media gets corrupted and unusable. Buffer Underrun Protection refers to the techniques used by optical writing devices to prevent the corruption. The writing is temporarily stopped when the buffer is depleted, and resumed when it is filled again. The gap that results is small enough to be tolerated by CD readers, thus ensuring that the CD is not corrupted. Different manufacturers use different names to refer to this technology—like Powerburn (Sony), Super Link (LG), etc.
2.2.5 Burning / Recording
Burning refers to the process of recording data on to Recordable media. It is called burning since the heat of the laser beam causes the dye to change from transparent to opaque. The opaque areas do not reflect light as well as the transparent area, thus simulating the behaviour of actual pits and lands.

2.2.6 CAV
Constant Angular Velocity refers to the rotational characteristic of the drive. In CAV mode, the rpm remains the same, so data closer to the outer margins of the CD are read or written faster than when present on the inner side. Most drives use this mode of operation when dealing with data nearer to the inner margin, and switch to CLV when closer to the outer margin (see next).

2.2.7 CLV
Constant Linear Velocity drives do not have a fixed rpm, but change this to allow the same length of track to be covered. This is made possible by using a higher rpm when reading areas close to the inner side, and using a lower rpm when reading data off the outer side.

2.2.8 CD
The Compact Disc was the first popular optical storage media. The result of a collaboration between Philips and Sony, its original use was for playback of audio recordings. CDs are available in the following types based on the content they carry: CD A (Audio CD), Video CD (for video), Mixed Mode CD (Containing audio and other data types), Data CD (containing all forms of files), CD—I (CDs containing interactive content), and more. Based on their recording capability, we have CD-ROM (Read-only; all pre-manufactured CDs are of this type); CD-R (recordable once); and CD-RW (read and write many times). The original CD drive could read data at 150 Kilobytes per second, and every subsequent CD drive speed has been rated as a multiple of this speed. The laser used in a CD drive has a wavelength of 780 nanometres. The rated storage capacity is 700 MB.
2.2.9 Combo Drive
This is a drive that can read and write CDs and also read DVDs.

2.2.10 Construction
All optical media are prepared using the same procedure. The sub-
strate is the clear plastic layer that forms the bulk of the disc. A thin
layer of dye is placed above the plastic. This is where the laser records
data in the form of burned or clear spots. The dye, which is com-
monly made of Cyanine or a compound thereof, changes its optical
properties under the laser beam. In the case of pre-manufactured
CDs, the pattern of pits and lands are stamped on the substrate itself.
A reflective film, usually made of silver or gold, comes next. Finally,
a protective acrylic coat is applied. Additionally, a layer for labelling
purposes is added. In case of dual-layer media, there are two layers of
dye with a layer of semi-reflective material in between them.

2.2.11 DAO
The Disk-at-Once mode of writing refers to when all tracks are
recorded without stopping the laser; the disc is finalised at the
end and no further data can be added. In a DAO writing, there is
only one Lead-in and Lead-out.

2.2.12 DVD
The Digital Versatile Disc was created to fulfil the need for storage
of high-quality video data. Two camps existed in the DVD technol-
gy arena: Philips and Sony were developing a new technology for
storage of high-quality video, while simultaneously, Toshiba,
Hitachi, and others were involved in developing a parallel tech-
nology that was incompatible with Sony’s technology. The two
camps agreed to collaborate and the result was the DVD, in 1995.

DVDs can store up to six times as much as a CD, at 4.7 GB (if
you consider a Kilobyte as 1,000 bytes), while using a disk of the
same size. This was possible by using a laser of a smaller wave-
length—630 nanometres—and reducing the width of the tracks
and the distance between them. The original DVD drive had a data
transfer rate of 1.5 Megabytes per second.
Based on the number of recording surfaces, DVD is available as single side—single layer (also referred to as DVD5), single side—dual layer (DVD9), double side—single layer (DVD 10), and double side—dual layer (DVD 18). Dual-layer DVDs effectively doubled the storage capacity to 8.5 gigabytes (per side).

Based on the recording capabilities, DVDs can be categorised into DVD-ROM (read-only, usually the format for pre-manufactured DVDs), DVD-RAM (Random Access Memory, allowing reading and writing), DVD-R, and DVD+R (one-time recordable), DVD+RW & DVD-RW (rewriteable). The “+” and “-” in the nomenclature refer to the two incompatible formats offering the same features. Drives that are labelled as “super multi” are capable of playing all formats.

2.2.13 Erasing
Rewriteable media can be reused by erasing the existing contents. Erasing involves overwriting all areas on the disk with the same data. Erasing can be of two types: Quick Erase, where only the Table of Contents is erased, and Full Erase, where every sector on the disc is filled with the same pattern.

2.2.14 EVD
Enhanced Versatile Disc is a Chinese government-backed recording media for storing DVD video content. The need for this format arose since the licensing fees to be paid for DVD players to foreign companies were high. EVD is free from content protection techniques, and is (initially) available only in the read-only form.

2.2.15 FVD
Forward Versatile Disc is a technology promoted by the Taiwanese government to store High Definition video content. It uses the Microsoft Windows Media Video (WMV9) and Audio (WMA9) codecs for compressing the audio/video streams. It uses normal DVDs, but increases the track count to allow storage of 5.5 GB of data on a single layer, with the capability to have three layers on one side, giving a total storage capacity of 15 GB.
2.2.16 HD-DVD / AOD
High-Definition DVD is a new format of optical storage that is primarily intended to store High Definition video data. It was also called Advanced Optical Disk. It is incompatible with Blu-ray disc technology. It uses a blue violet laser with wavelength of 405 nanometres. It is capable of storing 15 gigabytes of data on a single layer and 30 GB in dual-layer. HD-DVD disks appear in the following types: HD-DVD RAM (read and write), HD-DVD ROM (read-only; all pre-manufactured discs), HD-DVD—R (read once), and HD-DVD—RW (read and write). The data transfer rate of the first HD-DVD drive was 4.36 Megabytes per second.

2.2.17 ISO 9660
One comes across this term when writing a CD. ISO 9660 is a file format for CDs. It was necessary to create a standard file system since competing operating systems created CDs that were not compatible with other operating systems. The ISO 9660 file format is an old format and is used in CDs since it guarantees maximum compatibility with standalone CD players. This standard format has been extended to increase its functionality. The Joliet extension allows the use of filenames larger than eight letters and containing non-ASCII characters. The El Torito extension allowed optical media to be made bootable. ISO 9660 is being replaced by UDF.

2.2.18 Laser
The optical drive uses a laser to read from and record data onto optical discs. A laser-emitting diode is used to create the laser beam. In drives like the combo drive, two laser diodes are used, and depending on the nature of the media, the appropriate laser is used.

2.2.9 Lead-in
This refers to the additional information that identifies the data written in a session. The Lead-in contains a Table of Contents, which has a list of files written in the session.
2.2.20 **Lead-out**
This refers to the additional information written after the actual data to inform the drive about the completion of the session. Without this information, the device would continue to search the disc for additional data, as happens when a session is interrupted.

2.2.21 **Overburning**
Every writeable optical disc has a maximum stated capacity. Overburning refers to the practice of writing more data than the stated capacity. In some cases, the disc has the capacity to accommodate overhead information, and this area can be written to by overburning. The procedure can, however, be risky, since it could render the disc and/or the drive unusable.

2.2.22 **Packet Writing**
This is a specialised way of writing onto optical media that allows data to be erased and written to without the limitations imposed by normal optical media writing. Unlike normal writing, where writing can be performed only in sessions and deleting a session does not free space unless the drive is erased, packet writing allows data to be written and erased from optical media just as in the case of floppy disks. To be able to use packet writing, the drive should be compatible with the Mount Rainier specifications of the UDF file format, and the media needs to be specially formatted under the Mount Rainier format.

2.2.23 **Pits and Lands**
In pre-recorded optical drives, data is stored in the form of depressions on the track. The depressions or pits, and the non-pitted area or Land are interpreted as binary digits (0s and 1s).

2.2.24 **Read / Write Head**
The Read / Write head of an optical drive consists of a laser emitting diode, a lens, and an optical sensor. The lens focuses the laser beam
created by the diode onto the media. The lens is connected with springs that allow small changes to be made to accommodate for small differences in the disc surface. The laser is reflected by the reflective layer, but based on the presence of a Land or Pit (or transparent or opaque area) on the media, the laser is reflected back into the sensor accurately, or is diffused. This difference in intensity of the reflected light is interpreted as binary digits (0s or 1s).

2.2.25 SAO
The Session at Once mode of writing, also called Multisession writing, writes data to the medium in the form of sessions, complete with the Lead-in and Lead-out. This allows the data on an incompletely-written disc to be read.

2.2.26 Sectors
Tracks on an optical media are subdivided into sectors, which are the smallest storage unit of the medium. In CD ROMs, a sector contains 2352 bytes, while in a DVD, the sector is 2048 bytes long.

2.2.27 Session
A session refers to the basic unit of data written to a disc. A session consists of a Lead-in, the actual data, and a Lead-out.

2.2.28 Speed notation
The original “X” that is used to denote reading and writing speeds in optical drives of all types refers to the speed of the first drive of that type. So a 52X CD drive can read or write data 52 times faster than the original CD drive, which means at about 150 x 52, or 7800, Kilobytes per second. The notation seen on optical drives refers to the speeds during different operations. For example, a CD-Writer with the 52X24X40X notation can read CDs at 52X, erase CDs at 24X, and write CDs at 40X.

2.2.29 Stamping
Optical discs are manufactured in bulk by first creating a die that contains the pattern of pits and lands that represent the data. This pattern is then transferred to the disc by “stamping” it onto the die.
2.2.30 Standards
Optical media are governed by standards that are referred to as “Books,” like The Orange Book, The White Book, The Blue Book, etc. The Red Book, the original standard, specifies the requirements for Audio CDs. The White Book specifies the requirements for Video CDs.

2.2.31 TAO
The Track-at-Once mode of writing stops the writing process after a track is written, and does not add a Table of Contents (contrast with DAO). This allows the user to add another track later on, but till the last track is added and the Table of Contents written, the contents already on the media cannot be accessed. TAO is not to be confused with multisession writing.

2.2.32 Tracks
Every optical media or disk consists of a single spiral path, starting from the inner side and moving out, in which data is stored. This is called a track. A track is also used to denote the data portion in a session.

2.2.33 UDF
Universal Data Format is a file system used by optical media. It offers significant improvements over the older ISO 9660 used in CDs. UDF is the default format used in DVDs.

2.2.34 Video data
The search for faster and more capacious optical storage media is fuelled by the need to distribute video of better quality. This was evident in the emergence of DVD and now in the development of BD and HD-DVD. High Definition (HD) video refers to a video stream that meets or exceeds the resolution of 1280 x 720 pixels. In contrast, DVD Video supports resolutions up to 720 X 576 pixels, and Video CD supports a maximum of 352 x 288 pixels. Non-HD video is also referred to as Standard Definition (SD) video.

MPEG1 is the compression format used in VCDs, while MPEG2 is used in DVDs. The next generation media support multiple com-
pression formats like H.264 (an MPEG4 format) and VC1 (based on Windows Media Video 9), besides MPEG 2. Protection of the video content is also another factor influencing the adoption of newer optical media. Next-generation discs use Advanced Access Content System (AACS) and High Definition Content Protection (HDCP) to prevent unauthorised use.
2.3 Flash Drives

2.3.1 Bootable Flash Drive
Modern motherboard BIOSes allow USB Flash Drives to be used to boot the system.

2.3.2 Compact Flash
CF cards are based around NAND Flash technology, though initially it used NOR Flash technology. It was developed by Intel, and is the oldest format of Flash memory. The theoretical maximum capacity of CF is 137 Gigabytes. The transfer speeds have improved with every version of CF, with the latest version 4 CF cards capable of data transfers of 133 Megabytes per second.

2.3.3 Flash Memory
“Flash” Memory loosely refers to any non-volatile, rewriteable, random access memory. A Flash Drive or Thumb Drive consists of a Flash Memory chip that stores the data, a controller that manages the read/write operations, and a USB interface. Besides as an integrated unit, Flash memory also exists as distinct memory cards that can be plugged into Memory Card readers that have a USB interface. Memory card types include Compact Flash, Secure Digital, Multimedia, xD, Memory Stick, and more. These differ in their working, but offer similar functionality.

2.3.4 Memory Stick
Developed by Sony, it is available in different versions, like Memory Stick
Pro, MS Duo, MS Pro Duo, and the latest, the Pro HG. The maximum theoretical capacity is 32 GB, and the maximum transfer speed is 60 Megabytes per second.

2.3.5 MMC
The Multimedia Card was developed by Siemens and SanDisk. It relies on NAND Flash technology. Many types of MMC cards are available to suit different needs, like RS MMC (Reduced Size MMC) and Secure MMC. MMC cards have a theoretical maximum capacity of 128 GB, and the present maximum transfer speed is 40 Megabytes per second.

2.3.6 NAND / NOR Flash
Most Flash Memory products are based on NAND Flash, and a few use NOR Flash technology. NAND and NOR refer to the logic gates used to manage the contents stored in memory. NAND Flash typically lasts for a much larger number of read/write cycles.

2.3.7 Secure Digital
The SD card was developed by Toshiba, Panasonic, and SanDisk. It uses NAND Flash, and is mostly used in smaller devices like mobile phones and cameras due to its smaller size as compared to CF cards. SD cards offer a maximum theoretical capacity of 128 GB, and a peak data transfer rate of 20 Megabytes per second. SD cards are also available in smaller sizes, under the names of MiniSD and MicroSD. SD High Capacity (SDHC) is a newer version of SD that is not backward-compatible, and offers capacities above 2 GB.

2.3.8 xD Card
The Extreme Digital Card was developed by Olympus and Fujifilm—camera manufacturers—for use in their digital cameras. xD cards are comparatively slower, offering a maximum speed of 5 Megabytes per second. They also have a theoretical maximum capacity of just 8 GB.
This chapter covers the peripherals—that is, components typically associated with a computer system but not really considered a part of “the computer”. This includes the keyboard, mouse, printer, scanner, UPS, and also the system’s power supply unit (PSU).
3.1 The Power Supply Unit

The role of the Power Supply Unit (PSU) is easily overlooked—since it comes bundled with the cabinet—and rarely gets special mention. With more and more power-hungry components being plugged into PCs, the need for a proper PSU becomes important.

3.1.1 Amperage
This refers to the value of the current carried by a power cable, and is expressed in Amperes. Each of the voltage “rails” has an associated amperage. Since 12 V is used to drive all the motors (hard disk, optical drives), and also power the graphics card(s) (in the case of additional power being needed), it is recommended to buy a power supply unit with higher amperage in the 12 V rail.

3.1.2 ATX Power Supply Unit
PSUs are available in different form factors, with the ATX form factor being the most widely-used. The ATX power supply is not directly controlled by the user; the motherboard controls it. ATX specifications have been updated from the original so as to support additional, power-hungry components. The latest version is 2.2—it includes specifications for the 24-pin motherboard power connector (the original specifications included only a 20-pin power connector), the 12 V 4-pin motherboard power connector, and the 6-pin PCIE graphics card power connector.

3.1.4 Efficiency
Energy is lost during the conversion from AC to DC—mostly in the form of heat. The greater the amount of DC generated given a certain AC input, the better the efficiency of the unit. The quality of components used in the PSU influences its efficiency.

3.1.5 Modular Power Supply
These are power supplies that allow users to connect required cables only when needed, thus avoiding the clutter seen in most power supplies. These only have sockets for the required connections, though some have the motherboard connector preinstalled.
3.1.6 Rails
A PSU generates different voltages. All cables carrying the same voltage constitute a rail. In a PSU, the cables are colour-coded: the Red cable carries +5 V, the Yellow cable carries +12 V, the black cable is Ground, and so on.

3.1.8 SMPS
Switching-Mode (or Switched-Mode) Power Supply refers to that class of devices that use a switching transistor (along with other components) to convert AC current into DC current of different voltages. The switching transistor is used since the mode of operation—constantly switching off and on, effectively “chopping up” the input power—is the most power-efficient. Using the same mechanism as in adapters for single devices would result in significant loss of energy as heat during the conversion process.

3.1.9 Standby Power
In ATX power supplies, the user cannot directly power up the SMPS. The SMPS is connected to the motherboard, which controls it. Standby power is the minimal power (at 5 volts) that is used to keep the motherboard active even when shut down by the user. This allows the system to be powered up manually by the user by depressing the power button on the cabinet (which actually passes a signal to the motherboard, not to the power supply), or automatically by power-up events like sending a signal over the network (Wake on LAN) or by setting a wake-up time in the motherboard BIOS.

3.1.10 Wattage
This refers to the maximum power in watts that the PSU can provide. This is a peak value; the effective power will be less than this. A PSU that provides at least 20 per cent more power than what is needed by the system is recommended.
3.1.11 Power Connections
A few plug types seen in modern power units are:

- **20 / 24-pin Motherboard Power Connector**
The 24-pin power connector adds four additional pins to the original 20-pin specification. Many SMPSes offer a 24-pin plug with a detachable 4-pin section that can be used to plug in to older 20-pin sockets. The four additional pins provide additional power to the motherboard, and some motherboards with the 24-pin socket will not boot with the 20-pin plug.

- **4-pin 12 V Connector**
Like the 24-pin plug, the 4-pin 12 V plug is needed to provide additional power to the motherboard. Booting will not be possible if this additional power is not provided to the motherboard.

- **4-Pin Molex Connector**
Used to power hard disks, optical drives, cabinet fans, etc. Sometimes this may also be used to provide additional power to the graphics card, if it has the socket.

- **4-Pin Floppy Drive Connector**
For the floppy drive, of course, if it’s present.

- **6-pin PCIE Connector**
Powerful graphics cards require more power than the 75 watts that can be
provided by the PCIE bus, so there are additional power sockets on the card. Power supplies with the 6-pin connector are labelled SLI / CrossFire Ready.

- **SATA power connector**
  SATA drives require a different 15-pin power connector. Most motherboards bundle a 4-pin Molex-to 15-pin SATA converter.

### 3.1.12 SMPS Fan
The fan is used to cool the components in the SMPS. Since it sucks air out of the cabinet, it also helps reduce the temperature of the system.

### 3.1.13 Y-Splitter
This is used to increase the number of free power connectors. The Y-splitter consists of two pins on one end and a socket on the other. The socket is used to connect to any Molex converter. This is usually seen associated with additional cabinet fans.
3.2 Printers

Here are some terms common to both laser and inkjet printers.

3.2.1 Bidirectional Printing
In older printers, data could be only be sent from the PC to the printer. This meant no information about the status of the print job could be transmitted to the user. Bidirectional printing allowed the printer to convey messages to the PC, which made it easier for the user to track print progress, and be informed about the status of various parameters of the printer—ink level, for example.

3.2.2 Borderless Printing
This feature is commonly seen in printers that also offer photo printing. Normally, all printers restrict the user from printing the entire width and length of a paper, leaving a small border. But this can be manually overridden. Borderless printing is a feature that allows the creation of photos that look similar to those available from professional labs. When this setting is selected, the printer prints the entire width and length of the paper.

3.2.3 CMYK
This is the colour scheme used in printing technology. The name is derived from the four constituents of the scheme—Cyan, Magenta, Yellow, and Black. Colour inkjet printers have reservoirs for each of the colours. Some photo printers also carry additional colours like red, green, light cyan and light magenta to offer better colour fidelity.

3.2.4 Draft Mode / Ink Saving mode / Toner Saving Mode
These refer to an alternative mode of printing where the printer uses less ink or toner to print. This is also the fastest mode of printing, and is ideal for trial prints.

3.2.4 Duplex Printing
Refers to the ability to print on both sides of a page. This is managed by the printer by ordering the pages in the print queue so
that only alternate pages are printed first. After the first print cycle, the pages are inverted and printed on the reverse. In automatic duplex printing, the printer manages all the steps without requiring user intervention. In manual duplex printing, after the first print cycle, the user must reinsert the pages in the paper tray.

3.2.5 Duty Cycle
A printer’s construction is capable of withstanding only a certain workload, expressed in the number of pages that can be printed in a unit of time. The Monthly Duty Cycle is the workload that a printer is designed to handle in a month, and is expressed in terms of pages per month.

3.2.6 Network Printers / Workgroup Printers
Such printers have a LAN port and can be plugged into a hub or switch and used by any PC on the network. Since it is not connected to any particular system, a PC is not needed to control the printer.

3.2.7 Printer Buffer
Every printer has some memory on board, called the buffer, where content that needs to be printed is stored if the printer is currently printing. If the buffer is full, the printer will use the system RAM. Some printers come with upgradeable memory options. Using the printer buffer relieves the PC’s resources.

3.2.8 Paper Capacity / Tray Capacity
The number of pages that can be stored in the printer tray. Most printers come with at least a 100-page tray capacity.

3.2.9 Paper Jam
A paper jam refers to when a sheet of paper gets stuck in the printer. This can happen due to many factors, like page curl, page moisture, the roller not being clean, etc.

3.2.10 Paper Path
This refers to the route the paper travels in the printer during the printing process. Complicated paper paths make it difficult to
print of thicker media, besides increasing the chances of paper jams. Some printers print on the reverse side of the page, with reference to how the paper is placed in the tray, indicating a U-shaped paper path.

3.2.11 PictBridge
A protocol that allows digital cameras and photo printers to directly interact without the need to connect through a PC.

3.2.12 PostScript
A device-independent printing language. Documents sent for printing from any system are first converted into Postscript.

3.2.13 PPM
This refers to the maximum pages that can be printed by the printer in a unit time, expressed as pages per minute (ppm). Printing speed varies with the content, coverage, and colour qualities. Printing pictures takes more time than text, printing closely-typed text takes more time than printing double spaced text, and printing a colour image takes more time than printing the same image in monochrome.

3.2.14 Print Job
The pages sent to the printer at one time together constitute a job.

3.2.15 Print Media
The surface on which a printout is taken. Most printers allow printing on normal paper sheets as well as thicker envelope covers. Photo printing requires the much thicker photo paper which is specially treated to prevent ink blot. The paper path influences the print media that is supported by the printer.

3.2.16 Print Quality
Printers support printing at different quality settings, usually termed Draft, Normal, and Best. The quality setting influences the print speed. In draft mode, the print resolution is lower, as is the amount of ink or toner used. Best mode gives the highest possible
resolution, with a normal amount of ink, as in Normal mode. The time required for printing increases along with the resolution.

3.2.17 Print Queue
Documents can be sent to a printer even while it is already printing a document. These documents are stored in the print queue. Depending on the size of the printer buffer, the print queue can be on the printer or in the system. If the queue is in the printer, disconnecting the PC after a document has been sent to the queue will not cause the queued documents to be lost.

3.2.18 Resolution
This refers to the number of dots per square inch that a printer can print. The greater the resolution, the better the smoothness and clarity of the printed matter. Most current inkjet printers offer resolutions of up to 1200 x 1200 dpi, while the photo printers go up to 4800 x 4800 dpi. Laser printers usually offer 600 x 600 dpi with the better ones touching 1200 x 1200 dpi.

3.2.19 Toner / Cartridge capacity
The number of pages that can be printed on a single cartridge/toner. This figure is subjective and differs with test conditions. Usually, text printing capacity figures are based on a “5 per cent coverage”, meaning the printed matter only covers 5 per cent of the total paper surface.

3.2.20 Toner / Cartridge Refilling
Budget laser printers and all inkjet printers have ink reservoirs that need to be discarded once the ink is depleted, as recommended by the manufacturers. Refilling usually involves using crude methods (undertaken by the user) to replenish the ink / toner levels, and can be achieved at a fraction of the cost of buying a new cartridge. But doing so usually voids the manufacturer warranty, and can result in reduced print quality.
3.3 Laser Printers

3.3.1 Fuser
After the pattern on the drum has been passed on to the paper by rolling, it passes through the fuser, where heat is applied to fuse the pigment particles to the paper.

3.3.2 Multicolour Printers
These printers have toners for each of the colours Cyan, Magenta, Yellow, and Black. In most printers, the paper passes through all the four toners in sequence, accepting each colour component to complete the print image.

3.3.3 Printer Drum
In laser printers, the drum is used to transfer the file image onto paper. The surface of the drum is charged selectively by a laser, based on the pattern to be printed. When brought in contact with the Toner, the charged areas attract the toner particles to complete the pattern on the drum. When the paper is rolled over the drum, the pattern is transferred on to it. In many entry level models, the Drum and Fuser are combined with the toner hopper, so when the toner is depleted all the components have to be discarded.

3.3.4 Toner
This refers to the fine electrostatically charged powder that is used as the medium in a laser printer. It consists of minute particles of pigment and plastic. Monochrome printers have just a black toner. Multi colour printers have toners for each of the colours Cyan, Magenta and Yellow (besides black). The toner is packed into a receptacle called the Toner Hopper.
3.4 Inkjet Printers

3.4.1 Bubble Jet / Thermal Inkjet Printer
This is a type of Inkjet printer that uses heat to cause ink droplets to be sprayed on to the paper. This is the most widely used technology in Inkjet printers. The droplet size in the latest printers is advertised as 2 picolitre. (1 litre = 1,000,000,000,000 picolitres).

3.4.2 Cartridge
In inkjet printers, the colour is stored in reservoirs called cartridges. Cartridges can be individual where a single cartridge carries just one colour of ink or Combined, where each cartridge carries more than one ink within. Needless to say, if one of the colours in the combined cartridge is depleted, the entire cartridge needs to be discarded.

3.4.3 Photo Printers
While many normal inkjet printers can also print photos, Photo Printers are printers specially created to print photos. Presently all of these are inkjet printers. They are of a smaller size and use special photo paper in the usual photo sizes like 4 X 6 etc. They allow printing without connecting through the
PC by using PictBridge. They also have interfaces to connect digital camera or memory cards, and a screen to preview the photo. Some also allows rudimentary editing of the photo before printing.

**3.4.4 Print Head**

In inkjet printers, the cartridges and associated circuitry are loaded on a block that is moved along the width of the page during the printing process. This is called the print head. Some manufacturers like HP fuse the print head and the cartridge into a single unit which needs to be discarded once the cartridge is depleted. Others like Canon, separate the print head from the cartridge, allowing just the cartridge to be replaced when it is depleted.
3.5 Scanners

3.5.1 ADC
Analogue-to-Digital Converter refers to the device employed to convert analogue signals into digital form. In a scanner the voltages (analogue) from the CCD are passed to the ADC to be converted into binary (digital format).

3.5.2 ADF
Automatic document Feeder is an attachment seen in some scanners that can load the pages that need to be scanned, automatically into the scanner. This allows scanning without any manual intervention.

3.5.3 Bit Depth
The amount of bits dedicated to capturing information from the scan subject. For greater detail, more bits need to be captured. A 24 bit depth allocates 8 bits or 1 byte per colour in RGB.

3.5.4 CCD
Charge Coupled Device refers to the optical sensor used to detect the intensity in the reflected light. These devices are capable of converting the light into electric energy with corresponding intensity. Higher intensity of light generates higher voltage electric impulse. For colour scanning the CCDs are coated with either of the colours Red, Green, Blue to register the colour under each filter.

3.5.5 Document Scanners
These are special type of Scanners that are designed for scanning large number of documents. Here rather than have a moving scan head, the scan head is fixed and the paper is fed underneath it.

3.5.6 Flatbed Scanners
These scanners have a sheet of glass over which the object to be scanned is placed. The scan head consisting
of the light source, the reflecting mirror and the CCD array is moved under the glass sheet to scan the subject.

### 3.5.7 Hand Held Scanner
These are smaller scanners that rely on the user’s movement to scan the document below it. These can be in the form of Bar Code Scanners which are used to record bar codes on packages or as Pen scanners where moving the scanner over the document captures it’s contents.

### 3.5.8 Interpolated Resolution
If the hardware is unable to produce the resolution, the software can interpolate the values of two points to arrive at the values of a point in between them. This would be the interpolated resolution. Scanners achieve a higher resolution by Interpolation.

### 3.5.9 Negative Scanners
These scanners are used to scan photographic film negatives. In these scanners the optical sensor and the light source are on opposite sides of the scan subject. The scan result is the developed photo.

### 3.5.10 OCR
Optical Character Recognition refers to the process of identifying textual data present in an image file. All scanners come with a bundled OCR software. Good OCR software can identify textual and graphical data and retain the formatting of the original document. For best results, OCR software need a scanning resolution higher than 200 dpi.

### 3.5.11 Optical Resolution
If the resolution can be achieved by the hardware, it is the optical resolution. Optical resolution is the product of the number of
CCDs accommodated in one inch of a row on the sensor and the number of times the CCD captures light as the scan head rolls a distance of 1 inch over the subject.

3.5.12 Resolution
This refers to the number of distinct points in a square inch that can be detected by the scanner. Resolution can be of two types: optical and interpolated.

3.5.13 RGB
This refers to the scheme which uses Red, Green and Blue (RGB) as the primary colours. The other colours can be expressed as a combination of these colours in varying intensity.

3.5.14 Scan Speed
This is expressed as the time it takes the scanner to scan an object. This varies with the mode (colour, grey scale) and scan resolution.

3.5.15 TWAIN
A term frequently used with regard to image capturing devices like Scanners and Webcams, TWAIN is the image capture API that is needed to communicate with image capture devices. It is usually bundled with the device drivers.

3.5.16 Multi-function Devices
MFDs or Multi-function Devices combine the functionality of a Printer and Scanner. This allows them to be used also as a copier. Some MFDs also add additional facilities like a dial up modem that can be used to fax images scanned with the scanner. MFDs are also called All in Ones.
3.6 Mice

3.6.1 CPI / DPI
Short for Counts per Inch / Dots Per Inch, this is the number of unique points that can be detected by the sensor in one square inch area. The greater this value, the greater the capability of the mouse to detect movements (sensitivity).

3.6.2 Laser Mouse
This is the latest innovation in pointing technology. Moving a step ahead of the optical mouse, which uses normal light, the Laser mouse uses an infrared Laser beam (from a Laser Emitting Diode) to illuminate the surface. A laser sensitive sensor is then used to track changes in the surface. Due to the focussed nature of the laser beam, the Laser mouse can achieve 20 times the sensitivity of the optical mouse, besides being able to detect differences on surfaces that befuddle an optical mouse.

3.6.3 Mechanical Mouse
This mouse uses a ball to rotate two slit disks placed in the X and Y axis. The slit disks are placed between a set of light source and optical sensor. Any rotation of the disk causes a the slits to cut the beam of light received by the sensor which is translated into changes in the respective axis. Any movement of the ball is thus translated into changes in the X and Y axis. Mechanical mice are on the way out due to the advantages offered by the equally priced optical mice.

3.6.4 Mouse Driver
Usually the default driver offers the basic functionality of a 2 button scroll wheel mouse. To use the features of the mouse optimally, the driver created specifically for the mouse needs to be installed. The mouse driver allows the buttons on the mouse to be reconfigured.

3.6.5 Optical Mouse
The Optical mouse employs a camera or optical sensor to constantly take images of the surface beneath the mouse. Any changes in the surface is detected and the differences in the x and y posi-
tions compared to the previously recorded image is transmitted to the OS. A dedicated light emitting diode (LED) is used to illuminate the surface to make detection easier. Since the camera scans the surface for changes, it’s task is made difficult if the surface is devoid of any distinguishing pattern or is highly reflective.

### 3.6.6 Refresh Rate
Refresh rate is the number of images taken by the optical sensor of a mouse. This is variable and usually in the hundreds per second. A higher figure means a quicker response.

### 3.6.7 Scroll Wheel
This is the wheel found in between the main two mouse buttons, and can be used to scroll through a document. This is the default behaviour as set by the default driver. The mouse driver can be used to allocate a different function for the wheel.

### 3.6.8 Trackball
This is seen on some mice as a freely moving sphere that can be used to more accurately position the cursor on the screen.

### 3.6.9 Wireless Mouse
This mouse does away with the need for wires by using radio waves to communicate with a base station that is connected by wires to the system, usually to the USB port. The mouse has an independent power source, usually in the form of batteries, or can be recharged by plugging into the base station. Since radio waves can pass through objects, there is no need to position the mouse in front of the base station to use it.
3.7 Keyboards

Keyboards are the default input device of a system.

3.7.1 Ergonomic Keyboard
This keyboard is designed keeping the natural position of the hands. Since the wrists are stressed when the palms are positioned at an angle to the arm, the keyboard was redesigned to place the keys in the form of an arc, with the key switches split down the middle, allowing the user to keep the wrist unbent. Some keyboards also provide a wrist rest for the wrists.

3.7.2 Gaming Keyboard
These are special keyboards that are built for gamers. In most games a limited set of keys are used, and the position of these keys are determined keeping a gamer’s needs in mind. A dedicated gaming keyboard offers a more user friendly layout of keys, and each key is programmable.

3.7.3 Multimedia / Internet Keyboard
These refer to keyboards that have additional keys that are configured to launch special programs or perform certain tasks like increasing or decreasing the volume of the media player or launching a browser.

3.7.4 QWERTY / Dvorak
Two schemes for key placements on keyboards. The QWERTY scheme is more popular, and gets its name from the arrangement of
letters in the first row of the keyboard. The Dvorak scheme was introduced by August Dvorak, who arrived at the placement based on his observations about the frequency of letter usage and human physiology.

3.7.5 RSI
Repetitive Stress Injury refers to the condition caused by prolonged use of the keyboard and mouse. This is characterised by pain in the wrist and fingers and is attributed to bad posture and insufficient support while typing. Using ergonomic keyboards can reduce chances of RSI.

3.7.6 Typematic Rate / Repeat Rate
This refers to the speed with which letters are repeated when the key is pressed. A high repeat rate causes many letters to be input.

3.7.7 Wireless Keyboard
This keyboard uses radio waves to carry the data to the system, thus avoiding the need for wires. The keyboard communicates with a base station that is connected to the system, usually through the USB port. Since the keyboard needs additional power to create the radio signals, it uses batteries. Wireless keyboards can also be based on Bluetooth technology and Infra Red technology, the latter requires that the keyboard and sensor be in visible range.
3.8 Webcams

Webcams are important communication accessories that are used in conjunction with chatting on the Net. A few terms associated with webcams are discussed next.

3.8.1 Actual Resolution
This is the actual number of pixels that the camera CCD can capture. This is expressed in pixels (or megapixels).

3.8.2 AVI
Audio Video Interlace is a method for storing these two data streams by interleaving them. AVI is a popular file format. Webcams can be used to record video data which is stored in AVI format.

3.8.3 CCD
Charge Coupled Devices are optical sensors that are needed to convert the optical data into electrical impulses. These can be coloured to capture data related to each colour in the RGB scheme (Red, Green, Blue).

3.8.4 Compression
Uncompressed Video data is quite data intensive, and for transferring this data over the net one would need very high speed internet connections. Compressing the video streams reduced the file size, without causing any significant loss in quality. Different webcams use different codecs to compress the video.

3.8.5 FPS
Frames per second refers to the frequency with which the webcam updates the CCD. A high refresh rate means that the captured motion is smoother. Most webcams capture at speeds of 25 fps.
3.8.6 Interpolated Resolution
The colour of the points between two pixels can be estimated by software. This is used to boost the resolution of the camera. Such resolution is called interpolated resolution.

3.8.7 Megapixel
A megapixel = 1,000,000 pixels. This refers to the resolution of the camera.

3.8.8 Resolution
The number of pixels that can be captured by the CCD is it’s resolution. This is expressed as the number of pixels. Resolution can be actual or interpolated. The webcam can offer the maximum resolution for taking static photos while take videos at a lower resolution. Resolution can be expressed in the number of pixels in the horizontal and vertical axis, for example 640 X 480, or as a total number of pixels on the CCD, for example 1.3 megapixel.

3.8.9 TWAIN
The image capture API (application programming interface) that is needed for an image capture device, like a Webcam to interact with the system.

3.8.10 Video Capture
Similar to audio recording, Video Capture is the term used to denote the process of recording video data by using analog devices, like Webcams.

3.8.11 Video Conferencing
A term used to denote a meeting of remotely located people over telecommunication lines or the internet with utilising the services of microphone and webcam. All the parties in the meeting need to have both a webcam and microphone to be seen and heard.

3.8.12 Video Streaming
This refers to the practice of sending video data over the network to be viewed at the same time (and not be recorded).
3.8.13 Zooming
This refers to the magnification of the target either by using lenses (optical zoom) or by using software methods (digital zoom). Digital zoom usually results in loss of clarity since the existing picture is merely expanded causing the pixels to become apparent.

3.8.14 Tablet
This is another device that can be used to record user input. It is most suitable to record user handwriting or drawing. The Stylus is the pen shaped device that is used to write on the touch sensitive tablet surface to capture the pattern. The stylus can have one or more buttons on it.

3.10 Gaming Accessories
These are used specifically for enhancing the user's experience while playing games. These include driving wheels, gamepads and joysticks / flight sticks.

3.10.1 2-Axis / 3-Axis Gamepad
This refers to the number of axes which can be effected by buttons on the gamepad. Usually the three axis functionality is best utilised in case of Flight simulation games.

3.10.2 Force Feedback
This is a system of communication between the system and the gaming device. Using force feedback it is possible for the game
software to send back special signals that effect the way the gaming device handles, like vibration. Every Force Feedback compatible gamepad has a few type of vibration sequences stored in it. The software only passes a signal to the gamepad to execute one of these vibration sequences. Force Feedback is also used to create realism in driving wheels wherein the rotating resistance of the wheel is increased or decreased based on various factors present in the game.

3.10.3 HID
Human Interface Device are a class of devices that usually plug into the USB port and enhance user interaction with the system. HID also includes gamepads and joysticks and also USB mice and keyboards.

3.10.4 Vibration
Some joysticks contain motors that rotate when provided signals. These rotating motors impart a sensation of vibration. This effect is a part of the Force Feedback technology.
3.11 UPS

Uninterruptible Power Supplies are a class of power backup devices that meet the strict power requirements of PCs. PCs can tolerate a power outage without loss of data if power is restored within 10 milliseconds. If power is not restored within this time, the PC malfunctions causing a loss of data. A power backup system that meets this criteria can be called a UPS.

3.11.1 AH
Short for Ampere Hour, this is an indication of the capacity of the battery of the UPS, and refers to the current that the battery can supply (in Amperes) in an hour. The higher the AH value, the longer the battery can power the system. The AH value should be governed by the expected backup period, and not the load offered by the system. There is little relation between the VA value of the UPS and the AH value of its battery. So a 600 VA UPS need not support a system longer than a 500 VA UPS if both of them use a 7.2AH battery for backup.

3.11.2 Battery
This refers to the secondary battery, usually sealed Lead Acid battery, used to store the charge to be used in the absence of utility power. Most 500 and 600 VA UPSs have a 7.2 AH battery inside. UPSes with external batteries also exist that allow additional batteries to be added to increase backup time. Larger UPSes use Lead Acid batteries as used by heavy vehicles for backup.

3.11.3 Line Interactive UPS
This type of UPS constantly checks the quality of the mains power. In case of any anomaly, like a reduction in voltage the UPS starts utilising the battery power and boosts the voltage going to the system. This system offers better protection than Offline UPS.
3.11.4 Offline UPS
This UPS powers the system through the mains power till it fails, when it switches over to the battery backup. This is the cheapest and most widely available UPS.

3.11.5 Online UPS / Continuous UPS
This is the most reliable of UPS since the system is never powered by the mains. This type of UPS is mostly seen for servers or other critical equipment. The UPS is always working and the system is being powered off the backup batteries. This ensures that any problems with the mains supply is never felt by the system. In this scenario, when the mains power fails, there is no switchover.

3.11.6 Power Management Software
Many UPS bundle additional software that can be used to shutdown the system when the power level falls below a threshold. A serial cable connects the UPS to the system so that the necessary commands can be passed.

3.11.7 Switch Over Time
This is the time taken by the UPS to switch from utility power to battery power in the event of failure of utility power.

3.11.8 VA
Short for Volt Amperes, this refers to the load bearing capability of the UPS. The higher the VA rating, the greater the supported load. The supported load refers to the total power requirements of the PC. Since electrically Watts = VA, the total wattage of the components of the system is a good indicator of the suggested VA rating of the UPS that will be needed. It is recommended to leave some headroom and settle for an UPS marked at least 20% higher.
Sight and Sound

This is the chapter on multimedia, covering most of the terms you’ll come across related to displays, graphics and sound cards, and speakers. We’ve also included a brief section on connectors.
4.1 Monitors And TVs

The technologies driving monitors and televisions are similar. With the increasing use of PCs as media centres for entertainment purpose, the PC monitor is being replaced with larger displays that were once reserved for entertainment use.

4.1.1 Active Matrix LCD / TFT LCD
In such displays, each liquid crystal in the Liquid Crystal Display is connected to a Thin Film Transistor (TFT) that powers it. This allows the liquid crystals in the matrix to be addressed much faster, allowing for faster response times (this is in contrast to a Passive Matrix LCD).

4.1.2 Aperture Grille
This is an innovation in CRT technology that was developed by Sony for their Trinitron series of TVs. Rather than dots of differently-coloured phosphors, thin horizontal lines of the phosphors are used. A layer of thin metal strips is placed over the lines. These metal strips form the Aperture Grille. The electron beam is allowed by the grille to hit only the correct line of phosphor.

4.1.3 Aspect Ratio
The ratio between the width and height of a display screen. Displays that offer an Aspect Ratio of 4:3 are called “regular” or “standard” displays. Displays that offer an Aspect Ratio of 16:9 or 16:10 are referred to as widescreen displays.

4.1.4 Component Video
This form of video signal transmits the data to reproduce a colour image through three channels: the Luminance channel, which contains information about the image’s brightness / darkness or white / black (called the Y component), the blue
colour difference signal (called the Pb/Cb component), and the red colour difference signal (called Pr/Cr). The value of the green signal can be calculated from the values of the blue and red signals, to reproduce the original image. Component video cables usually have three RCA plugs for each of the channels, as seen on DVD players. Component video offers better quality output than S-video and Composite video.

4.1.5 Composite Video
For regular TV broadcasting purposes, the video information in the three channels in Component video is fused into one and compressed. This is the Composite video signal. The fusion of the luminance and colour information channels cannot be accurately undone at the receiver's end, so there is a loss in quality. The composite video signal can be carried over a single cable. For TV broadcasts, the audio signals are also combined with the Composite video and transmitted through coaxial cables, the connectors for which are seen on all TVs. Composite video offers the lowest video quality compared to Component video and S-video.

4.1.6 Contrast Ratio
This refers to the difference in luminosity between the brightest and darkest modes of the display. If the contrast ratio is high, the on-screen images are clear even when ambient light is high.

4.1.7 CRT
In CRT displays, a beam of electrons is accelerated under high voltage and made to collide on a phosphor-coated screen. The particular phosphor elements that are hit by electrons are illuminated. In monochrome CRTs, each pixel is represented by a single phosphor element, while in colour CRTs, each pixel has three phosphors, each one capable of emitting red, green, and blue
light. The electron beam constantly scans the screen, starting from the top left corner and ending at the bottom right corner, refreshing one row at a time.

Cathode Ray Tube technology is the predominant—though dated—technology, still powering most monitors. The high voltage needed to power up the display and the space the monitors occupy, in addition to the eye-strain caused by the flickering of the scanning electron beam, are the reasons for looking for alternatives. The ability to display at any resolution without loss of clarity puts them at an advantage over LCD screens.

### 4.1.8 Dead Pixels
Dead pixels refer to unresponsive elements in a digital display. Since they can no longer control the flow of light from the back panel, these pixels get displayed as spots on the screen that do not change their colour.

### 4.1.9 DLP
Digital Light Processing is the technology that drives projectors and rear projection TVs. This technology, a creation of Texas Instruments, uses tiltable microscopic mirrors (micromirrors) to manage the intensity of light available at the screen. The light from a source is directed onto a micromirror, whose tilt influences the intensity of reflected light passing to the screen. The position of the mirror when no reflected light reaches the screen is considered the Off position, and the position when the reflected light is available in full intensity is the On position. Each micromirror represents a pixel in the final image. The chip containing the micromirror is called the Digital Micromirror Device (DMD). Each mirror is switched On and Off many thousands of times per second, and depending on the intensity of light needed on the screen, the proportion of the On and Off positions is varied. To get a colour image, the light from the source is passed through a colour wheel containing filters for the three colours (Red, Green, and Blue). Due to the switching mechanism of this technology, the display is subject to the flickering effect as seen in CRTs.
4.1.10 Dot Pitch
The closest distance between two pixels on a screen. The smaller the dot pitch, the better the image quality. The definition can vary from product to product. Dot Pitch can mean the distance between two pixels arranged horizontally or diagonally; and depending on the way the pixels are arranged, these values may differ.

4.1.11 Flicker
In CRT displays, the phosphor element gradually loses its luminosity. If the interval between refreshes is long enough, the fluctuating levels of luminosity is noticeable to the eye, and is referred to as flicker. Higher refresh rates ensure that the fluctuation in phosphor luminosity is not noticeable, and flickering is less noticeable.

4.1.12 Ghosting
This phenomenon is seen in LCDs with a low response time. When dealing with any scene that involves fast motion, pixels that are not quickly updated retain their previous state for a brief moment even as the adjoining pixels have been updated, causing the eye to detect a double image, or “ghost.” Typically, a response time of below 16 milliseconds would mean no ghosting.

4.1.13 HDTV
A “High Definition TV” refers to a TV set that can produce a progressive display of resolutions above 1080 x 720 (widescreen aspect). The widescreen aspect is important, since HD transmission signals do not support the normal aspect.

4.1.14 Interlaced / Non-interlaced / Progressive
These are methods used to refresh a screen. When only alternate rows of pixels on the screen are refreshed at a time, the display is termed Interlaced. This is usually used to reduce the data that needs to be transferred through the interface. Since this refresh occurs many times per second, it is not easily evident to the human eye, except in scenes involving fast movement, where this manifests as jagged lines. A non-interlaced display refreshes all the
pixels at the same time. Non-interlaced displays are also called Progressive Displays. Normally, Interlaced displays have twice the refresh rate of a non-interlaced display. Interlaced displays are usually marked with an “i”, and Non-interlaced or Progressive displays are marked “NI” or “P”. Besides monitors, media devices like DVD players and TVs are also similarly marked.

4.1.15 LCD
Liquid Crystal Display technology uses an array of liquid crystals sandwiched between two sheets of polarised filters to control the amount of light generated by a cold cathode tube allowed to pass through to the front of the screen. The polarising filters are arranged in different directions of polarity, so that the light coming through one filter will be completely blocked by the other, in the absence of the layer of liquid crystals. The shape of the liquid crystal influences the amount of light passing through the second filter. By varying the voltage applied to the liquid crystal, its shape can be controlled. In colour LCDs, one pixel is made up of three liquid crystals, each coloured Red, Green, or Blue.

4.1.16 Native Resolution
This refers to the actual number of pixels in an LCD. Unlike CRTs, an LCD can only offer maximum clarity if the incoming signal is of the same resolution as the native resolution.

4.1.17 Passive Matrix LCD
This is the older type of LCD, and is still used in smaller displays. Here, the liquid crystals making up the display are addressed by their row and column number, and each row and column has a single controlling circuit. This form of addressing doesn’t allow
fast responses, and this is most noticeable in large screens, where it manifests as the ghosting effect.

After Active Matrix LCDs were invented, this technology began to be referred to as Passive Matrix.

**4.1.18 Pixels**

“Pixel” is a contraction of PICture ELeagent, and it refers to the smallest unit on a display medium that can be independently manipulated. In colour displays, a pixel is usually made up of sub-pixels / subelements for each of the colours Red, Green, and Blue.

**4.1.19 Plasma Technology**

Plasma is ionised gas. Displays made using Plasma technology use three sealed cells, each containing phosphor elements and plasma, to represent a pixel. The plasma sealed in the cells is usually derived from the gases Xeon or Neon. The phosphor elements in each of the three cells are either of the three colours Red, Green, and Blue. When an electric charge is passed through a cell, it excites the plasma, which causes the phosphor in that cell to light up. The combination of the three colour cells make up the colour of the pixel. Like in an LCD, displays based on Plasma technology have a native resolution.

**4.1.20 RGB**

RGB refers to the display scheme that identifies a colour based on the strength of each of the constituent colours Red, Green, and Blue. In digital systems, each of these colours is allocated 8 bits, and so can have 256 possible values. The RGB system, therefore, is a 24-bit colour code with about 16 million possible colour combinations. Video recording devices capture data in RGB format, but since transmitting in RGB format is bandwidth-intensive, the signal is compressed (with loss of quality) to other formats like Component, Composite, or S-video.

**4.1.21 Rear-projection TV**

Such TVs employ a projector placed inside the TV to project the video image onto the screen in front. By increasing the distance
between the screen and the projector, it is possible to increase the video size without significant additional expenditure. The projector used can be of the CRT, LCD, or DLP type.

4.1.22 Refresh Rate
In a CRT display, the refresh rate is the number of times per second that the electron beam scans through the screen. Since the beam travels row-wise from the top to the bottom, CRT displays have two refresh rates associated. The Horizontal Refresh Rate is the number of rows scanned by the beam per second. This is usually in the order of Kilohertz and is of not much importance. The Vertical Refresh Rate is the number of times all the rows in the screen are refreshed, and this is in the range of 50 to 150 Hertz. Normal references to “refresh rate” are to the Vertical Refresh Rate.

4.1.23 Resolution
The total number of pixels that make up a display is its resolution; it is normally denoted as the number of pixels on the horizontal axis and on the vertical axis. A screen with 1024 x 768 resolution has 768 rows of pixels with each row having 1024 pixels.

4.1.24 Response time
In LCDs, since the source of light is always on, the concept of refreshing is not applicable. Response time refers to the time it takes the liquid crystal to change shape. Since changing the shape also changes the light passing to the screen, response time is defined in two alternative ways. Black-to-black response time refers to the time it takes the liquid crystal to switch from a shape that allows no light to pass (black) to a shape that allows all light to pass (white) and revert. Grey-to-grey response time refers to the time it takes the liquid crystal to switch from any arbitrary shape to any other arbitrary shape, making a pixel change colour from one shade of grey to another. There is no common pair of shades of grey that is used by all manufacturers. Response time is usually mentioned in milliseconds.

Response time is an important factor that influences the display’s performance when dealing with fast-moving images. If the
response time is greater than 16 milliseconds, there will, typically, be blurring and ghosting effects visible.

4.1.25 S-video
This form of video connection carries the display data over two channels, the Luminance and Chrominance. The Luminance channel carries the same information as the one in Component video, while the Chrominance channel contains the combined data of the Pb and Pr channels of Component video. This offers better video quality than Composite video. S-video connections are present on graphics cards and DVD players, for example.

4.1.26 Shadow Mask
This refers to the fine mesh laid over the phosphor elements on a CRT screen. The mesh ensures that the electron beam only strikes the intended phosphor element. This enhances contrast in the image.

4.1.27 Viewing angle
Two types of viewing angles are referred to: Vertical And Horizontal. These refer to the maximum angle from which the contents on the screen can be viewed, with a contrast ratio of up to 10:1. CRT monitors offer the largest viewing angles—about 170 degrees. In LCD screens, except for the latest ones, the most common viewing angles are in the range of 120 degrees.
4.2 Graphics Cards

“Graphics cards” refers to expansion cards that contain additional hardware to ease the computational load on the CPU when dealing with graphics data. Graphics cards contain two important components, the GPU and the Frame Buffer.

4.2.1 AGP
Accelerated Graphics Port is a type of expansion slot dedicated for the use of graphics cards. The maximum bandwidth offered is 2133 Megabytes per second.

4.2.2 Graphics Aperture
Some part of the system RAM can be reserved for use by the graphics card to store data that exceeds its Frame Buffer. This is called the Graphics Aperture, or just Aperture. This value is set in the system BIOS.

4.2.3 Alpha Blending
This refers to the process by which information in the alpha channel is included with the colour characteristics of a pixel. The alpha channel carries information related to the transparency of the pixel, and is an 8-bit code capable of displaying 256 levels of transparency. A 32-bit colour scheme includes 8 bits of information for the Red, Green, Blue, and Alpha channels.

4.2.4 Anisotropic Filtering (AF)
The most advanced form of texture filtering (explained later), it works in conjunction with bilinear and trilinear filtering to correct artefacts from a larger perspective. Since the user’s view reveals object surfaces in different shapes—for example, a rectangular ceiling appears as a trapezoid—texture filtering has to ensure an even transition of the texture laid on this shape, and not the original shape of the object. Anisotropic Filtering ensures that bilinear and trilinear filtering achieves the correct transition effects by changing the sampling pattern based on the user’s perspective. AF can also be denoted by the number of samples taken, like AF 8X.
4.2.5 Anti-Aliasing (AA)
Aliasing refers to the jagged edges seen on slanting lines in any rendered image. Anti-Aliasing is the process of removing or reducing the effects of Aliasing. AA achieves smoother lines by taking a sample of the pixels around the point and using this information to fill the jagged edges. The process can take different forms, like FSAA or Full Screen Anti Aliasing, where all the pixels on the screen are sampled before making remedial modifications to the image. FSAA can also offer better result if more samples were taken. Depending on the number of samples taken, AA is denoted as 2X (2 samples), 4X, 8X, and 16X. Needless to say, taking these samples requires processing power, and usually the higher sample rates are achieved only by powerful graphics cards.

4.2.6 Artefacts
Artefacts are the defects that appear in a display. They are usually the result of bottlenecks in the system rather than defects in the display unit. Jagged edges and pixelated images are examples of artefacts.

4.2.7 Bilinear Filtering
To smoothen the texture at a particular point, a sample of values of the texels around the point is taken. This process is called Bilinear Filtering, and is used to arrive at values within one mipmap.

4.2.8 Bump Mapping
A bump map is a set of values that contain information about the elevation of points on an object’s surface. After a texture has been mapped, to increase realism, its surface can be modified according to the values in the bump map. This process is called bump mapping.

4.2.9 Core clock
This refers to the operating frequency of the GPU of the graphics card. Like a CPU, the GPU, too, can be overclocked.
4.2.10 DirectX
A graphics programming API proprietary to Microsoft. Games based on DirectX can only be played on a Microsoft OS. DirectX 10 is the latest version of this API. To be able to experience software written in DirectX 10, one requires Microsoft’s latest OS (Windows Vista) and a DirectX 10 compatible graphics card.

4.2.11 Dual Display
This is a feature of graphics cards that can power two monitors at the same time. In the case of analogue monitors, the graphics card will require two RAMDACs. In case of LCD monitors, two DVI ports are needed. The output image can be split across these monitors, creating one large image.

4.2.12 FPS
A Frame is a static image created by rendering. To give an illusion of motion, many frames are constantly rendered. Frames per second (fps) is a measure of the rendering speed. A higher frames-per-second rate of rendering ensures (an illusion of) smoother movement. This is also a measure of the computational abilities of a graphics card.

4.2.13 Frame Buffer
A buffer is a temporary storage area. The Frame Buffer refers to the RAM on the graphics card that is used to store the frames that have already been rendered by the GPU.

4.2.14 GPGPU
General Purpose GPUs refer to those GPUs that can also be used to perform non-graphics work. GPUs have increased in computational prowess to such an extent that they are capable of overtaking most CPUs in their ability to manage numerical—specifically decimal—data, which forms the bulk of graphics data that they are specially designed for. The GPGPU concept seeks to utilise this power of the GPU to perform general tasks that are heavy on number crunching, like weather simulations and space data manipulation. The fact that newer cards are increasingly programmable, allowing the developer to use them for custom purposes, helps the cause.
4.2.15 GPU

The Graphical Processing Unit is the computing core of a graphics card. These chips are designed to perform computations on graphical data much more efficiently than can CPUs. Modern GPUs are more complex than CPUs, if transistor count be considered. One of the fastest GPUs today, the GeForce 8800 GTX, has 754 million transistors, while the fastest CPU, the quad-core Intel Core 2 Quad, has 820 million transistors (including the 24 MB of L2 cache memory). GPUs can be subdivided into different areas specialising in a particular operation. The major sub-units are the Stream Processors, TMU, and ROP. Newer GPUs are released quicker than CPUs. The major manufacturers of GPUs are NVIDIA (the makers of the GeForce series) and ATI (the makers of the Radeon series).

Here are the features of a few GPUs:

<table>
<thead>
<tr>
<th>GPUs Compared</th>
<th>Transistor count (million)</th>
<th>Core Clock</th>
<th>RAM Clock</th>
<th>Memory Bus Width</th>
<th>Stream Processors</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeForce 8800 GT</td>
<td>754</td>
<td>600 MHz</td>
<td>1.8 GHz</td>
<td>256 bit</td>
<td>112</td>
</tr>
<tr>
<td>GeForce 8600 GTS</td>
<td>289</td>
<td>675 MHz</td>
<td>2.0 GHz</td>
<td>128 bit</td>
<td>32</td>
</tr>
<tr>
<td>Radeon HD 2600 PRO</td>
<td>390</td>
<td>600 MHz</td>
<td>1.0 GHz</td>
<td>128 bit</td>
<td>128</td>
</tr>
<tr>
<td>Radeon 3850</td>
<td>666</td>
<td>670 MHz</td>
<td>1.66 GHz</td>
<td>256 bit</td>
<td>320</td>
</tr>
</tbody>
</table>

4.2.16 Graphics Memory

Memory types used as system RAM can also be used for graphics cards in most cases. But high-end cards require memory faster than system RAM. GDDR2 was the first such special-purpose RAM used for graphics cards. The technology behind GDDR2 was different from that which powered DDR2, which was later introduced as
system RAM. GDDR3, a creation of ATI, seen in many present graphics cards, uses a technology distinct from that of DDR3, which is used in high-end computers. The latest graphics cards using GDDR4 also have a presence in the market.

4.2.17 HDR
High Dynamic Range is a relatively new display concept, only implemented in the latest GPUs. It refers to the range of lighting in which the detail of an image is preserved. Normally, visual elements that are too dark or too bright, for example areas that are overshadowed, are not displayed with the same amount of detail as well-lit areas. Doing so saves resources since in any case the detail in these areas are not noticeable to the eye. But in HDR mode, even these details become noticeable. Rendering in HDR requires higher computational power, which has become possible with the latest graphics cards.

4.2.18 Memory Bus Width
The width of the pathway between the Graphics RAM and the core is called the Memory Bus Width. The wider the pathway, the faster the data can be processed.

4.2.19 Memory Clock
This refers to the operating frequency of the graphics RAM on the graphics card. Depending on the type of RAM used, the effective and actual frequencies vary. In case of DDR2 and GDDR3 RAM, the effective speeds are twice the actual speeds, since the RAM outputs data twice during every clock cycle.

4.2.20 Mipmapping
This refers to the use of images of differing resolutions depending on the perspective distance between the user and the object in a graphical scene. At close range, the image is used at high resolution to reveal all detail, but as the distance increases, since detail is no longer important, a low-resolution version of the image is used. Doing so saves on resources and doesn’t affect the visual quality of the creation. A mipmap is a table that contains the different versions of the various images used in the scene.
4.2.21 PCIE
Peripheral Component Interconnect Express is the latest expansion slot type suitable for graphics cards. The slot commonly used for graphics cards has 16 lanes, each carrying data at 250 Megabytes per second in one direction.

4.2.22 Polygons
Modern computer graphics define a polygon as the smallest unit of an image. Any point in 3D space is called a vertex. A polygon is any shape that can be defined by its vertices. The simplest polygon is a triangle, defined by three vertices.

4.2.23 Rendering
This refers to the process of converting a model into an image. A model is a wire-frame representation of an object, which can have other properties associated with it, like texture and lighting information. While rendering, all this information is applied to the model to create the final picture, usually called a frame.

4.2.24 RAMDAC
Random Access Memory Digital to Analogue Converters are the chips the are responsible for converting the digital data that is generated from the GPU into analogue signals that can be output on analogue monitors (like CRTs). Since LCD monitors are digital in nature, RAMDACs are bypassed when signals are directed to the DVI port on a graphics card.

4.2.25 ROP
The Raster Operations Unit is the component of a GPU that lends the final touch to the data before it is output to the screen. Operations like Anti-Aliasing are done by the ROP. Data to be sent to an LCD monitor is directed to the DVI outputs. If
the data is to be sent to a CRT monitor, the ROP sends the data to the RAMDAC.

### 4.2.26 SBA

Side Band Addressing refers to use of the additional channels incorporated by the AGP bus. Besides the 32-bit bus, the AGP specifications created an additional 8-bit address bus, called the Side Band, for transfer of data requests. Using this channel, the 32-bit bus could be freed, thus improving data transfers.

### 4.2.27 SLI / CrossFire

Scalable Link Interface is a mechanism that allows the performance of two or more graphics cards plugged into PCI Express slots to be combined. It was created by graphics card manufacturer NVIDIA to work with NVIDIA graphics cards only. CrossFire is a similar technology launched by ATI (later taken over by AMD) that works only with their graphics cards. For SLI / CrossFire to work, the graphics cards must be of the same type, and the motherboard should support the technology, besides having two PCIE X16 slots. The graphics cards are connected via a special cable called a Bridge Connector (though CrossFire models connect through the PCIE bus or one of the cards should be a CrossFire edition card). In SLI mode, one of the cards acts as a master, and the output is available only through it. The graphics load is distributed in two ways. In Split Frame Rendering, the display area is divided into two halves horizontally, with each card responsible for one half; in Alternate Frame Rendering, each card renders every alternate frame.
4.2.28 Stream Processors
These refer to the Arithmetic and Logical Units (ALU) of the GPU which act on the shading instructions. These are called Stream Processors. In earlier GPUs (prior to the GeForce 8XXX series and the ATI 2XXX series), stream processors existed separately as Vertex Shaders and Pixel Shaders. Stream processors are completely programmable and can be used for either of the shading jobs. These can operate at a different clock speed from the other components of the GPU.

4.2.29 Texels
A TEXture ELement is the smallest unit of a texture image. The size of the final texture and the number of texels that are needed to create it are influenced by texture-filtering procedures.

4.2.30 Texture Filtering
A process to ensure a smooth transition between areas using the same texture but with different resolutions. Its role is similar to that of Anti-Aliasing to ensure smoother slanting lines. Oft-used texture filtering procedures include Bilinear, Trilinear, or Anisotropic Filtering.

4.2.31 Texture Mapping
This refers to the process of applying an image that represents the texture / surface of an object to the model of the object. The model usually consists of lines, and is called a wireframe.

4.2.32 TMU
Texture Mapping Units are those components that are responsible for correctly orienting texture units to objects in the scene.

4.2.33 Trilinear Filtering
When transitioning from one mipmap to another, the differences in them can be obvious. Trilinear filtering works similar to bilinear filtering, except it takes samples from both mipmaps to smoothen out the intervening edges.
4.2.34 V-Sync
Vertical Synchronisation refers to the limiting of the graphics card’s rendering rate to match the vertical refresh rate of the monitor.

4.2.35 Vertex
Any point in a 3D space is called a vertex, and can be defined by its coordinates on the X, Y, and Z axes.

4.2.36 VIVO
Video In / Video Out refers to the ability of a graphics card accept various video inputs like Component, Composite, or S-video, and also send out its signals to external devices through these connections. This feature is available in graphics cards that also provide video capture functionality through additional hardware. Incoming video can be recorded by the graphics card and stored to the hard disk, while the video-out function allows signals to be displayed on larger screens like a TV set, which is preferable when watching videos. The GPU does not play a role in video capture.

4.2.37 Workstation Graphics Cards
This term refers to those cards that are specially tailored for use in Workstations—computers used for pursuits like Computer Aided Design and Video Editing. Internally, they are based on the same architecture as their Desktop counterparts. ATI and NVIDIA have workstation graphics cards under the brand names FireGL and Quadro respectively.

4.2.38 Z Buffer
In a 3D scene, objects that are close to the viewer block objects behind them. From a computational point of view, both objects have the same X and Y coordinates of the screen, but differ in the Z coordinate, which represents depth. A Z buffer is the storage area where objects that have a greater Z axis value (and hence are not in view) are stored. This makes it easier to reproduce them when a perspective change requires that object to be displayed.
4.3 Speakers and Headphones

Briefly, speakers are devices that recreate a sound by converting electric signals into vibrations in the air with the use of an elastic diaphragm. The vibrations are translated into sound by the human ear. The human ear is capable of distinguishing vibrations ranging from 20 Hz to 20000 Hz. (1 Hertz (Hz) denotes one vibration per second).

4.3.1 Channels
A sound source can be recorded with many devices, and the stream recorded by each device is called a channel. Single-channel sound is called Mono, whereas two-channel sound (one each for the left and right sides) is called Stereo. Stereo playback creates a sense of space and direction due to the differences in the playback from each channel. A playback with five or more channels (4.1) is called multichannel.

4.3.3 Frequency Response
The range of frequencies that can be reproduced by the speaker is its frequency response. In actuality, no single speaker can cover the entire audible range of the human ear.

4.3.4 Multiway Speakers
A multiway speaker contains more than one type of driver in the same enclosure. Depending on the number of types of drivers in a speaker, the speaker can be classified as 2-way (2 drivers in the same enclosure), 3-way, etc. The different driver types—tweeter, midrange, woofer, full range—cover the entire audio spectrum.

4.3.5 PMPO
Peak Music Power Output is the maximum output capacity of a speaker. There is no standard procedure to calculate PMPO, and since this value cannot be sustained by the speaker for more than a brief period of time, it is not a reliable measure of the speaker’s capabilities.
4.3.6 RMS
Root Mean Square is the average power output rating of a speaker, and is considered a more accurate indicator of a speaker’s capability than PMPO. The total RMS of a system will be the sum of the RMS of all speakers in the system.

4.3.7 Amplifier
This is the circuitry that amplifies (increases) weak electrical signals so that they can be output through larger speakers. Most headphones do not have amplifiers and rely on the amplifier of the sound card to generate the sound. Larger speakers have their own amplifiers since the sound card doesn’t have adequate power.

4.3.8 Satellites
In any multichannel speaker system, the small speakers that offer directional audio are called the satellites. These are usually placed around the listener.

4.3.9 SNR
Signal to Noise Ratio is the difference between the sound played back and the accompanying noise created by equipment interference. It is an indicator of the quality of components used in the speaker system, since higher-quality components tend to cause less interference. It is expressed in decibels, and the greater the SNR, the less the adulteration by noise.
4.3.10 Speaker systems
Stereo speaker systems consist of two speakers, one for each sound channel. A 2.1 system denotes two satellites and one woofer unit. Satellites can be added to the system to create a 4.1 system, consisting of two satellites each in the front and back. A 5.1 system adds a centre speaker in the front to the 4.1 system. A 6.1 system adds a central back satellite to the 5.1 system. A 7.1 system adds two speakers at the same level as the listener to the 5.1 setup.

4.3.11 Speaker driver
The vibrating core of the speaker. This usually involves a diaphragm connected to a voice coil elastically suspended between magnets. When electrical impulses are passed through the voice coil, it is magnetised; the resulting interaction with the surrounding magnet causes the diaphragm to vibrate, which is interpreted as sound.

4.3.12 Tweeters
Speakers good at reproducing high-frequency sounds.

4.3.13 Woofer / Subwoofer
Speakers that can reproduce low-frequency sounds well. In any speaker setup, the “.1” represents the subwoofer.

4.3.14 Mid-range Speaker
Speakers that are best at reproducing frequencies in the 300 Hz to 5 kHz range.

4.3.15 Full-range Speakers
Speakers that can create sounds of almost all frequencies in the audible spectrum. Most affordable stereo speakers that contain just one driver fall in this category. Audio quality is compromised at both ends of the spectrum by such speakers.
4.3.16 Treble
This refers to the higher audible frequencies in sound, typically music.

4.3.17 Bass
This refers to the lower audible frequencies in sound, typically music.

4.3.18 Graphic Equaliser
A device that can selectively filter and modify various frequencies of a sound track. This can be implemented in hardware, and you’ll have a set of pegs to be pushed up or down to change the intensity of the related frequency. In software, you’ll have sliders in the media player. Depending on the number of distinct frequency bands it can filter, there are 2-band, 5-band, etc. graphic equalisers.

4.3.19 LFE
Low Frequency Effects refer to the parts of the audio track with low frequencies, which are directed to the subwoofer. The frequency is usually below 120 Hz. The sound of a roll of thunder, for example, is a LFE.

4.3.20 Dolby
Refers to Dolby Laboratories, which conducts R&D on sound recording and reproduction. It doesn’t have audio products of its own; companies license Dolby technology to use it, along with the label, in their equipment. Dolby Digital uses a 5.1 speaker system
to create surround sound effects, and is commonly seen in consumer-grade speaker sets and sound cards. This technology is also called AC3, and is used in DVD video to deliver surround sound.

4.3.21 THX
Loosely speaking, this is a certification that the playback device bearing the logo is of superior quality. The scheme was the brainchild of *Star Wars* creator George Lucas, who wanted his audience to experience his movies exactly as he had created it. This led to the need to ensure that every theatre in which his movie was screened met with stringent audio and video playback standards. So a THX-certified theatre offers the highest movie-viewing quality. This certification was later extended to home theatre systems as well.

4.3.22 Intra-aural Headphones
These are in the form of earplugs that are meant to be inserted into the ear canal.

4.4.23 Circumaural Headphones
The largest of the headphone types, these have large foam-padded ear cups that surround the ears. They are capable of significantly damping ambient noise. The spacious ear-cups can also hold comparatively larger speakers, or even multiple speakers, which offers the greatest frequency response.

4.3.24 Supra-aural headphones
These headphones rest over the ear without enveloping them. They therefore allow ambient noise to interfere with sound reproduction.
4.3.25 Earphones
These are small hemisphere-shaped headphones that can be positioned right in front of the auditory canal. They sometimes also have a retaining extension that goes around the ear that prevents them from falling off.

4.3.26 Noise Cancellation
Sound is in the form of vibrations. If two vibrations of the same magnitude but inverse directions collide, they nullify. This is the idea behind the concept of Noise Cancellation. Two type of Noise Cancellation techniques are used. Active Noise Cancellation uses microphones placed on the outside of the headphones to detect ambient noise. This information is used to create sound waves opposite to the ambient sound, thus nullifying the ambient noise. An additional power source is needed to drive the microphone, and this is usually in the form a batteries fitted into each ear-cup. Passive Noise cancellation relies on blocking out ambient noise by ensuring a tighter fit between the ear and the speaker. This technique is better implemented in circumaural and intra-aural headphones.

4.3.27 Impedance
This is the load that a speaker puts on an amplifier. Speakers with low impedance can be operated without external power, while speakers with higher impedances need external power to work. Higher-impedance speakers produce louder, and typically better, sound.
4.4 Sound Cards

Sound cards are expansion cards with chips to process audio information. With modern motherboards carrying such circuitry onboard, most users do not feel the need for a dedicated sound card. Many onboard sound processors are capable of supporting even 8-channel surround sound. Sound cards are used by audiophiles not satisfied by onboard sound quality, and professionals who find the features offered by onboard sound limited.

4.4.1 ADC / DAC
The Analogue-to-Digital Converter (ADC) is responsible for converting the analogue signals received through the sound source into digital signals capable of being processed by the PC. The reverse process of converting digital signals into analogue signals to be passed on to the speakers is done by the Digital-to-Analogue Converter. The quality of the conversion is influenced by the Sampling rate and Bit rate.

4.4.2 Bit Resolution
This refers to the amount of data that is used to store information about every sample while sampling (converting from one format to another). The better the bit resolution, the greater the fidelity of the recorded sound. Bit resolution is usually expressed in bits.

4.4.3 Bit Rate
The product of the sampling rate and the bit resolution is the bit rate. For example, if a conversion process takes 44.1 kHz as the sampling rate and 8 bits as the bit resolution per channel, the bit rate for the converted sound in mono would be 44.1 Kilobytes per second, and stereo, 88.2 Kilobytes per second.

4.4.4 Codec
A Codec, short for Compressor-Decompressor, is an algorithm used to convert and play back audio in a specific format. Audio stored by a particular codec can only be played back if the codec exists on
the system. Popular audio codecs include MP3 (MPEG Layer 3), AAC, and WMA (Windows Media Audio).

4.4.5 Decibel
A measure of sound intensity, calculated as the logarithmic value of a ratio of sound intensities. The basis is considered to be the threshold of hearing for a normal human ear. Every other sound is expressed in decibels in relation to this base sound intensity. 0 dB represents the threshold of hearing, while 120 is the higher level that the human ear can tolerate without feeling pain.

4.4.6 Dynamic Range
This refers to the range of loudness of sounds that can be detected by a recording device or reproduced by a speaker. This is measured as the difference in the highest and lowest sound, in decibels. The human ear has a dynamic range of 120 dB. A high dynamic range of recording or playback is representative of high-quality equipment.

4.4.7 MIDI
Musical Instrument Digital Interface is the default interface to connect any digital musical instrument to a sound card. This allows data to be transferred across the sound card and the device, and allows recording of any composition to the system. Each MIDI port can connect to up to 16 compatible devices simultaneously, enabling a single PC to control these devices. MIDI uses a standard set of codes that conveys information about how to produce the sound—rather than the sound itself—so MIDI files are small compared to the audio file for the same content. Since a MIDI file relies on the sound card’s wavetable to create an output, the results may vary with the sound card. The 15 pin D-sub MIDI interface also doubles as a gameport to plug in compatible gamepads.

4.4.8 Mono
An audio stream that contains only a single data channel would be called Mono (for monaural).
4.4.9 Sampling Rate
The conversion of analogue signals into digital format involves taking samples of the sound track at regular intervals and converting this into digital data. The Sampling rate is the frequency of the sampling or the number of samples taken per second. The greater the samples taken, the lesser the data lost in the conversion. CD Audio uses a 44.1 KHz sampling rate, that is, 44,100 samples per second.

4.4.10 Stereo
An audio stream that contains two data channels of data, one each for the left and right perspective, would be called stereo.

4.4.11 Surround Sound
This refers to multichannel sound where there are at least four discrete sound channels, representing the front left, front right, back left and back right channels. Surround sound can also comprise a larger number of channels.

4.4.12 Wavetable Synthesis
A Wavetable refers to the set of sample sounds of different instruments stored on the sound card. The use of the Wavetable to create and store sounds is called Wavetable Synthesis. Since the contents of the Wavetable varies with sound card, the composition need not sound the same on all systems.

4.4.13 WAV
WAV is a file format for uncompressed audio data.

4.4.14 Virtual Surround
Normal surround systems employ at least four speakers to create a spatial effect. Modern sound cards can create a similar effect with two speakers using advanced algorithms that can process the multichannel audio source to identify the “spatialness” and create an approximation by altering the stereo output. This is called Virtual Surround. While the totality of the “surroundness” can be achieved, the fidelity that is achieved with surround speakers cannot be duplicated. The reverse of the process is also seen, wherein
a normal stereo sound source is processed and surround sound channels suited for a 4.1 or higher speaker system is generated.

4.5 Interfaces

Here are some of the interfaces seen commonly on computers and TVs.

4.5.1 Analogue / mini D-Sub 15 / VGA
This is the standard interface for analogue monitors. It has 15 sockets.

4.5.2 Audio
Audio connections are colour-coded with Green for speaker output, Red for Microphone input, and Blue for other line input.

4.5.3 Coaxial
This connector is usually seen in TV antenna cables.

4.5.4 DVI
Digital Video Interface is needed to connect digital monitors like LCDs. Three types of DVI connections exist: the DVI-A, which carries analogue signals only, the DVI-D, which carries digital signals only, and the DVI-I, which can carry both analogue and digital streams. DVD-I sockets are the most common.

4.5.5 HDMI
High Definition Media Interface; a connector required to view High Definition
video on supporting hardware. This port is needed to view HDCP (High Definition Content Protection) protected content. Unlike earlier devices, which required separate audio and video cables, HDMI carries both signals.

4.5.6 RJ 45 / LAN
This is the socket to connect a LAN cable (used for networking).

4.5.7 PCI
Peripheral Component Interconnect, a 32-bit bus for data transfer. Typically used to connect devices like sound cards.

4.5.1 PCIE
Motherboards usually carry two types of PCIE slots—PCIE X16 and PCIE X2.

4.5.8 PS/2 Mini Din
This is a six-pin socket used to connect PS/2-compatible mice and keyboards.

4.5.9 RCA
This is the standard connector used for video and audio output signals from standalone media players. RCA jacks are the preferred connector for Composite and Component audio / video signals.

4.5.10 S-Video Mini Din
The Mini Din socket is seen in many graphics cards; it allows the signal to be displayed on a
TV set. The S-Video standard port consists of a Mini Din connector with four pins / sockets. But is it common to find Mini Din connections with more sockets in some cards. The locations of the sockets are such that a 4-pin Mini Din plug for S-Video can still be fitted in such non-standard sockets.

Mini Din sockets / plugs are also used to carry power signals, and can be seen as power connectors in some devices like external drive bays.

4.5.11 SATA
Serial ATA is still only commonly seen on hard disks, though other devices like optical drives are also supported.

4.5.12 Serial
Its importance has declined after USB devices became abundant,. Presently, mostly used to connect devices like external modems.

4.5.13 USB
Abundant in every system, with up to 10 USB connections (not all of them are on the back panel) per motherboard.
Mobile phones, iPods, PDAs, laptops: we carry these on our person like modern beasts of burden. While it’s always good to know, it’s even more important to know the jargon and TLAs when it comes to personal devices!
5.1 Laptops

5.1.1 Active Matrix
This is a type of display technology used in laptop screens, and such displays are also known as Thin Film Transistor (TFT) displays. These displays are made up of OLED pixels deposited on a grid of transistors and capacitors. These transistors work as switches, enabling precise control of current flowing through the individual pixels. The response times in this type of screen are very low, meaning the pixels can be switched on and off very fast. This ensures that Active Matrix displays show sharp colours. They also consume comparatively less electricity.

5.1.2 Desktop Replacements
Such laptops are not generally carried around much; they serve as replacements for Desktop computers. They typically have screen sizes from 17 to 20 inches. They are not optimised for power savings, and have limited battery life.

5.1.3 Docking station
A laptop accessory used to add functionality like extra optical drives, USB ports, PC Card slots, and keyboard or mouse connectors. Depending on the model of laptop, they can be attached or removed from the docking station without being restarted. Docking stations bring one the best of both worlds—the mobility of laptops and the expansion possibilities of Desktops.
5.1.4 ExpressCard
This is a faster standard replacing the PC Card interface, and is used in newer laptops. It was introduced in 2003, and comes in two flavours—ExpressCard 34 and ExpressCard 54. The numbers represent the width of the cards in mm. Devices that use this interface to connect to laptops are about 2.5 times faster than the PC Card interfaces, considerably lighter, and consume less power. Peripherals that can be used in the ExpressCard slot include wireless modems, TV-Tuner cards, memory sticks, and wireless modems.

5.1.5 Mobile Processors
Processors used for laptops are built a little differently from their Desktop and server counterparts. For one, they need to consume less power, which is limited in a mobile platform. Cooling options in laptops are limited: this requires the CPU to emit as little heat as possible. The two main CPU manufacturers, AMD and Intel, both have a slew of products for the mobile segment. These processors range from single cores in older models to quad cores in newer ones. AMD’s mobile processor range includes products like the dual-core Turion 64 X2 and Athlon 64 X2, and the single core Mobile Sempron, Mobile Athlon 64, and Turion 64. Intel markets mobile platforms under the name of Centrino, which collectively includes the processor, chipset, and wireless network adapter. Processors used in the Centrino platform are Pentium M, Core Solo, Core Duo, and Core 2 Duo. The Centrino
platform has seen several implementations, like Carmel (2003), Sonoma (2005), Napa (2006), Santa Rosa (2007), and the proposed Montevina (2008) and Calpella (2009).

**5.1.6 Passive Matrix**
This is a screen technology used in older laptops. Here, the individual pixels are still referred to by row and column addresses, but the amount of electricity flowing through individual pixels cannot be strictly controlled. This results in dull displays—effectively, pixels in a region of the screen can be manipulated, instead of single pixels. Additionally, response times are slower, resulting in dull colours and low contrast. Some passive matrix based screens are HPA (High Performance Addressing), STN (Super Twisted Nematic), and DSTN (Double-layer STN).

**5.1.7 PC Card**
Originally known as PCMCIA, this is a standard used for connecting peripherals like modems, network cards, and hard disks to laptop computers. It is an IBM derived standard, which has been used with laptops since the 1990s. They are divided into three types- I, II, and III. Type I PC cards are used for attaching memory like Flash and SRAM. Type II is used for peripherals like modem and LAN cards, while Type III is used for connecting hard drives. The three types differ only in thickness; they are all 85.6 mm long and 54 mm wide. This standard is not as fast as other standards like USB 2.0 and ExpressCard, but is still in use because of robust support by manufacturers.

**5.1.8 PowerNow!**
This is AMD’s answer to Intel’s SpeedStep (see below). PowerNow! is integrated with Turion 64 X2, Mobile Sempron, Mobile Athlon 64, and Athlon XP-M. PowerNow! has more variations in settings
than does SpeedStep. The latest Linux kernel has support for PowerNow! as well.

5.1.9 SO-DIMM
Small Outline Dual Inline Memory Module. SO-DIMMs are smaller in size than DIMMs, and are used mainly in laptop computers and also in high-end printers and routers. There are four types of SO-DIMM, differentiated by the number of pins: 72, 100, 144, and 200. The performance parameters of SO-DIMMs are almost similar to those of DIMMs.

5.1.10 SpeedStep
A power management technology used in Intel’s Mobile Pentium processors. This utility allows software to change the frequency settings and core voltage of the processor depending upon the currently-running applications. Windows XP supports this feature natively, while older versions needed special drivers to enable it. Linux distros as well as Mac OS X also support SpeedStep. Enhanced SpeedStep is a more feature-rich version of the original technology; it enables up to five variations in speed and voltage settings, as opposed to SpeedStep’s low power mode and maximum power mode.

5.1.11 Touchpad
An input device for laptops, used to control the cursor using the motions of the user’s fingers. Also known as trackpads, they are also found in PDAs and some portable media players. Touchpads have buttons above or below them, which serve as the standard mouse buttons. Touchpads also allow the use of multiple fingers for functionalities like click-and-drag.
5.1.12 UMPC

“Ultra Mobile PC” is a category of small form factor PCs. The UMPC is a joint effort of companies like Microsoft, Intel, and Samsung. These systems have a 7-inch touchscreen and run standard operating systems like Windows XP or Linux. They feature a processor consuming low power (Intel Celeron M, Core Solo, or VIA C7-M). Typical specifications are 1 GB RAM, USB 2.0 ports, and hard disks ranging from 30 to 160 GB. Some UMPCs available in the market are the Nokia N800, Samsung Q1, OQO, and the Asus Eee PC.

5.1.13 Ultra-portables

Laptops with screen sizes of less than 12 inches and which weigh less than 3 kg (typically 1.4–2.3 kg) are called ultra-portables. They have smaller-sized keyboards, and are targeted at frequent travellers. These laptops are more expensive than regular models and have extensive power saving features. Most manufacturers have ultra-portables in their product lines.
5.2 Mobile Services And Standards

5.2.1 1G
This is the first-generation telecommunication standard for mobile phones. It was prevalent in the 1980s and early 1990s and used analogue radio signals. It has been almost phased out.

5.2.2 2G
Successor to 1G, the second-generation standards used digital radio signals. This meant that voice signals could be encoded and multiplexed, resulting in more data being squeezed over the airwaves. The voice quality improved considerably, and the kind of static heard on 1G networks is absent. The digital systems also emit lower power. Lower power means that the devices can be smaller, and that the towers become more inexpensive to set up and maintain.

2G networks comprise mainly TDMA and CDMA networks, depending on the type of multiplexing i.e. the way in which the multiple radio waves are combined into a single stream. TDMA standards can be further divided into GSM, iDEN, and more. Indian mobile networks are primarily 2G.

5.2.3 3G
Third-generation networks deliver faster data speeds over existing 2G networks and also more types of services like broadband access and video telephony. The typical data transfer rates over 3G networks are in the region of 5-10 Megabits per second. Depending on location, 3G networks use either the same spectrum as 2G (in the US) or a different spectrum (in Asia and Europe). 3G-enabled phones are prevalent mostly in Europe and parts of Asia like South Korea and Japan. 3G-derived technologies include HSPA (High Speed Packet Access), WCDMA (Wideband Code Division Multiple Access), and UMTS (Universal Mobile Telecommunication System).

5.2.4 4G
Fourth-generation wireless networks are intended to provide a solution where voice, data, and video can be accessed seamlessly
without any bottlenecks. To be implemented using the IP protocol stack, 4G networks will provide connection speeds ranging from 100 Mbps to 1 Gbps, with assured security, high quality, and low cost. These networks will interoperate with existing networks and deliver applications like real-time streaming video, HDTV, and high-volume data.

5.2.5 CDMA
Code Division Multiple Access is an alternative technology to GSM for 2G and 3G networks. In CDMA, voice signals are digitised, and the frequency of the transmitted signal is varied according to a predefined code. This signal can only be intercepted by a receiver whose frequency response is programmed to vary with the same code. Since there are trillions of frequency-shifting sequences, CDMA signals offer considerable privacy. These signals use the 800 MHz and 1.9 GHz bands. CDMA signals utilise more bandwidth compared to GSM signals because of the variations in frequency. CDMA handsets are typically locked by carriers, which means you cannot switch your carrier without changing your handset.

5.2.6 CSD
Circuit Switched Data is a form of data transmission developed for TDMA networks like GSM. In this system, time slots are used to deliver data at the rate of 9.6 Kilobits per second. A newer variant is High Speed CSD (HSCSD) which employs more time slots and efficient coding methods to deliver data at enhanced rates.

5.2.7 EV-DO
Evolution-Data Optimised is a 3G protocol for wireless data transmission used mostly for broadband Internet access. EV-DO uses CDMA to transmit data at speeds of 500 to 1000 Kilobits per second, and is not compatible with GSM networks. Where signal strength is strong, EVDO enables a zone of pervasive computing where multiple devices can seamlessly use high-speed Internet access. Its primary competitor is HSDPA, which allows simultaneous voice and data transmission.
5.2.8 GPRS
General Packet Radio Service is a data transfer method used with GSM networks. In this method, data is transferred in packets using the Internet Protocol (IP), rather than in streams. Data transfer rates for GPRS vary from 56 to 114 Kilobits per second. It is a step slower than the EDGE (Enhanced Data GSM Environment) protocol, which delivers data at maximum rates of 384 Kilobits per second. Apple’s iPhone is a GPRS / EDGE enabled device.

5.2.9 GSM
Global System for Mobile communications is a 2G mobile network technology and currently the most popular globally, with a market share of more than 80 per cent. It is used by about 700 operators in 214 countries, covering 29 per cent of the global population. In GSM, voice signals are digitised, then compressed, and sent along with two similar data streams in different time slots but the same frequency spectrum (900 MHz or 1800 MHz). This indicates that it uses TDMA (Time Division Multiple Access) to send data. GSM networks also offer a degree of data encryption.

5.2.10 HSPA
High Speed Packet Access is based on the UMTS protocol. It is divided into two standards: HSDPA (HS Downlink PA) and HSUPA (HS Uplink PA). HSDPA is also known as “3.5G” and has theoretical data transfer rates of 8 ~ 10 Megabits per second. Multimedia and streaming video is the primary focus of HSDPA networks. Most new high-end phones come with HSDPA services enabled, though very few carriers support these high speeds.

5.2.11 UMTS
Universal Mobile Telecommunication System is a 3G-based wireless communication technology for cell phones using WCDMA as the air interface. UMTS is also called 3GSM because the protocol was intended to succeed GSM networks, and also used the GSM infrastructure to connect.
5.2.12 WAP
Wireless Access Protocol is designed to enable Internet access from mobile phones. This is done by using a special browser called a WAP browser (Opera Mini, for example), a simplified form of the Desktop browser, and accessing Web sites written in WML (Wireless Markup Language). Though WAP was projected to provide full functionality for Web browsing in phones, the attempt has not been successful because of technical and design issues.

5.2.13 WCDMA
Wideband CDMA is a 3G standard for wireless data access and is designed to provide higher access speeds than the 2G GSM networks. WCDMA is used mostly in Europe and Asia (particularly Japan). It is called wideband because while CDMA transmits on one or more pairs of 1.25 MHz channels, WCDMA transmits data on a pair of 5 MHz channels.

5.3 Mobile Phones

5.3.1 Bands (Dual- / tri- / quad-band)
Mobile networks operate in different frequency ranges in different countries. When a phone is dual-band, it could, for example, work in the 800 MHz / 1900 MHz bands. Such phones are capable of operating in different countries and take advantage of roaming services.

5.3.2 IMEI
The International Mobile Equipment Identity number is a 14-digit number used for identifying GSM handsets. Each handset has its unique IMEI number and has no relation to the SIM. In case of theft, the handset can be banned from accessing the network using the IMEI number, irrespective of whether the SIM card has been changed or not. Various phone models have different key combinations for displaying the IMEI—check your phone manual for your key combination.
5.3.3 MMS
Multimedia Messaging Service is an extension of the commonly-used SMS, where audio, video, and rich text like animated icons can be transmitted. It can work with packet data services like GPRS and EV-DO. MMS services need to be enabled on handsets. It is not as mainstream as SMS because of challenges like incompatibilities between the sender’s and recipient’s phones, network problems, and handset configuration.

5.3.4 Palm
Palm is a proprietary embedded operating system for mobile devices. It runs on smartphones, GPS devices, handheld gaming consoles, etc. Palm supports touchscreen actions with stylus or fingers, handwriting recognition, wireless connectivity, and multimedia capability, among other features. The current version is Palm 5.4. Some devices using Palm OS are Treo and TX.

5.3.5 PDA
Personal digital assistants were originally small handheld computers used for tasks like receiving e-mail, working on spreadsheets, word processing, etc. Newer PDAs have music and video capabilities along with Wi-Fi and Bluetooth functionality, making them jacks-of-all-trades.

5.3.6 S60
This is the software platform for mobile phones that run on the Symbian Operating System (one of the OSes used on phones, apart from Windows Mobile). S60 has application libraries that support applications such as address books, music players, and camera software. S60 also enables development of applications based on
Java, Python, and C++. S60 was developed by Nokia and licensed to other companies. Other development platforms include BREW and Google’s new Android.

5.3.7 SIM

The Subscriber Identity Module is a stamp-sized smart card that stores subscriber information for GSM phones. Additionally, it stores user information like preferences, contact lists, security keys, and text messages. SIM cards enable the easy migration of user data across handsets and carriers.

5.3.8 Windows Mobile

Microsoft’s compact operating system for mobile devices like smartphones and PDAs. It is based on the Win32 API and has a basic set of functionalities. The latest version of Windows Mobile is 6. The features of the Windows Mobile OS include Office Mobile, Windows Media Player Mobile, QWERTY keyboard, and wireless support. Devices that run Windows Mobile include the HTC Touch.
5.4 Cameras

5.4.1 AiAF
Artificial Intelligence Auto Focus is Canon’s patented focusing technology, which dynamically selects one or more focussing points based on factors like subject position and motion. It also detects camera position, as in, the focus automatically changes if the camera is held horizontally or vertically.

5.4.2 Aperture
The iris-like structure that controls the amount of light falling on the lens. The aperture is measured in f-stops. This range varies from f/1.4 to f/22, where f is the focal length of the lens.

5.4.3 CCD (Charge Coupled Device)
A CCD is a light-sensitive integrated circuit. It stores colour information for every pixel as electric charge, whose intensity depends upon the position of the colour in the colour spectrum. The charge for each pixel is read at one corner of the sensor and converted from analogue to digital. CCDs are used in digital cameras as sensors because they are extremely sensitive to colour variations and create low noise.

5.4.4 CMOS (Complementary Metal-Oxide Semiconductor)
CMOS is a technology that finds use in, among other things, camera sensors. It is the main competitor to CCD as a sensor technology. Though more susceptible to noise and less sensitive, they consume much less power, and are improving year after year in terms of quality.

5.4.5 Digic
Digital Image Core, or Digic, is a processor at the heart of any digital camera. Introduced by Canon, the Digic processor removes noise from the electric signals generated when light falls on the image sensor. It removes false colours, reproduces natural colours, and can deliver high-quality video and images even in adverse conditions like subject motion and poor light. The latest version is Digic III.
5.4.6 File Formats
Digital cameras store photographs in memory either in the JPEG, TIFF, or RAW formats. The TIFF and RAW formats do not apply any compression while storing photos, while JPEG does. JPEG is more popular with camera manufacturers due to the comparative space savings over TIFF and RAW. However, compression causes loss of detail, and saving photos in JPEG is not a good idea if professional-quality photographs are what you want.

5.4.7 Frames
A single photographic exposure is called a frame. A more important parameter is frame-rate, which is the number of exposures a camera can make in one second, and is measured in frames per second (fps). Generally this comes into play while shooting video, and the higher the fps, generally, the higher is the quality of the video.

5.4.8 Histogram
A graphical representation of the light and dark elements in a photograph. Most digital cameras give one the option of viewing the histogram of a picture after it is shot. Photographs which are darker or underexposed have peaks on the left side, while overexposed photos have peaks on the right side. An evenly-distributed histogram means that the image has been properly exposed.

5.4.9 Image Stabilisation
A technique used in many cameras to minimise the effects of lens shake. This problem is particularly noticeable when a tripod or support is not used, or at low shutter speeds. Sensors inside the camera attempt to compensate for the vibrations that shaking cause by varying the path of the light rays to the sensor.

5.4.10 ISO
A standard for measuring light sensitivity. The lower the ISO, the lower is the sensitivity of the film or sensor to light. This means
that ISO 200 needs a lower exposure time or smaller aperture setting than ISO 100. Higher ISO settings are suitable for situations where the ambient light is low.

5.4.11 Lens
The lens is one of the most important and expensive parts of a camera, and often makes the difference between a great photograph and a photograph. A camera may use a single lens, or a combination of lenses, which might be attached to the camera body, or detachable. Lenses are of many types, depending on what is being shot. Macro lenses are used to shoot at very small distances; telephoto lenses are suitable for objects at large distances. Wide-angle lenses (like the fisheye lens) are used for situations that need a wider angle of vision. Another category is the zoom lens, whose focal length can be varied, and is most commonly seen in point-and-shoot digital cameras.

5.4.12 Macro
A mode of photography where the subject is very close to the lens. Modern digital cameras have a setting for macro photography.

5.4.13 Noise
Imperfection caused in the output from digital photos when the pixels are not sufficiently exposed to light. Too much noise makes the finished photograph look grainy. Noise can be reduced by the camera’s sensors, and also with the appropriate light settings.

5.4.14 Shooting modes
A camera needs different settings for shooting photographs in different scenarios. For example, shooting subjects at night needs a different aperture, ISO, flash settings, etc. than when shooting subjects at the beach in daylight. Typical preset shooting modes that modern digital cameras come with include Auto, Portrait, Night, Landscape, and Macro.

5.4.15 White balance
This is a setting that makes it possible for objects that appear white to the eye appear the same in photos, irrespective of the
lighting conditions (cloudy, dark, bright, filament light). White balance settings are important because other colours are reproduced in the photograph depending on the sensor’s perception of whiteness. Most digital cameras have automatic white balance settings, where the camera’s sensor tries to guess the brain’s perception of the colours currently seen.

5.4.16 Zoom (Optical / Digital)
Optical zoom is the amount by which a subject’s distance—as seen through the viewfinder—can be changed by changing the position of the lens. This is done manually or by using tiny electric motors. Digital zoom, on the other hand, is simulated by the sensor in the camera. In digital zoom, the camera crops part of the image and enlarges the remaining portion. This results in loss of detail. For cameras, the optical zoom figure is much more important than the digital zoom, which can be simulated in image editing software like Photoshop.
5.5 Connectivity

5.5.1 Bluetooth
A short-range (10 m-100 m) wireless connectivity standard used to connect a wide variety of devices like music players, mobile phones, digital cameras, and laptops over a secure network. It consumes low power and transfers data at rates of 1-3 Megabits per second. The latest Bluetooth version is v2.1, while the faster v3.0 is in the works.

Bluetooth works without user intervention—a Bluetooth-enabled device continuously sends out very low powered signals, and upon receiving a response from another compatible device, starts an auto identification process, which culminates in the transfer of data. Bluetooth is suitable for personal area networks (within a radius of about 10 metres) for controlling several devices seamlessly.

5.5.2 FireWire
A high-speed interface, whose development was initiated by Apple. It is also known as IEEE 1394 High Speed Serial Bus. It was meant to be a replacement for the parallel SCSI bus, and also to provide connectivity to audio and video equipment. Camcorders, memory and storage devices, professional audio systems, etc. come with FireWire interfaces, as do several laptops. The data transfer rates over FireWire interfaces at 400 Mbps is comparable to that of USB 2.0, but unlike USB 2.0, the data flow rates can be sustained over a longer period of time. However, FireWire is more expensive because of licensing issues, and so is not as common as USB.
5.5.3 Infrared
Infrared is a region of the electromagnetic spectrum whose frequency is longer than that of visible light. Infrared is used in portable devices as a means of transferring data wirelessly. This might seem like Bluetooth and Wi-Fi, but has several disadvantages—it is line-of-sight (the two devices may not be separated by obstacles like walls), has a low data transfer rate, and is shorter-ranged. Some mobile phones as well as wireless keyboard and mice used to come with infrared ports; these have been replaced with Bluetooth and/or Wi-Fi.

5.5.4 PictBridge
A camera industry standard. It uses USB and cables to transfer data to a printer from a camera without having to connect to a computer in between, so a picture can be directly printed. Most new cameras and printers support PictBridge.

5.5.6 Ultra Wideband
A radio technology used for short-range, high-bandwidth (larger than 500 MHz) communications. It consumes very low energy and is suitable for applications like wirelessly transferring media from camcorders or high-speed printers.

5.5.7 USB
Universal Serial Bus is an almost ubiquitous standard for connecting devices like mice, keyboard, joysticks, printers, scanners, card readers, etc. to computers without switching off the system. USB comes in two versions—1.1 and 2.0, while a 3.0 standard is under development. These standards are based on speed. USB 1.1 transfers data at 1.5 to 12 Megabits per second, while USB 2.0 transfers data at 480 Megabits per second. USB 3.0 is projected to transfer data at a maximum rate of 4.8 Gigabits per second. A computer can connect to a maximum of 127 USB devices directly or by using hubs.
USB connectors are of two types—the A connector and the B connector. Most devices come with their own USB cables and they use the A connector to connect to the computer. Devices that don’t have their own USB cables, like digital cameras, have a slot for the narrower B connector for connecting them to the computer.

There are other variants of USB connectors, like MiniUSB, MicroUSB, and Wireless USB. MicroUSB and MiniUSB are used in smaller devices like mobile phones, while Wireless USB is a short-range, high-bandwidth data transfer standard using USB’s radio platform. Wireless USB is used in game controllers, digital cameras, printers, scanners etc. It is also used for streaming video.

5.5.8 Wibree
A wireless standard developed by Nokia that is more energy-efficient than Bluetooth. Wibree transfers data at 1 Megabit per second, but consumes about a tenth of Bluetooth’s power. Wibree is proposed to be used as a replacement for Bluetooth in sports sensors, smart watches, and health monitors, where power supply is limited.
5.6 Portable Media Players

5.6.1 Audio Formats
All PMPs invariably support MP3 audio, so that music can be easily swapped from your computer to your PMP and back, as MP3 is one of the most popular formats with a huge volume of existing media. Other formats supported are Microsoft’s WMA and also the open source Ogg Vorbis. WMA reduces the size of MP3 files by almost a factor of two, but due its proprietary nature, costs could increase. Ogg is technically superior in terms of compression, but lack of availability of media can be a problem.

AAC (Advanced Audio Coding) is a lossy compression and coding scheme for audio, and is touted to be the successor to MP3. AAC delivers better quality than MP3 at the same bitrate. AAC is the standard format used on the iPod and the iTunes store, and in the PlayStation 3. Other music players that support AAC include the Creative Zen and Microsoft’s Zune.

5.6.2 Bitrate
The amount of data per second in a media file is known as the bitrate, and is expressed in kilobits per second (kbps). The higher the bitrate, the higher would be the quality, and more storage space would be needed. Bitrate can also be variable, in which the rate at which data is packed in is varied over time. This means that more data can be stored for complex segments of media files, while lesser data is stored in simpler segments.

5.6.3 Connectors
The main types of ports in a PMP are the audio-out ports, which are used to pipe music to speakers or headphones. Some PMPs offer a TV-out port, which lets you hook it up to a large screen. USB and Mini USB ports are standard offerings for transferring media, along with power ports. iPods have a FireWire port, which allows simultaneous charging and data transfer. The FireWire port can also be used to attach to external speakers and the ubiquitous iPod dock.
5.6.4 DRM
Digital Rights Management is the idea of controlling the playing of music across hardware. Music bought online is often digitally encoded so that it cannot be shared. DRM has faced a lot of criticism; one example of DRM is Apple’s FairPlay mechanism.

5.6.5 Equaliser
This is a tool that allows one to manually vary the emphasis on different frequency bands when an audio file is being played. Most playback software comes with equalisers. The most common use of the equaliser is to increase the bass, treble, and mid-range frequencies; those very particular about what they want their music to sound like might use all the sliders.

5.6.6 MP3 Players
MP3 players are the most widely-sold personal media players. They are called so because they primarily play MP3 audio files, though other formats like WMA are often supported.

5.6.7 SD
A type of postage-stamp-sized Flash memory storage used for extending the memory of PMPs, cameras, and phones.

5.6.8 Skip Protection
A technology used in music players to prevent music from playing irregularly when the player is jerkily moved. This was an important feature for CD and MiniDisc players because they contained moving parts, and the read heads could be easily shaken. Skip protection usually works by compressing data to a memory buffer and then reading from it. This might result in lower quality because of the data loss during compression and decompression, but the benefit is uninterrupted music. Hard drive based PMPs do employ this
technology, but it is not an issue in Flash-based devices because they have no moving parts.

5.6.9 Video Formats
MPEG-4 video is widely supported by personal media players like iPod and PSP. Windows Media Video (.wmv) is another supported format, while many manufacturers support DivX and XviD formats. There is not much difference between these video formats in terms of quality, though open formats like MPEG-4 and XviD will have lesser compatibility issues with hardware.
For every piece of hardware you encounter, there’s an abundance of software for it running amok. This chapter covers all the terms you’re likely to encounter while you use them.
6.1 Operating Systems

6.1.1 AIX
Advanced Interactive Executive, an operating system developed by IBM, which is based on the UNIX operating system. It is typically used by larger enterprises, financial institutions, banks, etc. where there is a critical need for robust security features and mission-critical sturdiness. However, over the years, both Windows and Linux have narrowed this gap considerably.

6.1.2 Linux
Born out of a geek’s inability to gain access to a freeware version of UNIX, the Linux operating system, developed by Linus Torvalds, is among the most popular operating systems after Windows. Based loosely on UNIX, Linux is an open source operating system. For those of you who are scandalised by the prices that Microsoft charges for its licenses, a free operating system like Linux may just be the ticket. While it may lack the glamour, razzle-dazzle, and spit and polish of Windows, it is a highly stable system that can do most computing tasks that you do in Windows without your being any the worse for it. There are many applications available for Linux, including replacements for Microsoft Office in the form of OpenOffice.

6.1.3 Mac OS
The Macintosh operating system from Apple Computer has been around since 1984, and was the first operating system to introduce the graphical user interface (GUI). Since then, it has been overtaken by Windows, even though Mac users are quick to defend it and say that the Mac OS is superior to Windows in...
every way. While this may be true, the Macintosh lost market share due to a number of factors, the primary one being that Apple insisted that it supply all the hardware and software for the Mac. Windows, on the other hand was available on any PC that supported the IBM PC standard. A combination of factors helped Microsoft gain market share while the Mac OS languished. Of late, there has been renewed interest in the Mac; more and more people have begun buying Macs again. In March 2001, Apple introduced a new version of the Mac called Mac OS X (pronounced Mac OS ten). This was a complete rewrite of the entire Macintosh operating system and based on the UNIX operating system core.

### 6.1.4 Operating System

The software that drives the computer. Over the years many operating systems have been born (many more have died!). Commonly referred to as the “OS”, the operating system is the software that communicates with the hardware and provides the environment for software applications to run. There are many different types of operating systems with some being created for a specific purpose. Popular examples of operating systems are Windows, Mac OS, Linux, UNIX and others. Even cell phones and PDAs have operating systems. Windows CE, Symbian OS and Palm OS are popular among handhelds and PDAs.

### 6.1.5 Shell

On UNIX and UNIX-like systems, the shell is the section of the operating system that interprets text commands for the computer to execute. It is a command-line interface which means that any commands have to be in text form only. The shell is just one layer above the operating system and hence is a very powerful tool that can be used to do things that would normally be difficult with a GUI. In the right hands, the shell can be used to do powerful tasks like modifying files and folders; conversely, in the wrong hands, it could be devastating for your system. The shell in Windows is the DOS prompt that is still available for die-hard command-line fans.
6.1.6 Solaris
A version of UNIX from Sun Microsystems, it is legendary for its industrial-strength robustness and reliability. Before the advent of Linux, Solaris used to be one of the most popular operating systems for organisations looking for mission-critical systems that would remain operational 24x7. It had, and still has to some extent, a strong following in banks, financial institutions, and telecommunication companies.

6.1.7 UNIX
It is an operating system that was developed in the 1960s and gained popularity in the 1970s. With the advent of the internet and the need for web servers UNIX and its variants gained a tremendous boost in popularity and even to date is one of the most popular operating systems to run web servers. Its popularity is not unfounded as it is one of the most stable and rugged operating systems. UNIX has many variants, the main one being Linux.

6.1.8 Windows
The default operating system for more than 90 per cent of computer users the world over, this operating system from Microsoft is what most of us use day in and day out. Since the days of Windows 3.1 when it really gained in popularity it has gone from strength to strength and since then we have had Windows 95, Windows 98, Windows Millennium Edition, Windows 2000 Professional, Windows XP Home and Professional, Windows Vista Home Basic, Windows Vista Home Premium and Windows Vista Ultimate. Windows 2000 Professional and its predecessor Windows NT was designed for business users which was later enhanced to Windows XP Professional. In Windows Vista Business, users have a choice of choosing either Vista Business or Vista Ultimate.
Enterprise. From Windows 3.1 to Windows Millennium Edition, the operating system was primarily based on the DOS system. From Windows XP the DOS technology used for the earlier operating systems was abandoned in favour of the more robust technology based on the Windows NT technology.

6.2 General Software Terms

6.2.1 AIFF
Audio Interchange File Format. An audio file format from Apple computer for storing high quality audio. This is similar to the Windows WAV (wave) audio format in both audio quality and size.

6.2.2 Alert Box
A window that pops up on your screen with warnings generated by any running application which has encountered a special condition, where you are required to be notified of the situation. An anti-virus program scanning your system, for example, would pop up an alert box if it found something harmful.

6.2.3 Application
This is a generic term for any software program that runs on the computer. Applications run within operating systems and as such cannot be used between different operating systems. That is, an application that runs in the Mac OS will not under normal circumstances run on a Windows or Linux system. There are exceptions to this rule but those are essentially feats of software engineering genius. Systems software is a special class of applications and as such should be considered to be different from applications themselves.

6.2.4 Boot
If you’ve ever been asked to boot up or reboot the computer and you were not exactly sure as to what they meant, here is the skinny on that! Booting the computer is nothing more than switching it on. It’s been derived from the word bootstrap which
was used at one time to help people put their boots on. Bootstrapping has passed into general usage from there and refers to the process of using something small to start something much bigger. Which is exactly what happens with a computer when it is switched on. When the computer is switched on, a small computer program will run a basic test on all the essential hardware to ensure that it is responding correctly, wake up the motherboard and hard disk and call the system files of the operating system as part of the boot process. The operating system will then take over from the boot file and load all the required system files and driver software for the hardware. Once all the required files are loaded through this process, known as the boot process, the operating system is ready for use.

6.2.5 Closed Source
A closed source system is one in which the source code cannot be accessed without the express permission of the owner of the software product. Much of the software these days is closed source and software companies charge a license fee for using their program. As compared to open source software, the license to the end user only permits usage of the software product and does not allow them to reverse engineer the product or derive the source code for the product.

6.2.6 Directory
Also known as a folder in Windows, a directory can contain other directories or files. Directories are used to help in organising the files on your computer so that it is easily remembered for later access. The structure of a directory is like a tree and as you move up the tree you will finally reach the root directory of the drive. The root directory will contain many directories, usually grouped according to functions. Some directories are created by the system and any modifications to the directory or its contents should be handled with extreme care. Other directories are created by application software where files necessary to its smooth operation are stored.
6.2.7 Drivers

All hardware have a corresponding software that enables it to talk to the operating system, and through the operating system to other application software and/or devices. For example, printer driver software enables the printer to communicate with the operating system. Hence, when another application wants to print, it will “ask” the operating system, which will in turn connect it to the printer using the printer driver.

6.2.8 Installer

This is a software program that installs applications and other software onto your computer system. A typical application program may require many specific supporting system files before it can run properly. Programmers use the installer software to package all these files together. Depending on the size of the application, this could be a single file containing all the required data to complete the installation of the application software. The primary goal of installer programs is to hide the complexity of the installation process and to reduce the entire process to a point and click operation that can be used by any person whose knowledge of computer systems is minimal.

6.2.9 Open Source

Generally, open source refers to applications whose source code is available for any one to see and modify in any way they please. In general practice, over the last thirty to forty years since the birth of the software industry, software code has been considered to be the property of the organisation who designed the software, and anyone who used it was required to pay a license fee for using the software. In the early 1970s, Richard Stallman, a researcher at the Massachusetts Institute of Technology, took an ideological stand against the use of proprietary software declaring that the right to read and modify the source code is a fundamental right and that software should be open and free: “Free as in free speech, not free beer.” He came up with the General Public License (GPL) for open source software. The GPL essentially states that anyone who receives a copy of any software covered
under the GPL simultaneously receives the entire rights to read or modify the source code. The giver may decide to either give the software with the source code for free (as in “free beer”) or need that the recipient pay some fee. In either case, the giver has no right to restrict access to the source code. One of the most striking examples of the open source movement is the development of the Linux operating system. This was an open collaborative effort that saw a full-fledged operating system evolve out of a computer science student’s hobby.

6.2.10 Proprietary Systems
See Closed Source.

6.2.11 Systems Software
In addition to the core files that make up the operating system, there are a number of files and programs that are considered “part” of the operating system. These include software libraries of functions, system services, printer drivers, and other hardware, system preferences and configuration files—and much more. In contrast to applications, users have less choice as to what parts of the systems software should be installed. In general, systems software act as the first line of communication between the hardware and the software.

6.3 Programming

6.3.1 ActiveX
A technology from Microsoft used to view Desktop applications as Web content. For example, using ActiveX, you can view MS Word documents or Excel spreadsheets in your Web browser.

6.3.2 Array
Programmers sink their teeth into arrays when they need to organise data such that a related set of values can be easily sorted and searched. An array is essentially a data structure that contains a group of elements. Usually, the elements in the array are of the
same data type, such as integers, strings, characters, etc. Using arrays makes much more efficient use of memory than would have been the case if each value in the result had been assigned its own variable.

**6.3.3 ASP**
Active Server Pages. A Microsoft technology, ASP is a scripted language that is processed by the Web server when a user accesses the Web page. ASP pages can be quickly identified by their extension .asp, or .aspx, the more recent version of ASP. Like other scripting languages used on the Web, the primary aim of ASP is to be able to handle dynamic content, frequently-changing information, and accessing other information systems like databases. ASP is based on the Visual Basic programming language.

**6.3.4 ASP.Net**
This is a collection of Web development tools from Microsoft that includes software development programs like Visual Studio.NET and Visual Web Developer. These tools help programmers create dynamic Web sites by using a visual interface and using methods like drag and drop. Often looked on as the next “version” of ASP (Active Server Pages) technology, ASP.NET’s support is not limited to just Visual Basic.NET. It also supports Jscript.Net and open source languages like Python and Perl. ASP.NET is built on the .NET Framework. For an ASP.NET site to function properly, it should run on a Web server that supports ASP.NET. By far, the Web server that offers the best support for ASP.NET is the IIS (Internet Information Server) Web Server from Microsoft.

**6.3.5 BASIC**
Beginners All-Purpose Symbolic Instruction Code. Invented in the mid-1960s, BASIC was meant to be a programming language for beginners and students to quickly learn the concepts of programming. Since then, however, it has evolved into a robust language in its own right, and today there are versions of BASIC that are used to develop application software. The most widely-used version of BASIC is Visual Basic from Microsoft.
6.3.6 Batch File
This is a type of script used in Windows and DOS to automate certain tasks. It is essentially a series of instructions that are executed in sequence, and can either be invoked by the user or by a software program, or even when the computer starts up. Similar tasks in other operating systems like the Macintosh OS and UNIX are accomplished by AppleScript and shell commands respectively. See also: Script.

6.3.7 Batch Process
The process of executing a series of instructions in a batch file is known as a batch process. Typically, the batch process is used to execute repeatable tasks that can be tedious to do manually. For example, if you need to copy a particular folder to a backup drive at the end of the day, you would write a batch file with the necessary instructions, and the system would initiate a batch process to copy the files at the end of the day. The execution of the batch process is not limited to just Windows batch files. Any automated task that is set up to run can be considered as a batch process. This could be accomplished by an appropriate scripting language on any operating system. See also: Batch File, Script.

6.3.8 Binary
We normally write numbers in the Base 10 numerical system. Computer processors, however, can recognise only the on or off state of the transistors in the chip. This leads to the need for a compatible system of numerical notation. The binary system is a two-digit numerical system, or a Base 2 system, comprising 1 and 0 (zero). This is much easier for computer systems to manipulate, as the on and off states are easily represented as 1 or 0. And a combination of on and off switches would be the equivalent of a number, a letter, or any other character or group of characters. The number 110 (one-one-zero), for example, is the binary form of the base 10 number 6.

6.3.9 Boolean
To determine if a statement is True or False, computers use Boolean operators. There are four main Boolean operators: AND, NOT, OR,
and XOR. These logical operators are used together in complex ways to determine if a particular condition is True or False. Examples:

- \(x \text{ AND } y\) returns the value True if the condition is true for both \(x\) and \(y\) or else it returns False
- \(\neg x\) returns the value True if \(x\) is false (or null) and False if \(x\) is true
- \(x \text{ OR } y\) returns the value True if either or both \(x\) and \(y\) are true. It only returns false if both \(x\) and \(y\) are False for the given condition
- \(x \text{ XOR } y\) returns the value True only if either \(x\) or \(y\) are true. If both \(x\) and \(y\) are true then it will return the value False.

Using Boolean operators is not restricted to computer programming. End-users also use Boolean expressions when they need to filter results in a search engine window. For example, the Boolean expression “computers AND hardware NOT memory” when used in a search engine will return all pages containing the words “computers” and “hardware” while excluding all pages containing the word “memory”.

**6.3.10 C/C++**

As programming languages go, C and C++ (pronounced C plus plus) are among the older languages that are still going strong. C was originally developed in the mid 1970s, and was primarily used to write programs for the UNIX operating system. Since then, its use has expanded, and nowadays it is used to write applications for nearly every available system. Those working on embedded technologies and hardware interfaces are particularly enamoured by C due to its flexibility and efficient use of memory. C++ is an offshoot of the C language with almost identical syntax. The main improvement that C++ has over C is that it supports object-oriented features that allow programmers great leaps in productivity and efficiency.

**6.3.11 Character**

Any number, alphabetical character, symbol, or punctuation mark is a character. A computer assigns one byte for each character.
6.3.12 Data Type
Computers store data in variables. Each variable will be of a pre-defined type. These types, or data types as they are more popularly known, include integers, floating point numbers, characters, strings, and arrays. Other data types include such things as date, timestamps, Boolean values, and varchar (variable character) formats. Some languages are more flexible and do not require that you explicitly assign a data type to each variable, and will assume the data type from the first value assigned to the variable. This has both advantages and disadvantages. Data types are also an integral part of database applications. Fields within a database should normally be assigned to a specific data type.

6.3.13 Debugging
The process of correcting the errors (or “bugs”) in a software program. Computer programs are long and complex pieces of code, and it is likely that there will be errors. A programmer has to go through the complete logic of the program and correct the errors to the maximum extent possible before releasing the software to end-users.

6.3.13 Debugger
A program that is used to trace errors in the code as programmers work on the program. It quickly identifies where exactly the errors (or bugs as they are called) are. The debugger will highlight the exact lines of code where problems are found. These bugs are usually related to errors in syntax representation in the programming language that’s being used. To find errors which are not obvious in the code and are errors more related to the logic of the algorithm used or related to interaction characteristics with the system, debuggers also support a step-by-step walk through of the program, which enable the programmer to see how the application reacts to each line of code and where the code breaks or the system crashes.

6.3.14 Floating Point
This is a data type that contains floating decimal points. Thus 37.001 is a floating point number, as compared to integers, which
do not have decimal places. When a calculation includes a number with decimal places, the computer treats it as a floating point number. Earlier computers used to have a separate processor to handle floating point calculations, but nowadays, this ability is integrated with the CPU.

6.3.15 IDE
Integrated Development Environment. Most programming languages have a text editor that will highlight the source code based on the syntax for the language, a compiler that will compile the software program for execution by the computer, and a debugger to debug the source code. In many instances, the three programs are separate from each other, and a software developer would need to open each program to accomplish the associated task. An IDE gives the developer a single development environment with the editor, compiler, and debugger built into a single software system. In addition, depending on the compiler, it may support more than one programming language, and also allow the developer to use visual development tools especially for user interface development. Examples of IDEs are Visual Studio and Eclipse.

6.3.16 Integer
One of the most commonly-used data types, integers are whole numbers that can be positive, negative, or zero. Integers are not fractions or decimal numbers. Thus if the result of dividing two integers produces a non-integer result, then the decimal numbers may either be rounded or truncated to produce the integer result.

6.3.17 Java
A step up from C and C++, Java is the programming language of choice for many Web and software developers. Very similar to C and C++ in its syntax, it is object oriented but structured around “classes” instead of “functions.” To quote Sun Microsystems, the developers of the Java language,
Java is a “simple, object-oriented, distributed, interpreted, robust, secure, architecture-neutral, portable, high-performance, multi-threaded, dynamic, buzzword-compliant, general-purpose programming language.”

**6.3.18 Javascript**
A scripting language with no relation to Java. Through some complicated convolutions of the politics of naming languages, Javascript inherited the Java prefix. Javascript is similar to other scripting languages in that the code is executed as soon as it is read and does not require to be compiled as with normal source code. However, there is one big, important difference between Javascript and the other scripts like PHP, ASP, and others: Javascript is not a server-side script, it is a client-side script. That is, the instructions in a Javascript file are executed by the user’s Web browser and not by the server.

**6.3.19 Macro**
A small program or script that is used to automate certain tasks. A macro is usually a series of instructions that is recorded for a specific application and may involve specific keystrokes or mouse movements. Applications like Word and Excel support macros for repetitive tasks.

**6.3.20 Null character**
This is a character that has all its bits set to zero, and hence has a numerical value of zero as well. It is used to represent the end of a string and helps programmers determine the length of the string. In databases and spreadsheet programs likes Excel, null characters are used as space fillers.

**6.3.21 Object-Oriented Programming**
This is a method of programming where data structures are treated as “objects” rather than as variables. The main advantage with object-oriented programming is that it enables the management of very large software projects which if coded procedurally would have been almost impossible to support or extend. By
having objects that interact with each other, the programmer is able to logically limit the problem to a specific subset, and needs to only ensure that the localised problem is dealt with—rather than having to pay attention to larger issues that are irrelevant in the context.

6.3.22 Perl
Practical Extraction and Report Language. It is a scripting language with a syntax similar to C/C++ and is mainly used by Web programmers to create scripts for Web servers. It is especially good at parsing text, so programmers often use it for reading and searching through text files.

6.3.23 PHP
Hypertext Preprocessor. You may find it difficult to imagine how the expansion and the acronym correlate, but you will, if you delve into the mysteries of computer languages, learn that it is a recursive acronym. Till such time, take it from us that PHP is indeed an acronym for Hypertext Preprocessor! PHP is an HTML embedded scripting language for the Web. Much of PHP’s syntax is borrowed from C, Java, and Perl, but it has its unique features and functions. When a user sends a request for a PHP page, the server reads the PHP script that is embedded in the Web page, and translates the output into an HTML page which is then returned to the user. Because users only see the HTML output and not the actual PHP code, PHP offers a higher level of security for accessing databases and other secure information. The aim of PHP is to allow developers to quickly and easily write code that can generate dynamic pages.
6.3.24 Script
A computer script is exactly the same as the source code of programs, but with one important exception. Application source code is generally compiled before it is executed; a script, however, does not need to be compiled, and can be directly executed by the scripting engine. There are many scripts like PHP, ASP, JSP, DOS, VBScript, AppleScript, and so on. Each script has a corresponding scripting engine capable of reading and executing the instructions in the script. See also Batch file.

6.3.25 Source Code
All programs are written in one or the other programming language. The lines of text that comprise the program is known as the source code. The source code (or source as it is usually called) can run into tens of lines or into millions of lines. It contains variable declarations, functions, loops, instructions, and other statements that define the functioning of the program. Programmers often add “comments” to their source to ensure that they and other people who look at the source will be able to read it easier than having to spend hours trying to decipher what exactly the algorithm does. A program will usually have many source code files, which can run into even thousands depending on the complexity of the program. For the program to run on a computer, the source code needs to be compiled so that it will be in a language that the computer can understand. If any changes are made to the source code, it will need to be recompiled for those changes to be incorporated in the program.

6.3.26 String
A commonly-used data type, strings are used to represent text rather than numbers. A string is made of a group of characters which can include, text, spaces, numbers, and symbols. Even numbers can be treated as strings if the correct syntax is used. Typically, strings are enclosed in double quotes to distinguish it from variables. Thus Data1 will be treated as a variable, while “Data1” will be treated as a string.
6.3.27 Syntax
All languages have a set of rules that define how the words and sentences are formed. Similarly, computer languages follow a set of rules that define how declarations, functions, commands, and other statements are arranged. This set of rules is known as the syntax of the language. A program should have the correct syntax for it to run correctly. Even the lack of a parenthesis or a semi-colon can result in a syntax error. When a program runs into thousands of lines, it becomes next to impossible to discover syntax errors manually, so a debugger is used to identify errors.
The Network

You can’t get anything done without having to deal with the Internet, or at least the office / home network today—you might as well go into the field prepared.
7.1 Technologies

7.1.1 ADSL
Asymmetric Digital Subscriber Line. This is the technology used to deliver broadband over traditional copper telephone lines. The term Asymmetric denotes the difference between the download and upload speeds of broadband connections. Usually the download speeds are much higher than upload speeds in ADSL. So if you see an advertisement for ADSL at 1 Mbps, most likely that’s the download speed. The upload speed maybe 256 or 512 Kbps. In comparison SDSL (Symmetric Digital Subscriber Line) offers equivalent download and upload speeds. Almost always when you read about DSL in the media it normally refers to ADSL.

7.1.2 ATM
Asynchronous Transfer Mode. For most of us, ATM stands for Automatic Teller Machine, the place where you go withdraw money in the middle of the night, but ATM in the networking world is altogether a different kettle of fish! ATMs use 53-byte cells to transmit data which due to its extremely small size and when coupled with appropriate ATM switches results in transmission speeds of 600 Mbps. This kind of transmission speed can be used to send all types of bandwidth hungry applications like videos and high resolution graphics.

7.1.3 Base Station
Originally the towers used by cell phone providers were known as base station. With the advent of wireless LANs and Wi-Fi networks, the meaning of base station has been expanded to include the wireless access points that computers with wireless cards use to communicate. Essentially, a Wi-Fi base station is a router that connects all the computers within its range and also enables the users to connect to the internet.

7.1.4 CAT 5
Category 5. This is an Ethernet cabling standard and one of the most popular these days. To get speeds of 100 Mbps, you need to
use CAT5 cables. The term category 5 is used to indicate that this is the 5th generation in cabling standards for twisted pair cables. Each category of cabling standards describes the performance characteristics of the wiring standards. Category 5 is one of the best cabling standards available today. It essentially depends on the number of twists per inch and the higher this number the better the performance of the wiring as it will reject noise and provide greater bandwidth.

7.1.5 DSL
Digital Subscriber Line—see ADSL

7.1.6 Ethernet
This is a networking standard for Local Area Networks. In fact, this is by far the most popular of all networking standards for LANs. It supports speeds of up to 10 Gigbits per second. However, what is more common these days is 100 Mbps speed networks with selective points operating at 1 Gbps. It used special grades of twisted pair copper wires for data transmission though the earlier versions of Ethernet used co-axial cables. The name Ethernet was coined by Robert Metcalf, one of its developers.

7.1.7 Fibre Optics
Fibre optics is the process of transmitting information in the form of modulated light waves through very thin strands of pure glass bundled together. Because the information carrier is light, the information moves at the speed of light across the fibre-optic cable. One of the main uses of fibre-optics is in the area of long distance communication, as fibre optic cables can carry enormous quantities of data.

7.1.8 SDSL
Symmetric Digital Subscriber Line—see ADSL
7.1.2 Wi-Fi
The wireless standard that is used for local area networking and Internet access, Wi-Fi ostensibly stands for Wireless Fidelity. Using radio frequency technology, Wi-Fi routers enable computers or laptops equipped with Wi-Fi adapter cards to communicate with each other or access an Internet access point without the need to be physically connected to a cable. There are several Wi-Fi standards and Wi-Fi equipment are rated against these standards. The earlier standards were 802.11a and 802.11b, the current standard is 802.11g. Standards a and g have a maximum throughput of 54 Mbps and an active radius of about 30-35 meters indoors. Thus, if you would like to browse the Net while on your balcony, get yourself a wireless router; if you are using a laptop, chances are it comes Wi-Fi enabled already.
7.2 General Internet Terms

7.2.1 404 Error
The error page that is displayed when the site does not have the requested page. On many Web sites, the 404 page is customised to make it easier for humans to understand. When you see a page which says something like “Oops! We couldn’t find the page you are looking for, please contact the site administrator” that’s actually a customized 404 error page. (Also see 404 in Chapter 8 under Internet Culture)

7.2.2 Ad Hoc Network
A temporary network you quickly set up to transfer files or share other information, or even play a networked game. For example, you may pop over to your friend’s house with your laptop and decide to indulge in an impromptu game of Doom. You would then use a crossover Ethernet cable or hook up within the Bluetooth field of your PCs.

7.2.3 Adware
These are software programs distributed free, but with embedded advertisements. You will be required to watch the advertisement every time you open the program. Most adware are clearly marked and you know what you are getting when you download and install the application but in other cases the software authors get the software installed without explicit permission from the end user. They can also be particularly notorious for being hard to uninstall and usually get installed on your system through deceptive means by being bundled along with other freeware. Adware’s evil cousins are spyware (see spyware).

7.2.4 Anti-spyware
Software programs designed to sniff out and remove any spyware lurking under the covers in your PC. It is become an essential
part of the security arsenal of any system. (see also Anti-Adware and Anti-Virus)

7.2.5 Anti-adware
Software program that scans your PC for adware and removes them. Like anti-spyware and anti-virus, this type of program has also become the mainstay of your PC’s security blanket.

7.2.6 Anti-virus
Software program that scans and disinfects your PC from any virus programs. Most anti-virus programs these days scan for viruses, adware as well as spyware.

7.2.7 Applet
Not to be confused with the Apple computer company. The applet was initially a reference to a small Java program that is embedded in a Web page and in general refers to any application that is sufficiently small and usually runs within a Web browser. Applets usually are not allowed to access system resources—files or devices (modems, printers, scanners, etc.)—as a security precaution against anyone trying to maliciously take over the local computer.

7.2.8 Auto-responder
If you have ever received an automatic reply when you send a mail to someone, what you have interacted with is the auto-responder. An auto responder is an e-mail message that is triggered to be send to anyone who sends a mail to the given e-mail address. This feature is particularly useful when you want to set out-of-office replies to be sent to anyone who sends you an e-mail when you are expected to be away from your office for a length of time.

7.2.9 Backbone
Also called the Internet backbone, this is the main link that con-
nects smaller networks in the Internet. The ISP who provides you with the internet connection is the last link in a long chain of local, regional, national, pan-national, and international networks that connect to each other through a global Internet backbone. In one sense this is the main information highway along which zips large volumes of data going to and fro across the globe.

7.2.10 Bandwidth
This refers to the amount of data you can send through a modem connection or through the network and is measured in bits per second or bps. When you can send data in multiples of thousands, it is referred to as Kbps (Kilo bits per second) and in Mbps (Mega bits per second). Most modern LANs operate at 100 Mbps. Those with the latest technology operate at 1 Gbps (Gigabits per second) or 1024 Mbps. In comparison, bandwidth through a dial up modem is a measly 56 Kbps and through broadband DSL 256 Kbps and upwards. We are just starting to see the spread of 1 Mbps and above broadband connections.

7.2.11 Banner Ad
Nearly 90 per cent of the Internet is run on advertising, and one of the most ubiquitous tools used to deliver ads is the banner ad. This is the rectangular block of advertisement that you use at the top of most Web pages. They are usually 468 x 60 pixels. Ads used to be plain HTML with graphics and images, but these days as the internet user gets more and more sophisticated banner ads have also morphed. Nowadays banner ads use multiple gimmicks to attract the user including Flash movies, animations and more.

7.2.12 BCC
Blind Carbon Copy. For anyone who has ever sent e-mail, the BCC field is the one you use when you don’t want the main e-mail recipient to know that the same message is being delivered to one or more people other than the main recipient himself (or herself). It is also a good practice, or netiquette as its known, to use BCC when you are sending a message to multiple people. By using BCC you will be prevent one recipient from knowing the e-mail id of
another recipient. This helps reduce the likelihood of any of the recipients trying to use the e-mail IDs in the mail for spamming.

7.2.13 Bloatware
Any software that is stuffed with excessive features that have little or no practical use, and degrades system performance instead.

7.2.14 Botnet
Essentially an abbreviation for Robot Network. A botnet is a collection of computers, usually thousands, that have been taken over by a specific group of hackers and are then used for their a specific task or purpose. For example, the infamous Denial of Service attack on major Web sites are accomplished by using a botnet.

7.2.15 Cache
A cache (pronounced ‘cash’) is a temporary location where information is stored for very fast access. There are many types of caches in a computer, starting from the processor which has a cache known as the L2 cache. The operating system also has a cache known as the virtual memory or swap file where information in the RAM is temporarily swapped to the hard disk when the RAM gets full. Similarly the Web browser also has a cache for Web pages that have been recently accessed.

7.2.16 CC
Carbon Copy. A carbon copy is a term used to refer to the CC address in e-mail. The term is a carry-over from the days when carbon copies were created for a letter needed to be sent to many people. When typing an e-mail message the To: field will contain the address of the main recipient and the CC field will contain the addresses of all the other people who will receive a copy of the message. The term has become so common in usage that nowadays it is used as verb too: “I am CC-ing the mail to you as well!”

7.2.17 DOS Or Denial Of Service Attack
This is a type of attack on a Web site where the attacker tricks the site to try and serve more pages than it possibly can, leading it to
freeze to a halt and potentially crash the server. The motivation for a DOS attack can have many reasons, including financial profit or just malicious fun.

### 7.2.18 DDOS or Distributed Denial of Service

A DDOS attack would be what happens when a botnet is used to carry out the attack. See Botnet and Denial of Service.

### 7.2.19 Firewall

A software program or a hardware device used to filter the data that passes between your computer or network and the internet. Software firewalls are directly installed on your PC while hardware firewalls are connected to the entry point to your network from the internet.

### 7.2.20 Freeware

Programs that you can use for free without having to pay anything for them. Some software authors may request a donation, but in essence, the software program is completely free to use whether you donate or not. In some cases, the freeware version will be the younger cousin of a commercial offering of the same product. The commercial software will contain many more features than the freeware. The freeware then becomes a marketing vehicle for the commercial product.

### 7.2.21 Hacker

Generally referred to as a person who hacks or breaks into computers. The term hacking has undergone a mind shift in the past decade or so and has evolved to mean something fun and enjoyable. Hacking has evolved into a counterculture in its own right and has also taken on heroic and romantic overtones much like the ideas behind the likes of Robin Hood and the others. Hackers try to distant themselves from their evil cousins, the ones who hack into computers or networks with criminal or harmful intent.
In general both are known as hackers though a ‘good’ hacker would call the ‘evil’ one a cracker.

7.2.22 ISP
Internet Service Provider. The company who provides the internet connection. Like with telephones and other utilities, the ISP will have many tariff plans. Depending on your usage you can choose for bandwidth limited or time limited plans or if you are a heavy internet user you should look at the unlimited plans options. When you connect the internet through your broadband DSL connection or through a modem you are at the first level connecting to the ISP’s network, which will then connect you to a larger network or on to the Internet backbone. See also Backbone.

7.2.23 Keywords
A group of words that as accurately as possible describes everything about the subject matter. This could either be used in a search engine or could be used as tags to a particular item. For example: “weapons technology secret program” is an example of a set of keywords you would use in a search engine. Tags are also an example of keywords. When you tag a picture in Flickr you are making it easy for others to quickly find your picture when they search for matching or similar words.

7.2.24 LAN
The grand daddy of networking. The Local Area Network. A LAN is a computer network limited to a specific location like a building or an office or even the home. The LAN is the next step up from an Ad Hoc Network. Normally, LANs are created using switches and routers that connect multiple computers in a single location. LANs are usually limited to a small area where the computers are physically connected to the network. Variations of the LAN include WAN—Wide Area Network, MAN—Metropolitan Area Network and Wireless LAN or WLAN. WANs connect multiple LANs together using dedicated leased lines or via VPNs over the Internet. MANs are WANs created to serve a large neighbourhood like a suburb or even an entire city in itself. WLAN is the wireless version of the LAN normally using the
WiFi standards of wireless technology. It essentially enables users at the location to share information and resources, like printers etc, with each other. In the earlier days Novell used to be the defacto choice for networking software but these days Windows has more or less taken over the field completely. Most networks these days are Ethernet based as it is relatively easy to deploy and robust enough to give trouble free service. However, with the advent of Wi-Fi technology there is a strong move towards wireless networks or wireless LANs as they are called due to the relative ease of connection and the lack of the need for physical wiring in a location.

7.2.25 MAN
Metropolitan Area Networks—see LAN.

7.2.26 PAN
Personal Area Network is the network you create with your devices, usually using some form of wireless technology. Using Bluetooth to communicate between two PCs, your PC and your smartphone, transferring files, etc. are all examples of PANs in action.

7.2.27 Sandbox
An isolated part of the system or network where new or unknown programs are first installed and monitored for proper behaviour before being transferred to the main system. For example, all new Web sites that Google’s search bot discovers are placed in a sandbox for a period of 60-90 days. They are then progressively made available in the search engine results page.

7.2.28 Search Bot
Short for search robot. A software program that crawls the internet, runs though all the pages it finds and reports back to the search engine details of everything on the page. The search engine
will index and classify these details in a myriad of ways that will
then be made available to the users when they search for the infor-
mation based on the keywords they used in their search.

7.2.29 Search Engine
Google, Yahoo, Windows Live are
all examples of search engines. Using specialised software that
crawl the World Wide Web, search engines indexes all the
words it finds on Web pages. Of
recent, that is in the last few
years, search engines have
become extremely sophisticated
and not only index all the words
on a page but also try to correlate that with other bits of informa-
tion regarding the said Web page gathered from other parts of the
Web. Thus, using complex algorithms search engines try to guess
the most accurate result that will satisfy the search request of the
user. Search engines have become one of the core pieces of the internet as everyone needs to search for some information or the other
at some point in time.

7.2.30 Shareware
Programs that are essentially ‘shared’ with you so that you can get
to know how they work before you decide to buy it. Shareware pro-
grams may have a set of ‘locked’ features that you can only gain
access to after you buy the license for the product. The primary dif-
ference between shareware and freeware is that shareware are
usually time limited. For example one of the most popular com-
pression utilities WinZip is actually a shareware product which
can only be legally used for 15 days from the date of downloading.

7.2.31 Spyware
These are software programs that install silently in the back-
ground without your knowledge. These programs then monitor
everything you do on the system, from the keys you press on your
keyboard to the sites you visit, the applications you open and work with and so on. The gathered data is usually sent back to a central server which is then processed and used in marketing products or even in hacking into the user’s account depending on the program author.

7.2.32 Trojan
A software program which is disguised as a legitimate program but is actually a malicious piece of code that may infect and harm your system. The name is based on the Trojan horse story from the Greek tragedy about Helen of Troy.

7.2.33 Virus
A software program created to cause damage to your computer or to take over computer.

7.2.34 Virus definitions
Viruses appear nearly everyday and therefore anti-virus vendors need to constantly update their anti-virus disinfection programs to counter the new threats. These updates are generally referred to as virus definitions or virus signatures.

7.2.35 WAN
Wide Area Networks—see LAN.

7.2.36 WLAN
Wireless LAN—see LAN.

7.2.37 Web Host
A Web host at its very basic is a server which stores all the pages of your Web site and is connected to the Internet. Users who request for information will be serviced by this Web server. It is also used in reference to a provider of the server. Usually it is more cost effective to just buy rental space on a Web hosting service provider to run your Web site. The Web site will run alongside thousands of other small sites on a single server machine and is referred to as shared hosting or virtual hosting. However, when
users who simultaneously access the site increase, it will be necessary to have a single machine to ensure a consistent performance and user experience. Large sites with thousands of pages of information and millions of visitors will require hundreds of machines to ensure consistent performance.

7.2.38 Worm
A software program that self replicates spreading throughout the Net. This is usually done by reading the address book on the infected computer and then silently mailing itself out to all the people in the address book. The worms’ functions vary—some are harmless, many are harmful.

7.3 Web 2.0

7.3.1 ASP
Application Service Provider. See SaaS.

7.3.2 JSP
Java Server Pages. A Sun Microsystems technology, JSP is a scripted language that is compiled on the server rather than in the user’s Web browser. JSP is based on the Java programming language and is used for building dynamic, database driven Web sites. Similar to PHP and ASP, all the code in a JSP page is processed by the Web server and then sent to the user.

7.3.3 SaaS
Software-as-a-Service. Refers to offering software applications to end users on a rental or lease model where the user does not have to worry about maintaining servers or people to manage the hardware and software infrastructure required to support the application. This is typically considered by organizations when they want to procure and install expensive enterprise applications. An organisation which offers SaaS is referred to as an ASP or Application Service Provider.
And finally, a chapter for items that fell under no other chapter, but which we had to include—the Enterprise IT section in this chapter will be particularly useful, we think.
8.1 Computer Science Fundamentals

8.1.1 Algorithm
A set of instructions that are defined to perform a specific computing task. This can be something as simple as performing addition or something more complex like modifying an image in an image editor. Programmers spend a majority of their time creating algorithms that are then debugged to ensure that they work properly and efficiently. The primary goal is to create efficient algorithms that use computing resources like RAM and CPU time with the maximum efficiency. Obviously, when an algorithm is badly written, it will be a drag on performance.

8.1.2 Analogue
Anything that is read or accessed as a continuous stream is experienced as analogue. Humans perceive everything in analogue—as a continuous stream of data and information to our senses. Similarly, the grooves in a record player or the magnetic data stored on an audio or video tape is typically a representation of analogue data. In comparison, digital is an approximation of the audio or video signal. This means that analogue data is more accurate than digital data, but due to some inherent advantages with the digital format, analogue is being slowly eliminated.

8.1.3 Bespoke
In technology circles, a bespoke solution or system is something that is custom-developed to meet the requirements of a specific need. This can refer to both hardware and software. Typically an organisation would go for bespoke software if there is no off-the-shelf software package that can meet their needs. Software developers will then build a customised system to meet the requirements. Typically, bespoke solutions are expensive, and with the increase in commoditisation in the software market, more and more solutions are coming out-of-the-box with customisation features rather than being 100 per cent bespoke. The cases where only a bespoke solution will fit are rapidly shrinking from the general marketplace and are getting focused into niche segments.
8.1.4 Database
A system used to organise and store structured information for easy retrieval and manipulation. A database contains tables made up of rows and columns, and are used to store structured and hierarchical data like product details, employee information, etc. Databases today go beyond just storing textual information and can now store sound clips, pictures, and video too.

8.1.5 Digital
Information stored as a series of ones and zeroes is called digital information. Humans perceive information in analogue; digital devices estimate this information using ones and zeroes. This estimation, known as sampling, is the process of storing the information in a tiny slice of time. This could be several times per second, and while it is imperceptible to the human ear or eye, there is a tiny gap between two segments of information. A typical audio CD would be sampled at 44.1 KHz (44,100 samples per second) with a bit depth of 16 bits. This is a high-quality estimation of the audio signal, and provides a level of audio quality that sounds good to the ear. The major advantage with digital data is that it is much easier to copy, edit, and move without loss in quality.

8.1.7 End-user
The person who actually uses a software program. Among software developers, careful attention is paid to the wants and needs of the end-user when designing the program, as this person will either drive the adoption of the program or cause its downfall.

8.1.8 GUI (Graphical User Interface)
The graphical interface that we use with almost all computer systems these days. Before the GUI was invented, the way to interact with computer systems was through cryptic commands that were difficult for the ordinary user to remember or even understand. A GUI made life much easier, enabling people to use features like the dragging and dropping of objects with a mouse rather than enter text commands.
8.2 Upcoming Technologies

8.2.1 WiMAX
Worldwide Interoperability for Microwave Access. In the rapidly-evolving sphere of wireless technology, WiMAX is the next generation in wireless access to the Internet with speeds that are equivalent to cable or DSL connections. While Wi-Fi focused on providing wireless LAN and Internet access, WiMAX is geared to deliver broadband access over a range of 10 to 50 km at speeds varying from 10 to 70 Mbps. There are two main types of WiMAX: Fixed WiMAX and Mobile WiMAX. Similar to cellular networks, the WiMAX service is provided through a base station. In the case of Fixed WiMAX, you are limited to the range of the base station; in the case of Mobile WiMAX, you will be able to continuously access the Internet on the move, and you would get automatic handover when you cross from the range of one base station to another. In India, we may expect to see WiMAX availability as early as 2008.

8.2.2 Mobile Broadband Wireless Access (MBWA)
A technology standard still under discussion, being developed under the aegis of the IEEE 802.20 standards group. It is expected that MBWA would have a range of 120 to 150 km.

8.2.3 Cloud Computing
The term used to describe a kind of service where you can rent processor cycles and use them according to your needs. For example, if you wanted to do a complex maths problem that could only be comfortably handled by a powerful processor, cloud computing would enable the user to gain access to server resources that could be used to complete the job. The user thus need not invest in equipment for tasks that may be more effectively rented out.
8.3 Enterprise IT

8.3.1 Application Server
A server where a specific application or multiple applications reside. The application software on the server would connect to the database on the database server. This kind of separation between the application server and the database server is both a security measure as well as performance optimisation method.

8.3.2 Business Process
A word that is being increasingly encountered in the context of software discussions within organisations. A business process essentially is a series of interconnected activities that have a specific start and a specific end. For example, a company may have a purchase process which starts with a requisition for materials from a user; this requisition may result in triggering a request for quotes from vendors. Based on the vendor responses and after negotiation, a vendor is selected and the purchase order issued. Based on the purchase order, the vendor supplies the materials. He then submits a bill to the accounting department. The accounting department verifies his claims against the actual deliveries made to the company stores and releases the payment. This entire cycle, which started with the user’s requisition and ended with the material being delivered and the payment being made to the vendor, is a simplified example of a business process cycle. In actual fact, business processes are much more complex, and require a detailed understanding of each user’s perspective in the link. Organisations seeking to improve their efficiency use business process modelling tools to analyse how changes in the business processes will impact the organisation.

8.3.3 CRM
Customer Relationship Management. Software that is used to perform both the pre-sales management of the customers as well as the post-sales follow up for services. During the pre-sales stage, a sales force automation system provides the sales team with the tools and solutions to keep track of their potential customers and
to monitor their progress till they become a confirmed order. After order confirmation, the relationship management would be shifted to appropriate people who would take care of the order fulfilment and post sales services.

### 8.3.4 Data Centre
A facility where computer systems and associated components like storage and communications are housed. Data centres power much of the Internet, and it is an essential component in any enterprise that makes relatively extensive use of IT in its business. Irrespective of the fact that the data centre may be managed or owned by a third party, it is important that the centre be evaluated in terms of risk and reliability. That is, to the maximum extent possible, the data centre operator should have taken precautions against unknown factors like power failures and so on.

### 8.3.5 Database Server
Usually, a server hardware machine loaded with a database system like MySQL, SQL Server, Oracle, etc. The database system can be used by multiple application software programs to meet the requirements of various departments.

### 8.3.6 DMS
Document Management System. A software that stores multiple types of documents including e-mails and faxes and even scanned copies. Users can annotate notes to the documents, restrict access to the documents using permission settings, and much more. It is useful in organisations where there is a large amount of paper-based documents that need to be stored in an organised manner for easy and quick retrieval.
8.3.7 DMZ
Demilitarised Zone. A term borrowed from the army, the demilitarised zone in technology is a computer or a small network inserted between the company’s private LAN and the public Internet. This is used to prevent and trap hackers from getting at company information that resides securely in the private LAN. When hackers manage to break through the first layer of security, they would in all likelihood be trapped inside the DMZ under the false impression that they are within the actual private network. This sense of false security will give network security professionals sufficient time to track and trace the intrusion attack.

8.3.8 DNS
Domain Name System or Domain Name Service. Every domain name on the Internet has an associated IP address. The link between the IP address and the domain name is managed by the domain registry service at the InterNic, a global organisation. When a user types in a domain name—say thinkdigit.com—what happens is that a query is sent to the Domain Registry asking for the IP address of thinkdigit.com. This query and its resolution are handled by the DNS.

8.3.9 E-Commerce
The business of transacting on the Net, where transactions are carried out in real-time or quasi-real-time. For example, a valid e-commerce site would be one that sells various products online and allows the buyer to pay by credit card.

8.3.10 EDI
Electronic Data Interchange. EDI was the forerunner to the Internet and acted as an electronic means by which trading partners could share information and transact with each other. In some instances, the systems were so set up that when an item reached below a specified quantity of stock, automatic purchase orders were released from one company to the next via EDI. The receiving company would ship the item and inform via EDI that the items were shipped. While EDI is quite old technology, there
are still many firms that rely on EDI and are unwilling to change their technology platform.

8.3.11 ERP
Enterprise Resource Planning. A large and complex software system that integrates all the various departments of an organisation under a single software solution. Given the name, the primary task of the enterprise system is to optimise the use of resources and to provide the organisation’s management team with analytical information that would be helpful in the making of decisions and in the daily operations of the company. There are multiple ERP software systems in the market, catering to wide variety of industries.

8.3.12 Intranet
Internal networks in organisations that use Internet-related technologies, which normally would not be available on the public Internet.

8.3.13 Mail Server
Server software used to send, receive, and store the e-mail of all users who have mail IDs in the organisation. Typically, depending on the actual size of the organization, the mail server software could either reside on a server or run off a normal PC. There are many different kinds of mail server software. Commercial options include Microsoft Exchange and Lotus Notes. On Linux there are a number of free mail server software available. Your choice would depend on the complexity of requirements. Consider whether the company’s e-mail needs to be administered centrally or whether each individual user will manage his own mailbox.

8.3.14 Mainframe
This is older technology from the mid-1960s that refuses to die out! In the ’60s, before the advent of the PC, access to computers was expensive. As a matter of course, many users would connect to a single server-grade mainframe machine. Mainframes were built for reliability and stability, and as compared to standard PCs and serv-
er technology, mainframes contain multiple CPUs running into
dozens, have thousands of GB of RAM, and high-speed hard disk
subsystems that can hold terabytes of data. Mainframes have a
Mean Time Between Failure (MTBF) rating of 20 years. Of late, inter-
est in mainframes is being revived.

8.3.15 Milestone
In project management terminology, a milestone is a key event or
task. The completion of this task will signal that the project has
completed some important segment of the project. Each project
can have multiple milestones.

8.3.16 Outsourcing
Taking internal company functions and asking an outside agency
to do it. This may be due to cost advantages or because the com-
pany may not have the required skills or manpower.

8.3.17 Project Management Office
When an organisation has more than one major IT project being
implemented, it becomes imperative that the processes be well-
documented and the projects co-ordinated to ensure that there is
no overlap and that there will not be any conflicts of personality
or even data. The project management office provides a formal
mechanism by which multiple projects may be co-ordinated and
implemented in a structured and organised manner.

8.3.18 Remote Access
Accessing a remote computer and taking control over a computer
as if you were sitting at it and using its mouse and keyboard. In
Windows, such access is provided by RDP—Remote Desktop
Protocol. Using RDP (which the user is unaware of, by the way) a
user can request for assistance from a colleague or friend or from
the organisation’s help desk. The help desk technician connects to
the user’s Desktop, takes over control, and rectifies the problem as
if he were sitting at the user’s workstation. He then hands back
control to the user and disconnects the session. While Windows
uses RDP, Linux uses VNC or Virtual Network Computing to
achieve the same effect. When connecting to a computer over the Internet, things can get tricky, as both RDP and VNC are not very good at bandwidth management. Other software like LogMeIn.com and GoToMyPC.com are commercial options to connect to your computer using an extended and enhanced version of RDP / VNC. LogMeIn has a free version that provides basic remote Desktop functionality, but without the management features you would require if you are supporting multiple desktops.

8.3.19 ROI

Return on Investment. This is the magic number that finance managers like to ask for and IT geeks like to dodge. The return on investment is the only true measure of the cost effectiveness of your IT investments. However, the difficulty is in determining the parameters on which ROI will be calculated. This requires that any ROI measurement be pegged to some business driver that is suffering due to lack of technological support. The decision to use the business driver as the measure of ROI should be established through a consensus among the various project stakeholders. For example, a company may have a purchase process that is currently not efficient. A software has been identified which will improve the efficiency of the process. To calculate the ROI, we would first determine the cost of the current process and then compare it with the revamped process. The difference in cost between the two processes measured over a pre-agreed period of time will be the basis on which the ROI calculation will be worked out. However, this approach has its drawbacks, and in some cases where the change is not so readily visible, it may be that ROI is locked in to some secondary process.

8.3.20 SCM

Supply Chain Management. Company operations typically require that raw materials be bought from suppliers, be assembled or manufactured, and the finished goods despatched to customers. The entire link from supplier to customer is what is known as the supply chain. For organisations that want to create a competitive advantage, one of the areas of optimisation is the SCM segment
that can lead to savings, and increase in efficiency, which in turn would mean happier customers. SCM software provide this ability; however, SCM capabilities are often embedded into ERP software.

### 8.3.21 SEO

Search Engine Optimization. The process of fine tuning a Web site so that it shows up in the search engines and ranks high in the search results for specific keywords that are relevant to the business of your company/site. SEO is an industry in its own right and there are many theories as to how it should work. The basics, however, remain simple and straightforward: create a Web site for humans and not search engines, provide high-quality original content that will be relevant to the audience who reads the pages on the site, use CSS to the maximum extent possible, and ensure all your HTML pages are properly meta-tagged with the right information and keywords.

### 8.3.22 Server

A rugged PC with features such as hot swappable drives—that is, hard drives that can be swapped out of the system without shutting down or opening the system; redundant power supplies; and superior cooling mechanisms due to the amount of heat generated by the processor. This kind of PC would be designed to run 24x7. The operating system that runs on this server hardware is also known as the server.

### 8.3.23 SFA

Sales Force Automation; a subset of CRM. Many prospective customers may contact the sales team of your company, or converse-
ly, your sales team may be in touch with many people. An SFA system will enable you to gather leads through various sources and consolidate them in a single place. These leads would then be contacted and further qualified—and then converted into opportunities, and finally to an order if and when the prospective customer decides to buy.

8.3.24 SOA
Service-Oriented Architecture. Traditionally, software systems in organisations were built to meet a specific need. However, this led to a situation where a number of elements of data and business processes would overlap each other in software. The service-oriented architecture is a system architecture mechanism that essentially provides the guidelines for creating and managing business processes within the organisation. The business processes are delivered as services that are supported by the IT infrastructure. Functionality is broken down into small distinct elements or services which can be distributed over the network, can be mixed and matched together, and reused to create fresh business applications. Finally, these services are able to talk to each other by passing data from one service to another.

8.3.25 Technology Strategy
This is a broad outline that will explain in simple terms what a company wishes to do in terms of information technology and how this technology infrastructure ties in with the business plan of the organisation. Depending on the size and complexity of the organisation, the strategy may need to explore such issues as: building software versus purchasing off the shelf packages, the hardware infrastructure that should be standardised throughout the organisation, the software infrastructure that should be standardised throughout the organisation, why it makes business sense to go in for a specific technology initiative, and so on.

8.3.26 Unified Communications
The merger of multiple modes of communication into a common communication platform with the basic objective of ensuring that
the sender and recipient are able to communicate with each other irrespective of location or communication device. For example, a voice call to a person’s desk phone can be re-routed to his cell phone or email as a voice mail attachment.

8.3.27 VAR
Value Added Reseller. A VAR is an essential component in the sales and support of software. VARs are trained by the software and hardware companies to provide different levels of support to the end customer. Typically, VARs create their own, special packages on top of the main offering which acts as incentive to the prospective buyer. For example a VAR of ERP software may decide to provide a bundled offer to its customers which includes both the hardware and the software.

8.3.28 Virtualisation
The process of creating a virtual version of something such as an operating system, a server, storage devices, or network resources. Operating system virtualisation enables the user to use a software to run multiple operating systems on the same computer hardware. Some virtualisation software also allows you the capability of dynamically adding more hardware to increase the power and range of the virtualised software. There are three main areas of virtualisation that are increasingly becoming popular. One is network virtualisation, where the combined bandwidth of the network is split into several channels independent from each other and which can be assigned to a particular server or device in real time. By using virtualisation, users need not be concerned with the underlying complexity of the actual physical network. The second is to consolidate storage from multiple network storage devices into a single virtualised storage device that is managed from a single place. As far as the end-user is concerned, he will be dealing only with a hard disk, and will have no idea whether the drive is virtualised or not. The third is in server virtualisation, where a user may have full access to a range of operating system services in a virtualised environment.
8.3.29 VoIP
Voice over IP. Here, “IP” stands for Internet Protocol. If a company makes many international calls, and has a broadband connection, VoIP software could save it a ton of money. Typical examples of VoIP include Yahoo! Messenger, Google Talk, and Skype. In the traditional online chat services, users can chat with each other using the voice-enabled features of the software. With the extended features available in Yahoo! Messenger and Skype, users can call any land or mobile phone number (using prepaid credits) at a very low cost. For some countries, the cost savings can prove to be significant. Make sure you check the cost of the landline call and compare it with the VoIP service provider’s charges to calls in that country.

8.3.30 WBS
Work Breakdown Structure. In project management terminology, the WBS is a detailed schedule of the project that shows the tasks and sub-tasks and the related timelines that each task will be completed in. Each activity in a WBS will have a start date and end date, and further, they may be constrained to not start before or end after a specific date. In addition, each task may be dependant on the previous task and linked to the task that follows. If the start or end dates for any task changes, then correspondingly, the start and end dates of all tasks linked to this task will change.
8.4 Internet Culture

8.4.1 404
Based on the infamous 404 error thrown by a Web server (see §7.3, General Internet Terms) the term has moved into general usage where you might say “I’ve drawn a 404,” meaning “I’ve drawn a blank.”

8.4.2 Affiliate
One of the cornerstones of Internet marketing. Web site affiliates and affiliate programs are used to generate leads and sales of both physical and digital download products. The affiliate industry has evolved into a multi-million dollar sector. Affiliates normally earn commission on each item that’s sold by the site owner. The Internet has made it extremely easy to track users who have come to the site through the referral of a specific affiliate member.

8.4.3 Beta Software
This has become de facto on the Web! Every new startup’s site is in beta, probably having taken the lead from Google’s Gmail service. In actual fact, beta software is one of the stages of testing a software where the software (or site) is released to a limited number of developers for live testing and reporting on bugs, crashes, errors, and other such problems. Software creation being a complex process, it is inevitable that the testers will not catch all the bugs. Thus, Web sites and software companies make the beta software available to the public to aid them in their testing process. Due to the large number of users testing the software simultaneously, more and more bugs will be quickly discovered. This phenomenon led to the coining of the phrase: “Given enough eyeballs, all bugs are shallow,” as stated by Linus Torvalds, the creator of the Linux operating system.

8.4.4 Bounced message
Typically, an e-mail message that was not delivered and was “bounced” back to the inbox of the sender.
8.4.5 Chat
The process of talking to a person over IM using the keyboard.

8.4.6 Flaming
One of the more serious sins when participating in online forums is to start a flame war. When people begin discussing an issue in a place like an online forum, there is a tremendous amount of opinion generated on all sides of the issue. During the process of discussion and argumentation, some may feel offended and begin to make insulting or caustic responses that will inevitably trigger a similar reaction from the other party. And before one knows it, the entire thread of discussion has degenerated into a flame war, which is not useful to anyone. As a matter of good netiquette, it is always advisable to walk away or hold your peace when you feel that the online conversation may descend into a flame war.

8.4.7 IM
Instant Messaging using an Instant Messenger like Yahoo! Messenger, Windows Live Messenger, Google Talk, Gaim, etc.

8.4.8 Voice chat
Chatting to other people either one-on-one or in conference using, for example, a software like Skype, complemented by headsets (or microphones and speakers). Almost all popular IM clients support voice chat nowadays.